# DEPARTMENT OF MECHANICAL ENGINEERING

***PAKISTAN INSTITUTE OF ENGINEERING AND APPLIED SCIENCES (PIEAS)***
***NILORE, ISLAMABAD***


Curriculum
for
Bachelor of Science
in
Mechanical Engineering

(Rev. 2013)

# CONTENTS

# BS Mechanical Engineering

## PROGRAM SUMMARY

## SEMESTER DURATION

| | |
|---|---|
| Fall Semester | (16 weeks study + 2 weeks sessional exam + 2 weeks final exam) |
| Spring Semester | (16 weeks study + 2 weeks sessional exam + 2 weeks final exam) |
| Summer and Winter Vacations | 12 weeks |

## ELIGIBILITY

- Intermediate / A-level (with majors courses: Physics, Chemistry and Mathematics)
- At least 65% in SSC Examination / Matriculation / O-level
- At least 60% marks (1st Division) in HSSC Examination / Intermediate / A-level

## SALIENT FEATURES

| | |
|---|---|
| Duration: | **4 Years** |
| Number of semesters: | **8** |
| Number of weeks per semester: | **18** |
| Total number of credit hours: | **137** |
| Total number of courses: | **47** |
| Percentage of engineering courses: | **70.8 %** |
| Percentage of non-engineering courses: | **29.2 %** |

## BASIS

The entire curriculum has been designed on the following lines:

1. It is based on the concept of foundation, breadth and depth courses so that streams for different specializations can be created.
2. Foundation Courses: The foundation courses are the courses that all students must take. These courses provide students with the fundamental concepts and tools to pursue their studies at the higher level.
3. Breadth Courses: The breadth courses introduce students to different specialties of the discipline.
4. Depth Courses: The depth courses offer specialization within a field of the given engineering discipline.
5. All courses are also identified as engineering or non-engineering.

# LEARNING OUTCOMES

After successful completion of the course:

## General

a. They should develop well-rounded personalities with initiative and resourcefulness.
b. They should be conscious of the values of the society in which they will live and work.
c. They should have an awareness of the social, national and global context in which their professional work is to be done.
d. They should have excellent communication skills with abilities that enable them to fluently express themselves in writing as well as orally.
e. They should have the knowledge and skills to harness conventional and digital sources of information with ease.
f. They should have the ability to provide leadership and to work with others in team-work.
g. They should be fully aware of academic and professional ethics and be motivated to work in conformity with their demands.
h. They should have a well-developed curiosity that motivates them to continue the process of learning even after completing their formal education.
i. They should be adequately prepared for assuming professional responsibilities.

## Academic Field Related

a. They should be proficient in all the core areas that comprise the academic field.
b. They should have the ability to apply the knowledge of one or more specialized areas of the field in greater depth.
c. They should be able to apply basic principles and practices to identify, formulate, and solve substantive problems in the field.
d. They should be proficient in the use of computers and modern design tools to develop and implement solutions to problems.
e. They should have the ability to conduct experiments and to analyze and interpret experimental data.
f. They should be able to conduct investigative and research projects.

# COURSE CODING

| (Each course has been assigned a code XX-YSN or XXX-YSN according to the following scheme) | |
|---|---|
| Where XX or XXX indicates department offering the course: | |
| ME | Mechanical Engineering |
| EE | Electrical Engineering |
| PAM | Physics and Applied Mathematics |
| CMS | Communication and Management Sciences |
| CME | Chemical and Materials Engineering |
| MME | Materials and Metallurgical Engineering |
| Y indicates Year of study (first, second, third, final) | |
| SN is Serial Number assigned to the course | |

## List of Courses
## Non-Engineering Domain

| Knowledge Area | Sub Area | Course Code | Name of Course | Lec CH | Lab CH | Credit Hours |
|---|---|---|---|---|---|---|
| Humanities | English | CMS-104 | Composition & Grammar | 2 | 0 | 2 |
| | | CMS-105 | Communication Skills | 3 | 0 | 3 |
| | | CMS-106 | Technical Writing | 3 | 0 | 3 |
| | Culture | CMS-101 | Islamic Studies / Ethics | 2 | 0 | 2 |
| | | CMS-103 | Pakistan Studies | 2 | 0 | 2 |
| | Social Science | CMS-109 | Entrepreneurship | 2 | 0 | 2 |
| Management Sciences | | CMS-202 | Engineering Economics | 2 | 0 | 2 |
| | | CMS-301 | Principles of Management | 2 | 0 | 2 |
| Natural Sciences | Mathematics | PAM-101 | Calculus – I | 3 | 0 | 3 |
| | | PAM-202 | Calculus – II | 3 | 0 | 3 |
| | | PAM-242 | Linear Algebra | 2 | 0 | 2 |
| | | PAM-255 | Differential Equations | 2 | 0 | 2 |
| | | PAM-360 | Numerical Methods | 3 | 0 | 3 |
| | | PAM-267 | Probability & Statistics | 2 | 0 | 2 |
| | Physics | PAM-131 | Engineering Physics | 3 | 1 | 4 |
| | Chemistry | CME-200 | Applied Chemistry | 2 | 1 | 3 |
| | | | **Total:** | | | **40** |

# List of Courses
# Engineering Domain

| Knowledge Area | Status | Course Code | Name of Course | Lec CH | Lab CH | Credit Hours |
|---|---|---|---|---|---|---|
| Computing | Compulsory | EE-101 | Computer Fundamentals | 2 | 1 | 3 |
| Engineering Foundation | | ME-101 | Engineering Drawing & Graphics | 2 | 2 | 4 |
| | | ME-102 | Engineering Mechanics – I (Statics) | 3 | 0 | 3 |
| | | ME-103 | Workshop Practice | 0 | 2 | 2 |
| | | ME-201 | Engineering Mechanics – II (Dynamics) | 3 | 1 | 4 |
| | | ME-201 | Thermodynamics – I | 3 | 0 | 3 |
| | | ME-205 | Mechanics of Materials – I | 3 | 0 | 3 |
| | | ME-206 | Fluid Mechanics – I | 3 | 0 | 3 |
| | | ME-302 | Mechanics of Machines | 3 | 1 | 4 |
| | | ME-303 | Manufacturing Processes – I | 3 | 0 | 3 |
| | | ME-308 | Measurements & Instrumentation | 2 | 1 | 3 |
| Major Based Core (Breadth) | | ME-207 | Thermodynamics – II | 3 | 1 | 4 |
| | | ME-301 | Fluid Mechanics – II | 2 | 1 | 3 |
| | | ME-305 | Mechanics of Materials – II | 3 | 1 | 4 |
| | | ME-315 | Machine Design & CAD – I | 2 | 1 | 3 |
| | | ME-316 | Machine Design & CAD – II | 3 | 1 | 4 |
| | | ME-403 | Heat Transfer | 3 | 1 | 4 |
| | | ME-404 | Mass Transfer | 2 | 0 | 2 |
| Major Based Core (Depth) | | ME-307 | Manufacturing Processes – II | 3 | 0 | 3 |
| | | ME-312 | Refrigeration & Air conditioning | 2 | 1 | 3 |
| | | ME-405 | Mechanical Vibrations | 2 | 1 | 3 |
| | | ME-411 | Power Plants | 2 | 0 | 2 |
| | | ME-412 | Internal Combustion Engines | 3 | 0 | 3 |
| | Electives | ME-406 | Total Quality Management | 2 | 0 | 2 |
| | | ME-413 | Renewable Energy Resources | 2 | 0 | 2 |
| | | ME-414 | Finite Element Method | 3 | 0 | 3 |
| | | ME-415 | Mechanical Engg Design & Analysis | 3 | 0 | 3 |
| | | ME-416 | Tribology | 3 | 0 | 3 |
| | | ME-417 | Aerodynamics | 3 | 0 | 3 |
| | | ME-418 | Gas Dynamics | 3 | 0 | 3 |
| | | ME-419 | Computational Fluid Dynamics | 3 | 0 | 3 |
| Inter-Disciplinary Engineering | | EE-402 | Applications of Micro-Controllers in Mechanical Engineering | 2 | 1 | 3 |
| | Compulsory | MME-203 | Introduction to Engineering Materials | 3 | 0 | 3 |
| | | EE-151 | Electrical Engineering | 2 | 1 | 3 |
| | | EE-152 | Electronics | 2 | 1 | 3 |
| | | EE-401 | Control Engineering | 2 | 0 | 2 |
| Senior Design Project | | ME-499 | Design Project | 0 | 3 | 3 |
| | | ME-499 | Design Project | 0 | 3 | 3 |
| Industrial Training | | - | Four – Six Weeks Training | - | - | - |
| | | | **Total:** | | | **97** |

# Course Contents

## HUMANITIES

### CMS-101 ISLAMIC STUDIES

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 2+0 |
| *Prerequisite* | Nil |

Tauheed: Arguments for the existence and oneness of Allah; Purpose of creation; Impact of tauheed on human life. Risalat: Need for prophets; Finality of prophethood; Seerat (The life of the Holy Prophet ﷺ); Khutba Hijjat-ul-Wida; The importance of Sunnah. Aakhirat: The life after death; The day of judgement; The concept of accountability and its impact on daily life. The Holy Quran: Its revelation and compilation; Introduction to Aijaaz-ul-Quran and the principles of Tafseer-ul-Quran; Sura al-Fatiha; 1st Raku of Sura al-Baqarah; Sura Al-Hujraat and lessons from Sura Yaseen. Hadith: Its authenticity and importance; An introduction to Sihah-i-Sitta; Types of Ahadith; Chehal hadith (Forty Ahadith). Ibadah: The concept of Ibadah; Major Ibadaat (Salaat, Saum, Zakat, Hajj and Jihad). Moral, Social and Political Philosophy of Islam: The concept of good and evil; Akhlaq-i-Hasanah, Kasb-i-Hilal; Responsibilities of the head of state; Rights and duties of the citizens. Applications of Islamic teachings to social and economic developments of the modern age such as interest free economy, etc.

*Recommended Text:*

1. Ibn-i-Kasir, *Tafseer Ibn-i-Kasi,* Dar Ibn Hazam, Beirut, Lebanon, 2005.
2. A. B. Baqilani, *Al-Intisaar Lil-Quran,* Dar Ibn Hazam, Beirut, Lebanon, 2005.
3. *Majalisul Abrar* (for forty Ahadith), Mir Muhammad Kutabkhana, Markaz-i-Ilm-o-Adab Karachi, 2005.
4. Imam Nauwwi, *Arbaeen Hadith,* Maulana Manzoor Naumani, *Deen-o-Shariat*, Mir Muhammad Kutabkhana, Markaz-i-Ilm-o-Adab Karachi, 2005.

### CMS-102 ETHICS (FOR NON-MUSLIMS)

| | |
|---|---|
| *Status* | Compulsory (for Non-Muslims) |
| *Credits* | 2+0 |
| *Prerequisite* | Nil |

Ethics; Values; Individualism versus Altruism; Self Interest; Benevolence; Authority versus Freedom; Duty to the State; The Private Domain; The Autonomy of Conscience; Law and Morals; The Need for Enforcement; Social Justice; Individual Liberty; Liberty & Equality; Meta-Ethics and the problem of Justification; Indefinability of Good; Validation and Vindication; Prolegomena to a Theory of the Moral Criterion; Moral and Non-moral Values; First Principles of Axiology; War and Peace; The Golden rule of Ethics; Relationship between religion and ethics; Consideration of religious and ethical perspectives on contemporary issues; Interaction between Religion and Science; Religious understanding of creation and their relationship to scientific views; concepts of miracle; laws of nature; interventions of God; Role of religions as a source of ethical principles; Role of religions as a source of authority and inspiration for faith and practice.

*Recommended Texts:*

1. T. Donaldson, P. Werhane, *Ethical Issues in Business: A Philosophical Approach*, 7th ed, Pearson, 2007, ISBN 0131846191
2. R. Abelson, Marie-Lousie, *Ethics for Modern Life*, 6th ed, St. Martin's Press, 2003, ISBN 0312157614
3. D. Kolak, R. Martin, *Wisdom without Answers*, 5th ed, Wadsworth Publishing Co., 2001, ISBN 0534534651

### CMS-103 PAKISTAN STUDIES

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 2+0 |
| *Prerequisite* | Nil |

Important geological and geographical features of Pakistan; Pakistan's geographical location in a regional and global perspective. Earliest human settlements in Pakistan; The Indus Valley civilization; Aryan settlement and the Gandhara civilization; The advent of Islam in Pakistan; The work of Al-Beruni and early Sufi-savants in Pakistani lands. The British domination and its causes; Brief chronology of the freedom movement; The founding documents of Pakistan including Allama Iqbal's 1930 Allahabad address, the Lahore Resolution of 23rd March 1940, and Quaid-i-Azam's presidential address to the Constituent Assembly of Pakistan. Political and constitutional phases in Pakistan since 1947; Important features of the 1973 constitution and its current status. Current issues in Pakistan including: Administrative infra-structure; Population growth; Water, energy and mineral resources; Agricultural resources and industrial infra-structure; Educational problems; economic growth pattern and budgetary issues; Environmental problems; Foreign policy issues.

*Recommended Texts:*

1. K. A. Saeed, *The Economy of Pakistan, Oxford University Press, Karachi*, 2007.
2. J.Briscoe and U. Qamar, *Pakistan's Water Economy: Running Dry*, Oxford University Press, 2006.
3. J.M. Kenoyer, *Ancient Cities of the Indus Valley Civilization*, Oxford University Press, Karachi, 1998
4. L.A. Sherwani (Editor), Speeches, *Writings and Statements of Iqbal*, Iqbal Academy, Lahore, 1995.
5. *The New Oxford Atlas for Pakistan*, Oxford University Press, Karachi, 1998.
6. *Jinnah: Speeches and Statements 1947-48*, Oxford University Press, Karachi, 2000.

### CMS-104 COMPOSITION AND GRAMMAR

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 2+0 |
| *Prerequisite* | Nil |

Pre-writing techniques (cubing, looping, mind-maps, brainstorming, free-writing, narrowing and Focusing); Audience; Voice; Critical Reading and Analysis; Return to the Modes of Persuasion; Thesis Statements; Outlining and Organizing the Essay; Introductory Paragraphs;

Developing the Essay; Paragraphing; Summary and Paraphrase; Synthesis Essays; Basic Sentence Analysis/Usage; Correct sentences; Paragraph types including exemplification, narration, comparison/contrast, cause/effect, and persuasion; Fallacies in argumentation; Claim, Support, and Warrant; Counterarguments/ Rebuttals; Revision Techniques and Editing; Peer Reviews Grammar: Figure of speech; sentence elements; sentence types; coordination & subordination; verb tenses; sentence types; fragments; run-ons; subject-verb agreement; count/non-count and modals. Mechanics: commas, capitalization and punctuation.

*Recommended Texts:*

1. P. Hartmann, Laurie Blass, *Quest 1 – Reading and Writing,* Second Edition, McGraw-Hill ESL/ELT, 2007, ISBN 0073253022
2. P. Hartmann, Laurie Blass, *Quest 2 – Listening and Speaking*, Second Edition, McGraw-Hill ESL/ELT, 2007, ISBN 0073253305
3. Kolln and Funk, *Understanding English*, 7th ed, 2005, ISBN 0321415639
4. Ellen Balleisen, Susan Kesner Bland, *Intermediate Grammar: From Form to Meaning*, Oxford University Press, USA; Teacher's edition, 1996.

## CMS-105 COMMUNICATION SKILLS

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+0 |
| *Prerequisite* | Nil |

Overview and Importance of Effective Communications; Business Communication and the Ethical Context; Business Communication and the Technology Context; Successful Listening; Communicating in Teams and Mastering Listening and Nonverbal Communication Skills; Strategies for Successful Speaking and Successful Listening; Leading Feel; Logical Fallacies and the Art of Debate; General principles of Communication; The Seven C's of Effective Communication; Format and Layout of Business Documents; Preparing Effective Business Messages; Good News; Bad News and Neutral Messages; Persuasive Written Messages; Writing Resumes and Application Letters; Interviewing for Employment and Following Up; Reports; Proposals and Presentations; Research Process; Communicating Information Through Visuals; Short Reports; Formal Reports; Proposals. Oral Communication; Impromptu & Extempore Talks; Onion Ring Activity; Individual Talks; Meetings and Group Dynamics; Member Roles and Leadership in Groups; Communicating in Teams; Mastering Listening; Nonverbal Communication Skills; Strategies for Business and Group Meetings; Preparation for Presentations; Planning, writing, and Completing Oral Presentations; Strategies for Successful Speaking and Successful Listening.

*Recommended Texts:*

1. J. V. Thill, C. L. Bovee, *Business Communication Today*, Prentice-Hall, 8th Intl. ed, 2004,
2. T. Fulwiler, A.R. Hayakawa, C. Kupper, *The college writer's reference*, Prentice Hall, 1999, ISBN 0130824666
3. H A Murphy, H W Hildebrandt, J P Thomas, *Effective Business Communications*, 8th ed, McGraw-Hill/Irwin, 1997, ISBN 007044398X
4. Corporate Classrooms. *Get a grip on grammar: language skills for today's business world*, Prentice Hall, 1992, ISBN 0130124281

## CMS-106 TECHNICAL WRITING

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+0 |
| *Prerequisite* | Nil |

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

*Recommended Text:*

1. Tech Biz Writing, *"TechBiz Writing Course: A Free Course in Technical and Business Writing which builds gradually into a valuable resource"*, [Online] Available: http://www.techbizwriting.com [Accessed: Mar 11 2008]
2. K R Woolever, *Writing for the Technical Professions*, 4th ed, Longman, 2007, ISBN 0321477472

## CMS-109 ENTREPRENEURSHIP

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 2+0 |
| *Prerequisite* | Nil |

Introduction to Entrepreneurship; Entrepreneurial Process; Business opportunity identification; Market assessment; Financing the emerging firm; new product innovation; technology commercialization; Business plan development; Strategy and entrepreneurship; Managing the growing firm.

*Recommended Texts:*

1. P F Drucker, *Innovation and Entrepreneurship*, 2nd ed, Butterworth-Heinemann, 2007, ISBN 0750685085
2. P Burns, J D Hurst, *Small Business and Entrepreneurship*, Palgrave Macmillan, 2001
3. P. N. Singh, *Entrepreneurship for Economic Growth*, Vikas Publishing, ISBN 0195183517
4. John B. Miner, *Entrepreneurial Success*, Berrett-Koehler Publishers, 1996, ISBN 1881052821

### CMS-202 ENGINEERING ECONOMICS

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 2+0 |
| *Prerequisite* | Nil |

Principles of Engineering Economy; Cost Concepts and Design Economics; Time Value of Money; Applications of Time-Money Relationships (MARR, PW, FW, AW, IRR, ERR and Payback period methods); Comparison Methods; Depreciation; Cost Estimation Techniques; Replacement Analysis; Taxes; Inflation.

*Recommended Texts:*

1. W. G. Sullivan, J. A. Bontadelli and E. M. Wicks, *Engineering Economy*, 14th ed., Prentice Hall Inc., 2000, ISBN 0136142974
2. J. Knutson and I. Bitz, *Project Management: How to Plan and Manage Successful Projects*, American Management Association, 1991, ISBN 0814450431
3. Chan S. Park, and Gunter P. Sharp-Bette, *Advanced Engineering Economics*, 10th ed., John Wiley & Sons Inc., 1990, ISBN 0471799890

### CMS-301 PRINCIPLES OF MANAGEMENT

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 2+0 |
| *Prerequisite* | Nil |

Introduction to Management and Organizations; Organizational Vision, Mission and Strategies; Organizational Culture; Socially Responsible Organizations; Foundations of Planning; Planning Tools and Techniques; Organizational Structure and Design; Human Resource Management; Foundations of Behavior; Leadership and Motivation; Operations and Value Chain Management; Performance Management; Project Portfolio Management System; Project Networks; Scheduling; Resource Allocation and Resource Leveling; Project Execution and Controlling; Introduction to PMBOK.

*Recommended Texts:*

1. C F Gray, E W Larson, *Project Management: The Managerial Process*, Boston: McGraw-Hill/Irwin, 2005, ISBN 0071244466
2. S. P. Robbins, M. Coulter, *Management*, 10th ed, Prentice Hall, 2008, ISBN 0132090716
3. *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, 4th ed, Project Management Institute, ISBN 1933890517

## NATURAL SCIENCES

### PAM-131 ENGINEERING PHYSICS

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+1 |
| *Prerequisite* | Nil |

Measurement, Motion in a plane, forces and equilibrium, Newton's laws, Applications of Newton's law, Rotation, Torque, Rigid bodies and rotational dynamics, Work and potential energy, Collisions and conservation laws, Universal gravitation, Sound waves, Waves & Oscillations, Simple harmonic motion, Wave speed, Energy and power of Traveling waves, Doppler's effect, Nature and propagation of light.

*Recommended Texts:*

1. R Resnik, D Halliday, K S Krane, *Physics, Vol-1&2*, John Wiley & Sons Inc., 2007, ISBN 047004473X
2. R A Serway, *Physics, Vol1, Physics for Scientists & Engineers with Modern Physics*, Saunders College, Publishing, Philadelphia, 2007, ISBN 0495112941
3. H D Young, R A Freedman, T R Sandin, A L Ford, *University Physics*, Addison-Wesley, 2006.

### PAM-101 CALCULUS – I

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+0 |
| *Prerequisite* | Nil |

Functions, Limits and Continuity; Derivatives and its Applications; Rules of Differentiation; Implicit Differentiation; Extreme Values of Functions; Mean Value Theorem; Linearization and Differentials; Newton's Method; Integration and its Applications; Indefinite integrals; Rules of Integration; Riemann Sum; Definite Integrals; Improper Integrals; Integration by Parts; Partial Fractions; Trigonometric Substitution; L Hospital Rule; First Order Differential Equations; Linear Equation with Variable Coefficients; Separable Equations; Exact Equation and Integrating Factor; The Existence and Uniqueness Theorem; Infinite Series; Limits of Sequence of Numbers; Series of Non-negative Terms; Power Series; Taylor and Maclaurin Series; Application of Power Series; Fourier Series; Fourier Cosine and Sine Series.

*Recommended Texts:*

1. G. B. Thomas, R. L. Finney, *Calculus and Analytic Geometry*, AWL, 10th ed, 2002
2. E. Kreyszig, *Advance Engineering Mathematics*, John Wiley and Sons, 9th ed, 2005.
3. W. Kaplan, *Advanced Calculus*, 5th ed, Addison-Wesley, 2002.
4. R. Ellis, D. Gulick, *Calculus: One and Several Variables*, Saunders College Publishing, 1991.

### PAM-202 CALCULUS – II

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+0 |
| *Prerequisite* | PAM-101 |

Infinite Series; Limits of Sequence of Numbers; Series of Non-negative Terms; Power Series; Taylor and Maclaurin Series; Application of Power Series; Fourier Series; Fourier Cosine and Sine Series; Vectors in the Plane and Polar Functions; Dot Products; Vector Valued Functions; Modelling Projectile Motion; Polar Coordinates and Graphs; Calculus of Polar Curves; Vectors and Motion in Space; Cartesian Coordinates and Vectors in Space; Dot and Cross Product; Lines and Plane in Space; Cylinders and Quadric Surfaces; Vector Valued Functions and Space Curves; Arc Length and Unit Tangent Vector; Multivariable Functions and Their Derivatives; Limits and Continuity in Higher Dimensions; Partial Derivatives; The Chain Rule; Linearization and Differentials; Extreme Values and Saddle Points; Lagrange Multiplier; Partial Derivatives with Constrained Variables; Taylor's Formula for Two variables; Multiple Integrals; Double integrals; Areas, Moments and Centre of Mass; Double Integral in Polar and Rectangular Coordinates; Masses and Moments in Three Dimensions; Triple Integrals in Rectangular and Spherical Coordinates; Integration in Vector Field; Work, Circulation and Flux; Path Independence; Potential Functions and Conservative Fields; Green's Theorem in Planes; Surface Area and Surface Integrals; Parameterized Surface; Stokes Theorem; Divergence Theorem and Unified Theory.

*Recommended Texts:*

1. G. B. Thomas, R. L. Finney, *Calculus and Analytic Geometry*, AWL, 10th Edition, 2002.
2. E. Kreyszig, *Advance Engineering Mathematics*, John Wiley and Sons, 9th Edition, 2005.
3. W. Kaplan, *Advanced Calculus*, Addison-Wesley, 5th Edition, 2002.
4. R. Ellis, D. Gulick, *Calculus: One and Several Variables*, Saunders College Publishing, 1991.

## PAM-242 LINEAR ALGEBRA

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 2+0 |
| *Prerequisite* | PAM-202 |

Introduction to matrices; Elementary row operations; Symmetric and Hermitian matrices; Echelon forms; Rank and Inverse of a matrix; Determinants; Vector spaces; Linear combination; Complex numbers and functions; Complex vector spaces; Linear transformation; System of linear equations; Non-homogeneous and homogeneous linear equations; Gaussian elimination method; Gauss-Jordan method; Applications of linear algebra.

*Recommended Texts:*

1. A. Howard, C. Rorres, *Elementary Linear Algebra*, 9th ed, John Wiley and Sons, 2005, ISBN 0471669598
2. E. Kreyszig, *Advance Engineering Mathematics*, 9th ed, John Wiley and Sons, 2005. ISBN 0471488852

## PAM-255 DIFFERENTIAL EQUATIONS

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 2+0 |
| *Prerequisite* | PAM-101 |

Introduction to Differential Equations, Formation of differential equations, Initial and boundary conditions, Methods of solution of differential equation of first order and first-degree, Homogeneous linear equations of order n with constant coefficients, Auxiliary/characteristic equations, Solution of higher order differential equation according to the roots of auxiliary equation, Non-homogeneous linear equations, Working rules for finding particular integral, Cauchy-Euler equation, Method of variation of parameters, Systems of differential equations, Series solution of differential equations.

*Recommended Texts:*

1. E. Kreyszig, *Advanced Engineering Mathematics*, 9th ed, John Wiley & Sons, 2005. ISBN 0471488852
2. D. D. Benice, *Brief Calculus and its Applications*, 2nd ed, Houghton Mifflin Co, 1996, ISBN 0395824648

## PAM-267 PROBABILITY AND STATISTICS

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 2+0 |
| *Prerequisite* | Nil |

Frequency Distributions; Histograms, and Frequency Polygons; Mean, Median, Mode and other Measures of Central Tendency; Standard Deviation and Other Measures of Dispersion; Moments, Skewness and Kurtosis; Confidence interval examination; Testing of hypothesis; the goodness of fit; Test sample; Linear regression; Combinatorial Analysis; Probability and Conditional Probability; Dependent and Independent Events; Mutually Exclusive Events; Probability Distributions; Binomial , Normal and Poisson Distribution; Mathematical Expectation; Curve Fitting and Method of Least Squares.

*Recommended Texts:*

1. W DeCoursey, *Statistics & Probability for Engineering Applications,* Newnes, 2003, ISBN 0750676183
2. T T Soong, *Fundamentals of Probability & Statistics for Engineers,* John Wiley & Sons, 2004, ISBN 0470868139

## PAM-360 NUMERICAL METHODS

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+0 |
| *Prerequisite* | PAM-242, PAM-255 |

Floating point number system; Sources of errors; Error definitions and analysis; Taylor's theorem; Solutions of equations of one variable; Interpolation and polynomial approximation; Numerical differentiation and integration; Iterative methods for system of linear equations; Approximating eigenvalues; Numerical solution of ordinary and partial differential equations.

*Recommended Texts:*

1. E. Kreyszig, *Advanced Engineering Mathematics*, 9th ed, John Wiley & Sons, 2005.
2. R. L. Burden, J. D. Faires, *Numerical Methods*, 3rd ed, PWS, 2002, ISBN 0534407612
3. R. L. Burden, J. D. Faires, *Numerical Analysis*, 7th ed, Brooks Cole, 2001.

### CME-200 APPLIED CHEMISTRY

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 2+1 |
| *Prerequisite* | Nil |

Atomic and molecular structure; Thermodynamics; Chemical equilibrium and dynamics; Phase equilibrium and phase rule; Polymers, Resins, Plastics and elastomers; Composite materials; Metallurgy of copper, iron and aluminum etc; Steel manufacturing; Crystal structures; Structures of solids; Ceramics; Refractories; Electrochemistry; Battery and battery technologies; Corrosion; Lubricants; Protective coating; Fuel and combustion; Environmental chemistry and pollution control; Instrumental techniques in chemistry.

*Recommended Texts:*

1. S S Dara, S Chand, *A textbook of Engineering Chemistry*, S Chand & Co., 2005, ISBN 08121923476
2. Salahuddin, *Chemistry for Engineers*, National book Foundation, 1985
3. Maron and Landau, *Fundamentals of Physical Chemistry,* Macmillan, 1974.

## COMPUTING

### EE-101 COMPUTER FUNDAMENTALS

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 2+1 |
| *Prerequisite* | Nil |

Fundamentals of computer hardware and software; introduction to programming in C; data types; input and output operators; arithmetic operators; operator precedence; relational operators; conditional statements (if, if-else, and switch statements); loop statements (for, while, do-while statements); pointers; file handling and structures.

*Recommended Texts:*

1. R. Lafore, *Waite Group's Turbo C Programming for the PC*, Revised edition, Sams Pub., 1990
2. B.S. Gottfried, *Schaum's Outline of Programming with C*, McGraw Hill, 2nd Edition, 1996.

# ENGINEERING FOUNDATION

## ME-101 ENGINEERING DRAWING AND GRAPHICS

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 2+2 |
| *Prerequisite* | Nil |

Introduction, Types of lines, lettering, dimensioning, use of pencil and drawing instruments, planning of drawing sheet; Types of projections, orthographic projections, plane of projections, quadrants, projection of points and straight lines, examples with different quadrants, traces of a line, true length of a line, inclination to the planes, projection of oblique and auxiliary planes; Loci of points and generated curves. Loci of points and straight lines. cycloid, epicycloid, involute, Archemedian spiral; development of solids. types of solids: polyhedra, solids of revolution, prism, pyramid, cylinder, cone, sphere; intersection of surfaces. Intersection of various solids; projection of solids. projection of various solids in simple position and inclined positions; section of solids, true shape of section on auxiliary plane of various solids. Isometric and pictorial projections of solids/machine parts, making of freehand sketches from solid objects and from orthographic projections. Sections of joints, screw thread systems, nuts and bolts, keys and cotter, coupling and simple bearings, pipe connections and engine details, preparation of assembly drawings.

*Recommended Texts:*

1. Bertoline, Wiebe, Miller, Mohler, Irwin, *Technical Graphics Communication*, 2008, ISBN 0077221303
2. Croft, Meyers, Boyer, *Engineering Graphics*, John Wiley & Sons Inc, 1989, ISBN 0471857882

## ME-102 ENGINEERING MECHANICS – I (STATICS)

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+0 |
| *Prerequisite* | Nil |

Force System. Force, rectangular components, moment, couples, resultant of forces, moments and couples (two and three dimensional systems). Equilibrium. Mechanical systems, isolation and equilibrium equations for two and three dimensional systems. Free body diagram, two force and three force members. Structures. Plane trusses, method of joints, method of sections, frames and machine analysis. Forces in beams and cables. Friction. Types of friction, dry friction, application of friction.

*Recommended Texts:*

1. R.C. Hibbler, *Engineering Mechanics: Statics,* 12th ed, Prentice Hall, 2009, ISBN 9810681364
2. J.L. Meriam & L.G. Kraige *, Engineering Mechanics: Statics,* 6th ed, Wiley, 2006, ISBN 0471739324
3. F.P. Beer, E.R. Johnston *Vector Mechanics: Statics,* 7th ed, McGraw Hill, 2003, ISBN 007727556X

## ME-103 WORKSHOP PRACTICE

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 0+2 |
| *Prerequisite* | Nil |

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

*Recommended Texts:*

1. W A J Chapman, *Workshop Technology Part-I*, 5th ed, Butterworth-Heinemann, 1972, ISBN 0713132698
2. H P Schwan, *Electrical Wiring*, McGraw Hill, 1982
3. *Wiring Manual,* Pak Cables Limited.

## ME-201 ENGINEERING MECHANICS – II (DYNAMICS)

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+1 |
| *Prerequisite* | ME-102 |

Kinematics of Particles. Rectilinear motion, plane curvilinear motion, rectangular coordinates, normal and tangential coordinates, polar coordinates; Kinetics of Particles. Force, mass, and acceleration, Newton's second law of motion, equations of motion, kinetic diagrams, rectilinear motion, curvilinear motion. Work and energy, potential energy. Impulse and momentum, conservation of momentum; Plane Kinematics of Rigid Bodies. Angular motion relations, absolute motion, relative velocity, instantaneous center of zero velocity, relative acceleration; Plane Kinetics of Rigid Bodies: Force, mass, and acceleration, equation of motion, translation, fixed axis rotation, general plane motion, work and energy relationship, impulse and momentum equation.

*Recommended Texts:*

1. R.C. Hibbler *, Engineering Mechanics: Dynamics,* 12th ed, Prentice Hall, 2009, ISBN 0136077919
2. J.L. Meriam & L.G. Kraige *, Engineering Mechanics: Dynamics*, 6th ed, Wiley, 2006, ISBN 0471739316
3. F P Beer, E R Johnston *Vector Mechanics: Dynamics,* 7th ed, McGraw Hill, 2003, ISBN 0077295498

## ME-202 THERMODYNAMICS - I

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+0 |
| *Prerequisite* | Nil |

Basic concepts, system and control volume, working substance, heat and work, state and properties, Thermodynamic process and cycle, First law of thermodynamics, 1st law for a cycle, 1st law for state change, Internal energy, enthalpy, specific heats. Ideal gas laws, equations of state. Properties of pure substances. Phase diagram, use of steam tables. Thermodynamic processes relationship. Constant volume, constant pressure, constant temperature, constant enthalpy and general law processes. Steady state and steady flow process, uniform state and uniform flow processes. Steady flow energy equation and steady flow devices. Second law of thermodynamics, definitions, its applications. Reversible and irreversible processes. Carnot cycle and thermodynamic temperature scale, Concept of entropy and its application to flow and non-flow processes. Enthalpy-entropy diagrams of working fluids. Thermodynamic cycles, efficiencies, and their applications. Idealized P-V and T-S diagrams of cycles. Rankine cycle and its application. Difference between direct and reversed cycles. Concept of open and closed cycles.

*Recommended Texts:*

1. Y.A. Cengel, M.A. Boles, *Thermodynamics, An Engineering Approach,* McGraw Hill, 2007, ISBN 0071257713
2. Moran Michael , *Fundamentals of Thermodynamics*, 5th ed, Wiley, 2003, ISBN 0471274712
3. Van Wylen, Sonntag, *Fundamentals of Classical Thermodynamics,* 3rd ed, John Wiley & Sons, 1985, ISBN 0471800147

## ME-205 MECHANICS OF MATERIALS - I

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+0 |
| *Prerequisite* | ME-102 |

Mechanical properties of materials, tensile, compressive and shear stress and strain, Hooke's law, stress strain relationship, thermal stresses. Moments of inertia, shearing force and bending moment, pure bending of beams, shear stresses in beams, deflection of beams. Torsion of circular bars, hollow and compound shafts. Strain energy, theory of columns.

*Recommended Texts:*

1. F. P. Beer & E.R. Johnston, *Mechanics of Materials,* 5th ed, McGraw Hill, 2009, ISBN 0073529389
2. P.P. Benham, R.J. Crawford, *Mechanics of Engineering Materials,* 2nd ed, Prentice Hall, 1996, ISBN 0582251648

## ME-206 FLUID MECHANICS- I

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+0 |
| *Prerequisite* | Nil |

Fluid statics. Absolute, gage and vacuum pressures, difference between static and dynamic pressure. Pressure gradient, manometery and Bourdon gage, hydrostatic pressure, forces on plane and curved surfaces, buoyancy and stability. Integral relations for a control volume and incompressible flow. Reynold's transport theorem. Bernoulli's theorem, integral conservation equations of mass, linear momentum, angular momentum and energy and their applications. Total and static pressure. Impact of jets on curved surfaces. Differential relations for a fluid particle. Differential equations of mass, linear momentum, angular momentum and energy conservation. Introduction to Navier-Stokes equations, potential flow theory, stream function, stream lines and stream tube. Dimensional analysis, similitude and its applications viscous flow in ducts. Steady, quasi-steady and unsteady flow, underdeveloped and fully developed, laminar and turbulent flow, flow between parallel plates, flow in tubes, losses in pipes, Moody's chart and pumping power.

*Recommended Texts:*

1. Munson, Young, Okiishi, Huebsch, *Fundamentals of Fluid Mechanics*, 6th ed, John Wiley & Sons, 2009, ISBN 0470262842
2. F M White, *Fluid Mechanics,* 6th ed McGraw Hill, 2006, ISBN 0073309206
3. I Shames, *Fluid Mechanics*, 4th ed, McGraw Hill, 2002, ISBN 0071198899
4. C T Crowe, D F Elger, *Engineering Fluid Mechanics*, 9th ed, Wiley, 2008, ISBN 0470259779

## ME-302 MECHANICS OF MACHINES

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+1 |
| *Prerequisite* | ME-201 |

Friction between un-lubricated surfaces, motion on inclined plane, screw threads and efficiency, friction of pivot, collar and conical bearings, cone, plate and centrifugal clutch, belts and rope drives, chains and sprockets, bands and shoe brakes. Dead weight and spring loaded governors, effort and power, sensitivity, controlling force and stability. Gyroscope, gyroscopic stabilization. Geometry of gears, conditions for transmission of constant velocity ratio, velocity of sliding, path of contact, arc of contact, interference, simple and compound gear trains, epicyclic trains, compound epicyclic trains, torque on gear trains. Theory and applications of dynamometers. Dynamics of engine mechanism/slider-crank mechanism. Velocity and acceleration of piston, angular velocity, acceleration. Forces and couples transmitted in a direct acting engine, velocity and acceleration diagrams, turning moment diagram, fluctuation of energy and speed. Flywheels, valve diagrams and valve gears, steering gears. Types of cams and followers, motion for a given cam profile. Balancing of rotating and reciprocating masses, balancing of in-line engines, V-engines, radial engines, balancing machines.

*Recommended Texts:*

1. Erdman & Sandor, *Mechanism Design,* 4th ed, Prentice Hall, 2001, ISBN 0130408727
2. J.J. Uicker, J.E. Shigley, *Theory of Machines and Mechanisms,* 5th ed, Oxford University Press, 2010, ISBN 019515598X
3. R. Norton, *Design of Machinery,* 3rd ed, McGraw Hill, 2003, ISBN 0071214968
4. W.G. Green, *Theory of Machines,* Blackie, 1956 *

## ME-303 MANUFACTURING PROCESSES-I

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+0 |
| *Prerequisite* | Nil |

Forming & Shaping Processes and Equipment. Rolling. Flat rolling, rolling mills, shapes rolling, production of seam less tubing and piping. Extrusion and Drawing. Hot and cold extrusion, Extrusion and drawing equipment, Hydrostatic extrusion. Sheet Metal Forming. Sheet metal characteristics, formability of sheet metals, bending sheet and plate, tube bending & forming, deep drawing, supper plastic forming, explosive forming, equipment for sheet metal forming. Forming & Shaping Plastics & Composite Materials. Extrusion, injection molding, blow molding, thermo-forming, processing elastomers, processing reinforcer plastics, manufacturing honeycomb material, processing metal matrix and ceramic matrix composites. Joining Process & Equipment. Fusion welding process: Oxy-fuel gas welding, arc welding, electrodes, thermite welding, electron beam welding. Solid State welding process: Cold welding, ultrasonic welding, friction welding, resistance welding. Weld quality weldability, weld design and process selection, brazing, soldering, adhesive bonding, joining plastics. Metal Casting Process & Equipment. Molding and molding sands, classification of foundry process, casting and its types, pattern and pattern making, core and core making, furnaces, crucibles, molding tools and foundry equipment. Powder Metallurgy. Production of metal powders, compaction, sintering, design considerations. Surface Treatment, Coating and Cleaning. Mechanical surface treatment and coating, painting and its testing, thermal spraying, vapor deposition, electroplating and electro forming, anodizing, hot dipping, surface texturing and cleaning.

*Recommended Texts:*

1. Kalpakjian, *Manufacturing Engineering and Technology,* 6th ed, Prentice Hall, 2009, ISBN 0136081681
2. AJ Lissaman & SJ Martin, *Principle of Engineering Production,* 3rd ed, Butterworth-Heinemann 1996, ISBN 0340631953
3. R.A Higgins, *Engineering Metallurgy* 6th ed, Butterworth-Heinemann, 1993, ISBN 0340568305
4. Groover, *Fundamentals of Modern Manufacturing,* 3rd ed, John Wiley & Sons, 2007, ISBN 0471744859
5. E.P Degarmo, *Materials and Processes in Manufacturing,* 10th ed, Wiley, 2007, ISBN 047005512X

## ME-308 MEASUREMENTS AND INSTRUMENTATION

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 2+1 |
| *Prerequisite* | Nil |

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

*Recommended Texts:*

1. E. Doeblin*, Measurement Systems Applications and Design*, McGraw Hill, 1975 *
2. R. Figliola, D. Beasley*, Theory and Design for Mechanical Measurements*, 4th ed, John Wiley, 2005, ISBN 0471445932

# MAJOR BASED CORE (BREADTH)

## ME-207 THERMODYNAMICS - II

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+1 |
| *Prerequisite* | ME-202 |

Non reacting gas mixtures. Dalton's law and Gibbs-Dalton law, volumetric analysis of gas mixtures, gas mixture constants and specific heats. Adiabatic mixture of perfect gases. Psychrometry and its use for air-conditioning processes. Mixture with chemical reaction, simple reaction equation, Stoichiometric chemical reaction, rich and lean air-fuel ratio mixture, enthalpy of formation and reaction. Adiabatic flame temperature. Compressors, classification and working principles, single stage and multistage compressors, inter-cooling, efficiencies and p-v diagrams of reciprocating compressors. Velocity diagrams of centrifugal compressors. Performance characteristics and working regimes. Boilers, generation of steam through boilers. Classification and configurations of boilers and their applications. Boiler efficiencies and heat balance sheet. Steam nozzles, flow through steam nozzle and its efficiencies. Steam engine and steam turbine, their classification working principles, efficiency and heat balance sheet. Introduction to air/gas nozzles.

*Recommended Texts:*

1. Y.A. Cengel, M.A. Boles, *Thermodynamics*, *An Engineering Approach*, McGraw Hill, 2007
2. Moran Michael, *Fundamentals of Thermodynamics*, John Wiley, 2008
3. C Bourgnakke, G J Van Wylen, R E Sonntag, *Fundamentals of Thermodynamics*, John Wiley, 1997
4. Rayner Joel, *Basic Engineering Thermodynamic*, 5th ed, Prentice Hall, 1996, ISBN 058226291

## ME-301 FLUID MECHANICS - II

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+1 |
| *Prerequisite* | ME-206 |

Incompressible flow machines, hydraulic turbines, Introduction to hydraulic system, hydraulic fluids, hydraulic circuits, actuators. Hydraulic pumps and motors, their performance characteristics, efficiency and similarity laws. Hydraulic presses, lifts and jacks. Hydraulic cranes, accumulators, and intensifiers. Hydraulic couplings, rams and hydraulic systems of earth-moving machinery. Compressible Flow, mass, momentum and energy conservation equations of compressible flow. Adiabatic, isentropic flow, converging and diverging nozzles and diffusers. Boundary layer flow. Boundary layer equations, flat plate boundary layer, effect of pressure gradient, separation and wake, lift and drag of immersed bodies. Airfoil theory; numerical analysis. introduction to CFD.

*Recommended Texts:*

1. Munson, Young, Okiishi, Huebsch, *Fundamentals of Fluid Mechanics*, 6th ed, Wiley, 2009 ISBN 0470262
2. F.M. White, *Fluid Mechanics,* 6th ed McGraw Hill, 2006 ISBN 0073309206
3. I Shames, *Fluid Mechanics*, 4th ed, McGraw Hill, 2002 ISBN 0071198899
4. C T Crowe, D F Elger, *Engineering Fluid Mechanics*, 9th ed, Wiley, 2008 ISBN 0470259779

## ME-305 MECHANICS OF MATERIALS - II

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+1 |
| *Prerequisite* | ME-205 |

Plane stress and strain, principal stresses and strains, Mohr's circle for stress and strain, theories of failure. Yield, fatigue and creep. Hardness, stress concentration. Deflection and stresses, thin and thick curved bars, thin walled pressure vessels, thick cylinders. Photoelasticity. Strain gauges. Castigliano's theorem, Analysis of statically indeterminate beams, double integration method, superposition method, virtual work and its application. Introduction to fracture mechanics, toughness, critical stress intensity factor.

*Recommended Texts:*

1. F. P. Beer & E.R. Johnston, *Mechanics of Materials,* 5th ed, McGraw Hill, 2009
2. P.P. Benham, R.J. Crawford, *Mechanics of Engineering Materials,* 2nd ed, Prentice Hall, 1996

## ME-315 MACHINE DESIGN AND CAD – I

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 2+1 |
| *Prerequisite* | ME-101, ME-205, ME-302 |

Basic criteria of design of machine parts, determination of permissible and actual stresses, factor of safety, Design of keys, cotters, and couplings. Design of brakes and clutches, Design of welded, riveted and bolted joints. Design of translation screws. Design codes and standards BS, ANSI, JIS, DIN, ISO. Standards of fits and tolerances. Fundamentals of CAD using Creo Parametric.

*Recommended Texts:*

1. J.E. Shigley, *Mechanical Engineering Design,* 7th ed, McGraw Hill, 2007, ISBN 0071257632
2. R L Norton, *Mechanical Design*, *An Integrated Approach*, 3rd ed, Prentice Hall, 2005, ISBN 0131481908
3. M.F. Spotts, *Design of Machine Elements,* 8th ed, Prentice Hall, 2003, ISBN 0130489891
4. Creo Paramteric Training Manuals, PTC, 2012

## ME-316 MACHINE DESIGN AND CAD – II

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+1 |
| *Prerequisite* | ME-315 |

Kinematics & force analysis and design of spur, helical, bevel & worm gears, design of rolling contact bearings, hydrodynamic theory of lubrication, design of journal bearings, design of mechanical springs, design of belts,

ropes and chains; design of shafts; introduction to finite element analysis using ANSYS Workbench.

*Recommended Texts:*

1. J.E. Shigley, *Mechanical Engineering Design,* 7th ed, McGraw Hill, 2007, ISBN 0071257632
2. R L Norton, *Mechanical Design*, *An Integrated Approach*, 3rd ed, Prentice Hall, 2005, ISBN 0131481908
3. M.F. Spotts, *Design of Machine Elements,* 8th ed, Prentice Hall, 2003, ISBN 0130489891
4. ANSYS Documentation, Ansys Inc, 2011

## ME-403 HEAT AND MASS TRANSFER

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+1 |
| *Prerequisite* | ME-202, ME-206 |

Conduction, Heat equation, Fourier's law, one dimensional steady state heat conduction through plane and composite walls, cylinders and spheres with and without heat generating sources. Conduction heat transfer through extended surfaces, transient conduction, heat transfer lumped capacitance method. Convection, Newton's law of cooling, boundary layer, Natural (free) and forced convection heat transfer. Coefficient of heat transfer for free and forced convection, Effect of laminar, transition and turbulent flow on coefficient of heat transfer, flow over flat plates. Heat transfer through pipes and ducts flows. Critical thickness of insulation, Non-dimensional parameters related to heat transfer and their applications. Shear stress, friction coefficient for fully developed flow. Reynolds analogy. Radiation, Stefan Boltzmann's law, black body radiation, absorptivity, reflectivity, transmissivity. Wien's law, Kirchoff's law, grey body radiation. Radiation shape factor and its applications. Heat Exchangers. Classification, overall heat transfer co-efficient. LMTD and NTU methods.

*Recommended Texts:*

1. Incropera & Dewitt, *Fundamentals of Heat and Mass Transfer,* 6th ed, Wiley, 2006, ISBN 0471457280
2. Y.A. Cengel, *Heat Transfer, A Practical Approach,* 3rd ed , McGraw Hill, 2006
3. J. P. Holman, *Heat Transfer,* 10th ed, McGraw Hill, 2009, ISBN 0076529363

## ME-404 MASS TRANSFER

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 2+0 |
| *Prerequisite* | ME-403 |

Introduction to Mass transfer and Mass-Transfer Operations, Classification of the Mass-Transfer Operations and Choice of Separation Method, Diffusion and Mass Transfer, Molecular Diffusion in Fluids, Steady-State Molecular Diffusion in Fluids at Rest and in Laminar Flow, Convection Mass Transfer and Concept of Mass-Transfer Coefficients, Mass-Transfer Coefficients in Laminar and Turbulent Flow, Mass-, Heat-, and Momentum-Transfer Analogies, Mass-Transfer Data for Simple Situations, Simultaneous Mass and Heat Transfer Diffusion in Solids, Fick's-Law Diffusion, Types of Solid Diffusion

*Recommended Texts:*

1. Incropera Frank P., DeWitt David P. "*Fundamentals of Heat and Mass Transfer*" 3rd ed. 1990. John Wiley and Sons.
2. Treybal Robert E. "*Mass Transfer Operations*" , 1981, McGraw Hill Book Company.
3. Cengel Yunus A. "*Heat and Mass Transfer-A Practical approach*", 3rd ed. 2007, McGraw Hill Book Company.

# MAJOR BASED CORE (DEPTH)

## ME-307 MANUFACTURING PROCESSES - II

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+0 |
| *Prerequisite* | ME-303 |

Material Removal. Mechanics of chips formation, types of chips produced, forces and pressures involved, surface finishing and integrity, machinability. Calculation of material removal rate. Cutting Tools. Single point tool geometry, mill cutters, factors which affect tool life, tool life relationships, tool materials, types and properties of cutting fluids. Machine Processes for Producing Various Shapes. Milling operation, milling machines, planning and shaping, broaching and broaching machines, gear manufacturing machining. Abrasive Machining & Finishing Operations. Abrasive, bonded abrasives (grinding wheels), grinding process, grinding fluids, design considerations for grinding, ultrasonic machining. Non Conventional Machining Process. Machining, electrochemical, electrical–discharge machining, wire EDM Control of Machine Tools. Machine tools control, numerical control system, sequence control, PLC, servo copying, Computerized Numerical Control. (CNC), adaptive control, programming for numerical control Jigs & Fixtures. General design principle, elements of jig, locating devices and clamping devices. Computer Integrated Manufacturing System. Manufacturing system, Computer Integrated Manufacturing (CIM), Computer Aided Manufacturing (CAM), computer simulation of manufacturing process and system, group technology, Flexible Manufacturing System (FMS), Artificial Intelligence (AI), Cellular manufacturing. Introduction to Process Planning

*Recommended Texts:*

1. Kalpakjian, *Manufacturing Engineering and Technology,* 6th ed, Prentice Hall, 2009
2. AJ Lissaman & SJ Martin, *Principle of Engineering Production,* 3rd ed, Butterworth-Heinemann 1996
3. R.A Higgins, *Engineering Metallurgy* 6th ed, Butterworth-Heinemann, 1993

## ME-312 REFRIGERATION AND AIR-CONDITIONING

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 2+1 |
| *Prerequisite* | ME-207 |

Introduction**,** definition and basic terminology. Refrigeration cycles**:** vapor compression cycle, COP, pressure- enthalpy chart, types of refrigerants, air cycle refrigeration, vapor absorption system.
Air conditioning**:** Indoor and outdoor air conditions, comfort conditions and comfort zone, indoor air quality. psychrometry, Central air-conditioning system, essential components of central air-conditioning plant, water chiller and water heater, air handling unit, chilled water and hot water recirculation system, return air supply system, fresh air supply system air mixture chamber, supply fan. Air dust cleaning and bacteria removal, air supply and air return terminals, diffusers and grilles, CFM rating and tons of air-conditioning of a central air-conditioning plant. Cooling load and heating load calculation procedures, duct sizing and piping design, pumps and fans selection
Air ventilation: calculation of fresh air supply of a multi story building, air handling unit for untreated fresh air, dust and bacteria removal systems, forced convection based air ventilator design,

*Recommended Texts:*

1. R.S. Khurmi, J.K. Gupta, *A textbook of Refrigeration and Air conditioning,* S. Chand & Co, 1987, ISBN: 81-219-2781-1
2. G.F. Hundy, A.R. Trott, T.C. Welch, *Refrigeration and Air conditioning,* 4th edition, Butterworth-Heinemann, 2008, ISBN: 978-81-312-2026-9
3. C.P. Arora, *Refrigeration and Air conditioning,* 3rd ed McGraw-Hill, 2010, ISBN: 978-0-07-008390-5
4. P.N. Ananthanarayanan, *Basic Refrigeration and Air conditioning,* 3rd edition, McGraw-Hill, 2005, ISBN: 978-0-07-049500-5
5. ASHRAE Handbook

## ME-405 MECHANICAL VIBRATIONS

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+1 |
| *Prerequisite* | ME-201 |

Oscillatory motion. Elements of vibrating system, Harmonic motion, periodic motion, vibration terminology. Single degree of freedom systems. Equation of motion: Newton's method, energy method, undamped free vibration, viscously damped free vibration, logarithmic decrement, harmonically excited vibration, vibration isolation, vibration measuring instruments. Two degree of freedom systems. Normal modes of vibration, coordinate coupling, forced harmonic vibration, vibration absorber, vibration damper. Orthogonality conditions. Vibration of Elastic Bodies. Free and forced vibration of cables and uniform bars, free and forced lateral vibrations of simply supported thin beams, torsional vibration of circular shafts with single rotor and two rotors, critical speed of rotating shafts. Finding natural frequencies: Rayliegh method and Holzer method. Electrical and Mechanical analogies

*Recommended Texts:*

1. W. T. Thompson, *Mechanical Vibrations: Theory and Applications,* Prentice Hall. 5th ed, 1997, ISBN 013651068X
2. S. S. Rao, *Mechanical Vibrations,* 4th ed, Prentice Hall, 2003, ISBN 0130489875
3. L. Meirovitch, *Elements Of Vibration Analysis*, 2nd ed, McGraw Hill, 1986, ISBN 0070413428
4. Endrew Dimaogonas, *Vibration for Engineers*, 2nd ed, Prentice Hall, 1996, ISBN 0134562291

## ME-411 POWER PLANTS

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 2+0 |
| *Prerequisite* | ME-202 |

Thermodynamics of Conventional Power Plants, fossil fuel steam generator, Brayton cycle, Open and closed cycle power plants, combined cycle power plants, Combustion chamber configuration, Fuel injection system, combustion, flame stabilization. Gas turbine and jet engine power plants, Diesel engine power plant Combined heat and power plants (CHP), Hydro-electric power plants. Nuclear Power Plants.

*Recommended Texts:*

1. M. M. El Wakil, *Power Plant Technology,* McGraw Hill, 2002, ISBN 0070662746
2. F.T. Morse, *Power plant,* Von Nostrand Inc, 1950 *

### ME-412 INTERNAL COMBUSTION ENGINES

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+0 |
| *Prerequisite* | ME-202 |

Engine classification, Combustion, real engine cycle. Working principles of SI and CI engines, Ignition delay and combustion phases. Testing and performance characteristics of petrol and diesel engines under variable condition of load and speed. Knocking characteristics, Octane and Cetane numbers, engine valve timing and ignition advance and retard, Pressure-crank angle diagram. Working principle of turbo- charged engine, its performance characteristics and comparison with naturally aspirated engine of equal power. Engine emissions and their control through in-cylinder and out-cylinder techniques. Exhaust gas recirculation (EGR) system. Thermal reactor and catalytic converters. Trade off of NOx and HC emissions. Fuel injected petrol engine and its performance, advantages over conventional petrol engine. Engine performance under part cut-out conditions and fuel savings Introduction to duel fuel / multi fuel engines, CNG engines. Engine lubrication and lubricants, fuel additives.

*Recommended Texts:*

1. J.B. Heywood, *Internal Combustion Engine Fundamentals,* McGraw Hill, 1989.
2. Richard Stone, *Introduction to I. C. Engines,* 2nd ed, SAE Inc, 1993

# ELECTIVE COURSES

### ME-406 TOTAL QUALITY MANAGEMENT

| | |
|---|---|
| *Status* | Elective |
| *Credits* | 2+0 |
| *Prerequisite* | Nil |

Fundamental principles; Standards; Techniques for quality analysis and improvements; Statistical methods and statistical process control (SPC). Acceptance sampling; Quality function deployment (QFD); Value engineering; Cross-functional management and benchmarking; ISO 9000: application, clauses and implementation issues.

*Recommended Texts:*

1. William J. Stevenson, *Production / Operations Management*, 11th ed, McGraw-Hill, 2011
2. Amitava Mitra, *Fundamentals of Quality Control & Improvement*, 3rd ed, Wiley, 2008
3. Douglas L. Montgomery, *Introduction to Statistical Quality Control*, 6th ed, wiley, 2008.
4. Dale H. Besterfield, *Total Quality Management.* 3rd ed. Pearson Education Inc. 2003.
5. Armand. V. Feigenbaum, *Total Quality Control*, McGraw Hill, 1991.

### ME-413 RENEWABLE ENERGY RESOURCES

| | |
|---|---|
| *Status* | Elective |
| *Credits* | 2+0 |
| *Prerequisite* | Nil |

Introduction to types of renewable energy, solar energy, wind energy, geothermal energy, ocean thermal energy, tidal wave and geothermal energy, biomass energy. Fuel cell and heat pump systems, energy efficiency issues and energy storage. Potential of using renewable energy resources as supplement of conventional energy resources. Renewable and non-renewable energies used as hybrid energy systems, Modern renewable energy plants. Wind energy, wind turbine design specifications, compatible electric generators and major operational issues of the wind mill for electric power generation. Wind mills design usage for pumping water. Biomass energy conversion methods, detailed description of biomass energy conversion plant, operational and maintenance problems and their remedies.

*Recommended Texts:*

1. G Boyle, *Renewable Energy*, 2nd ed, Oxford University Press, 2004, ISBN 0199261784
2. J Twidell, T Weir, *Renewable Energy Resources*, 2nd ed, Spon Press, 2005, ISBN 0419253300

### ME-414 MECHANICAL ENGINEERING DESIGN AND ANALYSIS

| | |
|---|---|
| *Status* | Elective |
| *Credits* | 3+0 |
| *Prerequisite* | Nil |

Philosophy and concept of engineering design, Engineering creativity, phases and procedures in design,

Management of engineering projects, Modeling and Similitude, Optimization and reliability, Application of Industrial Design Codes,

*Recommended Texts:*

1. W E Eder, S Hosnedl, *Design Engineering: A Manual for Enhanced Creativity,* CRC Press, 2007, ISBN 140047655
2. A H Burr, J B Cheatham, *Mechanical Analysis and Design,* 2nd edition, Prentice Hall, 1995, ISBN 0023172657

## ME-415 FINITE ELEMENT METHOD

| | |
|---|---|
| *Status* | Elective |
| *Credits* | 3+0 |
| *Prerequisite* | Nil |

Introduction: Stress analysis by FEM, Variational Principles, Rayleigh Ritz Methods, Coordinate Transformation, Isoparametric Formulation, Solution of eigen-value problems, Boundary value problems, Discretized Time Dependent problems.

*Recommended Texts:*

1. P.E. Lewis, J.P. Ward, *The Finite Element Method, Principles and Applications,* Addison-Wesley Pub, 1991, ISBN 0201544156
2. Saeed Moaveni, *Finite Element Analysis, Theory and Application,* 3rd ed, Prentice Hall, 2007, ISBN 0131890808

## ME-416 TRIBOLOGY

| | |
|---|---|
| *Status* | Elective |
| *Credits* | 3+0 |
| *Prerequisite* | Nil |

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

*Recommended Texts:*

1. A Cameron, *Basic Lubrication Theory*, 3rd ed, Ellis Horwood Ltd, 1983 *, ISBN 0470275545
2. T Stolarski, *Tribology in Machine Design*, 2nd ed, Butterworth-Heinemann, 1999, ISBN 0750636238
3. Bharat Bhushan*, Modern Tribology Handbook, Vol-I*, CRC, 2000, ISBN 0849384036

## ME-417 AERODYNAMICS

| | |
|---|---|
| *Status* | Elective |
| *Credits* | 3+0 |
| *Prerequisite* | Nil |

Introduction, aerodynamics of incompressible flow, compressible and ideal fluid flow, Airfoil theory, Finite wing aerodynamics, blade element theory and aircraft propellers, Cascade aerodynamics, Jet propulsion, Intake and Nozzle performance, Aircraft performance measurement.

*Recommended Texts:*

1. E.I. Houghton, A.E. Brock, *Aerodynamics for Engineering Students,* Cambridge University Press, 2003, ISBN 0750651113
2. L.J. Clancy, *Aerodynamics*, Longman, 1986, ISBN 0273011200

## ME-418 GAS DYNAMICS

| | |
|---|---|
| *Status* | Elective |
| *Credits* | 3+0 |
| *Prerequisite* | Nil |

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

*Recommended Texts:*

1. M.J. Zucrow, J.D. Hoffman, *Gas Dynamics**, Wiley, 1976, ISBN 047198440X
2. Shapiro, *The Dynamics and Thermodynamics of Compressible Fluid Flow (Vol 1)**, Ronald Press, 1954, ISBN 0471066910

## ME-419 COMPUTATIONAL FLUID DYNAMICS

| | |
|---|---|
| *Status* | Elective |
| *Credits* | 3+0 |
| *Prerequisite* | Nil |

Types of ordinary and partial differential equations, solution of equation sets, Boundary value and initial value problems, Control volume approach, Time stepping, Accuracy stability, Consistency, Linearization, Diffusion, Turbulence modeling, Examples of external flow across various configurations, Internal flow through pipes, ducts and valves.

*Recommended Text:*

1. J. D. Anderson, *Computational Fluid Dynamics,* McGraw Hill, 1995, ISBN 0070016852

# INTER-DISCIPLINARY ENGINEERING

## MME-203 INTRODUCTION TO ENGINEERING MATERIALS

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 3+0 |
| *Prerequisite* | Nil |

Introduction of engineering materials, metals and alloys, polymers, ceramics and composites. Bonding in different classes of materials. Physical, mechanical and chemical properties of engineering materials. Crystal structure of metals and ceramic. Crystallographic planes and directions, slip and slip systems, dislocation, twinning, yield phenomenon and strain aging. Classification of metals and alloy systems, steels, cast irons, aluminum alloys, copper alloys, super alloys, the SAE and ASTM designations. The iron-iron carbide phase diagram, ferrite, austenite, cementite, pearlite, martensite, bainite, etc. Alloying elements and their effect on the properties of alloy steel. Heat treatment of steel, annealing, normalizing, tempering, quenching, austempering, hardening etc. Hot and cold forming, recovery and recrystallization. Types and properties of structural ceramics. Classification of polymeric materials and their engineering properties.

*Recommended Texts:*

1. Callister, W.D., '*Fundamentals of Materials Science*', 7th ed, John Wiley, 2007
2. M F Ashby, H Shercliff, D Cebon, '*Materials Engineering, Science, Processing and Design*', Butterworth-Heinemann, 2007
3. WF Smith, *Material Science,* 5th ed, McGraw Hill, 2009, ISBN 0073529249
4. MF Ashby, *Materials Selection in Mechanical design*, 4th ed, Butterworth-Heinemann, 2011

## EE-151 ELECTRICAL ENGINEERING

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 2+1 |
| *Prerequisite* | Nil |

Introduction to DC Circuits: Series and parallel circuits, DC circuit analysis. Theory of Alternating Current. Series and parallel circuits, resistance, inductance and capacitance of AC circuits, power factor, resonance in RLC circuits, single phase and polyphase circuits. Power and power factor measurement, current and voltage relationship in phase and line circuits. Types, characteristics and testing of AC motors, motor starters and switch gears, electric traction and braking, solenoids. Transformers. Voltage and current relationship of primary and secondary types of transformers, losses and efficiency. Generators and motors. Types, construction and characteristics. Motor starters. Testing and efficiency of machines.

*Recommended Texts:*

1. S Chapman, *Electric Machinery Fundamentals,* 4th ed, McGraw Hill, 2003, ISBN 0072465239
2. Theodore Wildi, *Electric Power Technology,* John Wiley & Sons, 1981, ISBN 047107764X
3. M Nahvi, J Edminister, *Electric Circuits, Basic Electricity, Schaum's Series*, 4th ed, McGraw Hill, 2002, ISBN 0071393072

## EE-152 ELECTRONICS

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 2+1 |
| *Prerequisite* | EE-151 |

Part-1: Semiconductors, rectifiers, transistors, relays, Operational Amplifiers; Part-2: Number systems, Boolean Algebra, gates. Combinational logic (adders, comparators, decoders, multiplexers, etc.) Sequential logic (flip-flops, registers, counters, ROM, PROM, EPROM). Microprocessors (registers; ALU; CU; memory, address, data and control buses). ADC and DAC. Micro-controllers.

*Recommended Texts:*

1. Floyd, *Electronic Devices,* 8th ed, Prentice Hall, 2007, ISBN 013242973
2. Malvino, A.Paul, *Electronic Principles,* 7th ed, McGraw Hill, 2006, ISBN 0073222771
3. Malvino, *Digital Computer Electronics,* 3rd ed, Career Education, 1992, ISBN 0028005945

## EE-401 CONTROL ENGINEERING

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | 2+0 |
| *Prerequisite* | ME-308 |

Basic Concepts. System, control system, input, output, open-loop and closed loop control systems, elements of a general control system, examples of control system. Mathematical Modeling of Physical System. Operational notation, grounded chair representation, series parallel laws, equations of motion for spring mass damper systems, levered system, rotational system, geared system, electrical components and R.L.C circuits, electrical analogies for mechanical systems, scale factors, thermal systems and fluid system. Transfer Functions and Systems Response. Review of Laplace transform, impulse, step and ramp functions, concept of transfer functions of common components, block diagram algebra, signal flow graphs, impulse, step, and ramp response of first and second order systems, characterization of response (time constant, gain, overshoot, rise time, setting time, steady state error, etc.) relation of system response to location of system poles and zeros. Stability of Control System. Concept of stability, Routh Hurwitz criterion. Root locus Methods and its Use in Control System Design Introduction to Digital Control.

*Recommended Texts:*

1. Francis H. Raven, *Automatic Control*, 5th ed, McGraw Hill, 1994, ISBN 0070513414
2. Richard C. Dorf, *Modern Control System*, 11th ed, Prentice Hall, 2007, ISBN 0132270285
3. B. B. Kuo, *Automatic Control Systems*, 9th ed, Wiley, 2009, ISBN 0470048964

### EE-402 APPLICATIONS OF MICRO-CONTROLLERS IN MECHANICAL ENGINEERING

| | |
|---|---|
| *Status* | Elective |
| *Credits* | 2+1 |
| *Prerequisite* | EE-152 |

PIC Micro-controller history and features; Interfacing using Assembly and C languages; I/O ports, timers, Serial port, Interrupt programming, CCP and ECCP programming, SPL, etc; Interfacing LCD, keyboards, ADC, DAC, sensors, etc; Full step and half step stepper motor control, DC motor control, Applications in mechanical engineering.

*Recommended Texts:*

1. MA Mazidi, RD McKinlay, RD Causey, "*PIC Micro-controller and Embedded Systems using Assembly and C for PIC18"*, 1st ed, Prentice Hall, 2007
2. Han-Way Huang, Leo Chartrand, "*PIC Micro-controller: An introduction to software & hardware interfacing"*, 1st edition, Cengage Learning, 2004
3. Datasheets of PIC18Fxxxx series.

## SENIOR DESIGN PROJECT

### ME-499 DESIGN PROJECT

| | |
|---|---|
| *Status* | Compulsory |
| *Credits* | (0+3) 7th Semester<br>(0+3) 8th Semester |
| *Prerequisite* | |

Students are required to select a design project. The project can be to solve a problem being faced in industry or it may be oriented towards designing a product. The project can also be motivated from a research problem taken from literature. At the end of 7th semester, students will have to submit a preliminary report of the project and have to clear a viva voce examination.
The remaining credit hours of work started in 7th semester should be completed in the 8th semester followed by the submission of the project report and viva voce.

*Recommended Texts:*

- As advised by the Project Supervisor