# MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY JAMSHORO



CURRICULUM

# FOR

# **BACHELOR'S DEGREE**

# IN

# MECHANICAL ENGINEERING 17-Batch & onwards

# **DEPARTMENT OF MECHANICAL ENGINEERING**

#### PREFACE

The Department of Mechanical Engineering was founded in 1963 when Sindh University Engineering College was established. The college was upgraded to Mehran University of Engineering and Technology in 1977. A four-year undergraduate program is being offered since then, leading to the degree of Bachelor of Engineering.

The Department has gained a good reputation in the country while designing its courses and syllabi keeping in view the trend and requirement of the field. The syllabus is therefore being revised and updated from time to time wherein the recommendations of National Curriculum Revision Committee (NCRC) are also well taken into consideration.

Maintaining this trend, the Department of Mechanical Engineering has implemented the conversion from term system to Semester system and revised its syllabus entirely, with the inclusion of a few new courses including Thermal Power Plants and Safety, Health & Environment. State of arts laboratories, e.g. Automobile, Aerodynamics, Engineering Mechanics, Energy systems, Fluid Mechanics, Mechatronics and Mechanical Vibrations have also been established within the department. Mechanical Engineering Workshop has also been equipped with the advanced and innovative machines to be employed for grooming the students in areas of design and Manufacturing, the revised syllabus has been approved by Board of Studies, Board of Faculty and Academic Council in *2012-2013*.

The undersigned would like to express gratitude to all the faculty members in general and senior faculty members in particular for their valuable co-operation and suggestions in preparing this revised syllabus.

March, 2018

Prof. Dr. Dur Muhammad Pathan Chairman Department of Mechanical Engineering

#### **INTRODUCTION**

This prospectus is intended to provide you an introduction to undergraduate and post graduate study at the Department of Mechanical Engineering and to help you decide whether this department provides what you are seeking in terms of both your academic and personal aspiration.

Sindh University Engineering College, established in 1963 and later upgraded to Mehran University of Engineering and Technology in 1977, is today one of the Pakistan's great civic universities. It owes to its origin to three major departments, the one of which is Mechanical Engineering Department. Our full-time student population of the department is almost 525 at undergraduate level and over 40 students are post graduate.

In 1975, the Department of Mechanical Engineering started a four years' degree course in Industrial Engineering. First batch of Industrial Engineering graduated in 1979-80. Presently it is a separate department.

With 23 academic staff, including 6 professors, and more than 18 academic related and technical support staff, the department possesses excellent computational and experimental facilities. Numerous personal computers are available, together with access to several mainframe machines. A number of experimental facilities are also available, including a large scale Mechanical Engineering Workshop. Other laboratory facilities cover all the main areas of Mechanical Engineering.

The Department offers Postgraduate programs in the fields of Mechanical Engineering, Manufacturing Engineering, Energy Systems Engineering and Mechatronics Engineering. The former was started in 1977 and is being conducted by highly qualified and experienced faculty of the Department under the Directorate of Postgraduate studies. The later has been started from the year 2010. These taught courses lead to Diploma or Masters. Part of the taught program is made up of course work. The remainder involves independent study for a supervised dissertation or project on a topic and to be submitted by a particular date. Both elements are examined.

Postgraduate study at the Department can also be undertaken in the form of research. The principal research degrees are Master of Philosophy (M.Phil.) and Doctor of Philosophy (PhD). Research degrees involve independent study, assisted by a supervisor and co- supervisor, leading to the completion of thesis.

#### Vision of MUET

To become world class educational and research institute and contribute effectively towards building up indigenous and technological capabilities for sustainable socio-economical development.

#### **Mission of MUET**

To equip our undergraduate, postgraduate and doctoral students with advance knowledge through collaborative opportunities emerged from linkages with academia, industry and government.

#### **Departments'** Vision

Mechanical Engineering Department intends to become a hub of high quality engineering education and research to produce skilled, innovative, entrepreneurial mechanical engineers who meet the ever changing engineering demands.

#### **Department's Mission**

Mechanical engineering department is to produce engineers and researchers with sound knowledge of traditional, emerging areas of engineering together with innovative design abilities to achieves sustainable national development. Develop the skill of the students to make them globally competitive engineers and researchers by providing quality education and research facilities.

#### **Program Educational Objectives (PEOs)**

The mechanical Engineering graduate:

**PEO-1**: To produce engineers with clear concepts about fundamentals of Mechanical Engineering discipline and allied subjects.

**PEO-2:** To produce engineers with analytical and problem-solving abilities.

**PEO-3:** To produce engineers with high level of professionalism and integrity.

**PEO-4:** To produce engineers with sound communication and leadership abilities along with the desire of continuously improving their knowledge and skills.

| Knowledge     | Subject   | Name of Course   | Lec   | Lab | Total | G.<br>Total | %       |
|---------------|-----------|--|-------|-----|-------|-------------|---------|
| Агеа          | Area      |  | СН    | СН  | CK    | Credits     | overall |
|               | Fnglish/  | Functional English   | 2     | 0   | 2     |             |         |
| ities         | Language  | Communication skills   | 3     | 0   | 3     | 5           | 3.62    |
| nan           |           | Pakistan Studies   | 2     | 0   | 2     |             |         |
| Hun           | Culture   | Islamic Studies/<br>Ethics   | 2     | 0   | 2     | 4           | 2.90    |
| iences        |           | Project<br>Management &<br>Optimization                                    | 3     | 0   | 3     |             |         |
| Management Sc |           | Entrepreneurship &<br>Engineering<br>Management                            | 3     | 0   | 3     | 8           | 5.80    |
|               |           | Health, Safety and<br>Environment  | 2     | 0   | 2     |             |         |
|               | Physics   | Applied Physics  | 2     | 0   | 2     |             |         |
|               | ttics     | Applied Calculus   | 3     | 0   | 3     |             |         |
| ances         |           | Linear Algebra,<br>Differential<br>Equations and<br>Analytical<br>geometry | 3     | 0   | 3     |             |         |
| ural Sc       | fathem    | Complex Variables<br>& Transforms  | 3     | 0   | 3     | 10          | 13.04   |
| Natı          | Z         | Numerical Analysis<br>& Computer<br>application                            | 3     | 1   | 4     |             |         |
|               | -         | Statistics &<br>Probability  | 3     | 0   | 3     |             |         |
|               | Chemistry | Applied Chemistry  | 2     | 0   | 2     | 2           | 1.45    |
|               | Hs Total  | 37   | 26.81 |     |       |             |         |

### Non-Engineering Domain

| Knowledge                        | Gerbie et Arres | Norma of Comme                     | Lec    | Lab     | Total   | G.Total | %       |
|----------------------------------|-----------------|------------------------------------|--------|---------|---------|---------|---------|
| Area                             | Subject Area    | Name of Course                     | СН     | СН      | CR      | Credits | overall |
| Computing                        | Fundamentals    | Computer Programming               | 2      | 1       | 3       | 3       | 2.17    |
|                                  |                 | Engineering Drawing and Graphics   | 2      | 2       | 4       |         |         |
| u                                |                 | Engineering Statics                | 2      | 1       | 3       |         |         |
| atic                             |                 | Engineering Dynamics               | 2      | 0       | 2       |         |         |
| pun                              |                 | Strength of Materials-I            | 2      | 0       | 2       |         |         |
| Fo                               |                 | Thermodynamics -I                  | 3      | 0       | 3       | 22      | 22.10   |
| ing                              |                 | Workshop Practice                  | 0      | 2       | 2       | 32      | 25.19   |
| leer                             |                 | Mechanics of Machine -I            | 2      | 0       | 2       |         |         |
| ılgir                            |                 | Mechanics of Machine -II           | 2      | 1       | 3       |         |         |
| E                                |                 | Fluid Mechanics-I                  | 3      | 1       | 4       |         |         |
|                                  |                 | Manufacturing Processes            | 3      | 1       | 4       |         |         |
|                                  |                 | Engineering Materials              | 3      | 0       | 3       |         |         |
|                                  |                 | Machine Design -I                  | 3      | 0       | 3       |         |         |
|                                  |                 | Machine Design -II                 | 3      | 0       | 3       |         |         |
| sd<br>th)                        |                 | CAMD                               | 0      | 1       | 1       |         |         |
| 3asc<br>ead                      |                 | Fluid Mechanics-II                 | 3      | 1       | 4       |         |         |
| or H<br>(Br                      |                 | Heat and Mass Transfer             | 3      | 1       | 4       | 26      | 18.84   |
| Maj<br>Core                      |                 | Instrumentation &<br>Measurement   | 2      | 1       | 3       |         |         |
|                                  |                 | Thermodynamics -II                 | 3      | 1       | 4       | -       |         |
|                                  |                 | Strength of Materials-II           | 3      | 1       | 4       |         |         |
|                                  |                 | Automobile Engineering             | 3      | 1       | 4       |         |         |
|                                  |                 | Mechanical Vibrations              | 3      | 1       | 4       |         |         |
| tased<br>epth)                   |                 | REFRIGERATION and Air Conditioning | 3      | 1       | 4       |         |         |
| Dr B                             |                 | Applied Aerodynamics               | 3      | 1       | 4       | 29      | 20.29   |
| 1ajo<br>ore                      |                 | Thermal Power Plants               | 3      | 1       | 4       |         |         |
| 20                               |                 | Control Engineering                | 2      | 1       | 3       |         |         |
|                                  |                 | Maintenance Engineering            | 2      | 0       | 2       |         |         |
|                                  |                 | REETs                              | 3      | 1       | 4       |         |         |
| Interdisciplinary<br>Engineering |                 | Electrical Technology              | 2      | 1       | 3       | 6       | 4 35    |
| Breadth<br>(Electives)           |                 | Basic Electronics                  | 2      | 1       | 3       |         | 1.55    |
| Senior Design<br>Project         |                 | Final Year Project                 |        | 6       | 6       | 6       | 4.35    |
|                                  |                 |                                    |        |         | Total   | 102     | 73.38   |
|                                  |                 | N                                  | on-Eng | gineeri | ng CHs  | 37      | 26.61   |
|                                  |                 |                                    |        | Gran    | d Total | 139     | 100     |

#### **Engineering Domain**

#### MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO DEPARTMENT OF MECHANICAL ENGINEERING SYLLABUS (FROM 17-BATCH ON WARDS)

| I            | First Semester  |  |        |              |     |       |    |
|--------------|-----------------|--|--------|--------------|-----|-------|----|
| S #          | Course Codes    | Name of Subject                            | Credit | Credit Hours |     | Marks |    |
| <b>3.</b> #. | Course Coues    |  | Th.    | Pr.          | Th. | Pr.   | #  |
| 1            | SS 111 / SS 104 | Islamic Studies / Ethics                   | 2      | 0            | 50  | 0     | 7  |
| 2            | (PS 106)        | Pakistan Studies                           | 2      | 0            | 50  | 0     | 11 |
| 3            | (MTH 108)       | Applied Calculus                           | 3      | 0            | 100 | 0     | 13 |
| 4            | (ME 102)        | Engineering Drawing &<br>Computer Graphics | 2      | 2            | 50  | 100   | 15 |
| 5            | (ME 112)        | Engineering Statics                        | 2      | 1            | 50  | 50    | 17 |
| 6            | (ME 122)        | Engineering Materials                      | 3      | 0            | 100 | 0     | 19 |
|              | Total: -        |  |        | 7            | 400 | 150   |    |

#### Second Semester

| S #          | Course Codes | Name of Subject       | Credit | Credit Hours |     | Marks |    |
|--------------|--------------|-----------------------|--------|--------------|-----|-------|----|
| <b>3.</b> #. | Course Coues |                       | Th.    | Pr.          | Th. | Pr.   | #  |
| 1            | (EN 101)     | Functional English    | 2      | 0            | 50  | 0     | 21 |
| 2            | (MTH 103)    | L.A,D.E&A.G           | 3      | 0            | 100 | 0     | 23 |
| 3            | (ME 132)     | Engineering Dynamics  | 2      | 0            | 50  | 0     | 25 |
| 4            | (EL 102)     | Electrical Technology | 2      | 1            | 50  | 50    | 27 |
| 5            | (ME 142)     | Workshop Practice     | 0      | 2            | 0   | 100   | 29 |
| 6            | (ES 281)     | Basic Electronics     | 2      | 1            | 50  | 50    | 31 |
| 7            | (ME 151)     | Applied Physics       | 2      | 0            | 50  | 0     | 33 |
| Total: -     |              | 1                     | 7      | 350          | 200 |       |    |

#### Third Semester

| <b>S</b> #   | Course Codes | Name of Subject                   | Credit Hours |     | Marks |     | Page |
|--------------|--------------|-----------------------------------|--------------|-----|-------|-----|------|
| <b>3.</b> #. | Course Codes |                                   | Th.          | Pr. | Th.   | Pr. | #    |
| 1            | (MTH 213)    | Complex Variables &<br>Transforms | 3            | 0   | 100   | 0   | 35   |
| 2            | (ME 202)     | Strength of Materials-I           | 2            | 0   | 50    | 0   | 37   |
| 7            | (CH 202)     | Applied Chemistry                 | 2            | 0   | 50    | 0   | 39   |
| 4            | (ME 222)     | Thermodynamics-I                  | 3            | 0   | 100   | 0   | 41   |
| 5            | (ME 252)     | Fluid Mechanics-I                 | 3            | 1   | 100   | 50  | 43   |
| 6            | (CS 232)     | Computer programming              | 2            | 1   | 50    | 50  | 45   |
| Total: -     |              |                                   | 1            | 7   | 450   | 100 |      |

#### Fourth Semester

| S #          | Course Codes | Name of Subject                                      | Credit Hours |     | Marks |     | Page |
|--------------|--------------|--|--------------|-----|-------|-----|------|
| <b>3.</b> #. | Course Coues |  | Th.          | Pr. | Th.   | Pr. | #    |
| 1            | (MTH 336)    | Numerical Analysis & Computer<br>Applications (NACA) | 3            | 1   | 100   | 50  | 47   |
| 2            | (ME 232)     | Strength of Materials-II                             | 3            | 1   | 100   | 50  | 49   |
| 3            | (ME 242)     | Thermodynamics-II                                    | 3            | 1   | 100   | 50  | 51   |
| 4            | (ME 226)     | Fluid Mechanics-II                                   | 3            | 1   | 100   | 50  | 53   |
| 5            | (ME 212)     | Mechanics of Machines-I                              | 2            | 0   | 50    | 0   | 55   |
| Total: -     |              |  | 1            | .8  | 450   | 200 |      |

#### **Fifth Semester**

| <b>C</b> #        | Course Codes | Name of Subject                            | Credit | Hours | Marks |     | Page |
|-------------------|--------------|--|--------|-------|-------|-----|------|
| S.#. Course Coues |              | Name of Subject                            | Th.    | Pr.   | Th.   | Pr. | #    |
| 1                 | (ME 302)     | Heat & Mass Transfer                       | 3      | 1     | 100   | 50  | 57   |
| 2                 | (ME 312)     | Applied Aerodynamics                       | 3      | 1     | 100   | 50  | 59   |
| 3                 | (EE 325)     | Safety, Health & Environment               | 2      | 0     | 50    | 0   | 61   |
| 4                 | (ME 332)     | Machine Design -I                          | 3      | 0     | 100   | 0   | 63   |
| 5                 | (EN 306)     | Communication Skills and Technical Writing | 3      | 0     | 100   | 0   | 65   |
| 6                 | (ME 366)     | Mechanics of Machine-II                    | 2      | 1     | 50    | 50  | 68   |
| Total: -          |              |  | 1      | 9     | 500   | 150 |      |

#### Sixth Semester

| <b>G</b> #   | Course Codes | Name of Subject                         | <b>Credit Hours</b> |     | Marks |     | Page |
|--------------|--------------|---|---------------------|-----|-------|-----|------|
| <b>3.</b> #. | Course Codes | Name of Subject                         | Th.                 | Pr. | Th.   | Pr. | #    |
| 1            | (ME 342)     | Instrumentation & Measurement           | 2                   | 1   | 50    | 50  | 70   |
| 2            | (MTH 317)    | Statistics & Probability                | 3                   | 0   | 100   | 0   | 72   |
| 3            | (ME 352)     | Machine Design-II                       | 3                   | 0   | 100   | 0   | 74   |
| 4            | (ME 372)     | Refrigeration & Air<br>Conditioning     | 3                   | 1   | 100   | 50  | 76   |
| 5            | (ME 382)     | Mechanical Vibrations                   | 3                   | 1   | 100   | 50  | 78   |
| 6            | (ME 356)     | Computer Aided Machine<br>Design (CAMD) | 0                   | 1   | 0     | 50  | 80   |
| Total: -     |              | 1                                       | .8                  | 450 | 200   |     |      |

#### Seventh Semester

| <b>S</b> # | Course Codes | Name of Subject                              | <b>Credit Hours</b> |     | Marks |     | Page |
|------------|--------------|--|---------------------|-----|-------|-----|------|
| 5.#.       | Course Coues | Name of Subject                              | Th.                 | Pr. | Th.   | Pr. | #    |
| 1          | (ME 402)     | Entrepreneurship & Engineering<br>Management | 3                   | 0   | 100   | 0   | 81   |
| 2          | (ME 491)     | Control Engineering                          | 2                   | 1   | 50    | 50  | 85   |
| 3          | (ME 462)     | Manufacturing Processes                      | 3                   | 1   | 100   | 50  | 87   |
| 4          | (ME 442)     | Thermal Power Plants                         | 3                   | 1   | 100   | 0   | 89   |
|            | (ME 498)     | Project/Thesis –I*                           |                     | 3   | 0     | 100 | 91   |
| Total: -   |              | 1  | 7                   | 350 | 200   |     |      |

#### **Eighth Semester**

| S.#.     | Course Codes | Name of Subject                                      | Credit Hours |     | Marks |     | Page<br># |
|----------|--------------|--|--------------|-----|-------|-----|-----------|
|          |              |  | Th.          | Pr. | Th.   | Pr. |           |
| 1        | (ME 452)     | Renewable and Emerging<br>Energy Technologies (REET) | 3            | 1   | 100   | 50  | 92        |
| 2        | (ME 472)     | Maintenance Engineering                              | 2            | 0   | 50    | 0   | 94        |
| 3        | (ME 482)     | Project Management & Optimization                    | 3            | 0   | 100   | 0   | 96        |
| 4        | (ME 412)     | Automobile Engineering                               | 3            | 1   | 100   | 50  | 83        |
| 5        | (ME 499)     | Project/Thesis-II                                    |              | 3   | 0     | 100 | 98        |
| Total: - |              | 1  | 6            | 250 | 200   |     |           |

| Title of Subject | : | ISLAMIC STUD    | IES              |        |       |   |
|------------------|---|-----------------|------------------|--------|-------|---|
| Course Code      | : | (SS-111)        |                  |        |       |   |
| Semester         | : | FIRST           |                  | Year : | FIRST |   |
| Discipline       | : | MECHANICAL      | 4                |        |       |   |
| Effective        | : | 17 Batch and on | wards            |        |       |   |
| Pre-requisite    | : |                 |                  |        |       |   |
| Co-requisite     | : |                 |                  |        |       |   |
|                  | : | Theory          |                  | Practi | cal   |   |
| Assessment       |   | 20% Sessional V | Vork,            |        |       |   |
|                  |   | 20% Mid Semes   | ter Examination  |        |       |   |
|                  |   | 60% Final Writ  | tten Examination |        |       |   |
| Credit Hours     | : | Theory          | 02               | Pract  | tical | 0 |
| Marks            | : | Theory          | 50               | Pract  | tical | 0 |

After Completing the "Islamic Studies" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain    | Taxonomy<br>Level | PLO |
|------------|---|-----------|-------------------|-----|
| 1.         | Effectively maintained his/her identity in a multicultural world  | Affective | 2                 | 6   |
| 2.         | Find solutions to his/her problems from own cultural practices, rather than be influenced by external ideologies. | Affective | 3                 | 8   |
| 3.         | Know why Muslims fail to equip themselves with essential survival tools needed in the world today.                | Affective | 2                 | 12  |

#### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):** The course is designed so that students will achieve the following PLOs:

| 1<br>2 | Engineering Knowledge<br>Problem Analysis: | 7<br>8 | Environment and Sustainability:<br>Ethics: | $\checkmark$ |
|--------|--|--------|--|--------------|
| 3      | Design/Development of Solutions:           | 9      | Individual and Team Work:                  |              |
| 4      | Investigation:                             | 10     | Communication:                             |              |
| 5      | Modern Tool Usage:                         | 11     | Project Management:                        |              |
| 6      | The Engineering Society: $$                | 12     | Lifelong Learning:                         |              |

#### Contents: Quran and Uloomul Quran.

- Quran and Uloomul Quran: Surah Al-Hujurat., Surah Al-Furqan (These both surahs cover all topics related to
- ethical values of Islamic society including Taqwa, Taqwa, Simplicity, Lawful earning, Social Justice, Rights
- of Parents, elders, neighbors, Fear of Allah and Truthfulness), Excellence of Holy Quran (Aijazul Quran), History
- of collection and compilation of Holy Quran.
- Basic Beliefs of Islam: Tauheed, its importance, effects on the life of believer, shirk and its types,

Existence of Angles, Holy Scriptures, Prophethood, its need and necessities, characteristics and Finality of Prophethood, Concept on life hereafter.Life history of Holy Prophet Muhammad (ﷺ): Life history at Makkah (Before Prophethood), Life history at Makkah (after Prophethood), Life history at Madina {including Brotherhood, Charter of Madina, Victory of Makkah and Last Sermon of Holy Prophet Muhammad (ﷺ), Importance of Hadith and Sunnah, Ten selected Ahadiths (Covering topics related to Proper usage of time, Hospitality, quality of shyness, love and affection to humanity, facilitate to others and tolerance etc).

Fundamentals of Islam: Testifying KalimaShahadah, Prayer, its importance, pre-conditions, obligations and effects, Zakat, its aims & objectives, Requirements, Legal recipients, Nisab and benefits, Fasting, its philosophy, requirements and benefits, Pilgrimage, requirements, types, obligations, procedure and benefits, Jihad and its types.Islam and Science: Quran and Science, Importance of science and technology in Islam, Historical contribution of Islam and Muslims in the development of science, Verses of Holy Quran those cover different fields of science e.g. social, management and natural science.

#### **Recommended Books**

#### A) Text Books

- 1 A.A. Umrani, Islam: The universal Religion, Naseem book dept, 1994.
- 2 A.Q. Natiq, Sirat-e-Mustaqeem, Urdu bazzar Karachi, 1992.

#### **B)** Reference Books

- 1 S.M. Saeed, Islam aurHamariZindagi, Naseem book dept, 1988.
- 2 M. Shabudden, Quran Science and Muslims, Al Maktabah Al Ashrafiya, Lahore, 2000.

Approval: Board of Studies Board of Faculty of Engineering Academic Council :Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10 Dated:17-03-2018 Dated: 29-03-2018 Dated:23-04-2018

| Title of Subject | : | ETHICS            |                               |      |          |       |  |  |  |
|------------------|---|-------------------|-------------------------------|------|----------|-------|--|--|--|
| Course Code      | : | SS104             | S104                          |      |          |       |  |  |  |
| Semester         | : | FIRST             |                               | Year | :        | FIRST |  |  |  |
| Discipline       | : | MECHANICAL        |                               |      |          |       |  |  |  |
| Effective        | : | 17 Batch and onwa | rds                           |      |          |       |  |  |  |
| Pre-requisite    | : |                   |                               |      |          |       |  |  |  |
| Co-requisite     | : |                   |                               |      |          |       |  |  |  |
|                  |   | Theory            | Practical                     |      |          |       |  |  |  |
| Assessment       |   | 20% Sessional Wo  | rk,                           |      |          |       |  |  |  |
| Assessment       |   | 20% Mid Semester  | Examination                   |      |          |       |  |  |  |
|                  |   | 60% Final Written | 60% Final Written Examination |      |          |       |  |  |  |
| Credit Hours     | : | Theory            | 02                            | ]    | Practica | 00    |  |  |  |
| Marks            | : | Theory            | 50                            | ]    | Practica | 00    |  |  |  |

After Completing the "Ethics" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain    | Taxonomy<br>Level | PLO |
|------------|---|-----------|-------------------|-----|
| 1.         | Create stable and healthy civilized atmosphere.   | Affective | 2                 | 6   |
| 2.         | Develop uniformity of moral beliefs and behavior. | Affective | 2                 | 8   |

#### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | 7      | Environment and Sustainability: |  |
|---|----------------------------------|--------|---------------------------------|--|
| 2 | Problem Analysis:                | 8      | Ethics:                         |  |
| 3 | Design/Development of Solutions: | 9      | Individual and Team Work:       |  |
| 4 | Investigation:                   | 10     | Communication:                  |  |
| 5 | Modern Tool Usage:               | 11     | Project Management:             |  |
| 6 | The Engineering Society:         | <br>12 | Lifelong Learning:              |  |

#### **Contents:**

Ethics: Definition of Ethics, Position of ethics in different religions.

Islam: Introduction, Role of Beliefs and Arakans in character building, Rights of Non-Muslim, Ill effects of corruption and respect of law.

Hinduism: Introduction, Role of doctrines in character building, Religious books, Concept of Re-Birth and its influence in social life, Celebration days and their social effects, Comparative study of cast systems in the contemporary atmosphere.

Buddhism: Introduction, Doctrines, Eight Nobel Paths of Buddha and its benefits, Critical study on concept of Renunciation of material & worldly life.

Christianity: Introduction, Doctrines, Religious books, Celebration days.

Judaism: Introduction, Doctrines, Religious books, Ten Commandments of Moses and its importance in social life.

Moral values of different religions: Patience, Modesty, Moderation, Tawakal, Taqwa, Lawful earning, Sincerity, Positivity, Forgiveness and Softening.

Bad morals: lying, pride, selfishness, Fame, Greed, Extravagantness, Bribe, Social injustice, Religious biasness and Discrimination on the basis of race, color and faith.

| Recom | nended             | books:   |  |  |  |  |  |  |
|-------|--------------------|--|--|--|--|--|--|--|
| А.    | Textbooks          |  |  |  |  |  |  |  |
|       | 1.                 | Dr. A Rasheed, Comparative Study of Religions Tahir sons Karachi, 2001.                              |  |  |  |  |  |  |
|       | 2.                 | AadilFaraz, IkhlaqiyatMazahib-e-AalamkiNazar main, ApnaIdara Lahore 2002.                            |  |  |  |  |  |  |
| B.    | B. Reference Books |  |  |  |  |  |  |  |
|       | 1.                 | Jeoge D. Chryssides, the study of religions – an introduction to key ideas and methods, London, 2007 |  |  |  |  |  |  |
|       | 2.                 | GhulamRasool Cheema MazahibAalamkaMutalia,Ilm o Irfan publishers Lahore 2006                         |  |  |  |  |  |  |

| Approval: | Board of Studies                | :Res.No.25.3.1 | Dated:17-03-2018  |
|-----------|---------------------------------|----------------|-------------------|
|           | Board of Faculty of Engineering | :Res.No.33.08  | Dated: 29-03-2018 |
|           | Academic Council                | :Res.No.92.10  | Dated:23-04-2018  |

| Title of Subject | : | PAKISTAN STUDIES   |             |           |              |  |  |  |
|------------------|---|--|-------------|-----------|--------------|--|--|--|
| Course Code      | : | (PS 106)   |             |           |              |  |  |  |
| Semester         | : | FIRST  | Year        | :         | FIRST        |  |  |  |
| Discipline       | : | MECHANICAL   |             |           |              |  |  |  |
| Effective        | : | 17 Batch and onwards   |             |           |              |  |  |  |
| Pre-requisite    | : |  |             |           |              |  |  |  |
| Co-requisite     | : |  |             |           |              |  |  |  |
| Assessment       |   | Theory   | P           | Practical |              |  |  |  |
|                  |   | <ul><li>20% Sessional Work,</li><li>20% Mid Semester Exam</li><li>60% Final Written Exar</li></ul> | ination     |           |              |  |  |  |
| Credit Hours     | : | Theory (   | )2 <b>F</b> | Practi    | <b>cal</b> 0 |  |  |  |
| Marks            | : | Theory 5   | 50 <b>F</b> | Practi    | cal 0        |  |  |  |

After Completing the "Pakistan Studies" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain    | Taxonomy<br>Level | PLO |
|------------|---|-----------|-------------------|-----|
| 1.         | Trace the Muslim Nationalism in South Asia and the creation of Pakistan.                  | Cognitive | 2                 | 6   |
| 2.         | Explore the Constitutional, Political and Diplomatic History of Pakistan                  | Cognitive | 2                 | 12  |
| 3.         | Analyze the Geo-strategic importance of Pakistan and contemporary challenges to Pakistan. | Cognitive | 3                 | 7   |

#### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | 7      | Environment and Sustainability: | $\checkmark$ |
|---|----------------------------------|--------|---------------------------------|--------------|
| 2 | Problem Analysis:                | 8      | Ethics:                         |              |
| 3 | Design/Development of Solutions: | 9      | Individual and Team Work:       |              |
| 4 | Investigation:                   | 10     | Communication:                  |              |
| 5 | Modern Tool Usage:               | 11     | Project Management:             |              |
| 6 | The Engineering Society:         | <br>12 | Lifelong Learning:              | $\checkmark$ |

#### **Contents:**

ne Historical Background of Pakistan

Evolution and growth of Muslim society in Subcontinent

Muslim Revivalist and Reformist Movements

The Factors that shaped the Muslim Nationalism in the Subcontinent

The Factors that led birth to Pakistan

Ideology of Pakistan with special reference to Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah

Role of Sindh in Making of Pakistan

History of Internal and External Affairs of Pakistan:

The Constitutional and Political Developments in Pakistan (1947-1973)

The Constitution of 1973; Salient Features and Amendments

Political Development in Pakistan (1973 to date)

Determinants of Foreign Policy of Pakistan

Pakistan's Relations with Big Powers Contemporary Pakistan (Issues and Challenges): Geo-Strategic Significance of Pakistan Economic Potential and its Utilization Challenges to National Security of Pakistan Internal Political, Economic and Legal Problems Futuristic Outlook of Pakistan

| Reco                | Recommended Books                                   |  |  |  |  |
|---------------------|---|--|--|--|--|
| A) To               | ext Books   |  |  |  |  |
| 1                   | IH Qureshi A Short History of Pakistan.             |  |  |  |  |
| 2                   | RafiullahShehab History of Pakistan.                |  |  |  |  |
| 3                   | G. Allana Our Freedom Fighters.                     |  |  |  |  |
| 4                   | K.K. Aziz The making of Pakistan.                   |  |  |  |  |
| 5                   | Choudhry Muhammad Ali The Emergence of Pakistan.    |  |  |  |  |
| <b>B</b> ) <b>R</b> | eference Books                                      |  |  |  |  |
| 1                   | K. Arif Pakistan's Foreign Policy.                  |  |  |  |  |
| 2                   | KhawajaAmjadSaeed Economy of Pakistan.              |  |  |  |  |
| 3                   | SafdarMahmood International Affairs.                |  |  |  |  |
| 4                   | Khalid bin SaeedThe Political System of Pakistan.   |  |  |  |  |
| 5                   | Mohammad Azam International relations and practice. |  |  |  |  |

Approval:Board of Studies:Res.No.25.3.1Dated:17-03-2018Board of Faculty of Engineering:Res.No.33.08Dated: 29-03-2018Academic Council:Res.No.92.10Dated:23-04-2018

| Title of Subject | : | APPLIED CALCULUS   |          |       |                |  |  |
|------------------|---|--|----------|-------|----------------|--|--|
| Course Code      | : | (MTH 108)  |          |       |                |  |  |
| Semester         | : | FIRST  | Year     | :     | FIRST          |  |  |
| Discipline       | : | MECHANICAL   |          |       |                |  |  |
| Effective        | : | 17 Batch and onwards   |          |       |                |  |  |
| Pre-requisite    | : |  |          |       |                |  |  |
| Co-requisite     | : |  |          |       |                |  |  |
|                  |   | Theory   | F        | racti | cal            |  |  |
| Assessment       |   | <ul><li>20% Sessional Work,</li><li>20% Mid Semester Examination</li><li>60% Final Written Examination</li></ul> | on<br>on |       |                |  |  |
| Credit Hours     | : | <b>Theory</b> 03   |          | Pract | <b>ical</b> 00 |  |  |
| Marks            | : | <b>Theory</b> 100  |          | Pract | <b>ical</b> 00 |  |  |

After Completing the "Applied Calculus" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain    | Taxonomy<br>Level | PLO |
|------------|---|-----------|-------------------|-----|
| 1.         | Evaluate the functions and their derivatives.         | Cognitive | 2                 | 2   |
| 2.         | Assess the Integral calculus with applications        | Cognitive | 3                 | 3   |
| 3.         | Apply the vector calculus in the field of engineering | Cognitive | 3                 | 3   |

#### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge               |              | 7  | Environment and Sustainability: |  |
|---|-------------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                   | $\checkmark$ | 8  | Ethics:                         |  |
| 3 | Design/Development of<br>Solutions: | $\checkmark$ | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                      |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:                  |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:            |              | 12 | Lifelong Learning:              |  |

**Contents:** 

**Introduction to functions:** Mathematical and physical meaning, graphs and types of function. **Introduction to limits:** Theorems of limits and their applications to functions. Right hand and left hand limits. Continuous and discontinuous functions and their applications.

**Derivatives:** Introduction to derivatives. Geometrical and physical meaning of derivatives. Partial derivatives and their geometric significance. Application problems (rate of change, marginal analysis). **Higher Derivatives:** Leibnitz theorem, Rolle's theorem, Mean value theorem. Taylors and Maclaurins series.

**Evaluation of limits using L' Hospital's rule:** Indeterminate forms (0/0),  $(\infty/\infty)$ ,  $(\infty\infty)$ ,  $(\infty-\infty)$ ,  $1^{\infty}$ ,  $\infty^{0}$ ,  $0^{0}$ . **Application of Derivatives:** Asymptotes, curvature and radius of curvature, differentials with application. **Application of partial Derivatives:** Euler's theorem, total differentials; maxima and minima of function of two variables.

Integral Calculus: Methods of integration by substitution and by parts. Integration of rational and irrational

algebraic functions. Definite integrals, improper integrals. Gamma and Beta functions; reduction formulae. **Application of Integral Calculus:** Cost function from marginal cost, rocket flights; area under curve. **Vector Calculus:** Vector differentiation and vector integration with their physical interpretation and applications. $\nabla$ operator, gradient, divergence and curl with their application.

| Recommended Books   |   |  |  |  |  |  |
|---|---|--|--|--|--|--|
| A) Text Books   |   |  |  |  |  |  |
| 1   | 1 Benice, D.D., Brief calculus and its applications, Latest Edition |  |  |  |  |  |
| 2   | Raymond, A.B., Applied calculus, Latest Edition                     |  |  |  |  |  |
| B) Reference Books  |   |  |  |  |  |  |
| 1 Yousuf, S.M., Calculus and analytical Geometry, IlmiKitabKhana, Lahore, 2001. |   |  |  |  |  |  |

| <u>Approval</u> : | Board of Studies                | :Res.No.25.3.1 | Dated:17-03-2018  |
|-------------------|---------------------------------|----------------|-------------------|
|                   | Board of Faculty of Engineering | :Res.No.33.08  | Dated: 29-03-2018 |
|                   | Academic Council                | :Res.No.92.10  | Dated:23-04-2018  |

| Title of Subject | : | ENGINEERING DRAWING AND COMPUTER GRAPHICS |                    |                            |               |  |  |  |  |  |
|------------------|---|---|--------------------|----------------------------|---------------|--|--|--|--|--|
| Course Code      | : | (ME 102)                                  |                    |                            |               |  |  |  |  |  |
| Semester         | : | FIRST                                     | FIRST Year : FIRST |                            |               |  |  |  |  |  |
| Discipline       | : | MECHANICAL                                |                    |                            |               |  |  |  |  |  |
| Effective        | : | 17 Batch and onwards                      |                    |                            |               |  |  |  |  |  |
| Pre-requisite    | : |   |                    |                            |               |  |  |  |  |  |
| Co-requisite     | : |   |                    |                            |               |  |  |  |  |  |
|                  | : | Theory                                    | P                  | Practical                  |               |  |  |  |  |  |
| Assassment       |   | 20% Sessional Work,                       | 40                 | 40% Sessional Work,        |               |  |  |  |  |  |
| Assessment       |   | 20% Mid Semester Exam                     | ination            | ,                          |               |  |  |  |  |  |
|                  |   | 60% Final Written Examination             |                    | 60% Final Lab. Examination |               |  |  |  |  |  |
| Credit Hours     | : | <b>Theory</b> (                           | )2 <b>F</b>        | Practio                    | <b>cal</b> 02 |  |  |  |  |  |
| Marks            | : | Theory 5                                  | 0 I                | Practic                    | <b>al</b> 100 |  |  |  |  |  |

After Completing the "Engineering Drawing And Computer Graphics" Course, each student will be able to:

| Sr.<br>No. | CLO  | Domain                   | Taxonomy<br>Level | PLO     |
|------------|--|--------------------------|-------------------|---------|
| 1.         | Comprehend the science of engineering drawing, to develop<br>skill of using proper engineering drawing techniques for<br>adequate representation of various machine parts. | Cognitive<br>Psychomotor | 2<br>3            | 1 & 2   |
| 2.         | Read and reproduce engineering drawings with ability to<br>convey ideas effectively by preparing freehand sketches,<br>mechanical and computer aided drawing.              | Cognitive<br>Psychomotor | 3<br>3& 4         | 1, 2& 3 |

#### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):** The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            |              | 7  | Environment and Sustainability: |  |
|---|----------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                |              | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: | $\checkmark$ | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |  |

#### **Contents:**

**Introduction & Basics**: Role of graphic language in engineering Drawing instruments, Line types and lettering. Plan the sheet layout and dimensioning. Basic drafting techniques and standards. Curves used in engineering.

**Orthographic Projections:** Orthographic Multiview projection of some simple and composite solids. **Sections:** Sectioning and projection of auxiliary views.

**Surface Development:** Surface development of simple solids such as cylinder, cone, prism and pyramid, surface development of intersecting solids.

Isometric Projection: Isometric projection and drawings. Piping drawings.

Freehand/Sketching: Sketching and basic rules of sketching.

**Computer Aided Drawing:** 2-D and 3-D work space in computer graphics, Creating & editing 2-D geometric entities, text and dimensions on 2-D drawings. Creating and editing 3-D primitives, extracting geometric information and mass properties, printing/plotting concepts.

**Detail, Assembly and Working Drawings:** Preparing detail, assembly and working drawings using conventional instruments and computer graphics tool, of various machine and engine parts such as, keys, cotters, foundation bolts, screws, pulleys, couplings, bearings, riveted joints and nut and bolts. Fundamentals of geometric dimensioning and tolerancing.

#### **Recommended Books**

#### A) Text Books

1 Bertoline–Wiebe, "Fundamentals of Graphics Communication", McGraw–Hill Primis, ISBN:

**•** 0–390–73230–3, Latest Edition.

2 Colin H Simmons, "Manual of Engineering Drawing", ISBN–13: 978-0-7506-8985-4, Latest Edition.

**3** User manual of the computer graphics software.

#### **B)** Reference Books

1 Frederick E. Giesecke, Alva Mitchell, Henry C. Spencer, Ivan Leroy Hill, John Thomas Dygdon, James

<u>E. Novak</u>, "Technical Drawing", ISBN-13: 978-0130081834, Latest Edition.

- 2 Paul Ross Wallach, "Fundamentals of modern drafting", latest edition.
- **3** Warren J. Luzzader." Fundamentals of Engineering Drawing", latest edition.

| Approval: | Board of Studies                |
|-----------|---------------------------------|
|           | Board of Faculty of Engineering |
|           | Academic Council                |

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| Title of Subject | : | ENGINEERING STATICS    |                    |                            |    |  |  |  |  |  |
|------------------|---|------------------------|--------------------|----------------------------|----|--|--|--|--|--|
| Course Code      | : | (ME 112)               |                    |                            |    |  |  |  |  |  |
| Semester         | : | FIRST                  | FIRST Year : FIRST |                            |    |  |  |  |  |  |
| Discipline       | : | MECHANICAL             |                    |                            |    |  |  |  |  |  |
| Effective        | : | 17 Batch and onwards   |                    |                            |    |  |  |  |  |  |
| Pre-requisite    | : | None                   |                    |                            |    |  |  |  |  |  |
| Co-requisite     | : | None                   |                    |                            |    |  |  |  |  |  |
|                  | : | Theory                 | P                  | Practical                  |    |  |  |  |  |  |
| Assessment       |   | 20% Sessional Work,    | 4                  | 40% Sessional Work,        |    |  |  |  |  |  |
| Assessment       |   | 20% Mid Semester Exam  | ination            | ,                          |    |  |  |  |  |  |
|                  |   | 60% Final Written Exan | nination 6         | 60% Final Lab. Examination |    |  |  |  |  |  |
| Credit Hours     | : | <b>Theory</b> 0        | 2 1                | Practical                  | 01 |  |  |  |  |  |
| Marks            | : | Theory 5               | 0 1                | Practical                  | 50 |  |  |  |  |  |

After Completing the "Engineering Statics" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain      | Taxonomy<br>Level | PLO  |
|------------|---|-------------|-------------------|------|
| 1.         | Determine Resultant of force vectors in a plane or space using Scalar<br>and Vector approach            | Cognitive   | C2                | 1    |
| 2.         | Investigate equilibrium of particles and rigid bodies and solve<br>problems involving frictional forces | Cognitive   | C3                | 1& 2 |
| 3.         | Perform experiments to demonstrate various concepts learned in theory lectures                          | psychomotor | Р3                | 2    |

### RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | <br>7 | Environment and Sustainability: |  |
|---|----------------------------------|-------|---------------------------------|--|
| 2 | Problem Analysis:                | <br>8 | Ethics:                         |  |
| 3 | Design/Development of Solutions: | 9     | Individual and Team Work:       |  |
| 4 | Investigation:                   | 10    | Communication:                  |  |
| 5 | Modern Tool Usage:               | 11    | Project Management:             |  |
| 6 | The Engineering Society:         | 12    | Lifelong Learning:              |  |

#### **Contents:**

**Force System**: Introduction to the subject, fundamental concepts of statics, representation & types of vectors, principle of transmissibility, graphical & analytical methods of vector operation, rectangular and non-rectangular components, cartesian vectors, \position vector.

**Equilibrium of Particle:** Free body diagram of particle in equilibrium, equilibrium of particle for 2D and 3D systems.

**Force System Resultants:** Moment of a force (scalar and vector formulation),moment of force about a specified axis, moment of a couple, resultant of a force and couple systems.

**Equilibrium of Rigid Bodies:** Free body diagram of rigid bodies in equilibrium, equilibrium of rigid bodies for 2D and 3D systems.

**Frames & Cables:** Free body diagram for frames & machines, cables andbeams subjected to various loads. **Friction:** Characteristics of dry friction, laws of friction, angle of friction, angleof repose, static and dynamic friction, friction on horizontal and inclined planes.

| Recon         | Recommended Books  |  |  |  |  |  |  |
|---------------|--|--|--|--|--|--|--|
| A) Text Books |  |  |  |  |  |  |  |
| 1             | R.C. Hibbler, "Engineering Mechanics (Statics)" latest edition.              |  |  |  |  |  |  |
| 2             | J.L Meriam, "Engineering Mechanics (Statics)" latest edition.                |  |  |  |  |  |  |
| B) Re         | B) Reference Books   |  |  |  |  |  |  |
| 1             | Beer & Johnston, "Vector Mechanics for Engineers (Statics)", latest edition. |  |  |  |  |  |  |
| 2             | Joseph f. Shelley, "Engineering Mechanics (Statics)", latest edition.        |  |  |  |  |  |  |

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| Title of Subject | : | ENGINEERING MATH   | ENGINEERING MATERIALS |         |       |  |  |  |  |
|------------------|---|--|-----------------------|---------|-------|--|--|--|--|
| Course Code      | : | (ME122)  |                       |         |       |  |  |  |  |
| Semester         | : | FIRST  | Year                  | :       | FIRST |  |  |  |  |
| Discipline       | : | MECHANICAL   |                       |         |       |  |  |  |  |
| Effective        | : | 17 Batch and onwards   |                       |         |       |  |  |  |  |
| Pre-requisite    | : |  |                       |         |       |  |  |  |  |
| Co-requisite     | : |  |                       |         |       |  |  |  |  |
|                  | : | Theory   | 1                     |         |       |  |  |  |  |
| Assessment       |   | <ul><li>20% Sessional Work,</li><li>20% Mid Semester Exam</li><li>60% Final Written Exam</li></ul> | ination               |         |       |  |  |  |  |
| Credit Hours     | : | <b>Theory</b> C  | 3 P                   | Practic | al 0  |  |  |  |  |
| Marks            | : | Theory 1   | 00 <b>P</b>           | Practic | al 0  |  |  |  |  |

After Completing the "Engineering Materials" Course, each student will be able to:

| Sr.<br>No. | CLO  | Domain    | Texanomy<br>Level | PLO |
|------------|--|-----------|-------------------|-----|
| 1.         | Identify characteristic properties of engineering materials and their<br>relation with atomic structure, select appropriate materials for various<br>engineering applications.                 | Cognitive | 1                 | 1   |
| 2.         | Understand the process extracting metals from their ores. Select<br>appropriate means of protecting materials against corrosion; and<br>identify the methods of enhancing material properties. | Cognitive | 1 & 2             | 2   |

#### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | <br>7 | Environment and Sustainability: |  |
|---|----------------------------------|-------|---------------------------------|--|
| 2 | Problem Analysis:                | <br>8 | Ethics:                         |  |
| 3 | Design/Development of Solutions: | 9     | Individual and Team Work:       |  |
| 4 | Investigation:                   | 10    | Communication:                  |  |
| 5 | Modern Tool Usage:               | 11    | Project Management:             |  |
| 6 | The Engineering Society:         | 12    | Lifelong Learning:              |  |

#### **Contents:**

**Introduction**: Classification of Engineering Materials and their properties. Crystalline structure of metals, allotropy, crystallographic planes, slip and slip system, dislocation and twining.

**Production of Iron and Steel and their alloy:** Production of iron wrought iron,cast iron, production of steel and its classification, production of various steel section. alloying elements and their effect on the properties of alloy steel. Ferrite, Austenite, Cementite, Pearlite, Martensite, &Banite. phase diagram & iron carbon phase diagram.

**Non-ferrous and their alloy:** Refining of copper, aluminum & zinc, aluminumalloys, zinc alloys, copper alloys brass & bronze, metals & alloys for special applications.

**Corrosion**: Reasons of corrosion attack on different materials. Modes of corrosion. Corrosion prevention methods.

**Heat treatment:** Heat treatment, critical temperature, transformation onheating/cooling, annealing, normalizing, tempering, quenching, austempering, hardening.

**Non-metallic Materials:** Classification of Polymers, molecular structure and bonding of polymer. Classification of ceramic, bonding and properties of ceramic material. Properties of glass, crystalline and amorphous glass, refractory materials and their types.

Advanced Materials: Composite materials and their classifications, Matrix materials and their types, glassfibre reinforced plastics, ceramic-metal composites (Cermets). Biomaterials and their applications, Nanomaterials and their applications. Semi-conducting materials.

| Reco  | Recommended Books  |  |  |  |  |
|-------|--|--|--|--|--|
| A) To | ext Books  |  |  |  |  |
| 1     | W. D. Callister, "Material Science and Engineering An Introduction", John Wiley & Sons. (latest edition)                           |  |  |  |  |
| 2     | D. R. Askeland, P.P. Fulay& W. J. Wright, "The Science and Engineering of Materials", Global Engineering. (latest edition)         |  |  |  |  |
| 3     | R. E. Smallman& R. J. Bishop, "Modern Physical Metallurgy & Materials Engineering", (latest edition)                               |  |  |  |  |
| B) Re | eference Books   |  |  |  |  |
| 1     | G. RenginaldBashforth, "The Manufacturing of Iron & Steel", Chapman & Hall Ltd, (latest edition)                                   |  |  |  |  |
| 2     | Sharma, "Basics of Engineering Materials", (latest edition)  |  |  |  |  |
| 3     | Mikell P. Groover, "Fundamentals of Modern Manufacturing: materials, processes, and systems", John Wiley & Sons, (latest edition). |  |  |  |  |
|       |  |  |  |  |  |

<u>Approval</u>: Board of Studies Board of Faculty of Engineering Academic Council :Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10 Dated: 17-03-2018 Dated: 29-03-2018 Dated: 23-04-2018

| Title of Subject | FUNCTIONAL ENGLISH                           |             |           |                       |       |   |  |  |  |  |  |
|------------------|--|-------------|-----------|-----------------------|-------|---|--|--|--|--|--|
| Course Code      | EN 101                                       |             |           |                       |       |   |  |  |  |  |  |
| Semester         | SECOND                                       |             | Year      | : :                   | FIRST |   |  |  |  |  |  |
| Discipline       | MECHANIC                                     | CAL         |           |                       |       |   |  |  |  |  |  |
| Effective        | 17 Batch and onwards                         |             |           |                       |       |   |  |  |  |  |  |
| Pre-requisite    | English Language Proficiency of intermediate |             |           |                       |       |   |  |  |  |  |  |
| Co-requisite     |  |             |           |                       |       |   |  |  |  |  |  |
|                  | Theory                                       |             | ]         | Practic               | al    |   |  |  |  |  |  |
| Assessment       | 20% Session                                  | al Work,    |           |                       |       |   |  |  |  |  |  |
|                  | 20% Mid Ser                                  | nester Exam | ination - |                       |       |   |  |  |  |  |  |
|                  | 60% Final V                                  | ination     |           |                       |       |   |  |  |  |  |  |
| Credit Hours     | Theory                                       | 0           | 2         | Practi                | cal   | 0 |  |  |  |  |  |
| Marks            | Theory                                       | 5           | 0         | Theory 50 Practical 0 |       |   |  |  |  |  |  |

After Completing the "Functional English" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain    | Taxonomy<br>Level | PLO   |
|------------|---|-----------|-------------------|-------|
| 1.         | Write varied contents including official letters, e-mails, and<br>applications and summarize the texts using appropriate<br>grammatical mechanisms and cohesive devices.  | Cognitive | 2                 | 12    |
| 2.         | Apply skimming, scanning and detailed reading and listening<br>strategies to understand gist of the text/conversation and to<br>demonstrate their skills using English language to express their<br>point of view | Cognitive | 3                 | 2& 10 |

### RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):

#### The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | 7     | Environment and Sustainability: |              |
|---|----------------------------------|-------|---------------------------------|--------------|
| 2 | Problem Analysis:                | <br>8 | Ethics:                         |              |
| 3 | Design/Development of Solutions: | 9     | Individual and Team Work:       |              |
| 4 | Investigation:                   | 10    | Communication:                  | $\checkmark$ |
| 5 | Modern Tool Usage:               | 11    | Project Management:             |              |
| 6 | The Engineering Society:         | 12    | Lifelong Learning:              |              |

#### **Contents:**

#### Reading:

Interactive Reading, Apply the skills of surveying, skimming, scanning and detailed reading and identify topic sentence.

#### Writing:

Audience related writing, composition of sentences, paragraphs, short descriptive wirting, précis and letter and application, identify contextual clues with the help of cohesive devices.

#### Listening:

Collect gist and important points from listening text or any other oral source viz. lecture, speech or conversation.

#### Speaking:

Taking part in different real life situations, answer question, argue and explain one's point of view, ask for information, turn taking techniques and presentation skills.

#### Grammar:

Mechanics of English language, punctuation, conservation words, tenses and sentence structure.

*Vocabulary:* Matching vocabulary items with their corresponding definitions, identification odds items out of a list of vocabulary items, classification of vocabulary items in lexical sets.

| Recommended Books   |   |  |  |  |
|---------------------|---|--|--|--|
| A) T                | ext Books   |  |  |  |
| 1                   | Selected text from Dawn, Readers Digest, New Scientist and other relevant material of teacher's choice.             |  |  |  |
| 2                   | Thomson A. J. and Mrtenet A. V. "A Practical English Grammar", 3rdEdn., OUP, latest edition.                        |  |  |  |
| 3                   | SarwarZakia, "English Study Skills", A Spelt Publication Karachi 1991.  |  |  |  |
|                     | R. R. Jordon, "Collins Study Skills in English", William Collins Sons and Co. GlasgowGreat Britain 1980.            |  |  |  |
| <b>B</b> ) <b>R</b> | eference Books  |  |  |  |
| 1                   | Jones Rhodri, "A New English Course (An Approach to GCSE English Language for Individual Study or Class Use), 1986. |  |  |  |
| 2                   | K James et al, "Listening Comprehension and Note-Taking Cours" in Collins Study Skills in English, 1986.            |  |  |  |
| 3                   | S. Jannifer, "Grammar in Practice 1 and 2", OUP, latest edition.  |  |  |  |
| 4                   | S. Michael, "Basic English Usage", OUP, latest edition.   |  |  |  |
| 5                   | S. Michael, "Practical English Usage", OUP, latest edition.   |  |  |  |

Approval:Board of Studies:Res.No.25.3.1Board of Faculty of Engineering<br/>Academic Council:Res.No.33.08:Res.No.92.10

Dated:17-03-2018 Dated: 29-03-2018 Dated:23-04-2018

| Title of Subject |   | LINEAR ALGEBRA, DIFFERENTIAL EQUATIONS AND |              |  |  |  |  |  |
|------------------|---|--|--------------|--|--|--|--|--|
|                  |   | ANALYTICAL GEOMETRY                        |              |  |  |  |  |  |
| Course Code      | : | (MTH 103)                                  |              |  |  |  |  |  |
| Semester         | : | SECOND                                     | Year : FIRST |  |  |  |  |  |
| Discipline       | : | MECHANICAL                                 |              |  |  |  |  |  |
| Effective        | : | 17 Batch and onwards                       |              |  |  |  |  |  |
| Pre-requisite    | : | Pre – Engineering                          |              |  |  |  |  |  |
| Co-requisite     | : |  |              |  |  |  |  |  |
|                  | : | Theory                                     | Practical    |  |  |  |  |  |
| Assessment       |   | 20% Sessional Work,                        |              |  |  |  |  |  |
| Assessment       |   | 20% Mid Semester Examination               |              |  |  |  |  |  |
|                  |   | 60% Final Written Examination              |              |  |  |  |  |  |
| Credit Hours     | : | Theory 03                                  | Practical 0  |  |  |  |  |  |
| Marks            | : | Theory 100                                 | Practical 0  |  |  |  |  |  |

After Completing the "Linear Algebra, Differential Equations And Analytical Geometry" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain    | Taxonomy<br>Level | PLO |
|------------|---|-----------|-------------------|-----|
| 1.         | Perform the basic operation of matrix algebra and solution of system of linear equations. | Cognitive | 2                 | 2   |
| 2.         | Assess first and higher order and differential equations methods.                         | Cognitive | 3                 | 3   |
| 3.         | Analyze area and volume of bounded regions by using multiple integrals                    | Cognitive | 3                 | 3   |

#### RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):

#### The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            |              | 7  | Environment and Sustainability: |  |
|---|----------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                |              | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: | $\checkmark$ | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |  |

#### **Contents:**

**Introductions to matrices and elementary row operations:** Brief introduction of matrices. Types of matrices. Introduction to elementary row operations. Echelon and reduced echelon forms. Rank of a matrix. Inverse of a matrix using elementary row operations.

**System of linear equations:** System of non-homogeneous and homogeneous linear equations. Gaussian elimination method, Gauss Jordan method. Consistence criterion for solution of homogeneous and non-homogeneous system of linear equations. Application of system of linear equations.

**Determinants:** Introduction to determinants. Properties of determinants of order n. Rank of a matrix by using determinants.

Analytic geometry of 3-dimensions: Introduction; Coordinates in R3.

**Line:** Coordination of a point dividing a line segment in a given ratio. Straight line, in  $\mathbb{R}^3$ . Vector form of a straight line, parametric equations of a straight line, equation of a straight line in symmetric form, direction ratios and direction cosines, angle between two straight lines; distance of a point from a line.

**Plane:** Equation of a plane, angle between two planes, intersection of two planes, a plane and a straight line; skew lines. Cylindrical and spherical coordinates.

**Sphere:** General equation of sphere.

**Differential equations of first order:** Ordinary differential equations and their classification, formation of differential equations, solution of differential equations; initial and boundary conditions. Methods of solution of differential equation of first order and first degree; geometrical and physical applications.

**Higher order linear differential equations:** Homogeneous and non-homogeneous linear equations of order n with constants coefficients. Cauchy Euler equation. Method of variation of parameters. Application of higher order linear differential equations.

Multiple Integrals: Evaluation of double and triple integrals in Cartesian and polar coordinates.

| Rec          | Recommended Books                                 |  |  |  |  |
|--------------|---|--|--|--|--|
| A) '         | A) Text Books                                     |  |  |  |  |
| 1            | Dr. S.M. Yusuf, Calculus and analytical geometry  |  |  |  |  |
| 2            | Dr. S.M. Yusuf, Mathematical methods              |  |  |  |  |
| <b>B</b> ) ] | B) Reference Books                                |  |  |  |  |
| 1            | Schaum outline series, Differential equations.    |  |  |  |  |
| 2            | Dr. B.S. Grewall, Higher Engineering Mathematics. |  |  |  |  |

| <u>Approval</u> : | Board of Studies                | :Res.No.25.3.1 | Dated:17-03-2018  |
|-------------------|---------------------------------|----------------|-------------------|
|                   | Board of Faculty of Engineering | :Res.No.33.08  | Dated: 29-03-2018 |
|                   | Academic Council                | :Res.No.92.10  | Dated:23-04-2018  |

| Title of Subject | : | ENGINEERING DYNAMICS   |   |          |      |  |  |
|------------------|---|--|---|----------|------|--|--|
| Course Code      | : | (ME 132)   |   |          |      |  |  |
| Semester         | : | SECOND   | Year  | : F      | IRST |  |  |
| Discipline       | : | MECHANICAL   |   |          |      |  |  |
| Effective        | : | 17 Batch and onwards   |   |          |      |  |  |
| Pre-requisite    | : | Engineering Drawing & O  | Engineering Drawing & Graphics (ME101), Engineering Statics |          |      |  |  |
| Co-requisite     | : |  |   |          |      |  |  |
|                  | : | Theory   | P   | ractical |      |  |  |
| Assessment       |   | <ul><li>20% Sessional Work,</li><li>20% Mid Semester Exam</li><li>60% Final Written Exam</li></ul> | ination   |          | -,   |  |  |
| Credit Hours     | : | Theory 0   | 2 <b>P</b>  | Practica | 0    |  |  |
| Marks            | : | Theory 5   | 0 <b>P</b>  | Practica | 0    |  |  |

After Completing the "Engineering Dynamics" Course, each student will be able to:

| Sr.<br>No. | CLO  | Domain    | Taxonomy<br>Level | PLO |
|------------|--|-----------|-------------------|-----|
| 1.         | Draw Free Body Diagram and solve problems related to particle or<br>rigid body dynamics in 2-D or 3-D using Newton's second law<br>applied to linear or angular motion | Cognitive | 2                 | 1   |
| 2.         | Apply the principle of work, energy, linear and angular momentum<br>to solve problems related to kinetics of particles or rigid body planar<br>kinetics.               | Cognitive | 3                 | 2   |

#### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | $\checkmark$ | 7  | Environment and Sustainability: |  |
|---|----------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                |              | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: |              | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |  |

#### **Contents:**

**KinematicsofParticle:** Introduction rectilinear motionvelocity and acceleration, equations of motion and the graphsof motion for constant and variableaccelerationrelative motion, curvilinear motionprojectilemotiontangential and normal components of acceleration, cylindrical components.

**Kinetics of Particle:** Newton's laws of Motion. D'Alembert'sprincipleequation of motion for rectangular, normal & tangential & cylindrical coordinates. work, power, energy,work of forcework-energy equation, law of conservation of energy, efficiency of machine, impulse and momentum, impulse and impulsive force, linear momentum and its conservation, impact & coefficient of restitution, angular momentum and its conservation. **Kinematics of Rigid body:** Rigid body motion about fixed axes, relative motion analysis,

**Kinetics of Rigid body:** Planer kinetic equation of motion with regard to translation & rotation about a fixed axes, general planer motion, kinetic energy of rotation, work of force & couple, principle of work & energy, conservation of energy, principle of impulse & momentum, conservation of momentum

| Reco | Recommended Books   |  |  |  |  |  |  |
|------|---|--|--|--|--|--|--|
| A) T | A) Text Books   |  |  |  |  |  |  |
| 1    | R.C. Hibbler, "Engineering Mechanics (Dynamics)" latest edition.              |  |  |  |  |  |  |
| 2    | J.L Meriam, "Engineering Mechanics (Dynamics)" latest edition.                |  |  |  |  |  |  |
| B) R | B) Reference Books  |  |  |  |  |  |  |
| 1    | Beer & Johnston, "Vector Mechanics for Engineers (Dynamics)", latest edition. |  |  |  |  |  |  |
| 2    | Joseph f. Shelley, "Engineering Mechanics (Dynamics)", latest edition.        |  |  |  |  |  |  |

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|           | Academic Council                | :Res.No.92.10  | Dated:23-04-2018  |

| Title of Subject | : | ELECTRICAL TECHN   | LECTRICAL TECHNOLOGY |         |                |  |  |
|------------------|---|--|----------------------|---------|----------------|--|--|
| Course Code      | : | (EL102)  | L102)                |         |                |  |  |
| Semester         | : | SECOND   | Year                 | :       | FIRST          |  |  |
| Discipline       | : | MECHANICAL   |                      |         |                |  |  |
| Effective        | : | 17 Batch and onwards                                     |                      |         |                |  |  |
| Pre-requisite    | : |  |                      |         |                |  |  |
| Co-requisite     | : |  |                      |         |                |  |  |
|                  | : | Theory   | I                    | Practic | cal            |  |  |
| Assessment       |   | 20% Sessional Work,                                      | 4                    | 10% Se  | essional Work, |  |  |
| Assessment       |   | 20% Mid Semester Exam                                    | nination -           |         | ,              |  |  |
|                  |   | 60% Final Written Examination 60% Final Lab. Examination |                      |         |                |  |  |
| Credit Hours     | : | Theory 02  |                      | Practi  | <b>cal</b> 01  |  |  |
| Marks            | : | Theory 50  |                      | Practi  | <b>cal</b> 50  |  |  |

After Completing the "Electrical Technology" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain      | Taxonomy<br>Level | PLO  |
|------------|---|-------------|-------------------|------|
| 1.         | Find electrical circuit parameters by using circuit laws. Analyze<br>the parameters and characteristics of electrical machines            | Cognitive   | 1& 4              | 1& 2 |
| 2.         | Explain the electromagnetism and express the construction,<br>fundamental principles of electrical machines and electrical<br>instruments | Cognitive   | 2                 | 1    |
| 3.         | ILLUSTRATE knowledge of primary electronic lab instruments including DMM, Function Generator, Oscilloscope and electronic trainer.        | Psychomotor | 3                 | 1    |

### RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):

#### The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | $\checkmark$ | 7  | Environment and Sustainability: |  |
|---|----------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                |              | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: |              | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |  |

#### **Contents:**

**Electrical circuits.** Circuit parameters, passive and active circuit elements, superposition theorem, Kirchoff's law, Thevenin's theorem, Delta-star and star-delta transformations, DC/AC distribution system, magnetic field due to an electric current, solenoid, force on current carrying conductor, electromagnetic induction and Faraday's laws, Flaming's right hand rule, Lans's law, magnitude of induced e.m.f.

**Direct and Alternating Current.** Generation of alternating e.m.f. in a rotating coil, slip rings, relationship between frequency, speed and number of pole pairs, two segments and four segments commutator action, instantaneous, peak average and r.m.s. values of a.c. form factor and peak factor, average and r.m.s. values of sinusoidal currents and voltages, representation of alternating quantities by a phasors.

**D.C. Machines.** Generators, fundamentals of D.C. generators; types and characteristics, e.m.f. equation, voltage regulation, parallel operation, automatic voltage regulation, motors, speed and torque equation, types and characteristics, starting and speed control of motors, braking and reversing.

**A.C. Machines.** Transformers, theory and e.m.f. equation, losses, some special types of transformers, E.M.F. of elementary alternators, rotating magnetic field slip, types and characteristics of induction motors, poly-phase

induction motors, losses and efficiency of induction motors. **Electrical measurements.** Different types of strain gauges and uses, different types of the voltmeters and current meters, measurement of power and power factor, introduction to oscilloscope.

| Reco  | Recommended Books  |  |  |  |  |  |
|-------|--|--|--|--|--|--|
| A) Te | ext Books  |  |  |  |  |  |
| 1     | Hughes, Longman, "Electrical Technology", 7th Edition, 2001 or latest edition                |  |  |  |  |  |
| 2     | Stephen J. Chapma,n" Electrical Machinery Fundamental", 3rd Edition, 1999 or latest edition. |  |  |  |  |  |
| B) Re | eference Books   |  |  |  |  |  |
| 1     | B.L. Theseja, "Electrical Technology", 16th Edition, 2001 or latest edition.                 |  |  |  |  |  |
|       |  |  |  |  |  |  |

| <u>Approval</u> : | Board of Studies                | :Res.No.25.3.1 | Dated:17-03-2018  |
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|                   | Academic Council                | :Res.No.92.10  | Dated:23-04-2018  |
|                   | rieddenne Counen                |                | Duicu.25 01 2010  |

| Title of Subject | : | WORKSHOP PRACTI          | WORKSHOP PRACTICE              |        |                      |  |  |
|------------------|---|--------------------------|--------------------------------|--------|----------------------|--|--|
| Course Code      | : | (ME 142)                 |                                |        |                      |  |  |
| Semester         | : | SECOND                   | SECOND Year : FIRST            |        |                      |  |  |
| Discipline       | : | MECHANICAL               |                                |        |                      |  |  |
| Effective        | : | 17 Batch and onwards     |                                |        |                      |  |  |
| Pre-requisite    | : | Engineering Materials (M | Engineering Materials (ME-121) |        |                      |  |  |
| Co-requisite     | : |                          |                                |        |                      |  |  |
|                  | : | Theory                   |                                | Practi | cal                  |  |  |
| Assessment       |   |                          |                                | 40% S  | essional Work,       |  |  |
| Assessment       |   |                          |                                |        | ,                    |  |  |
|                  |   |                          |                                | 60% Fi | nal Lab. Examination |  |  |
| Credit Hours     | : | Theory                   | 0                              | Practi | cal 2                |  |  |
| Marks            | : | Theory                   | )                              | Practi | <b>cal</b> 100       |  |  |

After Completing the "Workshop Practice" Course, each student will be able to:

| Sr.<br>No. | CLO  | Domain      | Taxonomy<br>Level | PLO |
|------------|--|-------------|-------------------|-----|
| 1.         | Understand the functions and learn the use of different hand tools,<br>machine tools, measuring and marking instruments used in<br>workshop practices. | Psychomotor | 3                 | 1   |
| 2.         | Design a component and select an appropriate manufacturing process to meet desired needs.  | Cognitive   | 4                 | 3   |
| 3.         | Demonstrate ability to work independently and in a team by participating in group projects.  | Affective   | 5                 | 9   |

### RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):

#### The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | $\checkmark$ | 7  | Environment and Sustainability: |              |
|---|----------------------------------|--------------|----|---------------------------------|--------------|
| 2 | Problem Analysis:                |              | 8  | Ethics:                         |              |
| 3 | Design/Development of Solutions: | $\checkmark$ | 9  | Individual and Team Work:       | $\checkmark$ |
| 4 | Investigation:                   |              | 10 | Communication:                  |              |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |              |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |              |

#### **Contents:**

#### 1. Workshop health and safety precautions

#### 2. Machine Shop

- a) Study main parts of different machine tools i.e. Lathe, milling, drilling, cutting, grinding.
- b) Methods of holding work, use of gauges, measurement & marking instruments.
- c) Learn to operate lathe, milling, drilling, cutting, grinding machine
- d) Making different work pieces involving turning, taper turning, facing, knurling, threading, boring, shaping, drilling and grinding

#### 3. Welding Shop

a) Introduction to tools & equipment used in welding shop.

- b) Fabrication exercises in electrical and gas welding.
- c) Fabrication exercises in soldering and brazing
- d) Inspection of welding joints steel metal work.

#### 4. Carpentry and Pattern Shop

- a) Introduction to tools & equipment used in carpentry shop.
- b) Pattern making practice, different types of pattern, shrinkage and other allowance.
- c) Preparations of a pattern with core print and core box.
- d) Make a wooden work piece from blue-print of a given design specifications.

#### 5. Foundry Shop

- a) Use of moulding/moulder's tools to prepare mould and core.
- b) Method of melting/shaping metals.
- c) Making of a casting from a simple pattern in either ferrous or non-ferrous metal.
- d) Inspection and defects in castings

#### 6. Forging Shop

- a) Introduction to tools & equipment used in forging shop.
- b) Making different work piece by applying forging processes

#### 7. Fitting Shop

- a) Introduction to tools & equipment used in fitting shop including surface plate, surface gauge, assembly tools, layout tools, filing, sawing, tap & die.
- b) Make a work piece involving marking out from blue-print, filing to size, and punching marks.
- c) Stripping down a small assembly to examine its needs for repair and its re-erection.
- d) Basic knowledge of limits and Fits system.

#### **Recommended Books**

| 110 | Accommented Books  |  |  |  |
|-----|--|--|--|--|
| A)  | A) Text Books  |  |  |  |
| 1   | Kempster, "Workshop Technology" 3rd Edition 2010                   |  |  |  |
| 2   | H.DBurghardt "Machine Tools Operation", latest edition             |  |  |  |
| 3   | R.A Higgins, "Engineering Metallurgy", latest edition              |  |  |  |
| B)  | Reference Books  |  |  |  |
| 1   | W.DWolansky, "Wood Working Fundamentals", latest edition           |  |  |  |
| 2   | Odams Boo, "General Engineering Workshop Practice", latest edition |  |  |  |

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| Title of Subject | : | BASIC ELECTRONICS             |                     |                            |               |  |  |  |
|------------------|---|-------------------------------|---------------------|----------------------------|---------------|--|--|--|
| Course Code      | : | (ES281)                       |                     |                            |               |  |  |  |
| Semester         | : | SECOND                        | SECOND Year : FIRST |                            |               |  |  |  |
| Discipline       | : | MECHANICAL                    |                     |                            |               |  |  |  |
| Effective        | : | 17 Batch and onwards          |                     |                            |               |  |  |  |
| Pre-requisite    | : |                               |                     |                            |               |  |  |  |
| Co-requisite     | : |                               |                     |                            |               |  |  |  |
|                  | : | Theory                        | P                   | ractic                     | al            |  |  |  |
| Assessment       |   | 20% Sessional Work,           | 40                  | 40% Sessional Work,        |               |  |  |  |
| Assessment       |   | 20% Mid Semester Examination, |                     |                            |               |  |  |  |
|                  |   | 60% Final Written Examination | 6                   | 60% Final Lab. Examination |               |  |  |  |
| Credit Hours     | : | Theory 02                     | I                   | Practi                     | cal 01        |  |  |  |
| Marks            | : | Theory 50                     | I                   | Practi                     | <b>cal</b> 50 |  |  |  |

After Completing the "Basic Electronics" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain      | Taxonomy<br>Level | PLO |
|------------|---|-------------|-------------------|-----|
| 1.         | <b>Explain</b> the basics of Semiconductor materials and devices especially diodes and learn how to distinguish various basic electronic components           | Cognitive   | 2                 | 1   |
| 2.         | <b>Interpret</b> the working and behavior of transistors and their types and be able to understand different transistor applications.                         | Cognitive   | 2                 | 1   |
| 3.         | <b>Begin</b> the working of various Electronic simulation platforms, show different electronic circuits involving diodes, transistors and their applications. | Psychomotor | 2                 | 5   |

#### RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):

#### The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | <br>7  | Environment and Sustainability: |  |
|---|----------------------------------|--------|---------------------------------|--|
| 2 | Problem Analysis:                | 8      | Ethics:                         |  |
| 3 | Design/Development of Solutions: | 9      | Individual and Team Work:       |  |
| 4 | Investigation:                   | 10     | Communication:                  |  |
| 5 | Modern Tool Usage:               | <br>11 | Project Management:             |  |
| 6 | The Engineering Society:         | 12     | Lifelong Learning:              |  |

#### **Contents:**

#### Introduction to electronics: diodes:

pn junction diode, forward and reverse characteristics of a diode, ideal diode, practical diode, equivalent circuit of a diode, current equation of a diode, diode as a switch.

#### **Types of diodes:**

Schottkydiode, zener diode, tunnel diode, varactor diode, LED, laser diode.

#### **Applications of diode:**

Half-and full-wave rectifiers, clipper and clamper circuits, voltage multipliers.

#### **Bipolar junction transistor:**

Operation, npnadpnp transistors, unbiased transistors, DC biasing of a transistor, static characteristics, DC circuit analysis, load line, operating point and bias stabilization, Transistor as an amplifier.

#### Transistor biasing configurations:

Common emitter, common base, common collector. Field-effect transistor.

#### **FET biasing techniques:**

Common drain, common source and common gate, fixed bias and self-bias configurations, voltage divider biasing, universal JFET bias curve.

Lab Outline: The emphasis is first on understanding the characteristics of basic circuits that use resistors, capacitors, diode, bipolar junction transistors and field-effect transistors. The students then use this understanding to design and construct more complex circuits such as rectifiers, amplifiers and power supplies.

| Re | ecommended Books  |
|----|---|
| A) | Text Books  |
| 1  | Robert Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", Prentice Hall, Latest Edition, ISBN: 0131189050.         |
| B) | Reference Books   |
| 1  | Robert Paynter, "Introductory Electronic Devices and Circuits: Electron Flow Version", Latest Edition, Prentice Hall, ISBN: 0131716395. |
|    |   |

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| Title of Subject | : | APPLIED PHYSICS   |                     |         |              |  |  |  |  |
|------------------|---|---|---------------------|---------|--------------|--|--|--|--|
| Course Code      | : | (ME 151)  |                     |         |              |  |  |  |  |
| Semester         | : | SECOND  | SECOND Year : FIRST |         |              |  |  |  |  |
| Discipline       | : | MECHANICAL  |                     |         |              |  |  |  |  |
| Effective        | : | 17 Batch and onwards  |                     |         |              |  |  |  |  |
| Pre-requisite    | : |   |                     |         |              |  |  |  |  |
| Co-requisite     | : |   |                     |         |              |  |  |  |  |
|                  | : | Theory  | P                   | ractica | d            |  |  |  |  |
| Assessment       |   | <ul><li>20% Sessional Work,</li><li>20% Mid Semester Exami</li><li>60% Final Written Exam</li></ul> | nation              |         |              |  |  |  |  |
| Credit Hours     | : | Theory 02   | ŀ                   | Practic | <b>al</b> 00 |  |  |  |  |
| Marks            | : | Theory 50   | ) I                 | Practic | <b>al</b> 00 |  |  |  |  |

After Completing the "Applied Physics" Course, each student will be able to:

| Sr.<br>No. | CLO  | Domain    | Taxonomy<br>Level | PLO |
|------------|--|-----------|-------------------|-----|
| 1.         | Define the basic concepts and fundamental laws of electrostatic<br>and magnetism and describe the fundamental knowledge of<br>modern physics | Cognitive | 1                 | 1   |
| 2.         | Explain the comprehensive knowledge of semiconductor physics, waves and oscillation, optics and lasers                                       | Cognitive | 2                 | 1   |

#### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge               | <br>7 | Environment and Sustainability: |  |
|---|-------------------------------------|-------|---------------------------------|--|
| 2 | Problem Analysis:                   | 8     | Ethics:                         |  |
| 3 | Design/Development of<br>Solutions: | 9     | Individual and Team Work:       |  |
| 4 | Investigation:                      | 10    | Communication:                  |  |
| 5 | Modern Tool Usage:                  | 11    | Project Management:             |  |
| 6 | The Engineering Society:            | 12    | Lifelong Learning:              |  |

#### **Contents:**

**Mechanics:** Standards of length, mass, time, dimensional analysis, significate figures, vectors motion in one and two dimensions, Newton's Laws of motion, energy for system, conservation of energy, Newton's Law of universal gravitation, kepler's laws and the motion of planets, energy considerations in planetry and satellite motion.

**Electrostatic and magnetism:** Coulomb's law, Gauss's law, Electric field arround conductors, Dielectircs. Magnetic force on current.

Semiconductor Physics: Energy levels in a semiconductor, Hole concept, Intrinsic and extrinsic regions, mass action law, P-N junction, Transistor.

**Waves and Oscillation:** Free oscillation os systems with one degree of freedom, Classical wave equation. Transverse modes for condinuous string. Standing waves. Dispersion relation for waves.

Optics and Laser: Basic introduction to Optics and Laser, Diffraction grating. Lasers, Population inversion.

**Modern Physics:** Electron microscope, Zeeman effect, Atomic nucleus, Mass energy relation, Binding energy, Nuclear forces and fundamental forces.

| Reco | Recommended Books  |  |  |  |
|------|--|--|--|--|
| A) T | ext Books  |  |  |  |
| 1    | Jewett and Serway, Physics for scientists and Engineers with modern physics latest Edition Cengage learning. |  |  |  |
| 2    | A.K. Saxena Principle of Modern physics, Latest edition publisher Narosa                                     |  |  |  |

| Approval: | Board of Studies                | :Res.No.25.3.1 | Dated:17-03-2018  |
|-----------|---------------------------------|----------------|-------------------|
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|           | Academic Council                | :Res.No.92.10  | Dated:23-04-2018  |

•
| Title of Subject | : | COMPLEX VARIABLE   | COMPLEX VARIABLES AND TRANSFORMS                       |         |        |  |  |  |
|------------------|---|--|--|---------|--------|--|--|--|
| Course Code      | : | (MTH213)   |  |         |        |  |  |  |
| Semester         | : | THIRD  | Year   | :       | SECOND |  |  |  |
| Discipline       | : | MECHANICAL   |  |         |        |  |  |  |
| Effective        | : | 17 Batch and onwards   |  |         |        |  |  |  |
| Pre-requisite    | : | Applied Calculus, Linea  | Applied Calculus, Linear Algebra & Coordinate Geometry |         |        |  |  |  |
| Co-requisite     | : |  |  |         |        |  |  |  |
|                  | : | Theory Practical   |  |         |        |  |  |  |
| Assessment       |   | 20% Sessional Work,20% Mid Semester Examination60% Final Written Examination |  |         |        |  |  |  |
| Credit Hours     | : | Theory 0   | 3 P  | Practic | al 0   |  |  |  |
| Marks            | : | Theory 10  | 00 <b>P</b>  | Practic | al 0   |  |  |  |

After Completing the "Complex Variables And Transforms" Course, each student will be able to:

| Sr.<br>No. | CLO  | Domain    | Taxonomy<br>Level | PLO |
|------------|--|-----------|-------------------|-----|
| 1.         | Evaluate complex number and complex variables. Complex differentiation and integration       | Cognitive | 2                 | 2   |
| 2.         | Apply Transformations, Laplace and Fourier and their geometrical<br>and physical application | Cognitive | 3                 | 3   |
| 3.         | Analyze Fourier transforms for the solution of differential equations                        | Cognitive | 3                 | 3   |

## RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):

## The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            |              | 7  | Environment and Sustainability: |  |
|---|----------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                | $\checkmark$ | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: | $\checkmark$ | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |  |

#### **Contents:**

**Complex Numbers System and Complex Variable Theory:** Introduction to complex number systems. De Moiver's theorem and its applications. Complex functions, Cauchy-Riemann equations (in Cartesian and polar coordinates). Complex integration, singularities, poles, residues and contour integration and applications.

**Laplace Transforms:** Laplace and inverse Laplace transform of elementary functions and their properties. Applications of Laplace transformation in various fields of engineering.

**Fourier Transforms:** Fourier transform and inverse Fourier transforms. Solution of differential equations using Fourier Transform.

| Reco                | Recommended Books   |  |  |  |  |  |
|---------------------|---|--|--|--|--|--|
| A) T                | ext Books   |  |  |  |  |  |
| 1                   | H.K. Dass, Engineering Mathematics, Latest Edition.   |  |  |  |  |  |
| 2                   | B.S.Grewall, Higher Engineering Mathematics, Khanna Publishers, 1988.                                   |  |  |  |  |  |
| 3                   | Erwin Kreyszig, Advance Engineering Mathematics, sixth edition, John wiley& sons, 1991                  |  |  |  |  |  |
| <b>B</b> ) <b>R</b> | eference Books  |  |  |  |  |  |
| 1                   | M.R. Speigel, Schaum's outline series, Theory and Problems of Laplace Transforms, McGraw-<br>Hill, 1986 |  |  |  |  |  |
| 2                   | M.R. Speigel, Schaum's outline series, Theory and Problems of Complex Variables McGraw-Hill, 1974       |  |  |  |  |  |

| Approval: | Board of Studies                | :Res.No.25.3.1 | Dated:17-03-2018  |
|-----------|---------------------------------|----------------|-------------------|
|           | Board of Faculty of Engineering | :Res.No.33.08  | Dated: 29-03-2018 |
|           | Academic Council                | :Res.No.92.10  | Dated:23-04-2018  |
|           | Academic Council                | :Res.No.92.10  | Dated:25-04-2018  |

| Title of Subject | : | STRENGTH OF MATH   | STRENGTH OF MATERIALS-I                                     |          |       |  |  |  |
|------------------|---|--|---|----------|-------|--|--|--|
| Course Code      | : | (ME 202)   |   |          |       |  |  |  |
| Semester         | : | THIRD  | Year  | : S      | ECOND |  |  |  |
| Discipline       | : | MECHANICAL   |   |          |       |  |  |  |
| Effective        | : | 17 Batch and onwards   |   |          |       |  |  |  |
| Pre-requisite    | : | Engineering Statics (ME  | Engineering Statics (ME 111), Engineering Materials(ME 121) |          |       |  |  |  |
| Co-requisite     | : |  |   |          |       |  |  |  |
|                  | : | Theory   | P   | ractica  | l     |  |  |  |
| Assessment       |   | 20% Sessional Work,20% Mid Semester Examination60% Final Written Examination |   |          |       |  |  |  |
| Credit Hours     | : | <b>Theory</b> (  | 2 <b>P</b>  | Practica | 1     |  |  |  |
| Marks            | : | Theory 5   | 0 <b>P</b>  | Practica | 1     |  |  |  |

After Completing the "Strength of Materials-I" Course, each student will be able to:

| Sr.<br>No. | CLO  | Domain    | Taxonomy<br>Level | PLO |
|------------|--|-----------|-------------------|-----|
| 1.         | Comprehend key concepts, such as stresses and strains and constitutive relationships.                                | Cognitive | 2                 | 1   |
| 2.         | Analyze statically determinate and indeterminate structures for safety based on strength or deflection consideration | Cognitive | 4                 | 2   |
| 3.         | Design beams by using shear force or bending moment diagrams for provide loading conditions.                         | Cognitive | 3                 | 3   |

## **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge               | $\checkmark$ | 7  | Environment and Sustainability: |  |
|---|-------------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                   | $\checkmark$ | 8  | Ethics:                         |  |
| 3 | Design/Development of<br>Solutions: | V            | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                      |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:                  |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:            |              | 12 | Lifelong Learning:              |  |

#### **Contents:**

**Stress, Strain and Axial Loading:** Mechanical properties of materials, Stress, strain and Hooke's law,stress strain diagrams, Poisson's ratio, elastic constants and their relationship, statically determinate and indeterminate problems in tension and compression, thermal stresses, strain energy, stresses due to impact loading, stresses on oblique sections, factor of safety, stress concentration.

**Torsion:** Torsion of solid and hallow circular shafts, shear stresses and twist in solid and hollow circular shafts. **Stresses in Beams:** Shear force and bending moment diagrams for simply supported and cantilever beams, relationship between loading shear force and bending moment, simple bending theory of beams, shear stresses in beams.

Moments of Inertia: Moment of inertia of an area, product of inertia for an area, moment of inertia for composite sections

**Deflection of Beams:** Differential equation of deflection curve, deflection of simply supported and cantilever beams, deflection by integration of bending moment equation, deflection by integration of shear force and load equations.

| Recomm   | Recommended Books  |  |  |  |  |  |
|----------|--|--|--|--|--|--|
| A) Text  | Books  |  |  |  |  |  |
| 1        | Ferdinand P. Beer, E. Russel Johnston Jr., John T. Dewolf, "Mechanics of Materials", McGraw Hill, LatestEdition, (SI units), |  |  |  |  |  |
| 2        | Ansel C. Ugural, "Mechanics of Materials", Wiley, LatestEdition,   |  |  |  |  |  |
| 3        | Mechanics of Materials, Russell C. Hibbeler, Prentice Hall, Latest Edition.  |  |  |  |  |  |
| B) Refer | rence Books  |  |  |  |  |  |
| 1        | J.M. Gere and S.P.Timoshenko,"Mechanics of Materials", Cengage Learning, Latest Edition.                                     |  |  |  |  |  |
| 2        | Arthur P. Boresi Richard J. Schmidit., "Advanced Mechanics of Materials", Wiley, Latest Edition.                             |  |  |  |  |  |
| 3        | R.K Rajput "Strength of Materials (Mechanics of Solids)"Latest Edition.  |  |  |  |  |  |

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|-----------|---------------------------------|
|           | Board of Faculty of Engineering |
|           | Academic Council                |

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| Title of Subject | : | APPLIED CHEMISTR   | APPLIED CHEMISTRY |         |       |  |  |  |
|------------------|---|--|-------------------|---------|-------|--|--|--|
| Course Code      | : | (CH202)  | (CH202)           |         |       |  |  |  |
| Semester         | : | THIRD  | Year              | : 5     | ECOND |  |  |  |
| Discipline       | : | MECHANICAL   |                   |         |       |  |  |  |
| Effective        | : | 17 Batch and onwards   |                   |         |       |  |  |  |
| Pre-requisite    | : |  |                   |         |       |  |  |  |
| Co-requisite     | : |  |                   |         |       |  |  |  |
|                  | : | Theory   | P                 | ractica | l     |  |  |  |
| Assessment       |   | <ul><li>20% Sessional Work,</li><li>20% Mid Semester Exam</li><li>60% Final Written Exam</li></ul> | ination           |         |       |  |  |  |
| Credit Hours     | : | Theory 0   | 2 <b>P</b>        | ractica | 1 0   |  |  |  |
| Marks            | : | Theory 5   | 0 <b>P</b>        | ractica | 1 0   |  |  |  |

After Completing the "Applied Chemistry" Course, each student will be able to:

| Sr.<br>No. | CLO  | Domain        | Taxonomy<br>Level | PLO  |
|------------|--|---------------|-------------------|------|
| 1.         | Demonstrate understanding of environment, hazards<br>fundamental concepts of matter by applying those to given<br>situations / problems. | Cognitiv<br>e | 2                 | 1& 2 |
| 2.         | Solve basic volumetric and solid state problems by applying the solution chemistry and solid state laws,                                 | Cognitiv<br>e | 3                 | 2    |

## RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | <br>7 | Environment and Sustainability: |  |
|---|----------------------------------|-------|---------------------------------|--|
| 2 | Problem Analysis:                | <br>8 | Ethics:                         |  |
| 3 | Design/Development of Solutions: | 9     | Individual and Team Work:       |  |
| 4 | Investigation:                   | 10    | Communication:                  |  |
| 5 | Modern Tool Usage:               | 11    | Project Management:             |  |
| 6 | The Engineering Society:         | 12    | Lifelong Learning:              |  |

## **Course contents**

**Physical Chemistry**: Introduction to Physical Chemistry, Dalton Law, Henry law, Roult's Law, Colloidal Chemistry.

Thermo-Chemistry: Chemical Thermodynamics, Hess's Law, heat of Formation

and reaction, relation between H and U, measurement of heat reaction, Bomb Calorimeter.

**Electrochemistry**: Concept of Electrochemistry, voltaic cell, cell emf, Nernst equation, electrolysis, commercial batteries and fuel cells, corrosion and its prevention.

**Chemical Kinetics and Equilibrium**: Reaction rates and stoichiometry, reaction order, rate laws and rate constants, first order and second order reactions, activation energy, Arrhenius equation, homogeneous and heterogeneous catalysis, catalytic converter, chemical equilibrium, equilibrium constant and its applications, Lechetelier's principle and its applications.

**Industrial Chemistry**: Introduction, manufacturing and uses of various hydrocarbons, lubricants and oils, production and application of paints, vulcanized rubber and fuels, cement chemistry, environmental pollution and control.

Introduction to Analytical methods: pH metry, Chromatography and its types, Spectroscopy.

| Reco | Recommended Books   |  |  |  |  |  |
|------|---|--|--|--|--|--|
| A) T | ext Books   |  |  |  |  |  |
| 1    | W. H. Brown and L. S. Brown, Chemistry for Engineering Students, Cengage Learning. Latest Edition                       |  |  |  |  |  |
| 2    | O. V. Roussak, H. D. Gesser, Applied Chemistry: A Textbook for Engineers and Technologists:<br>Springer. Latest Edition |  |  |  |  |  |
| 3    | S. S. Zumdahl, Chemistry: An Atoms First Approach, Cengage. Latest Edition  |  |  |  |  |  |
| B) R | eference Books  |  |  |  |  |  |
| 1    | N. J. Tro, Chemistry: A Molecular Approach, Pearson.Latest Edition  |  |  |  |  |  |
| 2    | M. J. Shultz, Engineering Chemistry, Cengage.Latest Edition   |  |  |  |  |  |
| 3    | A. Bahl, B. S. Bahl, G. D. Tuli, Essential of Physical Chemistry, S. Chand<br>Publishing, India.Latest Edition          |  |  |  |  |  |

<u>Approval</u>: Board of Studies Board of Faculty of Engineering Academic Council

:Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10

| Title of Subject | : | THERMODYNAMICS-I   |             |        |        |
|------------------|---|--|-------------|--------|--------|
| Course Code      | : | (ME 222)   |             |        |        |
| Semester         | : | THIRD  | Year        | • :    | SECOND |
| Discipline       | : | MECHANICAL   |             |        |        |
| Effective        | : | 17 Batch and onwards   |             |        |        |
| Pre-requisite    | : |  |             |        |        |
| Co-requisite     | : |  |             |        |        |
|                  | : | Theory   | ]           | Practi | cal    |
| Assessment       |   | <ul><li>20% Sessional Work,</li><li>20% Mid Semester Examinati</li><li>60% Final Written Examinati</li></ul> | on -<br>ion |        |        |
| Credit Hours     | : | Theory 03  |             | Pract  | ical 0 |
| Marks            | : | <b>Theory</b> 100  |             | Pract  | ical 0 |

After Completing the "Thermodynamics-I" Course, each student will be able to:

| Sr.<br>No. | CLO  | Domain    | Taxonomy<br>Level | PLO  |
|------------|--|-----------|-------------------|------|
| 1.         | Recognize/understand the types of thermodynamics systems, process, cycles and laws involved in the engineering practice.                           | Cognitive | 2                 | 1    |
| 2.         | Applyenergy, entropy and exergy balances to various thermodynamic system and analyzesthe problems and parameters related to thermodynamic systems. | Cognitive | 3& 4              | 1& 2 |

## **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | $\checkmark$ | 7  | Environment and Sustainability: |  |
|---|----------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                |              | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: |              | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |  |

## **Contents:**

**Introduction to Thermodynamics**: Application areas, thermodynamic systems, properties, state, processes and cycles, pure substances, ideal gas and ideal gas equation of state, work and heat, forms of work, energy and forms of energy, energy transfer by heat and work.

Laws of Thermodynamics: the first law of thermodynamics, cyclic processes and non-cyclic processes applied to closed and open systems, stored energy, internal energy, flow energy, enthalpy, specific heats, energy analysis of different thermodynamic systems, law-I efficiencies, energy reservoirs, heat engines, refrigerators and heat pumps, statements of the second law of thermodynamics, perpetual motion machines, reversible and irreversible processes, Carnot cycle, the Carnot theorems/principles, thermodynamic temperature scale, Carnot heat engine. Refrigerators/Heat pumps

**Entropy & Exergy:** Clausius inequality, entropy; increase of entropy principle, isentropic process, entropy as a coordinate, Gibbs equation, entropy change of ideal gases, entropy balance: entropy change, entropy transfer, entropy generation, closed and open systems entropy balance, <u>exergy concepts: exergy transfer</u>, <u>exergy generation and exergy balance for various thermal systems; law-II efficiency.</u>

**Gas power cycles:** Air standard assumptions; Otto cycle, Diesel cycle, Dualcycle, Brayton cycle. **Properties of steam and vapor power cycle:** Processes in formation of steam, property diagrams; property tables, Rankine cycle.

#### **Recommended Books**

#### A) Text Books

Yunus A. Cengel, Michael A. Boles," Thermodynamics: An Engineering Approach", McGraw-Hill, Latest Edition.

Michael J. Moran, Howard N. Shapiro, Daisie D. Boettner, Margaret Bailey, "Fundamentals of Engineering Thermodynamics", John Wiley & Sons, Latest Edition.

### **B) Reference Books**

Sanford Klein, Gregory Nellis," Thermodynamics", Cambridge University Press, Latest Edition..

Thomas DeasEastop, "Applied Thermodynamics for Engineering Technologists", Pearson Education, Latest Edition.

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|-----------|---------------------------------|----------------|-------------------|
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|           | Academic Council                | :Res.No.92.10  | Dated:23-04-2018  |

| Title of Subject | : | FLUID MECHANICS – I    |            |                            |               |  |  |
|------------------|---|------------------------|------------|----------------------------|---------------|--|--|
| Course Code      | : | (ME 252)               |            |                            |               |  |  |
| Semester         | : | THIRD                  | Year       | :                          | SECOND        |  |  |
| Discipline       | : | MECHANICAL             |            |                            |               |  |  |
| Effective        | : | 17 Batch and onwards   |            |                            |               |  |  |
| Pre-requisite    | : |                        |            |                            |               |  |  |
| Co-requisite     | : |                        |            |                            |               |  |  |
|                  | : | Theory                 | P          | Practic                    | al            |  |  |
| Assessment       |   | 20% Sessional Work,    | 4          | 0% Se                      | ssional Work, |  |  |
| Assessment       |   | 20% Mid Semester Exami | nation     | ,                          |               |  |  |
|                  |   | 60% Final Written Exam | ination 6  | 60% Final Lab. Examination |               |  |  |
| Credit Hours     | : | <b>Theory</b> 0        | 3 <b>I</b> | Practic                    | <b>al</b> 01  |  |  |
| Marks            | : | Theory 10              | 0 <b>I</b> | Practic                    | <b>al</b> 50  |  |  |

After Completing the "Fluid Mechanics-I" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain      | Taxonomy<br>Level | PLO |
|------------|---|-------------|-------------------|-----|
| 1.         | Demonstrate the concepts of fluid mechanics.  | Cognitive   | 1                 | 1   |
| 2.         | Analyze the fluid kinematics and dynamics parameters using<br>application and analyze the pipe flow problems using Bernoulli<br>equation. | Cognitive   | 4                 | 2   |
| 3.         | ANALYZE the performance of various turbo-machines.  | Psychomotor | 3                 | 4   |

#### **REEVANT PROGRAM LEARNING OUTCOMES (PLOs):** The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | <br>7  | Environment and Sustainability: |  |
|---|----------------------------------|--------|---------------------------------|--|
| 2 | Problem Analysis:                | <br>8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: | 9      | Individual and Team Work:       |  |
| 4 | Investigation:                   | <br>10 | Communication:                  |  |
| 5 | Modern Tool Usage:               | 11     | Project Management:             |  |
| 6 | The Engineering Society:         | 12     | Lifelong Learning:              |  |

## **Contents:**

**Introduction**: Fluid properties, continuum hypothesis, no slip condition, fluid energy, Newtonian and non-Newtonian fluids.

**Fluid Statics:** Pressure, pressure measuring devices, hydrostatic stress, equation in differential and integral form, hydrostatic force on submerged plane, inclined and curved surfaces, buoyancy and flotation, stability of immersed and floating body.

**Fluid Kinematics:** Eulerian and Lagragian description, flow pattern and flow visualization, types of flow lines, velocity gradient, vorticity and circulation, velocity potential and stream function.

**Fluid Dynamics:** Differential analysis of fluid flow, differential form of continuity equation, Bernoulli theorem and its practical application, mass & energy equation, momentum analysis of flow system, Reynolds transport theorem.

**Dimensional Analysis & Similitude:** Dimensions and units, dimensional homogeneity, dimensional analysis methods, model studies, similitude, dimensionless numbers.

Laminar & Turbulent flow: Reynolds experiment, laminar & turbulent flow in pipes, flow losses in pipes, piping network and pump selection, viscous fluid flow between two parallel plates, kinetic energy and momentum correction factor.

| Reco  | Recommended Books   |  |  |  |  |  |
|-------|---|--|--|--|--|--|
| A) To | ext Books   |  |  |  |  |  |
| 1     | Yunus. A Cengel, "Fluid Mechanics: Fundamental & Applications" (in SI units)", Tata McGraw Hill, 2 <sup>nd</sup> Edition, 2010        |  |  |  |  |  |
| 2     | I.G. Currie, "Fundamental Mechanics of Fluids", CRC Press, 4th edition, 2012.   |  |  |  |  |  |
| 3     | Edward J. Shaughnessy, Ira M. Katz, James P. Schaffer," Introduction to Fluid Mechanics", Oxford University Press, 1st edition, 2004. |  |  |  |  |  |
| 4     | Clayton T. Crowe, Donald F. Elger, John A. Roberson, "Engineering Fluid Mechanics", John Wiley & Sons; 8 <sup>th</sup> Edition, 2004. |  |  |  |  |  |
| B) Re | eference Books  |  |  |  |  |  |
| 1     | F.M White," Fluid Mechanics", McGraw Hill, 4th Edition, 1999.   |  |  |  |  |  |
| 2     | Dr. R.K. Bansal," A Text book of Fluid Mechanics", 1st Edition, 2008.   |  |  |  |  |  |
| 3     | Dr. R.K. Bansal," A Text book of Fluid Mechanics & Hydraulic Machines (SI System)", 9th Edition, 2005.                                |  |  |  |  |  |
| 4     | R.K. Rajput, "Fluid Mechanics & Hydraulic Machines", S. Chand Ltd., 4th Edition, 2008.  |  |  |  |  |  |

Approval:Board of StudiesBoard of Faculty of EngineeringAcademic Council

:Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10

| Title of Subject | : | <b>COMPUTER PROGRA</b> | COMPUTER PROGRAMMING                                   |         |                |  |  |  |
|------------------|---|------------------------|--|---------|----------------|--|--|--|
| Course Code      | : | (CS 232)               |  |         |                |  |  |  |
| Semester         | : | THIRD                  | Year   | :       | SECOND         |  |  |  |
| Discipline       | : | MECHANICAL             |  |         |                |  |  |  |
| Effective        | : | 17 Batch and onwards   |  |         |                |  |  |  |
| Pre-requisite    | : |                        |  |         |                |  |  |  |
| Co-requisite     | : |                        |  |         |                |  |  |  |
|                  | : | Theory                 | Р  | Practic | cal            |  |  |  |
| Assessment       |   | 20% Sessional Work,    | 4  | 0% Se   | essional Work, |  |  |  |
| Assessment       |   | 20% Mid Semester Exam  | ination  |         | ,              |  |  |  |
|                  |   | 60% Final Written Exam | % Final Written Examination 60% Final Lab. Examination |         |                |  |  |  |
| Credit Hours     | : | <b>Theory</b> (        | 2 <b>H</b>   | Practi  | <b>cal</b> 01  |  |  |  |
| Marks            | : | Theory 5               | 50 <b>F</b>  | Practi  | <b>cal</b> 50  |  |  |  |

After Completing the "Computer Programming" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain    | Taxonomy<br>Level | PLO |
|------------|---|-----------|-------------------|-----|
| 1.         | Evaluate programming construct and articulate how it is used to<br>achieve desired output using C++. Articulate use of correct<br>programming methodology for a given problem based on<br>optimal/efficient design. | Cognitive | 3                 | 2   |
| 2.         | Develop a computer-based solution to a well-defined problem.<br>This includes developing a general flow of logic, identifying the<br>variables, conditional/iterative execution, fail conditions.                   | Cognitive | 3                 | 5   |

## **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):** The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            |              | 7  | Environment and Sustainability: |  |
|---|----------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                | $\checkmark$ | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: |              | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |  |

## **Contents:**

**Introduction & History:** Introduction to IT and computing, History of Computers, Generation of Computers.

Data Processing: Data processing cycle, elements of data processing cycle.

Computers and Types: Computer and Categories and Computers

Devices: Input devices, output devices, Processing devices, Memory devices, Storage devices.

**Software Utilities:** Types of Software, System software and application software, Office suit, Disc Manager, Windows tools i.e. (check disc, de-fragmentation, backup), Software Installation Procedure, Internet services **Operating System**: Concept of Operating System, Types of Operating System, Features of Operation System.

**Basic of C++ Programming:** Constants and variables, -keywords, Identifiers, variable types: Integer, long, float, double and character, Types of variables: automatic/local, static, external/global, Standard and user defined function.

**Input and Output Functions:** INPUT: single character, word and multiword, OUTPUT: single character and other data types, strings, Format specifiers, -field width specifiers, Escape sequence, printing strings, characters and graphic characters.

**Operators:** Address operator (&), Arithmetic Operators, -operator precedence, Arithmetic Assignment operator, Special assignment operators, Relational Operators, Increment and Decrement Operator.

**Decision-Making Statements:** The if statement, The if-else statement, The else-if construct, Switch statement, go to statement, Conditional operator

Loops: The For-loop, Nested For-loop, The while loop, The do while loop, Continue & break statement.

Arrays and Strings: Define an Array, Initializing an array, Multidimensional arrays, Arrays as function arguments, Strings, null character, string functions.

**Functions and Structures:** Introduction to Function, Difference between pre- defined/standard function and user defined function, Using more than one function, use of external variable, Prototype, function that return a value, Using arguments to pass Data to a function.

**Pointers:** Pointer variable, Returning multiple values from functions, Pointers and arrays, Pointers arithmetic, Pointers and strings, Double indirection: Pointers to pointers, Structures, Nested structures, Arrays of structures, Object Oriented Programming Concepts.

**Files:** Standard file I/O, Character, string and formatted I/O, Block I/O, Binary and Text file modes, System level I/O, Random access, & redirection.

C++ Graphics: Text mode, Graphics mode

Note: Practical will be based on theory.

| Re | Recommended Books  |  |  |  |  |  |  |  |
|----|--|--|--|--|--|--|--|--|
| A) | A) Text Books  |  |  |  |  |  |  |  |
| 1  | Norton P.; Introduction to Computers, Latest Edition, McGraw-Hill, 2000, ISBN: 9780070671201.                                    |  |  |  |  |  |  |  |
| 2  | Lafore R.; Object Oriented Programming in Turbo C++, Prentice Hall, 5 <sup>th</sup> Edition 2002 or Latest, ISBN: 0-672-32308-7. |  |  |  |  |  |  |  |
| B) | B) Reference Books   |  |  |  |  |  |  |  |
| 1  | Schildt. H.; C++: The Complete Reference, McGraw-Hill, 5 <sup>th</sup> Edition (2008) or Latest ISBN: 007148860X.                |  |  |  |  |  |  |  |
| 2  | Deitel D.; C++ : How to Program, Prentice-Hall, Edition 2003 or Latest ISBN: 0-13-111881-1.                                      |  |  |  |  |  |  |  |

| <u>Approval</u> : | Board of Studies                | :Res.No.25.3.1 | Dated:17-03-2018  |
|-------------------|---------------------------------|----------------|-------------------|
|                   | Board of Faculty of Engineering | :Res.No.33.08  | Dated: 29-03-2018 |
|                   | Academic Council                | :Res.No.92.10  | Dated:23-04-2018  |
|                   |                                 |                |                   |

| Title of Subject | : | NUMERICAL ANALYSIS AND COMPUTER APPLICATIONS |                          |                            |               |  |  |  |  |
|------------------|---|--|--------------------------|----------------------------|---------------|--|--|--|--|
| Course Code      | : | (MTH336)                                     |                          |                            |               |  |  |  |  |
| Semester         | : | FOURTH                                       | Year                     | :                          | SECOND        |  |  |  |  |
| Discipline       | : | MECHANICAL                                   |                          |                            |               |  |  |  |  |
| Effective        | : | 17 Batch and onwards                         |                          |                            |               |  |  |  |  |
| Pre-requisite    | : | Intermediate Mathemat                        | Intermediate Mathematics |                            |               |  |  |  |  |
| Co-requisite     | : |  |                          |                            |               |  |  |  |  |
|                  |   | Theory                                       | P                        | Practical                  |               |  |  |  |  |
|                  |   | 20% Sessional Work,                          | 4                        | 40% Sessional Work,        |               |  |  |  |  |
| Assessment       |   | 20% Mid Semester Exam                        | ination                  | ,                          |               |  |  |  |  |
|                  |   | 60% Final Written Exan                       | nination 6               | 60% Final Lab. Examination |               |  |  |  |  |
|                  |   |  |                          |                            |               |  |  |  |  |
| Credit Hours     | : | <b>Theory</b> 0                              | 3 I                      | Praction                   | cal 01        |  |  |  |  |
| Marks            | : | Theory 1                                     | <b>I</b> 00              | Practio                    | <b>cal</b> 50 |  |  |  |  |

After Completing the "Numerical Analysis And Computer Applications" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain    | Taxonomy<br>Level | PLO |
|------------|---|-----------|-------------------|-----|
| 1.         | Assess the root of a non-linear equations and $f(x) = 0$ and its computation iterative methods for the solution of simultaneous linear algebraic equations. | Cognitive | 2                 | 2   |
| 2.         | Evaluate interpolation and extrapolation; Numerical differentiation and integration.  | Cognitive | 3                 | 3   |
| 3.         | Analyze numerical solution of ordinary differential equations   | Cognitive | 3                 | 3   |

### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):** The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | 7     | Environment and Sustainability: |  |
|---|----------------------------------|-------|---------------------------------|--|
| 2 | Problem Analysis:                | <br>8 | Ethics:                         |  |
| 3 | Design/Development of Solutions: | <br>9 | Individual and Team Work:       |  |
| 4 | Investigation:                   | 10    | Communication:                  |  |
| 5 | Modern Tool Usage:               | 11    | Project Management:             |  |
| 6 | The Engineering Society:         | 12    | Lifelong Learning:              |  |

#### **Contents:**

Error Analysis: Introduction, floating points, errors, types of errors.

**Solution of Non-Linear Equations:** Bisection method, Regula-Falsi method, Newton-Raphson method, Fixed-Point iterative method.

Solution of System of Linear Algebraic Equations: Iterative methods: Jaccobi's method, Guass-Seidal method.

Eigen Values and Eigen Vectors: Power method.

**Interpolation and Extrapolation:** Differences: Forward, backward, central, operators and their relations. Newton's forward interpolation formula. Newton's backward interpolation formula, Newton's divided difference formula,.Lagrange's interpolation formula.Stirling's formula.

**Numerical Differentiation:** Newton's forward and backward differentiation formulae. **Numerical Quadrature:** Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule, Weddle's rule, Gaussian quadrature.

**Numerical Solution of Ordinary Differential Equations:** Taylor series method, Euler's and its modified methods, Runge-Kutta methods, Predictor Corrector Methods; Miline's method, Adam-Bashforth method.

## **Recommended Books**

#### A) Text Books

Canal & Chapra, Numerical methods for Engineers

Curits F. Gerald, Applied Numerical Analysis

### **B) Reference Books**

EvvienCryzigg, Advance Engineering Mathematics

Dr. SaeedAkhterBhatti, A first course in numerical analysis.

| Board of Studies<br>Board of Faculty of Engineering<br>Academic Council | :Res.No.25.3.1<br>:Res.No.33.08<br>:Res.No.92.10                        | Dated:17-03-2018<br>Dated: 29-03-2018<br>Dated:23-04-2018   |
|---|---|---|
|   | .Res.100.92.10  | Dateu.23-04-201   |
|   | Board of Studies<br>Board of Faculty of Engineering<br>Academic Council | Board of Studies:Res.No.25.3.1Board of Faculty of Engineering:Res.No.33.08Academic Council:Res.No.92.10 |

| Title of Subject | : | STRENGTH OF MATERIALS-II         |                         |                            |               |  |  |  |  |  |
|------------------|---|----------------------------------|-------------------------|----------------------------|---------------|--|--|--|--|--|
| Course Code      | : | (ME 232)                         | (ME 232)                |                            |               |  |  |  |  |  |
| Semester         | : | FOURTH                           | Year                    | :                          | SECOND        |  |  |  |  |  |
| Discipline       | : | MECHANICAL                       |                         |                            |               |  |  |  |  |  |
| Effective        | : | 17 Batch and onwards             |                         |                            |               |  |  |  |  |  |
| Pre-requisite    | : | Strength of Materials-I (ME 202) |                         |                            |               |  |  |  |  |  |
| Co-requisite     | : |                                  |                         |                            |               |  |  |  |  |  |
|                  | : | Theory                           | ]                       | Practical                  |               |  |  |  |  |  |
|                  |   | 20% Sessional Work,              | 2                       | 40% Sessional Work,        |               |  |  |  |  |  |
| Assessment       |   | 20% Mid Semester Exam            | ination -               | ,                          |               |  |  |  |  |  |
|                  |   | 60% Final Written Exan           | nination 6              | 60% Final Lab. Examination |               |  |  |  |  |  |
|                  |   |                                  |                         |                            |               |  |  |  |  |  |
| Credit Hours     | : | <b>Theory</b> (                  | )3                      | Pract                      | <b>cal</b> 01 |  |  |  |  |  |
| Marks            | : | Theory 1                         | Theory 100 Practical 50 |                            |               |  |  |  |  |  |

After Completing the "Strength Of Materials-II" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain      | Taxonomy<br>Level | PLO |
|------------|---|-------------|-------------------|-----|
| 1.         | Analyze buckling of column members under different loading<br>conditions.<br>Stresses and strains in machine and structural components<br>subjected to combine loading by using theories of failure.<br>Analyze 2D or 3D stress elements on planes by using Mohr's<br>circle. | Cognitive   | 4                 | 2   |
| 2.         | Design beam or shell structure for safety in terms of both strength and deflection consideration.   | Cognitive   | 3                 | 3   |
| 3.         | To analyze the behavior of metal subjected to normal and shear stresses by means of experiments.  | Psychomotor | 2                 | 2   |

### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):** The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            |              | 7  | Environment and Sustainability: |  |
|---|----------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                |              | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: | $\checkmark$ | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |  |

#### **Contents:**

**Theory of Columns:** Failure of column, Euler's theory of buckling, equivalent length of a column, end conditions of a column, slenderness ratio, limitations of Euler's column theory, eccentric loading of long columns, empirical design formulae for columns.

Theories of Failure: Theories of failure and their graphical representations.

Biaxial Stresses: *Stress transformation and Mohr's circle for 2D (Analysis of two dimensional stress and strain)*. Stresses in thin-walled cylinder and spherical shell under internal pressure.

**Tri-axial Stress Analysis:** Principal tri-axial stresses and strains, volumetric strain, strain energy and resilience of tri-axial stresses, Experimental stress analysis

**Thick-Walled Cylinders:** Lame's theory, radial and hoop stresses in thick-walled cylinders under internal pressure, special cases.

Bending in Beams: Bending of curved beams with small initial and large initial curvature, crane hooks.

**Plastic Bending of Beams:** Plastic behavior of materials, plastic bending of symmetrical sections, shape factors of various geometric shapes, residual stresses in elasto-plastic and fully plastic conditions.

**Unsymmetrical Bending:** Introduction to unsymmetrical bending, stress at a point due to unsymmetrical bending, direction of principal and neutral axis.

**Creep and Fatigue:** Creep and its mechanism of failure, various parameter methods to calculate time required to cause rupture by creep, fatigue behavior of materials, mechanism of fatigue failure, fatigue loads and stresses, S-N curves.

Energy Methods: Work and energy under several loads, Castigliano's theorem, Maxwell theorem, Rayleigh Ritz method.

| Reco                | Recommended Books   |  |  |  |  |  |  |
|---------------------|---|--|--|--|--|--|--|
| A) T                | ext Books   |  |  |  |  |  |  |
| 1                   | Ferdinand P. Beer, E. Russel Johnston Jr., John T. Dewolf, "Mechanics of Materials", McGraw Hill, Latest Edition, (SI units). |  |  |  |  |  |  |
| 2                   | Ansel C. Ugural, "Mechanics of Materials", Wiley, Latest Edition.   |  |  |  |  |  |  |
| 3                   | R.CHibbeler, "Mechanics of Materials" Prentice Hall, Latest Edition.  |  |  |  |  |  |  |
| <b>B</b> ) <b>R</b> | eference Books  |  |  |  |  |  |  |
| 1                   | Dr. Kamal Kumar, "Advanced Mechanics of Materials", Khana Publishers, Latest Edition.   |  |  |  |  |  |  |
| 2                   | Ansel C. Ugural, "Advanced Mechanics of Materials and Applied Elasticity" Prentice Hall, Latest Edition                       |  |  |  |  |  |  |
| 3                   | Arthur P. Boresi Richard J. Schmidit., "Advanced Mechanics of Materials", Wiley, Latest Edition                               |  |  |  |  |  |  |

Approval: Board of Studies Board of Faculty of Engineering Academic Council :Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10

| Title of Subject | : | THERMODYNAMICS – II           |             |                            |              |  |  |  |  |
|------------------|---|-------------------------------|-------------|----------------------------|--------------|--|--|--|--|
| Course Code      | : | (ME 242)                      |             |                            |              |  |  |  |  |
| Semester         | : | FOURTH                        | Year        | :                          | SECOND       |  |  |  |  |
| Discipline       | : | MECHANICAL                    |             |                            |              |  |  |  |  |
| Effective        | : | 17 Batch and onwards          |             |                            |              |  |  |  |  |
| Pre-requisite    | : | Thermodynamics-I (ME 221)     |             |                            |              |  |  |  |  |
| Co-requisite     | : |                               |             |                            |              |  |  |  |  |
|                  | : | Theory                        | P           | Practical                  |              |  |  |  |  |
| Assessment       |   | 20% Sessional Work,           | 40          | 40% Sessional Work,        |              |  |  |  |  |
| Assessment       |   | 20% Mid Semester Exam         | ination     | ,                          |              |  |  |  |  |
|                  |   | 60% Final Written Examination |             | 60% Final Lab. Examination |              |  |  |  |  |
| Credit Hours     | : | <b>Theory</b> 0               | 3 <b>F</b>  | Practic                    | <b>al</b> 01 |  |  |  |  |
| Marks            | : | Theory 10                     | 00 <b>F</b> | Practic                    | al 50        |  |  |  |  |

After Completing the "Thermodynamics-II" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain      | Taxonomy<br>Level | PLO |
|------------|---|-------------|-------------------|-----|
| 1.         | Illustrate the construction and operation of different components involved in thermal systems | Cognitive   | 2                 | 1   |
| 2.         | Apply the laws of thermodynamics to combustion process.                                       | Cognitive   | 3                 | 2   |
| 3.         | Analyze the different devices involved in thermal systems for performance evolution.          | Cognitive   | 4                 | 2   |
| 4.         | Determine performance characteristics of power cycles   | Psychomotor | 4                 | 2   |

### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):** The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | $\checkmark$ | 7  | Environment and Sustainability: |  |
|---|----------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                |              | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: |              | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |  |

#### **Contents:**

**Fuels & combustion**: Theoretical & actual combustion processes, enthalpy of formation & enthalpy of combustion, first law analysis of reacting systems, adiabatic flame temperature, entropy change of reacting systems.

**Steam generators:** Classification & working of different types of steamgenerators, construction, mountings and accessories, methods to calculate the performance of steam generators, heat balance sheets, draught and its classification, introduction to furnaces, classification according to type of fuel used, combustion process in the furnace

**Nozzles:** General flow analysis (one-dimensional) through nozzles, effect ofvarying area in subsonic and supersonic flow, isentropic flow with varying area, maximum flow rate through nozzle, critical pressure ratio, effect of back pressure on mass flow rate, under expansion and overexpansion nozzles, nozzle efficiency, coefficients for nozzle, steam nozzle analysis (supersaturated flow), stagnation condition and effects of friction.

**Steam turbines:** Classification of steam turbines, flow of steam, over blade, velocity diagrams, stage efficiency, diagram efficiency overall efficiency and reheat factor, compounding of steam turbine for velocity, pressure and pressure-velocity losses in the steam turbines, <u>governing and control of steam</u> <u>turbines</u>.

**Gas turbines:** Gas turbine cycles, Brayton cycle (ideal, actual, and modified), developments in gas turbines, applications, combustion process.

**Air compressors**: Classification of air compressors, working of reciprocating air compressors, compression processes, isothermal efficiency, methods of increasing isothermal efficiency, effects of cylinder clearance, volumetric efficiency, multistage compression and inter coolers, conditions for maximum efficiency, steady-flow energy analysis, introduction to rotary compressors, performance of rotary compressors.

| Reco               | Recommended Books   |  |  |  |  |
|--------------------|---|--|--|--|--|
| A) To              | A) Text Books   |  |  |  |  |
| 1                  | YunusCengel& M. Boles; "Thermodynamics: An engineering approach", McGraw Hill, 5th Edition,     |  |  |  |  |
|                    |   |  |  |  |  |
| 2                  | R. Joel "Basic Engineering Thermodynamics", Prentice Hall, 5 <sup>th</sup> Edition, 1997.       |  |  |  |  |
| B) Reference Books |   |  |  |  |  |
| 1                  | T.D.Eastop&A.McConkey, "Applied Thermodynamics for Engineering Technologies", Longman           |  |  |  |  |
| T                  | Scientific and Technical, 5th Edition, 1997.  |  |  |  |  |
| •                  | Bhalchandra V. Karlekar "Thermodynamics for Engineers", Prentice Hall College Div, 1st Edition, |  |  |  |  |
| 4                  | 1982.   |  |  |  |  |

<u>Approval</u>: Board of Studies Board of Faculty of Engineering Academic Council :Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10

| Title of Subject | : | FLUID MECHANICS-II           |             |                            |        |  |  |  |
|------------------|---|------------------------------|-------------|----------------------------|--------|--|--|--|
| Course Code      | : | (ME 226)                     | (ME 226)    |                            |        |  |  |  |
| Semester         | : | FOURTH                       | Year        | : !                        | Second |  |  |  |
| Discipline       | : | MECHANICAL                   |             |                            |        |  |  |  |
| Effective        | : | 17 Batch and onwards         |             |                            |        |  |  |  |
| Pre-requisite    | : | Fluid Mechanics – I (ME 251) |             |                            |        |  |  |  |
| Co-requisite     | : | Heat & Mass Transfer (M      | E 301)      |                            |        |  |  |  |
|                  | : | Theory                       | P           | ractica                    | 1      |  |  |  |
| Assessment       |   | 20% Sessional Work,          | 40          | 40% Sessional Work,        |        |  |  |  |
| Assessment       |   | 20% Mid Semester Exam        | ination     | ,                          |        |  |  |  |
|                  |   | 60% Final Written Exan       | nination 60 | 60% Final Lab. Examination |        |  |  |  |
| Credit Hours     | : | Theory 0                     | 3 <b>F</b>  | Practic                    | al 01  |  |  |  |
| Marks            | : | Theory 10                    | )0 <b>F</b> | Practic                    | al 50  |  |  |  |

After Completing the "Fluid Mechanics-II" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain      | Taxonomy<br>Level | PLO |
|------------|---|-------------|-------------------|-----|
| 1.         | Calculate design parameters of turbo machinery (turbine and pump) | Cognitive   | 5                 | 3   |
| 2.         | Apply finite difference method to solve fluid dynamics equations. | Cognitive   | 3                 | 5   |
| 3.         | Analyze the performance of various turbo-machines.                | Psychomotor | 3                 | 4   |

## RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            |              | 7  | Environment and Sustainability: |  |
|---|----------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                |              | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: | $\checkmark$ | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |  |

## **Contents:**

**Navier Stokes equations of motion:** Navier-Stokes equation in Cartesian and polar co-ordinates, limiting cases of Navier-Stoke equation, simple application of Navier-stoke.

**Boundary layer theory:** Introduction, boundary layer definitions and characteristics, laminar boundary layer, turbulent boundary layer, total drag due to laminar and turbulent layers, boundary layer separation and its control.

**Hydraulic Turbines:** Introduction, classification of hydraulic turbines, draft tube, *Velocity diagrams and determination of work, power and efficiency*, specific speed, performance characteristics of hydraulic turbines, governing of hydraulic turbines, cavitation, selection of turbines.

## **Pumps:**

(i) Centrifugal pumps: Component parts of a centrifugal pump, work done by impeller on liquid, losses and

**Numerical Methods in fluid flow:** Numerical methods in fluid flow, finite difference method, numerical solutions of Navier-stoke equation in different cases, turbulence modeling, computational fluid dynamics (CFD).

efficiencies of centrifugal pump, specific speed, characteristics of centrifugal pumps, priming of a centrifugal pump, selection of pumps.

(ii) **Reciprocating pumps:** Main components and working of reciprocating pump, co-efficient of discharge and slip of reciprocating pump, effect of acceleration of piston on velocity and pressure in the suction and delivery pipes. *Pumps in parallel and pumps in series.* 

**Fluid Systems:** Hydraulic press jack, hydraulic ram, hydraulic intensifier, hydraulic crane, hydraulic accumulator, air lift pump, hydraulic coupling.

| A) T                | ext Books   |
|---------------------|---|
| 1                   | Yunus. A Cengel, "Essential od Fluid Mechanics Fundamentals & Applications", Mc Graw Hill,          |
| 1                   | Latest Edition.   |
| 2                   | V. Gupta and K. Gupta,"Fuid Mechanics and its applications", Latest Edition.                        |
| 3                   | J.d. Anderson and Grundmann., "Computational Fluid Dynamics an introduction", Latest Edition        |
| <b>B</b> ) <b>R</b> | eference Books  |
| 1                   | Dr.K.R. Arora, "Fluid Mechanics, and hydraulic machines", Standard, Publishers distributors, Latest |
| 1                   | Edition   |
| 2                   | R.K. Rajput, "Fluid Mechanics & Power Engineering", S.C Chand, Latest Edition.                      |
|                     |   |

<u>Approval</u>: Board of Studies Board of Faculty of Engineering Academic Council :Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10

| Title of Subject | : | MECHANICS OF MACHINES – I  |               |        |               |  |  |  |  |
|------------------|---|--|---------------|--------|---------------|--|--|--|--|
| Course Code      | : | (ME 212)   | (ME 212)      |        |               |  |  |  |  |
| Semester         | : | FOURTH   | Year          | :      | SECOND        |  |  |  |  |
| Discipline       | : | MECHANICAL   |               |        |               |  |  |  |  |
| Effective        | : | 17 Batch and onwards   |               |        |               |  |  |  |  |
| Pre-requisite    | : | ENGINEERING DYNAM  | MICS (ME 132) |        |               |  |  |  |  |
| Co-requisite     | : |  |               |        |               |  |  |  |  |
|                  | : | Theory   | P             | ractio | al            |  |  |  |  |
| Assessment       |   | <ul><li>20% Sessional Work,</li><li>20% Mid Semester Exam</li><li>60% Final Written Exan</li></ul> | ination       |        | ,             |  |  |  |  |
| Credit Hours     | : | <b>Theory</b> 0  | 2 P           | Practi | <b>cal</b> 00 |  |  |  |  |
| Marks            | : | Theory 5   | 0 P           | Practi | <b>cal</b> 00 |  |  |  |  |

After Completing the "Mechanics of Machine-I" Course, each student will be able to:

| Sr.<br>No. | CLO  | Domain    | Taxonomy<br>Level | PLO |
|------------|--|-----------|-------------------|-----|
| 1.         | Understand fundamentals of linkages, different braking systems and dynamometers. | Cognitive | 2                 | 1   |
| 2.         | Analysis kinematics of various mechanisms.                                       | Cognitive | 4                 | 2   |

## RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):

## The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | <br>7 | Environment and Sustainability: |  |
|---|----------------------------------|-------|---------------------------------|--|
| 2 | Problem Analysis:                | <br>8 | Ethics:                         |  |
| 3 | Design/Development of Solutions: | 9     | Individual and Team Work:       |  |
| 4 | Investigation:                   | 10    | Communication:                  |  |
| 5 | Modern Tool Usage:               | 11    | Project Management:             |  |
| 6 | The Engineering Society:         | 12    | Lifelong Learning:              |  |

## **Contents:**

**Linkage fundamentals:** Kinematic link, pairs, classification of kinematic pairs, kinematic chain and its types, Mechanism and its inversions, kinematic diagram and mobility of a mechanism, Quick return mechanisms. Steering wheel mechanism. Universal Joint.

**Displacement analysis:** graphical and analytical methods of displacement analysis of various mechanisms. Velocity analysis: graphical and analytical methods of velocity analysis using instantaneous center method and relative velocity method

Acceleration analysis: graphical and analytical methods of acceleration analysis of various mechanisms. Brakes and dynamometers: Types and their working mechanism

| Reco          | Recommended Books  |  |  |  |  |
|---------------|--|--|--|--|--|
| A) Text Books |  |  |  |  |  |
| 1             | David H. Myszka, "Machines & Mechanisms", Prentice Hall, latest edition.                             |  |  |  |  |
| 2             | J.E.Shigley, "Theory of Machines", McGraw Hill, latest edition.                                      |  |  |  |  |
| 3             | R.S. Khurmi, J.K. Gupta, "Theory of Machines", Eurasia publishing house, latest edition.             |  |  |  |  |
| B) R          | eference Books   |  |  |  |  |
| 1             | J.EShigley, John Joseph Uicker Jr. "Theory of Machines and Mechanisms", McGraw Hill, latest edition. |  |  |  |  |
|               |  |  |  |  |  |

| Approval: | Board of Studies                |
|-----------|---------------------------------|
|           | Board of Faculty of Engineering |
|           | Academic Council                |

:Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10

| Title of Subject | : | HEAT AND MASS TRANSFER |  |                            |              |  |  |
|------------------|---|------------------------|--|----------------------------|--------------|--|--|
| Course Code      | : | (ME302)                | ME302)   |                            |              |  |  |
| Semester         | : | FIFTH                  | IFTH Year : THIRD                                      |                            |              |  |  |
| Discipline       | : | MECHANICAL             |  |                            |              |  |  |
| Effective        | : | 17 Batch and onwards   |  |                            |              |  |  |
| Pre-requisite    | : | Thermodynamics-II (ME  | Thermodynamics-II (ME241) and Fluid Mechanics-I(ME251) |                            |              |  |  |
| Co-requisite     | : |                        |  |                            |              |  |  |
|                  | : | Theory                 | P  | ractic                     | l            |  |  |
| Assessment       |   | 20% Sessional Work,    | 40   | 40% Sessional Work,        |              |  |  |
| Assessment       |   | 20% Mid Semester Exam  | ination  | ,                          |              |  |  |
|                  |   | 60% Final Written Exan | nination 60  | 60% Final Lab. Examination |              |  |  |
| Credit Hours     | : | Theory C               | 3 <b>F</b>   | Practic                    | <b>al</b> 01 |  |  |
| Marks            | : | Theory 10              | <b>I</b> 00  | Practic                    | <b>al</b> 50 |  |  |

After Completing the "Heat and Mass Transfer" Course, each student will be able to:

| Sr.<br>No. | CLO  | Domain      | Taxonomy<br>Level | PLO |
|------------|--|-------------|-------------------|-----|
| 1.         | Understandthe modes of heat transfer and governing equations/laws.                               | Cognitive   | 2                 | 1   |
| 2.         | Applylaws and principles of Heat Transfer for the solution of Heat transfer problems.            | Cognitive   | 3                 | 2   |
| 3.         | Analysis a general energyPerformance for heat exchanger and develop relations for effectiveness. | Cognitive   | 3 & 4             | 3   |
| 4.         | Analyze the effects of various heat transfer modes   | psychomotor | 3                 | 2   |

## RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):

## The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | $\checkmark$ | 7  | Environment and Sustainability: |  |
|---|----------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                | $\checkmark$ | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: | V            | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |  |

## **Contents:**

**Introduction**: Modes of heat transfer, steady, unsteady state, Fourier's law of heat conduction, basic terminology, thermal conductivity, dimensions and units.

**Conduction Heat Transfer:** <u>One dimensional steady heat conduction</u>throughplane wall, composite wall, cylinder, sphere, effect of variable thermal conductivity, overall heat transfer coefficient, critical radius of insulation, heat source problem of wall, cylinder, and sphere, fins. *Lumped system analysis for transient heat conduction*.

**Convection Heat Transfer:** *Newtons' law of cooling,* Convection heat transfer numbers, bulktemperature, heat transfer in laminar and turbulent flow for various geometrical shapes, thermal laminar and turbulent boundary layers. *Boiling and Condensation heat transfer.* 

Heat Exchanger: Types of heat exchanger, LMTD, NTUmethods, selection and design of heat exchangers.

**Radiation Heat Transfer:** Boltzmann's law, properties of radiation, environmental radiation, momentum, heat transfer analogy, Kirchhoff's law and shape factor.

**Mass Transfer**: Introduction, analogy between heat and mass transfer, mass diffusion, Fick's law, simultaneous heat and mass transfer.

| Reco | Recommended Books   |  |  |  |  |  |
|------|---|--|--|--|--|--|
| A) T | ext Books   |  |  |  |  |  |
| 1    | Heat Transfer A Practical Approach, Younus A. Cengel, McGraw Hill, Latest edition.                          |  |  |  |  |  |
| 2    | Fundamentals of Heat Transfer, F.PIncropera and D.P. Dewitt, 6th Edition, J.Wiley and sons, Latest edition. |  |  |  |  |  |
| B) R | eference Books  |  |  |  |  |  |
| 1    | J. P. Holman, Heat Transfer, 8th Edition, McGraw Hill Inc, Latest edition.                                  |  |  |  |  |  |

| Approval: | Board of Studies                |
|-----------|---------------------------------|
|           | Board of Faculty of Engineering |
|           | Academic Council                |

:Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10

| Title of Subject | : | APPLIED AERODYNAMICS                                 |                                |                            |        |  |  |  |
|------------------|---|--|--------------------------------|----------------------------|--------|--|--|--|
| Course Code      | : | (ME312)  | ME312)                         |                            |        |  |  |  |
| Semester         | : | FIFTH  | IFTH Year : THIRD              |                            |        |  |  |  |
| Discipline       | : | MECHANICAL ENGIN                                     | EERING                         |                            |        |  |  |  |
| Effective        | : | 17 Batch and onwards                                 |                                |                            |        |  |  |  |
| Pre-requisite    | : | Thermodynamics-II (ME241), Fluid Mechanics-I (ME251) |                                |                            |        |  |  |  |
| Co-requisite     | : | Heat and Mass Transfer (                             | Heat and Mass Transfer (ME301) |                            |        |  |  |  |
|                  |   | Theory   | I                              | Practical                  |        |  |  |  |
| Assessment       |   | 20% Sessional Work,                                  |                                | 40% Sessional Work,        |        |  |  |  |
| Assessment       |   | 20% Mid Semester Exam                                | ination -                      | ,                          |        |  |  |  |
|                  |   | 60% Final Written Examination                        |                                | 60% Final Lab. Examination |        |  |  |  |
| Credit Hours     | : | <b>Theory</b> 0                                      | 3                              | Practi                     | cal 01 |  |  |  |
| Marks            | : | Theory 1   | 00                             | Practi                     | cal 50 |  |  |  |

After Completing the "Applied Aerodynamics" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain          | Taxonomy<br>Level | PLO  |
|------------|---|-----------------|-------------------|------|
| 1.         | Analysis performance of different flows and Predict the behavior of aerodynamics bodies in different flows. | Cognitive       | 2 &4              | 2& 4 |
| 2.         | Design the aerodynamic shape as required specifications   | Cognitive       | 5                 | 3    |
| 3.         | Analyze the effect of change in parameters on the aerodynamics performance                                  | Cognitive       | 3                 | 5    |
| 4.         | Perform experiments for analysis and calculation of lift and drag<br>forces and moment coefficients         | psychomo<br>tor | 3                 | 2    |

### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):** The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            |              | 7  | Environment and Sustainability: |  |
|---|----------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                |              | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: | $\checkmark$ | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |  |

## **Contents:**

**Atmosphere**: Introduction, aerodynamics and its evolution, atmosphere and its properties, viscosity temperature models for atmosphere, International Standard Atmosphere (ISA).

**Incompressible and In-viscid Flow**: Introduction, flow through venture tubes and wind tunnels, Pitot static tube, pressure coefficient, Laplace equation, *measurement of flight speed*.

**Compressible Flow**: Introduction, speed of sound, Mach number, flow regimes based on mach number, stagnation properties, special forms of energy equation, isentropic flow in a variable area stream tube, normal and oblique shock waves, measurement of air speed in compressible fluid flow.

**Flow over Airfoils and Wings**: Introduction, aerodynamic forces, moments and coefficients, aerodynamic center and center of pressure, airfoil nomenclature, airfoil characteristics, high lift airfoil sections, wing geometry parameters, down wash and induced drag, delta wing and swept wing.

**Propulsion**: Introduction, Froude's momentum theory, turbojet, turbofan, turboprop, helicopter rotor dynamics, energy analysis.

**Flight Dynamics:** Dynamics of steady level, climbing and gliding flight, landing and take-off performance, stability and control for different flight configurations.

| Reco | Recommended Books   |  |  |  |  |  |
|------|---|--|--|--|--|--|
| A) T | ext Books   |  |  |  |  |  |
| 1    | Anderson J.D.(Jr), "Fundamental of Aerodynamics", McGraw-Hill, Latest Edition.  |  |  |  |  |  |
| 2    | Houghton, E.I., Carpenter, P.W., Collicot, S.H., Velentine, D.T., "Aerodynamics for Engineering Students", Butterworth-Heinemann, Latest Edition. |  |  |  |  |  |
| 3    | Anderson J.D.(Jr), "Introduction to flight", McGraw-Hill, Latest Edition.   |  |  |  |  |  |
| B) R | eference Books  |  |  |  |  |  |
| 1    | John. J Bertin and Russell M Cummings, "Aerodynamics for Engineers", Prentice Hall, , Latest Edition.   |  |  |  |  |  |
| 2    | Barnes W. McCormick, "Aerodynamics, Aeronautics, and Flight Mechanics", Wilay, , Latest Edition.  |  |  |  |  |  |
| 3    | Katz, Joseph, "Automotive aerodynamics", John Wiley & Sons, , Latest Edition.   |  |  |  |  |  |

<u>Approval</u>: Board of Studies Board of Faculty of Engineering Academic Council

:Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10

| Title of Subject | SAFETY, HEALTH & ENVIRONMENT                          |                          |           |      |  |  |  |  |
|------------------|---|--------------------------|-----------|------|--|--|--|--|
| Course Code      | EE 425  |                          |           |      |  |  |  |  |
| Semester         | FIFTH   | <b>TFTH</b> Year : THIRD |           |      |  |  |  |  |
| Discipline       | MECHANICAL  | MECHANICAL               |           |      |  |  |  |  |
| Effective        | 17 Batch and onwards                                  | 17 Batch and onwards     |           |      |  |  |  |  |
| Pre-requisite    | Thermodynamics, Industrial Engineering and Management |                          |           |      |  |  |  |  |
| Co-requisite     |   |                          |           |      |  |  |  |  |
|                  | Theory  | I                        | Practical |      |  |  |  |  |
| Assessment       | 20% Sessional Work,                                   | -                        | ,         |      |  |  |  |  |
| Assessment       | 20% Mid Semester Exam                                 | ination -                | ,         |      |  |  |  |  |
|                  | 60% Final Written Exan                                | nination -               | ,         |      |  |  |  |  |
| Credit Hours     | <b>Theory</b> C                                       | 2                        | Practica  | 1 00 |  |  |  |  |
| Marks            | Theory 5  | 0                        | Practica  | 1 00 |  |  |  |  |

After Completing the "Safety, Health & Environment" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain    | Taxonomy<br>Level | PLO   |
|------------|---|-----------|-------------------|-------|
| 1.         | Assess the current situation of health, safety and environment at<br>any working place. To develop a health, safety and environment<br>Plan for any industry. | Cognitive | 1& 5              | 6& 11 |
| 2.         | Propose solution for various local, national and international environmental problems   | Cognitive | 4                 | 5& 7  |

## **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):**

#### The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | 7      | Environment and Sustainability: | $\checkmark$ |
|---|----------------------------------|--------|---------------------------------|--------------|
| 2 | Problem Analysis:                | 8      | Ethics:                         |              |
| 3 | Design/Development of Solutions: | 9      | Individual and Team Work:       |              |
| 4 | Investigation:                   | 10     | Communication:                  |              |
| 5 | Modern Tool Usage:               | <br>11 | Project Management:             |              |
| 6 | The Engineering Society:         | <br>12 | Lifelong Learning:              |              |

#### **Contents:**

Introduction to Health, Safety and Environment and its necessity; overview of international EI IS practices in various industries (Construction, aviation, fisheries, Manufacturing. etc.), Occupational health and safety in practices in Pakistan.

Environmental Impacts of some industries; pollution and waste control techniques and main elements of EMS.

Principles of public health; communicable &non communicable water borne diseases. Food borne, air borne and sanitation related diseases and control measures.

National and International regulation regarding HSE, Labor code or Pakistan. Industrial- Nuclear and occupational rules and regulations in Pakistan. Agricultural Pesticide Ordinance. OHSAS-1800 I and International Labour Standards on Occupational Safety and Health.

Health and safety management; Hazard and its types, hazards identification. Quantification and elimination techniques, Risk assessment and its control procedures, responsibility distribution. Accident and incidents, their causes, investigation and control measures, measuring safety performance of implemented system.

| Reco | Recommended Books  |  |  |  |  |  |  |
|------|--|--|--|--|--|--|--|
| A) T | A) Text Books  |  |  |  |  |  |  |
| 1    | Salvata, Environmental Engineering. & Sanitation, Wiley Interscience.        |  |  |  |  |  |  |
| 2    | S. Caeneross, Environmental Health Engineering, Wiley Interscience.          |  |  |  |  |  |  |
| B) R | B) Reference Books   |  |  |  |  |  |  |
| 1    | K.F.H. Murrell, Safety for Industry Economics, Chapman & Hall International. |  |  |  |  |  |  |

Approval: Board of Studies Board of Faculty of Engineering Academic Council :Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10

| Title of Subject           | :  | <b>MACHINE DESIGN - I</b>  | AACHINE DESIGN - I                |       |             |  |  |  |
|----------------------------|----|--|-----------------------------------|-------|-------------|--|--|--|
| Course Code                | •• | (ME 332)   |                                   |       |             |  |  |  |
| Semester                   | :  | FIFTH  | Year                              | :     | THIRD       |  |  |  |
| Discipline                 | :  | MECHANICAL   | Discipline Co                     | ode   | ME          |  |  |  |
| Effective                  | :  | 17 Batch and onwards   |                                   |       |             |  |  |  |
| Pre-requisite              | :  | Strength of Materials II ()  | Strength of Materials II (ME 231) |       |             |  |  |  |
| Co-requisite               | :  |  |                                   |       |             |  |  |  |
| •                          |    |  |                                   |       |             |  |  |  |
|                            | :  | Theory   |                                   |       | Practical   |  |  |  |
| Assassment                 | :  | Theory20% Sessional Work,  |                                   |       | Practical   |  |  |  |
| Assessment                 | :  | Theory20% Sessional Work,20% Mid Semester Exam                             | ination                           |       | Practical   |  |  |  |
| Assessment                 | :  | Theory20% Sessional Work,20% Mid Semester Exam60% Final Written Exam       | ination                           |       | ,           |  |  |  |
| Assessment<br>Credit Hours | :  | Theory20% Sessional Work,20% Mid Semester Exam60% Final Written ExamTheory | ination                           | Pract | ,<br>ical 0 |  |  |  |

After Completing the "Machine Design-I" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain    | Taxonomy<br>Level | PLO |
|------------|---|-----------|-------------------|-----|
| 1.         | Demonstrate a thorough understanding of fundamental principles of<br>strength of materials and solid mechanics as they pertain to the design<br>of machine elements | Cognitive | 3                 | 1   |
| 2.         | Designcommon machine elements like springs, Gears and power screws.   | Cognitive | 5                 | 3   |
| 3.         | Designandanalyzevarious types of joints (Riveted and welded) using codes / standards / basic machine design theory.   | Cognitive | 4                 | 3   |

## RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):

#### The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | $\checkmark$ | 7  | Environment and Sustainability: |  |
|---|----------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                |              | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: | $\checkmark$ | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |  |

## **Contents:**

### Introduction:

Basic procedure of machine design, Basic requirement of Machine elements design, Traditional design methods, Design synthesis, Use of standards in design.

**Springs** – **Helical and Leaf:** Primary functions of springs, spring materials, design of helical springs, surge and vibration, buckling of compression springs, spring design formulae and general data, standard wire size, helical springs subjected to fatigue loading, stresses and deflection in helical springs of non- circular wire construction of leaf spring, equalized stresses in spring leaves (Nipping), standard sizes of automobile suspension springs.

**Riveted Joints:** Introduction, material for rivets, types of joints, design of riveted joint, modes of failure, efficiency of joint, general considerations, structural joints, boiler joints.

**Welded Joints:** Introduction, types of weldedjoints, stresses in butt welds, stresses in fillet welds, welding symbols, design procedure of eccentrically loaded welded joints, design of welded joints subjected to bending moment, welded joints under fatigue loading.

*Pipes and Pipe joints:* Types of pipe joints, design of pipes, standard pipe flanges for steam, hydraulic pipe joint for high pressures, design of circular, oval and square-flanged pipe joints.

**Spur Gears:** Introduction, design considerations of a gear drive, beam strength of gear teeth (Lewis equation), tooth loads (dynamic, static and wear), causes of gear tooth failure, design procedure for spur gears.

Helical Gears: Introduction, equivalent spur gear and virtual number of teeth, design equation for helical gears, force analysis.

**Bevel Gears:** Introduction, formative or equivalent number of teeth for bevel gears, forces acting on a bevel gears, design of a shaft for bevel gears.

**Power Screws:** Introduction, torque and efficiency of power screw, stress analysis of power screws, design of screw Jack, differential and compound screws.

| Reco | ecommended Books   |  |  |  |  |  |  |
|------|--|--|--|--|--|--|--|
| A) T | ext Books  |  |  |  |  |  |  |
| 1    | V.B. Bhandari, "Design of Machine Elements", Tata McGraw-Hill, Latest Edition.                             |  |  |  |  |  |  |
| 2    | R.S. Khurrmi, "A Text Book of Machine Design" S. Chand and Company Ltd. Latest Edition.                    |  |  |  |  |  |  |
| B) R | eference Books   |  |  |  |  |  |  |
| 1.   | J.E. Shigley, C.R. Mischke and R.G. Budynas, "Mechanical Engineering Design", McGraw Hill, Latest Edition. |  |  |  |  |  |  |
| 2.   | Robert L. Mott., "Machine Elements in Mechanical Design", Prentice Hall, Latest Edition.                   |  |  |  |  |  |  |
| 3.   | M.F. Spotts, "Design of Machine Elements", Prentice Hall, Latest Edition.                                  |  |  |  |  |  |  |
| 4.   | Robert L. Norton, "Machine Design An Integrated Approach", Prentice Hall, Latest Edition.                  |  |  |  |  |  |  |

Approval: Board of Studies Board of Faculty of Engineering Academic Council

:Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10

| Title of Subject | COMMUNICATION SKILLS AND TECHNICAL WRITING |                      |           |               |  |  |  |  |
|------------------|--|----------------------|-----------|---------------|--|--|--|--|
| Course Code      | EN 306                                     |                      |           |               |  |  |  |  |
| Semester         | FIFTH Year : THIRD                         |                      |           |               |  |  |  |  |
| Discipline       | MECHANICAL                                 | MECHANICAL           |           |               |  |  |  |  |
| Effective        | 17 Batch and onwards                       | 17 Batch and onwards |           |               |  |  |  |  |
| Pre-requisite    |  |                      |           |               |  |  |  |  |
| Co-requisite     |  |                      |           |               |  |  |  |  |
|                  | Theory                                     | P                    | Practical |               |  |  |  |  |
| Assessment       | 20% Sessional Work,                        |                      |           |               |  |  |  |  |
| Assessment       | 20% Mid Semester Exa                       | mination             |           |               |  |  |  |  |
|                  | 60% Final Written Ex                       | amination            |           |               |  |  |  |  |
| Credit Hours     | Theory                                     | 03                   | Practic   | cal 00        |  |  |  |  |
| Marks            | Theory                                     | 100                  | Practic   | <b>cal</b> 00 |  |  |  |  |

After Completing the "Communication Skills And Technical Writing" Course, each student will be able to:

| Sr.<br>No. | CLO  | Domain    | Taxonomy<br>Level | PLO |
|------------|--|-----------|-------------------|-----|
| 1.         | Draft varied texts including formal letters, CV, cover letter for<br>jobs, and Technical Reports using mechanisms of academic<br>writing integrated with paraphrasing and summarizing techniques.  | Cognitive | 2                 | 1   |
|            | Analyze and develop the content and structure of various technical<br>and academic research documents e.g., dissertations, research<br>papers or articles, proceeding papers and research review papers.   |           | 3                 | 10  |
|            | Understand, interpret and infer the texts critically and apply the<br>knowledge in real life situations by participating in public<br>speaking acts and group discussions  |           | 2                 | 9   |
| 2.         | Distinguish between formal and informal reports and use different<br>type of reports, such as; progress reports, research report,<br>recommendation report, evaluation report and feasibility report,<br>internship reports). Besides, Format proposals, elements and types<br>of different proposals along with technical manuals and SOPs. | Cognitive | 3                 | 10  |

### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):** The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge               | <br>7 | Environment and Sustainability: |  |
|---|-------------------------------------|-------|---------------------------------|--|
| 2 | Problem Analysis:                   | 8     | Ethics:                         |  |
| 3 | Design/Development of<br>Solutions: | 9     | Individual and Team Work:       |  |
| 4 | Investigation:                      | 10    | Communication:                  |  |
| 5 | Modern Tool Usage:                  | 11    | Project Management:             |  |
| 6 | The Engineering Society:            | 12    | Lifelong Learning:              |  |

## **Contents:**

## **Introduction to Writing Process**

- Technical Writing Process: Pre-writing, Writing & Revising (Demonstration & Illustration)
- Context & technical writing
- Implicit vs Explicit features of writing/ Text

## Writing a Technical Document

- Analyzing, anticipating and adapting
- Researching, organizing and composing
- Revising, proofreading and evaluating
- Elements of technical document
- Usability Testing on Technical Writing

## **Technical Correspondence**

- Using Technical Terms, definitions and descriptions
- Components of a Technical/business letters
- Electronic Channels of Communication and their applications

## **Types of Business correspondence**

• Emails: Elements and formats

## **Organizational Technical Correspondence**

- Memos: Purpose, elements and formation
- Types of Memos
- The process of Writing in technical correspondence

## Thesis/Dissertation & Research papers-I

- Academic & Scientific Language: Word to Sentence & Sentences to Paragraph
- Punctuation
- Styles, citation & referencing
- Annotation, paraphrasing and Summarization
- Thesis/Dissertation writing process
- Document Purposes: Explicit Vs Implicit
- Components of dissertations & Format
- Interpretation of Thesis/Dissertations Section
- Graphs, Charts and Numbers (Numeral Vs Numerical)
- Types of Research articles & Scientific Publications
- Pre & Post publication Processes
- Use of Language: Tone, Context and
- Review & Types of review
- Thesis Defense

## Types of Proposals

- Formal Proposals Vs Informal Proposals
- Business Proposals
- Grant proposals
- Academic Proposals
- Research Proposals

Informal Technical Reports

- Types of Informal Reports
- Elements of informal report

- Progress report
- Research/lab report
- Incident report

## Formal Technical Reports

- Problem solving documentation in formal reports
- Components of formal reports
- Feasibility report
- Recommendation report
- Evaluation Report
- Internship Reports

## **Module 16: Technical Instructions**

- Content of Technical instruction
- Analysis of Audience
- The writing process for technical instructions

| A) T | ext Books  |
|------|--|
| 1    | Perelman, L. C., J. Paradis, and E. Barrett. <i>Mayfield Handbook of Technical and Scientific Writing</i> , Mountain View, Mayfield, 1997. |
| 2    | Sharma, S. D. A Text Book of Scientific and Technical Communication Writing for Engineers and Professionals. Sarup& Sons, 2007.            |
| 3    | Glasman, Hilary. Science research writing: For non-native speakers of English. Imperial College Press: London, UK, 2010.                   |
| B) R | eference Books   |
| 1    | Van Aken, David C., and William F. Hosford. <i>Reporting Results</i> . Cambridge University Press, 2008.                                   |
| 2    | Alred, Gerald J., Charles T. Brusaw, and Walter E. Oliu. <i>Handbook of technical writing</i> . Macmillan, 2009.                           |

Approval:Board of StudiesBoard of Faculty of EngineeringAcademic Council

:Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10

| Title of Subject | : | MECHANICS OF MACHINES – II |                                    |                            |              |  |  |  |
|------------------|---|----------------------------|------------------------------------|----------------------------|--------------|--|--|--|
| Course Code      | : | (ME 366)                   |                                    |                            |              |  |  |  |
| Semester         | : | FIFTH                      | IFTH Year : THIRD                  |                            |              |  |  |  |
| Discipline       | : | MECHANICAL                 |                                    |                            |              |  |  |  |
| Effective        | : | 17 Batch and onwards       |                                    |                            |              |  |  |  |
| Pre-requisite    | : | MECHANICS OF MACI          | MECHANICS OF MACHINES – I (ME 212) |                            |              |  |  |  |
| Co-requisite     | : |                            |                                    |                            |              |  |  |  |
|                  |   | Theory                     | P                                  | ractic                     | al           |  |  |  |
| Assessment       |   | 20% Sessional Work,        | 40                                 | 40% Sessional Work,        |              |  |  |  |
| Assessment       |   | 20% Mid Semester Exam      | ination                            | ,                          |              |  |  |  |
|                  |   | 60% Final Written Exan     | nination 6                         | 60% Final Lab. Examination |              |  |  |  |
| Credit Hours     | : | <b>Theory</b> 0            | )2 <b>F</b>                        | Practic                    | <b>al</b> 01 |  |  |  |
| Marks            | : | Theory 5                   | 50 <b>F</b>                        | Practic                    | <b>al</b> 50 |  |  |  |

After Completing the "Mechanics of Machines-II" Course, each student will be able to:

| Sr.<br>No. | CLO  | Domain          | Taxonomy<br>Level | PLO   |
|------------|--|-----------------|-------------------|-------|
| 1.         | Analyze and generate cam profiles based on different motion schemes.   | Cognitive       | 4 & 5             | 2 & 3 |
| 2.         | Design the balancing of rotating masses in single and different<br>planesand balancing the primary & secondary forces of multi-<br>cylinder in-line engines. | Cognitive       | 5                 | 3     |
| 3.         | COLLECT linear & angular displacement data and graphically DETERMINE velocity & acceleration for various mechanisms.   | Psychomot<br>or | 3                 | 2     |

### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):** The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            |              | 7  | Environment and Sustainability: |  |
|---|----------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                |              | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: | $\checkmark$ | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |  |

## **Contents:**

**Turning moment diagram & flywheel:** Turning moment diagram of single & multi-cylinder I.C engine, energy stored by flywheel.

**Cams & followers:** Types, displacement diagram, types of follower motion, drawing of cam profile, velocity & acceleration of follower.

**Balancing:** Balancing of rotating masses in single & different planes, balancing of reciprocating masses, balancing of single & multi-cylinder in-line engines, balancing of V-engines.

| Recommended Books  |   |  |  |  |
|--------------------|---|--|--|--|
| A) Text Books      |   |  |  |  |
| 1                  | J.E. Shigley, "Theory of Machines", McGraw Hill, 1st Edition, 1961.   |  |  |  |
| 2                  | David H. Myszka, "Machines and Mechanisms", Prentice Hall, 3 <sup>rd</sup> Edition, 2005.                             |  |  |  |
| B) Reference Books |   |  |  |  |
| 1                  | J.E. Shigley, John Joseph Uicker Jr. "Theory of Machines and Mechanisms", McGraw Hill, 2 <sup>nd</sup> Edition, 1995. |  |  |  |
| 2                  | R. S. Khurmi, J. K. Gupta, "Theory of Machines", Eurasia Publishing House, 14thEedition, 2008                         |  |  |  |

| Approval:Board of Studies:Res.No.25.3.1Dated:17-03-Board of Faculty of Engineering:Res.No.33.08Dated: 29-03-Academic Council:Res.No.92.10Dated:23-04- |
|---|
|---|

| Title of Subject | : | INSTRUMENTATION AND MEASUREMENT |             |                            |             |  |  |
|------------------|---|---------------------------------|-------------|----------------------------|-------------|--|--|
| Course Code      | : | (ME 342)                        |             |                            |             |  |  |
| Semester         | : | SIXTH                           | Year        | : 7                        | THIRD       |  |  |
| Discipline       | : | MECHANICAL                      |             |                            |             |  |  |
| Effective        | : | 17 Batch and onwards            |             |                            |             |  |  |
| Pre-requisite    | : | Basic Electronics               |             |                            |             |  |  |
| Co-requisite     | : |                                 |             |                            |             |  |  |
|                  | : | Theory (if exist)               | P           | Practical (if exist)       |             |  |  |
| Assessment       |   | 20% Sessional Work,             | 40          | 40% Sessional Work,        |             |  |  |
| Assessment       |   | 20% Mid Semester Exam           | ination     | ,                          |             |  |  |
|                  |   | 60% Final Written Exar          | nination 60 | 60% Final Lab. Examination |             |  |  |
| Credit Hours     | : | Theory (                        | )2 <b>F</b> | Practica                   | <b>d</b> 01 |  |  |
| Marks            | : | Theory 5                        | 50 <b>F</b> | Practica                   | <b>d</b> 50 |  |  |

After Completing the "Instrumentation And Measurement" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain      | Taxonomy<br>Level | PLO   |
|------------|---|-------------|-------------------|-------|
| 1.         | Apply engineering measurement techniques by using any of the studied sensors. | Cognitive   | 3                 | 1     |
| 2.         | Data Acquisition and Signal Processing for a given problem                    | Cognitive   | 4                 | 3     |
| 3.         | Calibrate sensors and interface them to data acquisition devices.             | Psychomotor | 3                 | 2 & 3 |

## **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):**

### The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | $\checkmark$ | 7  | Environment and Sustainability: |  |
|---|----------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                |              | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: | $\checkmark$ | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |  |

#### **Contents:**

#### Introduction

Elements of Measurement System, Sensor Classifications, Static and Dynamic characteristics of instruments, Calibration, Types and Sources of Errors, Error propagation

#### Sensors/Transducers

Temperature

Resistance temperature detector, Thermistor, Thermocouple, Radiative Temperature Sensor *Displacement and velocity* 

Potentiometer, Linear variable differential transformer, Capacitive Sensor, Laser Displacement sensor, Optical Encoder, Drag cup tachometer, Stroboscope, Dial Indicator

Force

Spring Balance, Pneumatic Load Cell, Hydraulic Load Cell, Electronic Load Cell *Strain*
Resistance Strain Gauge, Optical Strain Gauge

Dipstick, Float systems, Hydrostatic system, Ultrasonic level gauge

Pressure

McLeod Gauge, Manometer, Bourdon Tube, Bellows, Diaphragms

Flow

Orifice meter, Venturi Meter, Rotameter

# Signal Conditioners

Mechanical amplifiers, need of electronic data acquisition and signal conditioning, Operational Amplifier, Sampling, Multiplexing, Analog to digital and digital to analog conversion, Interfacing **Display** 

Classification of Display devices, Dial indicator, Mechanical chart recorder, Moving coil mechanism, Dot Matrix display, Seven Segment display, Cathode ray oscilloscope

| Reco  | Recommended Books  |  |  |  |  |  |  |
|-------|--|--|--|--|--|--|--|
| A) To | ext Books  |  |  |  |  |  |  |
| 1     | Alan S. Morris and Reza Langari, "Measurement and Instrumentation: Theory and Application", Butterworth-Heinemann, Latest Edition. |  |  |  |  |  |  |
| 2     | Haslam & Summers & Williams, "Engineering Instrumentation and Control", Edward Arnold, Latest Edition.                             |  |  |  |  |  |  |
| B) Re | eference Books   |  |  |  |  |  |  |
| 1     | Richard S. Figliola and Donald E. Beasley, "Theory and Design for Mechanical Measurements", John Wiley & Sons, Latest Edition.     |  |  |  |  |  |  |
| 2     | Curtis D. Johnson, "Process Control Instrumentation Technology", Prentice-Hall, Latest Edition.                                    |  |  |  |  |  |  |

Approval: Board of Studies Board of Faculty of Engineering Academic Council

:Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10

| Title of Subject | : | STATISTICS AND PROBABILITY   |             |         |       |  |
|------------------|---|--|-------------|---------|-------|--|
| Course Code      | : | (MTH 317)  |             |         |       |  |
| Semester         | : | SIXTH  | Year        | :       | THIRD |  |
| Discipline       | : | MECHANICAL   |             |         |       |  |
| Effective        | : | 17 Batch and onwards   |             |         |       |  |
| Pre-requisite    | : |  |             |         |       |  |
| Co-requisite     | : |  |             |         |       |  |
|                  | : | Theory   | P           | ractic  | al    |  |
| Assessment       |   | <ul><li>20% Sessional Work,</li><li>20% Mid Semester Examination</li><li>60% Final Written Examination</li></ul> |             |         |       |  |
| Credit Hours     | : | Theory (   | )3 <b>F</b> | Practic | al 00 |  |
| Marks            | : | Theory 1   | 00 <b>F</b> | Practic | al 00 |  |

After Completing the "Statistics and Probability" Course, each student will be able to:

| Sr.<br>No. | CLO  | Domain    | Taxonomy<br>Level | PLO |
|------------|--|-----------|-------------------|-----|
| 1.         | Describe different statistical methods to obtain the measure of central values of a data and their interpretation. | Cognitive | 2                 | 2   |
| 2.         | Apply Probability and its rules. Different probability distributions<br>and their uses                             | Cognitive | 3                 | 3   |
| 3.         | Analyze Estimations and hypothesis along with regression and correlation analysis                                  | Cognitive | 3                 | 3   |

#### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):** The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            |   | 7  | Environment and Sustainability: |  |
|---|----------------------------------|---|----|---------------------------------|--|
| 2 | Problem Analysis:                |   | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: | V | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |   | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |   | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |   | 12 | Lifelong Learning:              |  |

### **Contents:**

**Introduction:** Nature and importance of statistics, descriptive and inferential statistics, population and samples.

Descriptive Measures: Measures of central tendency and measures of dispersions.

**Probability:** Introduction to probability, counting techniques, dependent and independent events, conditional probability, additive rule of probability. Contingency tables, joint and marginal probabilities, the multiplication rule, Bayes's theorem.

**Probability Distribution:** Concept of random variables, discrete and continuous probability distributions., Mean and variance of a random variables. Binomial and Poisson distributions, mean and variance of Binomial and Poisson distribution. Normal distribution, Standard normal distribution and inverse use of table

of areas under the normal curve.

**Sampling Distribution:** Sampling distribution of means with replacement and without replacement, Central limit theorem.

**Estimation of Parameters:** Confidence interval of one population mean, estimation a population mean, estimating the difference between two population mean. The Chi-square distribution.

**Tests of Hypothesis:** Testing a statistical hypothesis, Type I & II error, one tailed and two tailed tests. Test concerning means and variances, testing the difference between two means, Good-ness of fit test.

**Simple Regression and Correlation:** Regression analysis by least squares method, testing the significance of the slope, simple correlation analysis, coefficient of correlation, testing the significance of coefficient of correlation.

| Reco | Recommended Books   |  |  |  |  |  |
|------|---|--|--|--|--|--|
| A) T | A) Text Books   |  |  |  |  |  |
| 1    | M. Anwar Solangi; Statistical Methods and Estimations. Latest Edition                     |  |  |  |  |  |
| 2    | Ronald Walpole, Introductory Statistics. Latest Edition                                   |  |  |  |  |  |
| 3    | Sher Muhammad Choudhry, Introduction to Statistics vol. I & II. Latest Edition            |  |  |  |  |  |
| B) R | B) Reference Books  |  |  |  |  |  |
| 1    | IqbalBhatti, Elements of Statistics. Latest Edition                                       |  |  |  |  |  |
| 2    | Douglas C. Montgomery, Applied Statistics and Probability for Engineering. Latest Edition |  |  |  |  |  |

| Approval: | Board of Studies                | :] |
|-----------|---------------------------------|----|
|           | Board of Faculty of Engineering | :] |
|           | Academic Council                | :] |

:Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10

| Title of Subject | : | MACHINE DESIGN - II      |             |         |           |  |  |
|------------------|---|--------------------------|-------------|---------|-----------|--|--|
| Course Code      | : | (ME 352)                 |             |         |           |  |  |
| Semester         | : | SIXTH                    | Year        | :       | THIRD     |  |  |
| Discipline       | : | MECHANICAL               |             |         |           |  |  |
| Effective        | : | 17 Batch and onwards     |             |         |           |  |  |
| Pre-requisite    | : | MachineDesign -I (ME 3)  | 31)         |         |           |  |  |
| Co-requisite     | : | Mechanical Vibrations (N | AE 381)     |         |           |  |  |
|                  | : | Theory                   |             |         | Practical |  |  |
| Assessment       |   | 20% Sessional Work,      |             |         |           |  |  |
| Assessment       |   | 20% Mid Semester Exam    | ination     |         |           |  |  |
|                  |   | 60% Final Written Exan   | nination    |         |           |  |  |
| Credit Hours     | : | <b>Theory</b> 0          | 3 P         | Practic | al 0      |  |  |
| Marks            | : | Theory 10                | 00 <b>P</b> | Practic | al 0      |  |  |

After Completing the "Machine Design-II" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain    | Taxonomy<br>Level | PLO |
|------------|---|-----------|-------------------|-----|
| 1.         | Designamachine component while considering their functional requirements and constraints placed over them           | Cognitive | 5                 | 3   |
| 2.         | Analyze the standards and techniques used in the design of machine elements like shafts, keys, and Bearings.        | Cognitive | 4                 | 2   |
| 3.         | Applyappropriate theories of failure in the design of new machine components under both static and dynamic loading. | Cognitive | 3                 | 5   |

### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):**

### The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            |              | 7  | Environment and Sustainability: |  |
|---|----------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                |              | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: | $\checkmark$ | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |  |

#### **Contents:**

**Shaft Design:** Introduction, transmission shafts, shaft design on the strength basis, shaft design on torsional rigidity basis, ASME code for shaft design, design of hollow shaft on strength basis, design of hollow shaft on torsional rigidity basis, flexible shafts.

**Keys and Couplings:** Types of keys, design of square and flat keys, design of Kennedy keys, splines, types of coupling, design procedure for muff, clamp, rigid flange and bushed pin flexible couplings.

**Design / Selection of Friction clutches:** Introduction, principles of friction clutches, practical design aspects, theory of centrifugal clutch.

Design / Selection of Brakes: Types of brakes, material of brake lining, design of brakes.

**Design / Selection of V-belt and Rope drives:** Introduction, types of belts, Strength of belt, creep, design procedure, Construction of wire ropes, designation of wire ropes, stresses in wire ropes, design procedure for a wire rope.

Design / Selection of Bearings: Sliding contact bearing, types of sliding contact bearings, assumptions in

hydrodynamic lubricated bearings, sliding contact bearing materials, lubricants, terms used in hydrodynamic journal bearings, design procedure for journal bearing, design of bearing caps and bolts, rolling contact bearing, construction and types, standard dimensions and designation of ball bearings, static equivalent load, life of bearing, basic dynamic load rating, dynamic equivalent load, dynamic load rating for rolling contact bearing under variable load, reliability of a bearing, selection of radial ball bearings, lubrication of Ball and roller bearings.

**Design of Flywheel:** Introduction, energy stored in a flywheel, stresses in a flywheel rim, stresses in flywheel arms, construction of flywheels.

| Reco  | Recommended Books  |  |  |  |  |  |
|-------|--|--|--|--|--|--|
| A) To | A) Text Books  |  |  |  |  |  |
| 1     | V.B. Bhandari, "Design of Machine Elements", Tata McGraw-Hill, Latest Edition.                             |  |  |  |  |  |
| 2     | R.S. Khurrmi, "A Text Book of Machine Design" S. Chand and Company Ltd. Latest Edition.                    |  |  |  |  |  |
| B) Re | eference Books   |  |  |  |  |  |
| 1.    | J.E. Shigley, C.R. Mischke and R.G. Budynas, "Mechanical Engineering Design", McGraw Hill, Latest Edition. |  |  |  |  |  |
| 2.    | Robert L. Mott., "Machine Elements in Mechanical Design", Prentice Hall, Latest Edition.                   |  |  |  |  |  |
| 3.    | M.F. Spotts, "Design of Machine Elements", Prentice Hall, Latest Edition.                                  |  |  |  |  |  |
| 4.    | Robert L. Norton, "Machine Design An Integrated Approach", Prentice Hall, Latest Edition                   |  |  |  |  |  |

| Approval: | Board of Studies                | :Res.No.25.3.1 | Dated:17-03-2018  |
|-----------|---------------------------------|----------------|-------------------|
|           | Board of Faculty of Engineering | :Res.No.33.08  | Dated: 29-03-2018 |
|           | Academic Council                | :Res.No.92.10  | Dated:23-04-2018  |

| Title of Subject | : | <b>REFRIGERATION AND AIR CONDITIONING</b> |                |                            |                |  |  |
|------------------|---|---|----------------|----------------------------|----------------|--|--|
| Course Code      | : | (ME 372)                                  |                |                            |                |  |  |
| Semester         | : | SIXTH                                     | Year           | : '                        | THIRD          |  |  |
| Discipline       | : | MECHANICAL                                |                |                            |                |  |  |
| Effective        | : | 17 Batch and onwards                      |                |                            |                |  |  |
| Pre-requisite    | : | Thermodynamics-I (ME2                     | 21), Heat & Ma | ass Tra                    | nsfer (ME 301) |  |  |
| Co-requisite     | : |   |                |                            |                |  |  |
|                  |   | Theory                                    | P              | ractica                    | d              |  |  |
| Assessment       |   | 20% Sessional Work,                       | 40             | 40% Sessional Work,        |                |  |  |
| Assessment       |   | 20% Mid Semester Exam                     | ination        | ,                          |                |  |  |
|                  |   | 60% Final Written Exan                    | nination 60    | 60% Final Lab. Examination |                |  |  |
| Credit Hours     | : | <b>Theory</b> 0                           | 3 <b>F</b>     | Practic                    | <b>al</b> 01   |  |  |
| Marks            | : | Theory 10                                 | 00 <b>F</b>    | Practic                    | al 50          |  |  |

After Completing the "Refrigeration And Air Conditioning" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain          | Taxonomy<br>Level | PLO   |
|------------|---|-----------------|-------------------|-------|
| 1.         | Understanding the basic terms, laws and principles of refrigeration and air conditioning systems                              | Cognitive       | 2                 | 1     |
| 2.         | Analyzethe refrigeration, and air-conditioning systems using energy principles.   | Cognitive       | 3                 | 2     |
| 3.         | Implement the heating and cooling load calculations and analyze the factors affecting thermal comfort                         | Cognitive       | 3                 | 3&6   |
| 4.         | Take measurements of various quantities and show the processes/cycles involved in refrigeration and air conditioning systems. | Psychomo<br>tor | 2                 | 1 & 2 |

# **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):**

### The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | $\checkmark$ | 7  | Environment and Sustainability: |  |
|---|----------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                |              | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: | $\checkmark$ | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |  |

### **Contents:**

Introduction: Major uses of refrigeration, terms and definitions, developments *and applications*, reversed Carnot cycle

Vapor compression refrigeration (VCR) :Ideal and actual <u>VCR cycles</u>, *refrigerants: groups, chemistry, encoding and decoding, and properties* use of property tables, Ph/Ts- diagrams, *Energy and performance analyses*, effects of suction <u>and condensing fluid pressure</u>/ temperature and pressure losses, heat pumps, classifications & applications, innovative <u>VCR</u> systems, cascade, multistage-compression, multipurpose refrigeration systems and cryogenics, domestic and commercial units.

Vapor absorption refrigeration systems (VAR): Basic and modified cycles, different solutions used in the

system, *and their properties; use of solution PTx/hTx charts, energy and performance analyses* domestic and commercial units, combined VCR and VAR system.

**Steam jet refrigeration system:** Principle of operation, representation of different processes on Mollier and Ts-diagrams, energy and performance analyses.

<u>Air / Gas refrigeration Note</u>: Reversed Brayton cycle (*simple and regenerative*), *modifications and applications*, energy and performance analyses.

**<u>Psychrometry</u>** and <u>air conditioning</u>: *psychrometric properties*, Adiabatic saturation temperature, psychrometric chart, psychrometric processes for air conditioning, wet cooling towers.

Air conditioning systems: Functions of air conditioning system, systemselection, components and applications, ventilation.

**Cooling load calculations**: Heating and cooling load calculations for buildings,human body and thermal comfort, design conditions, heat gain from people, lights and appliances, heat transfer through walls, roofs, floors, and basement walls, heat transfer through windows, solar heat gain, air change load and weatherizing, cooling load calculation for refrigeration and freezing of foods, product load, air change load, internal load, refrigeration equipment load, *load calculations standards and software's*.

| Reco  | Recommended Books  |  |  |  |  |  |  |
|-------|--|--|--|--|--|--|--|
| A) Te | ext Books  |  |  |  |  |  |  |
| 1     | Ibrahim Dincer, "Refrigeration systems & applications", John Wiley & Sons, Latest Edition,                 |  |  |  |  |  |  |
| 2     | Stoecker W.F., "Refrigeration and Air conditioning", McGraw-Hill, Latest Edition                           |  |  |  |  |  |  |
| 3     | Yunus A. Cengel, Michael A. Boles," Thermodynamics: An Engineering Approach", McGraw-Hill, Latest Edition. |  |  |  |  |  |  |
| B) Re | eference Books   |  |  |  |  |  |  |
| 1     | Jordan and Priester, "Refrigeration and Air conditioning", John Wiley & Sons, Latest Edition,              |  |  |  |  |  |  |
| 2     | Yunus A Cengel, "Heat transfer: a practical approach", Tata McGraw hill, Latest Edition                    |  |  |  |  |  |  |
| 3     | Dossat R.J., "Principles of refrigeration", John Wiley & Sons, S.I., latest Edition.                       |  |  |  |  |  |  |

Approval:Board of StudiesBoard of Faculty of EngineeringAcademic Council

:Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10

| Title of Subject | : | MECHANICAL VIBRATIONS         |                    |                     |                            |              |  |  |  |  |
|------------------|---|-------------------------------|--------------------|---------------------|----------------------------|--------------|--|--|--|--|
| Course Code      | : | (ME 382)                      |                    |                     |                            |              |  |  |  |  |
| Semester         | : | SIXTH                         | SIXTH Year : THIRD |                     |                            |              |  |  |  |  |
| Discipline       | : | MECHANICAL ENGINEERIN         | IG                 |                     |                            |              |  |  |  |  |
| Effective        | : | 17 Batch and onwards          |                    |                     |                            |              |  |  |  |  |
| Pre-requisite    | : | Engineering Dynamics          |                    |                     |                            |              |  |  |  |  |
| Co-requisite     | : |                               |                    |                     |                            |              |  |  |  |  |
|                  | : | Theory                        |                    | Practical           |                            |              |  |  |  |  |
| Assessment       |   | 20% Sessional Work,           |                    | 40% Sessional Work, |                            |              |  |  |  |  |
| Assessment       |   | 20% Mid Semester Examination  | 1                  | ,                   |                            |              |  |  |  |  |
|                  |   | 60% Final Written Examination |                    |                     | 60% Final Lab. Examination |              |  |  |  |  |
| Credit Hours     | : | Theory 03                     |                    | Pra                 | actic                      | <b>al</b> 01 |  |  |  |  |
| Marks            | : | <b>Theory</b> 100             |                    | Pra                 | actic                      | al 50        |  |  |  |  |

After Completing the "Mechanical Vibrations" Course, each student will be able to:

| Sr.<br>No. | CLO  | Domain      | Taxonomy<br>Level | PLO |
|------------|--|-------------|-------------------|-----|
| 1.         | Study and Analyze free vibrations and forced vibration of harmonically excited systems.                    | Cognitive   | 2 & 4             | 2   |
| 2.         | Analyze single/Multi degree of freedom system by using energy method.                                      | Cognitive   | 4                 | 2   |
| 3.         | Manupulatemathematical models and compute frequency responses for single and multi-degree freedom systems. | Cognitive   | 3                 | 3   |
| 4.         | Relate the concepts taught in the lab and complete lab reports individually in time.                       | Affective   | 3 &4              | 10  |
| 5.         | To perform series of experiment on prescribed equipment both individually and in teams                     | Psychomotor | 5                 | 9   |

### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):** The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            |              | 7  | Environment and Sustainability: |              |
|---|----------------------------------|--------------|----|---------------------------------|--------------|
| 2 | Problem Analysis:                |              | 8  | Ethics:                         |              |
| 3 | Design/Development of Solutions: | $\checkmark$ | 9  | Individual and Team Work:       | $\checkmark$ |
| 4 | Investigation:                   |              | 10 | Communication:                  |              |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |              |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |              |

# **Contents:**

**Introduction:** Importance of the study of vibration, elementary parts of vibrating system, degree of freedom, simple harmonic motion, addition of harmonic motions, free and forced vibration.

Systems with one degree of freedom: Damped free vibration, root locus study of damping, logarithmic decrement, response of un-damped and damped systems under harmonic excitation, base excitation, rotating unbalance, self-excitation and stability analysis, vibration under general forcing conditions, response under

periodic and non-periodic forces.

**Two degree of freedom systems:** Free and forced vibration, analysis of un-damped and damped systems, normal modes, co-ordinate coupling and principal coordinates vehicle suspension systems.

Multi degree of freedom systems: Influence coefficient, generalized coordinates and generalized forces, Lagrange's equation, eigen value problems.

**Numerical methods:**Dunkerley's formula, Holzer method, vibration of continuous system, transverse vibration of a string, longitudinal vibration of a rod, torsional vibration of shaft, lateral vibration of beams, Rayleigh-Ritz method.

Vibration control: Methods of vibration control, whirling of shaft, vibration isolation, dynamic vibration absorber.

Vibration measurement: Transducers, vibration pickups, accelerometers, vibration exciters, signal analysis, power spectral density, machine condition monitoring (diagnosis and analysis). Note: Practical work is based on the above theoretical course

#### **Recommended books:**

| А. | Textbo | oks   |
|----|--------|---|
|    | 1      | Thomson, W.T., Dahleh, M.D., Padmanabhan, C., "Theory of Vibration with Application",               |
|    | 1.     | Dorling Kindersley (India) Pvt. Ltd., licensees of Pearson Education in South Asia, Latest Edition. |
|    | 2.     | Rao S.S., "Mechanical Vibration", Prentice Hall, Latest Edition.                                    |
|    | 3.     | S. Graham Kelly, "Mechanical Vibrations Theory and Applications", SI Edition, Latest Edition.       |
| В. | Refere | nce Books   |
|    | 1.     | De silva, C.W., "Vibration Fundamentals and Practice", Taylor & Francis, Latest Edition             |
|    | 2.     | Kelly S. G. "Fundamentals of Mechanical Vibrations", McGraw-Hill, Latest Edition.                   |
|    | 3      | William T. Thomson, Prentice Hall, "Theory of Vibration with Application", Prentice Hall, Latest    |
|    | э.     | Edition.  |

| Approval: | Board of Studies                |
|-----------|---------------------------------|
|           | Board of Faculty of Engineering |
|           | Academic Council                |

:Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10

| Title of Subject | : | COMPUTER AIDED MACHINE DESIGN (CAMD) |                             |    |                            |           |  |  |  |
|------------------|---|--------------------------------------|-----------------------------|----|----------------------------|-----------|--|--|--|
| Course Code      | : | (ME 356)                             |                             |    |                            |           |  |  |  |
| Semester         | : | SIXTH                                | SIXTH Year : THIRD          |    |                            |           |  |  |  |
| Discipline       | : | MECHANICAL                           |                             |    |                            |           |  |  |  |
| Effective        | : | 17 Batch and onwards                 |                             |    |                            |           |  |  |  |
| Pre-requisite    | : | Machine Design -I (ME 331)           |                             |    |                            |           |  |  |  |
| Co-requisite     | : | Machine Design -II (ME               | Machine Design -II (ME 351) |    |                            |           |  |  |  |
|                  | : | Theory                               |                             |    |                            | Practical |  |  |  |
| Assessment       |   |                                      |                             |    | 40% Sessional Work,        |           |  |  |  |
|                  |   |                                      |                             | 60 | 60% Final Lab. Examination |           |  |  |  |
| Credit Hours     | : | <b>Theory</b> C                      | 0                           | P  | racti                      | ical 01   |  |  |  |
| Marks            | : | <b>Theory</b> C                      | 0                           | P  | racti                      | ical 50   |  |  |  |

After Completing the "Computer Aided Machine Design (CAMD)" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain      | Taxonomy<br>Level | PLO |
|------------|---|-------------|-------------------|-----|
| 1.         | Identity the role of CAD to speed up and optimize design process.                             | Cognitive   | 2                 | 2   |
| 2.         | Generate basic and advanced 3D solid models of mechanical parts.                              | Cognitive   | 5                 | 3   |
| 3.         | Use of 3-D modeling software for structure type problems and generate detailed drawings.      | Cognitive   | 3                 | 5   |
| 4.         | Demonstrate and develop the 3D model of the machine elements by using related CAD software's. | Psychomotor | 3                 | 3   |

# **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):**

### The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            |              | 7  | Environment and Sustainability: |  |
|---|----------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                | $\checkmark$ | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: | V            | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |  |

### **Contents:**

Introduce the concepts of computer-aided design (CAD) using contemporary solid modeling software. This course include feature-based solid, assembly and mechanism design, dimensioning and detailed drawings for documentation.

- **01.** Sketching and Extruding Features,
- **02**. Feature-Based Modeling and Construction Tools,
- **03**. Groups and Modifying Features,
- 04. Detailed Drawings and Documentation,
- 05. Sections and Auxiliary Views,
- **06.** Assemblies and Mechanism Design,
- **07.** Sweeps, Blends and Advanced Modeling Techniques

| Title of Subject | :  | ENTREPRENEURSHIP & ENGINEERING MANAGEMENT  |                     |           |              |  |  |  |  |  |
|------------------|----|--|---------------------|-----------|--------------|--|--|--|--|--|
| Course Code      | :  | (ME 402)   |                     |           |              |  |  |  |  |  |
| Semester         | :  | SEVENTH Year : FOURTH  |                     |           |              |  |  |  |  |  |
| Discipline       | :  | MECHANICAL   |                     |           |              |  |  |  |  |  |
| Effective        | :  | 17 Batch and onwards   |                     |           |              |  |  |  |  |  |
| Pre-requisite    | •• |  |                     |           |              |  |  |  |  |  |
| Co-requisite     | :  |  |                     |           |              |  |  |  |  |  |
|                  | :  | Theory   | P                   | Practical |              |  |  |  |  |  |
| Assessment       |    | <ul><li>20% Sessional Work,</li><li>20% Mid Semester Exam</li><li>60% Final Written Exam</li></ul> | ination<br>nination |           |              |  |  |  |  |  |
| Credit Hours     | :  | <b>Theory</b> 0  | 03 P                | Practica  | <b>al</b> 00 |  |  |  |  |  |
| Marks            | :  | Theory 1   | 00 P                | Practica  | al 00        |  |  |  |  |  |

After Completing the "Entrepreneurship & Engineering Management" Course, each student will be able to:

| Sr.<br>No. | CLO  | Domain    | Taxonomy<br>Level | PLO   |
|------------|--|-----------|-------------------|-------|
| 1.         | Manage manufacturing operations and systems.               | Cognitive | 2                 | 1& 10 |
| 2.         | Make economic analysis of industrial and business systems. | Cognitive | 3                 | 2& 8  |
| 3.         | Implement sustainable business plans.                      | Cognitive | 3                 | 3& 11 |

#### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):** The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            |   | 7  | Environment and Sustainability: |              |
|---|----------------------------------|---|----|---------------------------------|--------------|
| 2 | Problem Analysis:                |   | 8  | Ethics:                         | $\checkmark$ |
| 3 | Design/Development of Solutions: | V | 9  | Individual and Team Work:       |              |
| 4 | Investigation:                   |   | 10 | Communication:                  |              |
| 5 | Modern Tool Usage:               |   | 11 | Project Management:             |              |
| 6 | The Engineering Society:         |   | 12 | Lifelong Learning:              |              |

# **Contents:**

A: INDUSTRIAL ENGINEERING AND MANAGEMENT: Industrial competitiveness and significance for industrial productivity. Industrial Setup and Layout. Types of Production. Process Design. Material Handling. Industrial operations and their management. Production planning and control. Inventory Control and Management. Quality Control and Management.

**B: ENGINEERING ECONOMY:** Basic economic concepts and principles. GNP and GDP. Supply and Demand. Circular flow of money. Cost and its various types. Cost estimation techniques. Time value of money. Laws of return (The present worth method, the future worth method, the internal rate of return, payback period method). Break even analysis. Engineering economic analysis. Depreciation and its calculation.

# **C: ENTREPRENEURSHIP**

Introduction to entrepreneurship: meaning and concept of entrepreneurship. Economic and social perspectives

of entrepreneurship. Role and importance of entrepreneurship. Entrepreneurship in services sector. Entrepreneurial mindset. Forms of enterprise. Social and ethical responsibilities.

**Entrepreneurial Process:** competing models of entrepreneurship. Developing and screening ideas. Identifying and evaluating opportunities. Business Plan. Business plan v/s Business Model.

**Entrepreneurial Finance:** financial objectives of entrepreneurial ventures. Sources of funding for new ventures. Debit financing. Equity financing.

**Entrepreneurial Marketing:** Marketing research. Marketing Plan. Marketing strategies. Product marketing v/s Services marketing. Product and service quality.

#### **Recommended Books**

#### A) Text Books

Degarmo E. Paul, "Engineering Economy" Pearson, Latest Edition.

Willium J. Stevenson "Operations Management" McGraw Hill, Latest Edition.

#### **B) Reference Books**

Robert Hisrich, Michael Peters & Dean Shepherd , 'Entrepreneurship' McGraw Hill, latest edition

| Approval: | Board of Studies                |
|-----------|---------------------------------|
|           | Board of Faculty of Engineering |
|           | Academic Council                |

:Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10

| Title of Subject | :      | CONTROL ENGINEER   | CONTROL ENGINEERING |                     |               |  |  |  |
|------------------|--------|--|---------------------|---------------------|---------------|--|--|--|
| Course Code      | :      | (ME 491)   |                     |                     |               |  |  |  |
| Semester         | :      | SEVENTH  | Year                | :                   | FOURTH        |  |  |  |
| Discipline       | :      | MECHANICAL   |                     |                     |               |  |  |  |
| Effective        | :      | 17 Batch and onwards                                     |                     |                     |               |  |  |  |
| Pre-requisite    | :      |  |                     |                     |               |  |  |  |
| Co-requisite     | :      |  |                     |                     |               |  |  |  |
|                  | Theory | P  | ractio              | cal                 |               |  |  |  |
| Assessment       |        | 20% Sessional Work,                                      | 40                  | 40% Sessional Work, |               |  |  |  |
| Assessment       |        | 20% Mid Semester Examin                                  | nation              | ,                   |               |  |  |  |
|                  |        | 50% Final Written Examination 60% Final Lab. Examination |                     |                     |               |  |  |  |
| Credit Hours     | :      | Theory 02  | 2 <b>F</b>          | Practi              | <b>cal</b> 01 |  |  |  |
| Marks            | :      | Theory 50  | ) <b>F</b>          | Practi              | <b>cal</b> 50 |  |  |  |

After Completing the "Control Engineering" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain      | Taxonomy<br>Level | PLO      |
|------------|---|-------------|-------------------|----------|
| 1.         | Apply the knowledge of open/ close loop system to solve the given<br>problem, Solve flow diagram/ mechanical system based on<br>graphical/ mathematical modelling | Cognitive   | 3                 | 2        |
| 2.         | Carry out a root locus analysis for an engineering system.  | Cognitive   | 4                 | 2        |
| 3.         | Physically implement control system using analog and digital devices  | Psychomotor | 2                 | 1 &<br>3 |

# RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):

### The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | $\checkmark$ | 7  | Environment and Sustainability: |  |
|---|----------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                | $\checkmark$ | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: | $\checkmark$ | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |  |

# **Contents:**

### Introduction

Analysis and design objectives, open loop systems, closed loop systems, Block diagram representation, signal flow graph

### **Mathematical Modeling**

Transfer function, Modeling of Mechanical systems, Electrical systems, Fluid systems and Thermal systems

# Time Response

Test input signals, Transient and Steady-state response of First order systems and Second order systems, Pole-zero map, effects of additional poles and zeros on the system response, Stability of Control Systems

# PID Control

Effect of Proportional, Integral and Derivative terms on the system response, PID tuning methods

# **Root Locus Analysis**

Properties of root locus, Transient response design via Gain adjustment, Pole sensitivity

#### **State-Space Analysis**

State-space representation of transfer functions, Controllability, Observability, Introduction to state feedback control, Optimal control and Adaptive control

| Reco                | Recommended Books   |  |  |  |  |  |  |
|---------------------|---|--|--|--|--|--|--|
| A) T                | ext Books   |  |  |  |  |  |  |
| 1                   | Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall, Latest Edition.                                       |  |  |  |  |  |  |
| 2                   | Norman S. Nise, "Control Systems Engineering", John Wiley & Sons, Latest Edition.                                   |  |  |  |  |  |  |
| <b>B</b> ) <b>R</b> | eference Books  |  |  |  |  |  |  |
| 1                   | Gene F. Franklin, J. Da Powell, Abbas Emami-Naeini, "Feedback Control of Dynamic Systems", Pearson, Latest Edition. |  |  |  |  |  |  |
| 2                   | Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Prentice Hall, Latest Edition.                      |  |  |  |  |  |  |
|                     |   |  |  |  |  |  |  |

| <u>Approval</u> : | Board of Studies                |
|-------------------|---------------------------------|
|                   | Board of Faculty of Engineering |
|                   | Academic Council                |

| :Res.No.25.3.1 |  |
|----------------|--|
| :Res.No.33.08  |  |
| :Res.No.92.10  |  |

| Title of Subject | : | MANUFACTURING P          | MANUFACTURING PROCESSES |                     |                    |  |  |
|------------------|---|--------------------------|-------------------------|---------------------|--------------------|--|--|
| Course Code      | : | (ME 462)                 |                         |                     |                    |  |  |
| Semester         | : | SEVENTH                  | Year                    | : F                 | OURTH              |  |  |
| Discipline       | : | MECHANICAL               |                         |                     |                    |  |  |
| Effective        | : | 17 Batch and onwards     |                         |                     |                    |  |  |
| Pre-requisite    | : | Engineering Materials (M | IE 121), Worksh         | hop Prac            | tice (ME 141)      |  |  |
| Co-requisite     | : |                          |                         |                     |                    |  |  |
|                  |   | Theory                   | P                       | Practical           |                    |  |  |
| Assessment       |   | 20% Sessional Work,      | 40                      | 40% Sessional Work, |                    |  |  |
| Assessment       |   | 20% Mid Semester Exam    | ination                 |                     | -                  |  |  |
|                  |   | 60% Final Written Exan   | nination 60             | 0% Fina             | l Lab. Examination |  |  |
| Credit Hours     | : | <b>Theory</b> 0          | )3 <b>P</b>             | Practica            | 01                 |  |  |
| Marks            | : | Theory 1                 | 00 P                    | Practica            | 50                 |  |  |

After Completing the "Manufacturing Process" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain      | Taxonomy<br>Level | PLO |
|------------|---|-------------|-------------------|-----|
| 1.         | Comprehend various manufacturing processes, understanding their<br>key characteristics and parameters needed in the selection of<br>appropriate manufacturing process to meet desired needs<br>Comprehend the use of computers in manufacturing | Cognitive   | 2                 | 1   |
| 2.         | Investigate characteristics of major material removal processes and<br>determine relevant quantities such as forces, energy, power,<br>temperature, machining time and material removal rate.   | Cognitive   | 3                 | 2   |
| 3.         | Basic skill to perform following processes under guided instructions<br>and supervision, machining, casting, metal forming and joining.   | Psychomotor | 3                 | 3   |

# RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):

### The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            | $\checkmark$ | 7  | Environment and Sustainability: |  |
|---|----------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                | $\checkmark$ | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: |              | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |  |

#### **Contents:**

**Material Removal Processes:** Single point tool, cutting tool geometry, mechanics of machining, chip formation and types of chips, oblique and orthogonal machining, forces, energy, power and temperature in machining, tool failure, cutting fluids, cutting tool materials and their characteristics, determination of machining time and material removal rate. Computer numerical control system (CNC).

Abrasive Machining: Abrasives, dressing, truing and balancing of grinding wheel.

Non-Traditional Machining (NTM) Processes: Chemical machining (CHM), electrochemical machining process (ECM), water jet machining (WJM), Ultrasonic Machining, and electrical discharge machining (EDM).

**Metal Casting:** Sand casting, making of sand molds, pattern and core making, Investment casting, die casting, hot and cold chamber processes, inspection, cleaning and finishing of castings.

Metal Forming: Rolling, forging, extrusion and drawing.

**Plastic Forming and Shaping:** Blow molding, compression molding, transfer molding, injection molding and extrusion.

**Powder Metallurgy:** Basic process, production of metal powder, powder mixing and blending, compaction, sintering and secondary operations, advantages and limitations of powder metallurgy.

**Joining Processes:** Welding and classification of welding processes, oxyacetylene gas welding (OAW), shielded metal arc welding (SMAW), designation system for arc welding electrode, resistance spot welding (RSW), laser beam welding (LBW), brazing, and soldering.

Regenerative Manufacturing: Introduction to rapid prototyping and methods of rapid prototyping

Work-holding Devices: Standard parts of a work-holder, general selection and design criteria of work-holders. Limits and Fits: Standardization and interchangeability, limits and fits, standard systems of limits and fits.

| Reco  | Recommended Books  |  |  |  |  |  |  |  |
|-------|--|--|--|--|--|--|--|--|
| A) To | ext Books  |  |  |  |  |  |  |  |
| 1     | Mikell P. Groover, "Fundamentals of Modern Manufacturing: materials, processes, and systems", John Wiley & Sons, Inc., Latest Edition. |  |  |  |  |  |  |  |
| 2     | J T Black; R A Kohser, "Materials and Processes in Manufacturing", John Wiley & Sons, Latest Edition.                                  |  |  |  |  |  |  |  |
| 3     | SeropeKalpakjian, "Manufacturing Engineering and Technology", Pearson Education India, Latest Edition.                                 |  |  |  |  |  |  |  |
| B) R  | B) Reference Books   |  |  |  |  |  |  |  |
| 1     | SeropeKalpakjian, and Steven Schmid, "Manufacturing Processes for Engineering Materials" Pearson, Prentice Hill, Latest Edition.       |  |  |  |  |  |  |  |
| 2     | John A Schey, "Introduction to Manufacturing processes", McGraw-Hill, Latest Edition.  |  |  |  |  |  |  |  |
| 3     | P.C. Sharma, "A Text Book of Production Engineering", S. Chand & Company, Latest Edition.  |  |  |  |  |  |  |  |

Approval:Board of StudiesBoard of Faculty of EngineeringAcademic Council

:Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10

| Title of Subject | : | THERMAL POWER P  | THERMAL POWER PLANTS |       |        |  |  |  |
|------------------|---|--|----------------------|-------|--------|--|--|--|
| Course Code      | : | (ME 442)   |                      |       |        |  |  |  |
| Semester         | : | SEVENTH  | Year                 | :     | FOURTH |  |  |  |
| Discipline       | : | MECHANICAL   |                      |       |        |  |  |  |
| Effective        | : | 17 Batch and onwards   |                      |       |        |  |  |  |
|                  |   | Thermodynamics-I (ME 221), Thermodynamics – II (ME 241), Engineering |                      |       |        |  |  |  |
| r re-requisite   | · | Management and Economics; Safety, Health and Environment             |                      |       |        |  |  |  |
| Co-requisite     | : | Automobile Engineering   |                      |       |        |  |  |  |
|                  |   | Theory   | P                    | racti | cal    |  |  |  |
| Assessment       |   | 20% Sessional Work,  |                      |       |        |  |  |  |
| Assessment       |   | 20% Mid Semester Exam  | ination              |       |        |  |  |  |
|                  |   | 60% Final Written Exar   | nination             |       |        |  |  |  |
| Credit Hours     | : | Theory 03 Practical 0  |                      |       | cal 0  |  |  |  |
| Marks            | : | Theory 1   | 00 P                 | racti | cal 0  |  |  |  |

After Completing the "Thermal Power Plansts" Course, each student will be able to:

| Sr.<br>No. | CLO  | Domain    | Taxonomy<br>Level | PLO |
|------------|--|-----------|-------------------|-----|
| 1.         | Illustrate the construction and operation of different components of<br>thermal power plants. Analyze the performance of various<br>components or systems of thermal power plants. | Cognitive | 4                 | 2   |
| 2.         | Design the major components or systems of thermal power plants.  | Cognitive | 5                 | 3   |
| 4.         | Evaluate various economic and environmental aspects of thermal power plants.   | Cognitive | 6                 | 7   |

#### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):** The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge               |              | 7  | Environment and Sustainability: |  |
|---|-------------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                   |              | 8  | Ethics:                         |  |
| 3 | Design/Development of<br>Solutions: | $\checkmark$ | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                      |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:                  |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:            |              | 12 | Lifelong Learning:              |  |

#### **Contents:**

Introduction: Importance of power plants, energy sources, energy conversion systems, Types of power plants., Steam Power Plant: Basic and modified power cycle components and analyses, Layout and operation of steam power plant, site selection criterion, Fuelhandling, Combustion and firing methods for different fuels, clean-coal technologies, Ash handling.

**Gas Turbine Power Plant:** Basic power cycle components and analyses, regeneration and modifications, site selection criterion, combustion equipment and firing methods.

**Diesel Engine Power Plant:** Types of diesel engine power plants, generallayout, site selection criterion, and performance characteristics.

**Combined Cycle Power Plant:** Basic concepts, *types* and benefits, binary vaporcycles, combined gassteam power plant, integrated gasification combined cycle power plant. **Cogeneration:** Basic concepts of cogeneration, benefits, balance of energydemand, types of prime movers, micro-cogeneration units.

**Nuclear Power Plant:** Nuclear fuels: fundamentals and nuclear reaction types, components of nuclear power plant, parts of a nuclear reactor, types of reactors, site selection criterion, safety operation of power plant.

Economics of Power Plants: Terms and definitions, Load curves, Cost analysis, Economics in plant selection, Energy rates.

Pollution and Its Control: Emissions and radioactive wastes from thermal power plants and their control, Thermal pollution.

| Rec          | Recommended Books   |  |  |  |  |  |  |  |
|--------------|---|--|--|--|--|--|--|--|
| A) '         | A) Text Books   |  |  |  |  |  |  |  |
| 1            | Black & Veatch, "Power Plant Engineering", CBS Publishers & Distributors, Latest Edition.                                   |  |  |  |  |  |  |  |
| 2            | Larry Drbal, Pat Boston, "Power Plant Engineering", CBS Publishers, Latest Edition.   |  |  |  |  |  |  |  |
| 3            | El-Wakil M.M, "Power Plant Technology", McGraw-Hill Education, Latest Edition   |  |  |  |  |  |  |  |
| <b>B</b> ) I | Reference Books   |  |  |  |  |  |  |  |
| 1            | I. Dincer, C. Zamfirescu, Advanced Power generation systems, Elseveir, Latest Edition                                       |  |  |  |  |  |  |  |
| 2            | Thomas Elliott, Kao Chen, Robert Swanekamp, "Standard Handbook of Power Plant Engineering",<br>McGraw-Hill, Latest Edition. |  |  |  |  |  |  |  |
| 2            | Uqaili, M A and Harijan, K,, Energy, Environment & Sustainable Development, Springer, Latest Edition.                       |  |  |  |  |  |  |  |

| Approval: | Board of Studies                |
|-----------|---------------------------------|
|           | Board of Faculty of Engineering |
|           | Academic Council                |

:Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10

| Title of Subject |   | DDOIECT / THESIS I   |      |        |          |
|------------------|---|----------------------|------|--------|----------|
| The of Subject   | ÷ | FROJECT / THESIS-I   |      |        |          |
| Course Code      | : | (ME 498)             |      |        |          |
| Semester         | : | SEVENTH              | Year | : :    | FOURTH   |
| Discipline       | : | MECHANICAL           |      |        |          |
| Effective        | : | 17 Batch and onwards |      |        |          |
| Pre-requisite    | : |                      |      |        |          |
| Co-requisite     | : |                      |      |        |          |
|                  | : | Theory               |      | Practi | cal      |
| Assessment       |   |                      |      |        |          |
| Credit Hours     | : | Theory 0             | 0    | Pract  | ical 03  |
| Marks            | : | Theory 0             | 0    | Pract  | ical 100 |

After Completing the "PROJECT / THESIS –I"Course, each student will be able to following program learning outcomes:

After Completing the "Entrepreneurship & Engineering Management" Course, each student will be able to:

| Sr.<br>No. | Rubrics   | Domain    | Taxonomy<br>Level | PLO          |
|------------|---|-----------|-------------------|--------------|
| 1.         | Literature Review and formulating the problem statement and setting the objectives/ goals | Cognitive | 3                 | 2            |
| 2.         | Devise the methodology for achieving the objectives. activities                           | Cognitive | 4                 | 3            |
| 3.         | Conclude the ideas and present the interim report   | Cognitive | 4                 | 9,10 &<br>11 |

### **Contents (Area of Study)**

A group students shall select one of the area related to Mechanical Engineering for their Thesis Project.

| Approval: | Board of Studies                | :Res.No.25.3.1 | Dated:17-03-2018  |
|-----------|---------------------------------|----------------|-------------------|
|           | Board of Faculty of Engineering | :Res.No.33.08  | Dated: 29-03-2018 |
|           | Academic Council                | :Res.No.92.10  | Dated:23-04-2018  |

### MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO DEPARTMENT OF MECHANICAL ENGINEERING.

| Title of Subject | : | <b>RENEWABLE AND EMERGING ENERGY TECHNOLOGIES</b> |
|------------------|---|---|
|------------------|---|---|

| Course Code   | : | (ME 452)  |             |                            |                |  |  |  |
|---------------|---|---|-------------|----------------------------|----------------|--|--|--|
| Semester      | : | EIGHTH  | Year        | :                          | FOURTH         |  |  |  |
| Discipline    | : | MECHANICAL  |             |                            |                |  |  |  |
| Effective     | : | 17 Batch and onwards  |             |                            |                |  |  |  |
| Pre-requisite | : | : Thermal Power Plants; Engineering Management and Economics; Sa<br>Health and Environment; Heat and Mass Transfer; Applied Aerodyn |             |                            |                |  |  |  |
| Co-requisite  | : |   |             |                            |                |  |  |  |
|               | : | Theory  | P           | Practical                  |                |  |  |  |
| Assessment    |   | 20% Sessional Work,   | 40          | 40% Sessional Work,        |                |  |  |  |
|               |   | 20% Mid Semester Exam   | ination     | ,                          |                |  |  |  |
|               |   | 60% Final Written Exan  | nination 6  | 60% Final Lab. Examination |                |  |  |  |
| Credit Hours  | : | Theory 03 Practical 01  |             |                            | <b>ical</b> 01 |  |  |  |
| Marks         | : | Theory 10   | 00 <b>F</b> | Pract                      | ical 50        |  |  |  |

After Completing the "Renewable And Emerging Energy Technologies" Course, each student will be able to:

| Sr.<br>No. | CLO  | Domain    | Taxonomy<br>Level | PLO  |
|------------|--|-----------|-------------------|------|
| 1.         | Understand the fundamentals of renewable energy resources and technologies.                                      | Cognitive | 2                 | 1    |
| 2.         | Illustrate the construction and operation of different components of renewable and emerging energy technologies. | Cognitive | 4                 | 2    |
| 3.         | Design and analyze the performance of various renewable and emerging energy technologies.                        | Cognitive | 5                 | 3& 7 |

#### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):** The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge               | <br>7 | Environment and Sustainability: | $\checkmark$ |
|---|-------------------------------------|-------|---------------------------------|--------------|
| 2 | Problem Analysis:                   | <br>8 | Ethics:                         |              |
| 3 | Design/Development of<br>Solutions: | <br>9 | Individual and Team Work:       |              |
| 4 | Investigation:                      | 10    | Communication:                  |              |
| 5 | Modern Tool Usage:                  | 11    | Project Management:             |              |
| 6 | The Engineering Society:            | 12    | Lifelong Learning:              |              |

#### **Contents:**

Introduction: Renewable energy sources, fundamentals, technical and social implications.

**Solar Energy:** Solar radiation and its measurement, solar energy collectors, solar thermal conversion systems, solar photovoltaics, solar cells, storage and applications; economics and environmental aspects.

**Wind Energy:** Basic principle, Site selection, components and classification of WECS, windmills and wind turbines, performance of wind machines, storage and applications; ` and environmental aspects.

**Biomass Energy:** Biomass energy sources, conversion technologies - directcombustion; biogas generation, biogas plants: types, classification and design, biomass gasification, pyrolysis, biofuels; bioenergy storage and applications, economics and environmental aspects.

**Hydropower:** Hydrology, essential elements, classification, site selection, advantages and disadvantages; storage, economics and environmental aspects.

**Ocean Energy:** Ocean thermal energy conversion, energy from tides, components of tidal power plant, energy from ocean waves, wave energy conversion devices, site selection, advantages and limitations; ocean energy storage; economics and environmental aspects<del>.</del>

**Geothermal Energy:** Geothermal sources, hydrothermal resources, hot dryrock resources, magma resources, prime movers of geothermal energy conversion, geothermal energy applications; storage, economics and environmental aspects.

**Emerging Energy Technologies:** Basic physics, chemistry, and engineering of emerging energy technologies, including fuel cells, thermo-electrics, batteries, hydrogen technologies.

| Reco | Recommended Books  |  |  |
|------|--|--|--|
| A) T | ext Books  |  |  |
| 1    | John Twidell& Tony Weir," Renewable Energy Resources", Taylor and Francis, Latest Edition.   |  |  |
| 2    | El-Wakil M.M.," Power Plant Technology", McGraw Hill Education, Latest Edition.  |  |  |
| 3    | Volker Quaschning, Understanding Renewable Energy Systems, Eartscan, Latest Edition.   |  |  |
| 4    | B. K. Hodge, Alternative Energy Systems and Applications, Wiley, Latest Edition  |  |  |
| B) R | eference Books   |  |  |
| 1    | Bent Sorensen," Renewable Energy Conversion, Transmission, and Storage", Academic Press, Latest Edition.                                   |  |  |
| 2    | KaltschmittMartin, Streicher Wolfgang, & Wiese Andreas, Renewable Energy: Technology, Economics and Environment, Springer, Latest Edition. |  |  |
| 3    | Gavin Buxton, Alternative Energy Technologies: An Introduction with Computer Simulations,<br>CRC Press, Latest Edition                     |  |  |
| 4    | Uqaili, M A and Harijan, K, Energy, Environment & Sustainable Development, Springer, Latest Edition.                                       |  |  |
|      |  |  |  |

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|-----------|---------------------------------|----------------|-------------------|
|           | Board of Faculty of Engineering | :Res.No.33.08  | Dated: 29-03-2018 |
|           | Academic Council                | :Res.No.92.10  | Dated:23-04-2018  |

| Title of Subject | :         | MAINTENANCE ENG                 | MAINTENANCE ENGINEERING |       |       |  |  |  |  |
|------------------|-----------|---------------------------------|-------------------------|-------|-------|--|--|--|--|
| Course Code      | :         | (ME 472)                        |                         |       |       |  |  |  |  |
| Semester         | :         | EIGHT                           | EIGHT Year : FOURTH     |       |       |  |  |  |  |
| Discipline       | :         | MECHANICAL                      |                         |       |       |  |  |  |  |
| Effective        | :         | 17 Batch and onwards            |                         |       |       |  |  |  |  |
| Pre-requisite    | :         | Mechanical Vibrations (ME 381). |                         |       |       |  |  |  |  |
| Co-requisite     | :         |                                 |                         |       |       |  |  |  |  |
|                  | :         | Theory                          | P                       | racti | cal   |  |  |  |  |
| Assessment       |           | 20% Sessional Work,             |                         | ,     |       |  |  |  |  |
|                  |           | 20% Mid Semester Exam           | ination                 | ,     |       |  |  |  |  |
|                  | 60% Final |                                 |                         | ,     |       |  |  |  |  |
| Credit Hours     | :         | <b>Theory</b> 0                 | 2 P                     | racti | cal 0 |  |  |  |  |
| Marks            | :         | Theory 5                        | 0 <b>P</b>              | racti | cal 0 |  |  |  |  |

After Completing the "Maintenance Engineering" Course, each student will be able to:

| Sr.<br>No. | CLO   | Domain    | Taxonomy<br>Level | PLO |
|------------|---|-----------|-------------------|-----|
| 1.         | Develop preventive maintenance plan for an organization.                          | Cognitive | 5                 | 03  |
| 2.         | Describe the routine maintenance of selected mechanical and electrical equipment. | Cognitive | 2                 | 01  |

#### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):** The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge               |              | 7  | Environment and Sustainability: |  |
|---|-------------------------------------|--------------|----|---------------------------------|--|
| 2 | Problem Analysis:                   |              | 8  | Ethics:                         |  |
| 3 | Design/Development of<br>Solutions: | $\checkmark$ | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                      |              | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:                  |              | 11 | Project Management:             |  |
| 6 | The Engineering Society:            |              | 12 | Lifelong Learning:              |  |

#### **Contents:**

Theory Practice Maintenance Engineering: Introduction, of and of principles organization, primary and secondary functions, policies for the operation of maintenance organization / department (work allocation, interplant relations, control, centralization and decentralization, communication and cost control)

**Preventive Maintenance (PM):** How to design PM program, how to start PM program, what to inspect for PM (inspection), major benefits of PM, equipment repair history, corrosion control and industrial chemical cleaning.

Lubrication: Conventionaltests for lubrication and major benefits of lubrications.

Maintenance of Mechanical Equipment: Maintenance of bearings, couplings, power transmission, gear drives, cranes, clutches and brakes.

Maintenance of major Electrical Equipment: Maintenance of electric motors and industrial batteries.

| Reco | Recommended Books   |  |  |
|------|---|--|--|
| A) 1 | Sext Books  |  |  |
| 1    | P.E. Lindley, R. Higgin, "Maintenance Engineering Handbook", McGraw Hill, Latest Edition.   |  |  |
| B) R | Reference Books   |  |  |
| 1    | Jeffrey A. Clade & Michael Brumbach, "Industrial Maintenance", Thomson Delmar Learning, Latest Edition.                                   |  |  |
| 2    | B.S Dhillon, "Engineering Maintenance: A Modern Approach", Tayler & Francis, Latest Edition.  |  |  |
| 3    | Joel Levitt, "Complete Guide to Preventive and Predictive Maintenance", Library of Congress Latest Edition.                               |  |  |
| 4    | R. Keith Mobley, "Maintenance Fundamentals (Plant Engineering Maintenance Series)", EL series<br>Butterworth – Heinemann, Latest Edition. |  |  |
| 5    | Richard D. Palmer, "Maintenance Planning and Scheduling Handbook" McGraw Hill, Latest Edition.  |  |  |

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|-------------------|---------------------------------|----------------|-------------------|
|                   | Board of Faculty of Engineering | :Res.No.33.08  | Dated: 29-03-2018 |
|                   | Academic Council                | :Res.No.92.10  | Dated:23-04-2018  |

| Title of Subject | : | PROJECT MANAGEM  | PROJECT MANAGEMENT & OPTIMIZATION |        |               |  |  |  |
|------------------|---|--|-----------------------------------|--------|---------------|--|--|--|
| Course Code      | : | (ME 482)   |                                   |        |               |  |  |  |
| Semester         | : | EIGTH  | Year                              | :      | FOURTH        |  |  |  |
| Discipline       | : | MECHANICAL   |                                   |        |               |  |  |  |
| Effective        | : | 17 Batch and onwards   |                                   |        |               |  |  |  |
| Pre-requisite    | : |  |                                   |        |               |  |  |  |
| Co-requisite     | : |  |                                   |        |               |  |  |  |
|                  | : | Theory   | P                                 | ractio | cal           |  |  |  |
| Assessment       |   | <ul><li>20% Sessional Work,</li><li>20% Mid Semester Exam</li><li>60% Final Written Exam</li></ul> | ination                           |        |               |  |  |  |
| Credit Hours     | : | <b>Theory</b> 0  | )3 P                              | Practi | <b>cal</b> 00 |  |  |  |
| Marks            | : | Theory 1   | 00 P                              | Practi | <b>cal</b> 00 |  |  |  |

After Completing the "Project Management & Optimization" Course, each student will be able to:

| Sr.<br>No. | CLO  | Domain    | Taxonomy<br>Level | PLO      |
|------------|--|-----------|-------------------|----------|
| 1.         | Acquaintance with knowledge areas of project management                    | Cognitive | 2                 | 1& 10    |
| 2.         | Manage projects successfully and apply modern tools of project management. | Cognitive | 3                 | 2, 3& 11 |

#### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):** The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            |   | 7  | Environment and Sustainability: |  |
|---|----------------------------------|---|----|---------------------------------|--|
| 2 | Problem Analysis:                |   | 8  | Ethics:                         |  |
| 3 | Design/Development of Solutions: | V | 9  | Individual and Team Work:       |  |
| 4 | Investigation:                   |   | 10 | Communication:                  |  |
| 5 | Modern Tool Usage:               |   | 11 | Project Management:             |  |
| 6 | The Engineering Society:         |   | 12 | Lifelong Learning:              |  |

### **Contents:**

**INTRODUCTION:** Introduction to Project and project management. Project lifecycle. Project management knowledge areas. Significance and need of project management. Project management organization types. **PROJECT INITIATION PHASE:** Defining project goals, objectives and scope. Creating work breakdown (WBS) and organizational breakdown structures (OBS). Establishing project priorities.

**PROJECT PLANNING PHASE**: Scheduling Techniques: Gantt/ Bar chart. Network fundamentals. Critical path method (CPM), Program evaluation and review techniques (PERT), Precedence diagram Method (PDM), Graphical evaluation and review technique (GERT). Estimation techniques: cost estimation. Time estimation. Resources Management. Risk Management.

**<u>PROJECT EXECUTION PHASE</u>**: Monitoring progress. Creating a monitoring system. Status reporting, Controlling project duration. Resource Leveling, creating project baseline plan. Measuring performance. Comparing planned and actual performance. Taking actions for control.

**PROJECT CLOSING PHASE:** preparing for transfer of control and authority. Customer training, releasing resources, evaluation.

**OPTIMIZATION:** Introduction to optimization theory, overview of optimization techniques, liner programming, applications of linear programming to project planning and control, project resources optimization.

| Reco                | Recommended Books  |  |  |  |  |
|---------------------|--|--|--|--|--|
| A) T                | ext Books  |  |  |  |  |
| 1                   | Erik W. Larson & Clifford F.Gray, 'Project management: the managerial Process' Mcgraw- Hill Irwin. |  |  |  |  |
|                     | Latest Edition,  |  |  |  |  |
| 2                   | Harold Kerzner, ' Project Management, A system approach to planning, scheduling and controlling'.  |  |  |  |  |
|                     | Paramount, Latest Edition,   |  |  |  |  |
| <b>B</b> ) <b>R</b> | eference Books   |  |  |  |  |
| 1                   | Hamdy A. Taha, Operations Research An Introduction' Pearson Prentice Hall. Latest edition          |  |  |  |  |

| <u>Approval</u> : | Board of Studies                |
|-------------------|---------------------------------|
|                   | Board of Faculty of Engineering |
|                   | Academic Council                |

:Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10

| Title of Subject | :         | AUTOMOBILE ENGINEERING            |                      |                            |               |  |  |  |
|------------------|-----------|-----------------------------------|----------------------|----------------------------|---------------|--|--|--|
| Course Code      | :         | (ME 412)                          |                      |                            |               |  |  |  |
| Semester         | :         | EIGHTH                            | Year                 | :                          | FOURTH        |  |  |  |
| Discipline       | :         | MECHANICAL                        |                      |                            |               |  |  |  |
| Effective        | :         | 17 Batch and onwards              |                      |                            |               |  |  |  |
| Pre-requisite    | :         | Mechanics of Machines II (ME 261) |                      |                            |               |  |  |  |
| Co-requisite     | :         |                                   |                      |                            |               |  |  |  |
|                  | :         | Theory                            | P                    | Practical                  |               |  |  |  |
| Assessment       | sment 20% |                                   | 40                   | 40% Sessional Work,        |               |  |  |  |
| Assessment       |           |                                   | ination              | ,                          |               |  |  |  |
|                  |           | 60% Final Written Exan            | nination 6           | 60% Final Lab. Examination |               |  |  |  |
| Credit Hours     | :         | <b>Theory</b> 0                   | 3 <b>P</b>           | Practic                    | <b>cal</b> 01 |  |  |  |
| Marks            | :         | Theory 10                         | Theory100Practical50 |                            |               |  |  |  |

After Completing the "Automobile Engineering" Course, each student will be able to:

| Sr.<br>No. | CLO  | Domain      | Taxonomy<br>Level | PLO   |
|------------|--|-------------|-------------------|-------|
| 1.         | Identify various parts of automobile and explain the working of<br>engine, transmission, clutch, brakes, steering, and the suspension<br>system. | Cognitive   | 4                 | 2 & 4 |
| 2.         | Understand the environmental implications of automobile emissions.   | Cognitive   | 2                 | 6&7   |
| 3.         | Develop strong base for understanding future developments in the automobile industry.  | Cognitive   | 5                 | 12    |
| 4.         | Demonstrate the functions of various automobile systems  | psychomotor | 3                 | 2     |

# RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):

# The course is designed so that students will achieve the following PLOs:

| 1 | Engineering Knowledge            |              | 7  | Environment and Sustainability: | $\checkmark$ |
|---|----------------------------------|--------------|----|---------------------------------|--------------|
| 2 | Problem Analysis:                | $\checkmark$ | 8  | Ethics:                         |              |
| 3 | Design/Development of Solutions: |              | 9  | Individual and Team Work:       |              |
| 4 | Investigation:                   |              | 10 | Communication:                  |              |
| 5 | Modern Tool Usage:               |              | 11 | Project Management:             |              |
| 6 | The Engineering Society:         |              | 12 | Lifelong Learning:              |              |

### **Contents:**

Introduction and History: Types of automobiles, classification of automobiles, systems in an automobile.

Chassis and body: Body, chassis frame, parts of automobile body.

*Power unit:* All engine components' cylinder heads, cylinder block, piston, piston rings, connecting rod, crank shaft, valve and valve activating mechanisms, combustion chambers, multi cylinder engines, engine balance, firing order brief discussion of testing devices, engine tuning.

*Engine Ignition System:* Carburetor and EFI system, diesel fuel pump, atomizer and spark plug, preignition, knocking and detonation.

Electrical System: Generator circuit and need for cut-out, starting with solenoid and overrunning clutch,

lighting points in a passenger car, circuits for flashers, horn, wind screen wiper, fuel level indicator, speedometer.

*Transmission System Gear Box:* Tractive effort, types of gear boxes, over drive, Electronic Transmission, Controls, Clutch-Functions of clutches, Single and multi-plate clutch, Construction of friction disc, wet and Cone clutches, other types of clutches. Propeller shafts- torque tube drive, four wheel drive arrangement., Different gear box.

*Braking Systems*: Principle of operation, Theory of leading and trailing shoes, Brake effectiveness, constructional classification, parking brakes, ABS brake system.

*Steering System:* Principles and need of steering, components parts, steering gear, steering ratio, Steering lock, turning radius, Centre point, wheel geometry, power steering principle and typical schemes, Front axle scheme and end connections, rear axle, functions, types of rear axle, loads on rear axles, axle casing.

*Suspension System*: Functions of suspension, component parts, coil springs, leaf springs, air springs, shock absorbers, torsion bars, stabilizer bars, typical combinations of components in suspension systems, Hotchkiss Drive-design considerations.

*Wheel and Tyres:* Wheel assembly and parts, wheel rim, Tyres, aspect ratio, tyres with tubes and tubeless tyres, advantages, construction of a tyre, plies, radial plies, tyre treads and tyre specifications.

*Emissions and Control: E*missions and their effects, pollution control measures, exhaust system layout, mufflers and resonators, cyaniding, nitriding, decarbonization.

Engine cooling systems: Cooling system pump, radiator and air fan.

*Engine oiling systems:* Oiling system pump and oil flow paths.

#### **Recommended Books**

| <b>A</b> ) '       | A) Text Books   |  |  |  |  |
|--------------------|---|--|--|--|--|
| 1                  | Kamaraju Ramakrishna, "Automobile Engineering", PHI Learning, New Delhi, Latest Edition.                |  |  |  |  |
| 2                  | Jain &Asthana, "Automobile Engineering", Tata McGraw-Hill, New Delhi, Latest Edition.                   |  |  |  |  |
| 3                  | Dr. Kirpal Singh, —Automobile Engineering  , Vol. I & II, Standard Publishers New Delhi Latest Edition. |  |  |  |  |
| B) Reference Books |   |  |  |  |  |
| 1                  | Heinz Heisler, "Advanced Vehicle Technology", Elsevier, New Delhi, Latest Edition                       |  |  |  |  |
| 2                  | Crouse & Anglin, "Automotive Mechanics", Tata McGraw Hill, New Delhi, Latest Edition.                   |  |  |  |  |
| 3                  | R. K. Rajput — Automobile Engineering", PHI Learning Pvt. Ltd., Latest Edition.                         |  |  |  |  |

# Approval:Board of StudiesBoard of Faculty of EngineeringAcademic Council

:Res.No.25.3.1 :Res.No.33.08 :Res.No.92.10

| Title of Subject | : | PROJECT / THESIS-I   | [                    |         |                |  |
|------------------|---|----------------------|----------------------|---------|----------------|--|
| Course Code      | : | (ME 499)             |                      |         |                |  |
| Semester         | : | EIGHTH               | EIGHTH Year : FOURTH |         |                |  |
| Discipline       | : | MECHANICAL           |                      |         |                |  |
| Effective        | : | 17 Batch and onwards | 17 Batch and onwards |         |                |  |
| Pre-requisite    | : |                      |                      |         |                |  |
| Co-requisite     | : |                      |                      |         |                |  |
|                  | : | Theory               | ]                    | Practio | cal            |  |
| Assessment       |   |                      |                      |         |                |  |
| Credit Hours     | : | <b>Theory</b> 0      | 0                    | Practi  | <b>cal</b> 03  |  |
| Marks            | : | Theory (             | 0                    | Practi  | <b>cal</b> 100 |  |

After Completing the "Project / Thesis –II" Course, each student will be able to following program learning outcomes:

| Sr.<br>No. | Rubrics   | Domain      | Taxonomy<br>Level | PLO           |
|------------|---|-------------|-------------------|---------------|
| 1.         | Conduct experiments/ simulation/ study and obtain data. | Psychomotor | 4                 | 5& 9          |
| 2.         | Analyze the data and generate the results.              | Cognitive   | 4                 | 4             |
| 3.         | Report writing and interpret the results.               | Cognitive   | 5                 | 8,9,10<br>&11 |
|            | Project presentation and defend the outcomes            | Affective   | 3                 | 5,9,10        |

# **Contents (Area of Study)**

A group students shall select one of the area related to Mechanical Engineering for their Thesis Project.

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