# Bharati Vidyapeeth

## (Deemed to be University)

## College of Engineering, Pune- 411043

**The Structure of the Curriculum: 2014 Course**

**Choice Based Credit System (CBCS)**

# B. TECH. MECHANICAL: SEMESTER- V & VI

# Bharati Vidyapeeth
# (Deemed to be University)
# College of Engineering, Pune
## Department of Mechanical Engineering

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**Vision of the Bharati Vidyapeeth (Deemed to be University) College of Engineering is:**

*To be a World Class Institute for Social Transformation through Dynamic Education*

**Missions of the Bharati Vidyapeeth (Deemed to be University) College of Engineering are:**

- *To provide quality technical education with advanced equipment, qualified faculty members, infrastructure to meet needs of profession & society.*
- *To provide an environment conducive to innovation, creativity, research and entrepreneurial leadership.*
- *To practice and promote professional ethics, transparency and accountability for social community, economic & environmental conditions.*

**Goals of the Bharati Vidyapeeth (Deemed to be) University College of Engineering are:**

- *Recruiting experienced faculty.*
- *Organizing faculty development programs.*
- *Identifying socio-economically relevant areas & emerging technologies.*
- *Constant review &up gradation of curricula.*
- *Up gradation of laboratories, library & communication facilities.*
- *Collaboration with industry and research & development organizations.*
- *Sharing of knowledge, infra-structure and resources.*
- *Training, extension, testing and consultancy services.*
- *Promoting interdisciplinary research.*

**Vision of the Mechanical Engineering Department is:**

*To develop, high quality Mechanical Engineers through dynamic education to meet social and global challenges.*

**Mission Statements of the Mechanical Engineering Department are:**

- *To provide extensive theoretical and practical knowledge to the students with well-equipped laboratories and ICT tools through motivated faculty members.*
- *To inculcate aptitude for research, innovation and entrepreneurial qualities in students.*
- *To acquaint students with ethical, social and professional responsibilities to adapt to the demands of working environment.*

**Program Educational Objectives (PEOs) of the B. Tech. Mechanical are:**

*Graduates will be able,*

- *To fulfill need of industry and society with theoretical and practical knowledge.*
- *To engage in research, innovation, lifelong learning and continued professional development.*
- *To fulfill professional ethics and social responsibilities.*

**PROGRAM OUTCOMES**

***Engineering Graduates will be able to:***

1. ***Engineering knowledge****: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.*
2. ***Problem analysis****: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.*
3. ***Design/development of solutions****: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.*
4. ***Conduct investigations of complex problems****: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.*
5. ***Modern tool usage****: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.*
6. ***The engineer and society****: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.*
7. ***Environment and sustainability****: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.*
8. ***Ethics****: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.*
9. ***Individual and team work****: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.*
10. ***Communication****: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.*

11. ***Project management and finance****: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.*
12. ***Life-long learning****: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.*

**Statements of Programme Specific Outcomes (PSOs)**

*PSO1:* *Apply the knowledge of thermal, design, manufacturing engineering and computational sciences to solve Mechanical Engineering problems.*

*PSO2:* *Apply Mechanical Engineering principles for research, innovation and develop entrepreneurial skills.*

*PSO3:* *Apply concepts of mechanical engineering to asses' societal, environmental, health and safety issues with professional ethics.*

## B. TECH. MECHANICAL: SEMESTER- V (2014 Course)

| S. N. | Course | Teaching Scheme (Contact Hrs. /week) | | | Examination Scheme (Marks) | | | | | | | Total Credits | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | L | P/ D | T | EndSem. Exam. | Continuous Assessment | | | | | Total | TH | TW | Total |
| | | | | | | Unit Test | Attendance | Assignments | TW/OR | TW/PR | | | | |
| C301 | Machine Design –I* | 3 | 2 | - | 60* | 20 | 10 | 10 | 50 | -- | 150 | 3 | 1 | 4 |
| C302 | Theory of Machines | 4 | 2 | - | 60 | 20 | 10 | 10 | 50 | -- | 150 | 4 | 1 | 5 |
| C303 | Advanced Computer Graphics & Solid Modelling | 3 | 2 | - | 60 | 20 | 10 | 10 | -- | 50 | 150 | 3 | 1 | 4 |
| C304 | Heat and Mass Transfer | 4 | 2 | - | 60 | 20 | 10 | 10 | 50 | -- | 150 | 4 | 1 | 5 |
| C305 | Advanced Manufacturing Processes | 3 | -- | - | 60 | 20 | 10 | 10 | -- | -- | 100 | 3 | -- | 3 |
| C306 | Professional skill Development-V | 4 | -- | - | 100 | - | | - | -- | -- | 100 | 4 | -- | 4 |
| | **Total** | 21 | 08 | 0 | 400 | 100 | 50 | 50 | 150 | 50 | 800 | 21 | 4 | 25 |

* End Semester examination of duration 4 Hours.

## B. TECH. MECHANICAL: SEMESTER- VI (2014 Course)

| S. N. | Course | Teaching Scheme (Contact Hrs. /week) | | | Examination Scheme (Marks) | | | | | | | Total Credits | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | L | P/ D | T | End Sem. Exam | Continuous Assessment | | | | | Total | TH | TW | Total |
| | | | | | | Unit Test | Attendance | Assignments | TW/OR | TW/PR | | | | |
| C307 | Machine Design –II* | 4 | 2 | -- | 60* | 20 | 10 | 10 | 50 | -- | 150 | 4 | 1 | 5 |
| C308 | Refrigeration Air Conditioning | 3 | 2 | -- | 60 | 20 | 10 | 10 | 50 | -- | 150 | 3 | 1 | 4 |
| C309 | Internal Combustion Engines | 3 | 2 | - | 60 | 20 | 10 | 10 | - | 50 | 150 | 3 | 1 | 4 |
| C310 | Mechanical Measurement & Metrology | 4 | 2 | -- | 60 | 20 | 10 | 10 | -- | 50 | 150 | 4 | 1 | 5 |
| C311 | Elective -I | 3 | -- | -- | 60 | 20 | 10 | 10 | -- | -- | 100 | 3 | -- | 3 |
| C316 | Professional skill Development-VI | 4 | -- | -- | 100 | - | | - | -- | -- | 100 | 4 | -- | 4 |
| | **Total** | 21 | 8 | -- | 400 | 100 | 50 | 50 | 100 | 100 | 800 | 21 | 4 | 25 |

* End Semester examination of duration 4 Hours.

Total Credits Sem. V – 25

Total Credits Sem. VI – 25

Grand Total - 50

**Elective-I**

1) Machine Tool Design
2) Energy Audit and Management
3) Reliability Engineering
4) Design of Pumps, Blowers and Compressors
5) Management Information System

# Rules for Conducting Tests

**Mode of the test**

- In each semester for each subject three tests shall be conducted. The schedule for the same will be declared at the commencement of academic year in the academic calendar.
- Each test shall carry 20 marks.
- University examination pattern has given weightage of 20 marks for the tests.

- To calculate these marks following procedure is followed:

  i) Out of the three tests conducted during the semester, the marks of only two tests in which the candidate has shown his/her best performance shall be considered, to decide the provisional marks in each subject.

  ii) Average marks obtained in two tests in which students have performed well, shall be considered as provisional marks obtained by the student in the tests.

  iii) If the candidate appears only for two tests conducted during the semester, he/ she will not be given benefit of the best performance in the tests.

  iv) If the candidate appears only for one test conducted during the semester, to calculate the marks obtained in the tests it will be considered that the candidate has got 0 (zero) marks in other tests.

  v) The provisional marks obtained by the candidate in class tests should reflect as proportional to theory marks. In cases of disparity of more than 15% it will be scaled down accordingly; these marks will be final marks obtained by the student. No scaling up is permitted.

  vi) If the candidate is absent for theory examination or fails in theory examination his final marks for tests of that subject will not be declared. After the candidate clears the theory, the provisional marks will be finalized as above.

  - Paper pattern for tests

    i) All questions will be compulsory with weightage as following

    | | | |
    |---|---|---|
    | Question 1 | - | 7 marks |
    | Question 2 | - | 7 marks |
    | Question 3 | - | 6 Marks |

    ii) There will not be any sub-questions.

  - For granting the term it is mandatory to appear for all three tests conducted in each semester.
  - Roll nos. allotted to students shall be the examination nos. for the tests.

# B. TECH. MECHANICAL: SEMESTER- V

## Machine Design I

**(Course No: C301)**

| Teaching Scheme: | Examination Scheme: | | Credits Allotted |
|---|---|---|---|
| Theory:- 03 Hours / Week | End Semester Examination | 60 Marks | 03 |
| Practical:- 02 Hours / Week | Unit Test | 20 Marks | |
| | Assignments | 10 Marks | |
| | Internal Evaluation | 10 Marks | |
| | Term Work / Oral | 50 Marks | 01 |
| | Total | 150 Marks | 04 |

**Course Prerequisite:-** Student should have knowledge of

1. Engineering drawing
2. Mechanical Engineering Drawing
3. Solid Mechanics

**Course Objective:-**

1. To study basic concepts of machine design, aesthetic and ergonomic.
2. To Design of different types of machine elements and to analyze the forces acting on machine element.
3. To Design of machine component for finite and infinite life and subjected to fluctuating load

**Course Outcomes:-** Learner will able to-

1. Understand the basic concept of machine design, engineering material, aesthetic and ergonomic consideration in design
2. Understand the fundamental concepts for design of shaft, keys and coupling and evaluate forces and dimensions.
3. Understand the concept to design Power Screws and analyze it for various applications.
4. Understand the Design concept of spring and evaluate its strength and stiffness.
5. Understand the concept of fasteners and welded joints; analyze when it is subjected to different loading conditions.
6. Understand the basic concept of fluctuating loads and Analyze design of components under fluctuating loads.

### Unit 1 Basic Concept of Machine Design (06 Hrs)

Traditional types of design methods, basic procedure of machine design, introduction to use of standards in design, selection of preferred series, introduction to aesthetic and ergonomic consideration in design. Engineering materials- properties, designation, and selection of material. Weighted point method. Castiglione's theorem.

| | | |
|---|---|---|
| **Unit 2** | **Design of Shafts, Keys & Couplings** | **(06 Hrs)** |

Shaft design on strength basis, shaft design on torsional rigidity basis, ASME code of shaft design, keys – saddle, sunk, feather, woodruff, square, flat, Kennedy key, key design, design of splines, types of couplings, muff coupling, flange coupling, flexible bush pin type coupling.

| | | |
|---|---|---|
| **Unit 3** | **Design of Power Screws** | **(06 Hrs)** |

Forms of threads, differential & compound screw, design of square & trapezoidal threads , self-locking screw, design of power screws, screw jack, recirculating ball screw, design of bolted joint.

| | | |
|---|---|---|
| **Unit 4** | **Design of Springs** | **(06 Hrs)** |

Types, materials, stress & deflection equations for helical, tension & compression spring, torsional and multi leaf springs, styles of ends, nipping of leaf spring, shot peening, spring in series & parallel, concentric springs,

| | | |
|---|---|---|
| **Unit 5** | **Design of Welded & Riveted Joints** | **(06 Hrs)** |

Design of welded joint: advantages, limitations, butt & fillet welds, parallel & transverse fillet welds, axially loaded unsymmetrical welded joint, eccentric loading in plane of weld, welded joint subjected to bending & torsional moment, basic types of riveted joints, different parameters of a riveted joints, uses of riveted joints, failure of riveting joint, strength of riveting joint and efficiency of riveting joints.

| | | |
|---|---|---|
| **Unit 6** | **Design for Fluctuating Load** | **(06 Hrs)** |

Stress concentration - causes & remedies, fluctuating stresses, fatigue failures, S-N curve, endurance limit, notch sensitivity, endurance strength modifying factors, design for finite and infinite life, cumulative damage in fatigue failure, Soderberg, Gerber, Goodman, modified Goodman diagrams, fatigue design of components under combined stresses.

**Assignments**

1. At least five theory of questions based on basic concept of machine design.
2. Two or three design projects which includes details and assembly drawing of shaft and bearing/ types of coupling.
3. Two or three design projects based on screw jack (Details and Assembly)
4. At least five numerical questions based on design of springs.
5. At least five numerical questions based on design of welding.
6. At least five numerical questions based on riveted joints.
7. At least five numerical questions based on design for fluctuating load.
8. At least five theory questions based on design of springs.
9. At least five theory questions based on design of welding.
10. At least five theory questions based on riveted joints.
11. At least five theory questions based on design for fluctuating load.
12. At least one design project by using Auto CAD.

**Term Work**

Term work shall consist of two design projects by using AutoCAD/manually. Design projects should be in the form of system design comprising of machine elements studied in syllabus. Design data book should be used extensively.
Four assignments on remaining topics.

**Text Books**


1. Shigley J. E. and Mischke C. R., "Mechanical Engineering Design", McGraw Hill Publication Co. Ltd.
2. Spotts M. F. and Shoup T.E., "Design of Machine Elements", Prentice Hall International
3. Bhandari V. B, "Design of Machine Elements", Tata McGraw Hill Publication Co. Ltd.
4. Juvinal R. C, "Fundamentals of Machine Components Design", John Wiley and Sons.


**Reference Books**


1. Black P.H. and O. Eugene Adams, "Machine Design", McGraw Hill Book Co. Inc.
2. Willium C. Orthwein, "Machine Components Design", West Publishing Co. and Jaico Publications House.
3. Hall A. S., Holowenko A. R. and Laughlin H. G, "Theory and Problems of Machine Design", Schaum's Outline Series.
4. Sharma C. S. and Purohit Kamlesh, "Design of Machine Elements", PHI Learing Pvt. Ltd.
5. D. K. Aggarwal & Sharma P. C., "Machine Design", S.K Kataria and Sons
6. Gope P. C., "Machine Design: Fundamentals and Applications", PHI Learing Pvt. Ltd.
7. "Design Data- P. S. G." College of Technology, Coimbatore.
8. Bhandari, V. B. "Machine Design data book", Tata McGraw Hill Publication Co. Ltd.


**Unit Tests-**

| | |
|---|---|
| Unit Test-I | Unit-I, II and III |
| Unit Test-II | Unit-IV, V and VI |

## Theory of Machines
**(Course No: C302)**

| Teaching Scheme: | Examination Scheme: | | Credits Allotted |
|---|---|---|---|
| Theory:- 04 Hours / Week | End Semester Examination | 60 Marks | 04 |
| Practical:- 02 Hours / Week | Unit Test | 20 Marks | |
| | Assignments | 10 Marks | |
| | Internal Evaluation | 10 Marks | |
| | Term Work / Oral | 50 Marks | 01 |
| | Total | 150 Marks | 05 |

**Course Prerequisite:-** Student should have knowledge of

1. Fundamentals of engineering mechanics
2. Engineering Mathematics
3. Mechanism of Machine

**Course Objective:-**

1. To develop competency in understanding of theory of all types of gears and to understand the analysis of gear train.
2. To develop competency in understanding of different types of clutch, breakes and dynamometer.
3. To develop competency in drawing the cam profile and understand the follower motion
4. To develop competency in mechanisms for system control with Gyroscope and working mechanism of different types of governors

**Course Outcomes:-** Learner will able to-

1. Understand the kinematics of spur gear, interference and undercutting and evaluate its performance.
2. Understand the kinematics of Helical, Bevel and Worm Gears and apply it to perform force analysis of gears.
3. Understand the concept of inertia of geared systems and gear trains and evaluate torque transmitting capacity and speed in gear trains.
4. Understand the dynamic behaviour principle and operations of clutches, brakes, dynamometers; and evaluate frictional losses and torque transmission capacity.
5. Understand the basics of cam and Follower and apply it to design cam profile for given follower motions.
6. Understand the basic concepts of gyroscopes and governors; and analyze the gyroscopic effect.

### Course Content

**Unit 1 Kinematics of Spur Gears (08 Hrs)**

Classification and applications of gears, terminology of gearing, law of gearing, velocity of sliding, conjugate action, forms of teeth, path of contact, arc of contact, interference, undercutting, methods to avoid interference and undercutting, effect of centre distance variation, friction between gear teeth, involutometry.

## Unit 2 Kinematics of Helical, Bevel and Worm Gears (08 Hrs)

**Helical gears:** Terminology, virtual number of teeth, torque transmitted, Spiral gears: terminology and efficiency.

**Worm gears & bevel gears:** Terminology, geometrical relationships, tooth forces, torque transmitted.

## Unit 3 Inertia of Geared Systems and Gear Trains (08 Hrs)

Inertia of gear systems, types of gear trains - simple, compound, reverted and epicyclic gear trains, analysis of epicyclic gear trains, torque on sun and planet gears, compound epicyclic gear trains, bevel epicyclic gear trains.

## Unit 5 Friction, Clutches , Brakes & Dynamometers (08 Hrs)

**Friction:**

Friction and types of friction, laws of friction, Friction in turning pairs, Friction circle, Friction axis, Friction in 4 bars and single slider crank mechanism.

**Friction Cutches:**

Pivot and collar friction, plate clutches, cone clutch, centrifugal clutch, torque transmitting capacity

**Brakes and Dynamometers:**

Different types of brakes, Shoe brakes, External and internal shoe brakes, Block brakes, Band brakes, Band and block brakes, Braking torques, Different types of absorption and transmission type dynamometers

## Unit 5 Cams & Followers (08 Hrs)

Types of cams and followers, analysis follower, determination of cam profiles analysis of cams with specified contours- of standard motions to the for given follower motions, circular arc cam, eccentric cam, methods of control: pressure angle, radius of curvature and undercutting, kinematically equivalent system, jump phenomenon. Introduction to advanced cam curves.

tangent cam,

## Unit 6 Gyroscopes and Introduction to Governors (08 Hrs)

Gyroscopes, concept of gyroscopic action, gyroscopic couple, effect of gyroscopic couple on ship, airplanes, and vehicles.

Introduction to Governors, Types centrifugal governor (Watt, Porter, and Hartnell governor only), controlling force, governor effort and governor power with numerical treatment, sensitivity, stability, isochronism and hunting, friction, insensitiveness. (No Numerical Treatment)

**Assignments**

1. Minimum five theory questions based on kinematics of spur gear.
2. Minimum five theory questions based on kinematics of helical and bevel gears
3. Minimum five theory questions based on kinematics of worm gear.
4. Minimum five theory questions based on types of gear trains.
5. Minimum five theory questions based on friction clutches.
6. Minimum five theory questions based on brakes & dynamometers.
7. Minimum five theory questions based on cams and followers.
8. Minimum five theory questions based on gyroscopes and governors.
9. Minimum five numerical questions based on helical gear.

10. Minimum five numerical questions based on bevel and worm gears.
11. Minimum five numerical questions based on compound gear trains.
12. Minimum five numerical questions based on brakes and clutches.
13. Minimum five numerical questions based on cams and followers.

(To be solved on drawing sheet).

**Term Work:**

The term work shall consist of the following experiments:

1. To draw conjugate profile for any general type of gear tooth.
2. To generate involute gear tooth profile and to study the effect of undercutting and rack shift using model.
3. To study various types of gearboxes such as: Industrial gear box, Synchromesh gearbox, Differential gearbox, or PIV gearbox.
4. To measure transmitted torque and holding torque of an epicyclic gear train.
5. To study the slip in belt drives.
6. To draw cam profiles for various types of follower motions.
7. To verify gyroscopic couple.
8. To determine the characteristic curves for centrifugal governor and to find its coefficient of insensitiveness and stability.

**Text Books**


1. Ratan S. S., "Theory of Machines", Tata McGraw Hill
2. Beven T ," Theory of Machines", Longman Publication
3. Ballaney P. L. "Theory of Machines", Khanna Publications


**Reference Books**


1. Hannah and Stephans, "Mechanics of Machines", Edward Arnolde Publication.
2. Jagdish Lal, "Theory of Machines ", Metrapolitan Book Co. Pvt. Ltd. N. Delhi.
3. Khurmi, R. S. and Gupta, J. K." Theory of Machines", Eurasia Publishing House (Pvt.) Ltd., New Delhi.
4. Ghosh Malik, "Theory of Mechanism and Machines", East-West Pvt. Ltd..
5. Dr.V.P.singh,"Theory of machine", Dhanpatrai and son.
6. David H. Myszka, "Machines and Mechanism", PHI..


**Unit Tests-**

| | |
|---|---|
| Unit Test-I | Unit-I,II and III |
| Unit Test-II | Unit-IV,V and VI |

## Advanced Computer Graphics & Solid Modelling

**(Course No: C303)**

| Teaching Scheme: | Examination Scheme: | | Credits Allotted |
|---|---|---|---|
| Theory:- 03 Hours / Week | End Semester Examination | 60 Marks | 03 |
| Practical:- 02 Hours / Week | Unit Test<br>Assignments<br>Internal Evaluation | 20 Marks<br>10 Marks<br>10 Marks | |
| | Term Work / Pract. | 50 Marks | 01 |
| | Total | 150 Marks | 04 |

**Course Prerequisite:-**

1. Engineering Graphics
2. Mechanical engineering drawing

**Course Objective:-**

1. To introduce new and exciting field of Intelligent CAD with particular focus on engineering product design.
2. To introduce basic analytical concepts that are used to create and manipulate geometric models by using computer program.
3. To develop competency in engineering design by modern computational methods.
4. To develop 3-D geometric model of machine components including assembly and drafting.

**Course Outcomes:-**

Able to understand-

1. Understand different algorithms and apply it to generate pixel position of points, lines, circles, ellipse and different polygons.
2. Understand the concepts of 2D transformations apply it for composite transformation using homogeneous co-ordinate systems.
3. Understand the concepts 3D transformation and apply for different types of projections.
4. Understand the concepts of geometric modeling and parametric representation apply it to draw analytic and synthetic curves.
5. Understand the concepts of surface modeling and parametric representation apply it for analytic and synthetic surfaces.
6. Understand steps required for solid modeling and the concept of CAD/CAM data exchange.

**Unit 1 Output primitives (06 Hrs)**

Points and Lines, Line Drawing Algorithms-DDA Algorithm, Bresenham's Line Drawing Algorithms, Thick Line Segments. Circle and Ellipse Generation Algorithm.

Polygon-Polygon Filling, Flood Fill, Boundary Fill, Scan Line Fill.

**Unit 2 Two Dimensional Transformations (06 Hrs)**

Basic Transformation – Translation, Rotation, Scaling, Reflection, Shear, Matrix Representation and Homogeneous Co-Ordinates.

Composite Transformations.

**Unit 3 Three-Dimensional Transformations (06 Hrs)**

Introduction to 3D, Translation, Rotation, Scaling, Reflection, Shear, Affine and Perspective Geometry. Orthographic, Axonometric, Oblique Projection.

**Unit 4 Geometrical Modeling (06 Hrs)**

Mathematical Representation of Curves, Wire Frame Model, Wire Frame Entities.
Parametric Representation of Analytic Curves- Lines, Circles, Ellipses. Parametric Representation of Synthetic Curves- Hermit, Cubic-Splines, Bezier Curve, B-Spline Curve.
Curve Manipulation: Displaying, Evaluating Points on Curve, Blending Segmentation.
Surface Manipulation: Displaying, Evaluating Points & Curve on Surfaces, Segmentation, Trimming, Intersection, Projection and Transformations.

**Unit 5 Surface Modeling (06 Hrs)**

Surface Models, Surface Entities, Surface Representation.

Parametric Representation of Analytic Surfaces- Plan Surfaces, Ruled Surfaces, Surface of Revolution, Tabulated Cylinder.
Parametric Representation of Synthetic Surfaces- Hermit, Bi-cubic Surfaces, Bezier Surfaces, B-spline Surfaces.

**Unit 6 Solid Modeling (06 Hrs)**

Solid Models, Solid Entities, Solid Representation, Fundamentals of Solid Modeling, Boundary Representation, Constructive Solid Geometry, Sweep Representation.
CAD/CAM Data Exchange: Evaluation of data exchange formation, IGES data representation & Structure, PDES Data representation, STEP Architecture.

**Assignments:**

1. At least five theory questions based on output primitives.
2. At least five theory questions based on two-dimensional transformation.
3. At least five theory questions based on three-dimensional transformation.
4. At least five theory questions based on geometrical modelling.
5. At least five theory questions based on surface modeling.
6. At least five theory questions based on solid modeling.
7. At least five problems based on algorithms to generate point, lines, circle, ellipse and different polygons.
8. At least five problems based on basic transformations in 2D modelling.
9. At least five problems based on transformations in 3D modelling.
10. At least five theory questions based on parametric representation of synthetic curves.
11. At least five theory questions based on parametric representation of synthetic surfaces.
12. At least five theory questions based on CAD/CAM data exchange.

**Term Work:**

The term work shall consist of record of eight experiments from the following:

1. DDA Line Drawing Algorithm.
2. 2 D Transformation.
3. 3D Transformation.
4. Assignment on 2-D sketching with geometrical and dimensional constraints using any commercially used solid modeling software.

5. Assignment on parametric solid modeling of a machine component using various commands and features of the software.
6. Assignment on solid modeling of the parts of a machine (min. 5 components).
7. Assignment on assembly modeling of the parts modeled in assignment 6 using proper mating conditions and generation of exploded view.
8. Generation of production drawings of the parts and assembly with appropriate tolerancing.

**Reference Books**


1. Ibrahim Zeid and R. Siva-Subramaniam – "CAD/CAM- Theory and Practice", Tata McGraw Hill, Publishing Co. 2009.
2. Rao P. N., "CAD/CAM", Tata McGraw Hill.
3. Foley, Van Dam, Feiner and Hughes, "Computer Graphics Principles and Practice", Second edition, Addison–Wesley, 2000.
4. Martenson, E. Micheal, "Geometric Modelling", John Wiley & Sons, 1995.
5. Hill Jr, F.S., "Computer Graphics Using OpenGL", Pearson Education, 2003.
6. Rao Singeresu S., "Engineering Optimization-Theory and Practice", New Age International Limited Publishers, 2000.
7. Ray C. Johnson. "Optimum Design of Mechanical Elements", Wiley, John & Sons, 1981.
8. Radhakrishnan P., Subramanyam S., "CAD/CAM/CIM", New Age International.
9. Ramamurti V., "Computer Aided Mechanical Design and Analysis", Tata McGraw Hill-1992.


**Unit Tests-**

| | |
|---|---|
| Unit Test-I | Unit-I,II and III |
| Unit Test-II | Unit-IV,V and VI |

# Heat and Mass Transfer

**(Course No: C304)**

| Teaching Scheme: | Examination Scheme: | | Credits Allotted |
|---|---|---|---|
| Theory:- 04 Hours / Week | End Semester Examination | 60 Marks | 04 |
| Practical:- 02 Hours / Week | Unit Test | 20 Marks | |
| | Assignments | 10 Marks | |
| | Internal Evaluation | 10 Marks | |
| | Term Work / Oral | 50 Marks | 01 |
| | Total | 150 Marks | 05 |

**Course Prerequisite:-**

1. Engineering Thermodynamics
2. Engineering Mathematics
3. Fluid Mechanics

**Course Objective:-** To provide the knowledge of

1. laws governing process of heat and mass transfer
2. One dimensional steady, unsteady heat conduction.
3. Natural and forced convection heat transfer, condensation and boiling
4. radiative heat transfer and heat exchangers.

**Course Outcomes:-** Able to understand-

1. Understand laws governing process of heat transfer and use them to analyze practical problems.
2. Understand the concepts of one-dimensional steady heat conduction and use them to analyze practical problems.
3. Understand the concepts of fins, unsteady heat conduction and use them to analyze practical problems.
4. Understand the concepts of natural and forced convection and use them to analyze practical problems.
5. understand the concepts of radiative heat transfer, condensation and boiling and use the concept of radiation to analyze practical problems
6. Understand the concept of mass transfer and analyze the performance of heat exchangers.

## Unit 1 Introduction and Basic Concepts (08 Hrs)

Overview of subject, Modes of heat transfer, Applications of heat transfer in different fields of engineering, Fourier's law of conduction, Newton's law of cooling, Stefan- Boltzmann's law of radiation, Isotropic and anisotropic materials, Three dimensional heat conduction equation in Cartesian coordinate for anisotropic material for steady state condition, and reduction to Fourier equation, Laplace equation and Poisson's equation, Three dimensional heat conduction equation in cylindrical and spherical coordinates (no derivation), Thermal diffusivity.

**One dimensional steady state heat conduction:**

One dimensional steady state heat conduction through a plane wall, cylindrical wall and sphere, Analogy between heat flow and electricity, heat conduction through a composite slab, cylinder and sphere, Overall heat transfer coefficient, Concept of thermal resistance and conductance.

## Unit 2 Thermal Insulation (08 Hrs)

Purpose of insulation, critical radius of Insulation, Economic thickness of Insulation, Thermal contact resistance, thermal conductivity and it's variation with temperature for metals, non metallic solids, gases and liquids, one dimensional problems of variable thermal conductivity.

**One Dimensional Steady State Heat Conduction with Internal Heat Generation:**

Symmetrical boundary condition in plane wall, conduction in solid, hollow cylinder and sphere, practical problems of heat generation.

## Unit 3 Extended Surfaces (08 Hrs)

Heat transfer through extended surfaces, Classification of fins, Derivation of differential equation for fins with constant cross sectional area with insulated tip boundary conditions, Effectiveness and efficiency of a fin, design of thermo well.

**Unsteady state heat conduction :**

System with negligible internal resistance, Biot & Fourier numbers, Criteria for neglecting internal temperature gradient, Concept of time constant

## Unit 4 Convection (08 Hrs)

Introduction to hydrodynamic and thermal boundary layer, Laminar & turbulent flow over & closed conducts, convection heat transfer coefficients & order of magnitude, Dimensional analysis of free & forced convection, physical significance of the dimensionless ,parameters, Nusselt's number, Reynold's number, Prandtl's number, Grashoff's number, Stanton number, Rayleigh number.

**Forced Convection**

Empirical correlations for heat transfer in laminar and turbulent flow over a flat plate and in a circular pipe, Concept of hydraulic diameter, reference temperature.

**Natural Convection**

Flow patterns, Empirical correlations for free convection, heat transfer over horizontal, vertical plate

## Unit 5 Thermal Radiation (08 Hrs)

Fundamental concepts, Black body radiation, Kirchoff's law, Planck's distribution law, Wein's displacement law, Stefan Boltzmann law, Surface emission, relative properties of a surface, Grey, black and real surface, solid angle and intensity of radiation, Lambert's Cosine law, Heat exchange by radiation between two finite black surfaces, Radiation shape factor, use of shape factor charts, Irradiation, radiosity, Electrical network, Heat exchange between two infinitely parallel planes and cylinders, Radiation shields.

**Condensation and Boiling**

Film and drop-wise condensation, heat transfer coefficient for laminar film condensation on vertical and inclined plate (descriptive treatment), Correlations for condensation on and inside tubes, modes of pool boiling,
critical heat flux, pool boiling.

**Unit 6 Heat Exchangers (08 Hrs)**

Classification, Applications of heat exchangers, Heat exchanger analysis, Logarithmic Mean Temperature Difference for parallel and counter flow heat exchangers, LMTD correction factors, fouling factor. The effectiveness: NTD method for parallel and counter flow heat exchangers, Design considerations for heat exchanger.

**Mass Transfer**

Introduction, Modes of mass transfer, Analogy between heat and mass transfer, Mass diffusion (Mass basis, Mole basis), Fick's law of diffusion

**Assignments:**

1. At least five theory questions based on basics concepts of heat transfer.
2. At least five theory questions based on insulation of heat conduction with internal heat generation.
3. At least five theory questions based on extended surfaces and unsteady heat transfer.
4. At least five theory questions based on forced convection.
5. At least five theory questions based on natural convection.
6. At least five theory questions based on radiation and condensation &boiling.
7. At least five theory questions based on heat exchanger and mass transfer.
8. At least five numerical questions based on basics concepts of heat transfer.
9. At least five numerical questions based on insulation of heat conduction with internal heat generation.
10. At least five numerical questions based on extended surfaces and unsteady heat transfer.
11. At least five numerical questions based on forced convection.
12. At least five numerical questions based on natural convection.
13. At least five numerical questions based on thermal radiation and condensation &boiling.

**Term Work:**

Term work shall consist of any eight experiments

1. Determination of thermal conductivity of insulating powder.
2. Determination of thermal conductivity of metal rod.
3. Determination of thermal conductivity of different materials in composite wall.
4. Temperature distribution along a length of a fin and determination of fin effectiveness and fin efficiencies.
5. Determination of film heat transfer coefficient on a hollow vertical tube heated from inside.
6. Determination of film heat transfer coefficient for turbulent flow inside a pipe.
7. Determination of emissivity of a non black surface.
8. Determination of Stefan-Boltzmann constant.
9. Performance of a parallel flow and counter flow heat exchanger.

10. Calibration of thermocouple.
11. Demonstration of a heat pipe.
12. CFD simulation of conduction or convection problem.

**Text Books**


1. Incropera F. P., Dewitt D. P., "Fundamentals of Heat and Mass Transfer", John Wiley.
2. Cengel Y. A. and Ghajar A. J., "Heat and Mass Transfer – Fundamentals and Applications", Tata McGraw Hill Education Private Limited.
3. Sukhatme S. P., "A Textbook on Heat Transfer", Universities Press.
4. Mills A. F., "Basic Heat and Mass Transfer", Pearson.


**Reference Books**


1. Venkatesan S. P., "Heat Transfer", Ane Books Pvt. Ltd.
2. Holman J. P., "Fundamentals of Heat and Mass Transfer", McGraw – Hill publication.
3. Nag P. K., "Heat & Mass Transfer", McGraw Hill Education Private Limited.
4. Thirumaleshwar M., "Fundamentals of Heat and Mass Transfer", Pearson Education India.
5. Sachdeva R.C., "Fundamentals of Engineering Heat and Mass Transfer", New Age Science


**Unit Tests-**

| | |
|---|---|
| Unit Test-I | Unit-I, II and III |
| Unit Test-II | Unit-IV, V and VI |

## Advanced Manufacturing Processes

**(Course No: C305)**

| Teaching Scheme: | Examination Scheme: | | Credits Allotted |
|---|---|---|---|
| Theory:- 03 Hours / Week | End Semester Examination | 60 Marks | 03 |
| | Unit Test<br>Assignments<br>Internal Evaluation | 20 Marks<br>10 Marks<br>10 Marks | |
| | Total | 100 Marks | 03 |

**Course Prerequisite:-** Student should have knowledge of

1. manufacturing processes, Mechanical engineering drawing
2. Basic information of material science

**Course Objective:-**

1. To acquire knowledge of sheet metal working processes and introduce to use of jigs and fixtures.
2. To introduce various non-conventional machining processes and concepts of CNC programming and robotic applications.
3. To acquire knowledge of heat treatment of steels, alloys and introduce to the procedure of processing composites

**Course Outcomes:-** Learner will be able to understand

1. Understand the different press working operations, Dies and evaluate process parameters in manufacturing of sheet metal component
2. Understand the design concepts of Jigs and Fixtures and apply for the manufacturing processes.
3. Understand the different non-conventional machining processes and apply in manufacturing of components.
4. Understand the Concepts of CNC programming and robotic applications in manufacturing industries and apply for multidisciplinary applications.
5. Understand the different heat treatment processes and apply it for engineering applications
6. Understand the stages of powder manufacturing techniques, composite materials and apply for manufacturing components.

### Unit 1 Sheet Metal Working (06 Hrs)

Study of various press tools and presses, Study of various processes like Piercing, Notching forming, drawing, coining *etc*. Elements of dies and punches. Types of dies – simple, compound, combination and progressive dies and punches for various press working operations such as punching, blanking, drawing, bending, forming, coining etc. Calculations of clearances, centre of pressure, forces, press tonnage, blank size, number of draws, strip layout, sheet utilization, ratio. Methods of reducing forces. Design of simple blanking die, Progressive die, & Deep Drawing die.

**Unit 2 Jigs and Fixtures (06 Hrs)**

Definitions, elements, Basic principles and guide lines for design. Location, types of locators and their selection. Clamping, basic principles, types and their selection, indexing methods. Design of drilling jigs. Design of milling& Turning fixtures.

**Unit 3 Non-Conventional Machining (06 Hrs)**

Concept of non-conventional machining. Study of processes like, Electrochemical Machining, Electro Discharge Machining, Abrasive Jet Machining, Plasma Machining, LASER Machining, Ion beam Machining, Ultrasonic Machining, Electron Beam Machining with reference to process capabilities, working principle, Material removal rate, Advantages and limitations.

**Unit 4 C. N. C. Machine Tools & Robotics (06 Hrs)**

Principle of operation of CNC, Types, Features, Direct numerical control (DNC) and its applications. NC part programming, axes nomenclature of CNC machines. Manual part programming using. Computer aided part programming using APT. Types of Robots, construction and operation of robots, robot axes and configuration, robot applications, robot selection and economic justification. FMS, FMC and Adaptive Control.

**Unit 5 Heat Treatment of Steels and Alloys (06 Hrs)**

Iron and Iron Carbide Equilibrium Diagram, Transformation product of Austenite, Martensite transformation, Time- Temperature. Transformation curve, Heat treatment of steels, Annealing, Normalizing, Hardening and tempering, Hard ability, Jominy End quench test, Surface hardening heat treatments, Carburizing, Nitriding, Carbo-nitriding, Induction and flame hardening, Tool steels, Classification, Properties and application of tool steels, Heat treatment of tool steels.

**Unit 6 Powder Metallurgy , Ceramics and Composite Manufacturing (06 Hrs)**

Important characteristics and methods of powder production, different techniques - pressing, extruding, isostatic moulding, fiber metal process, sintering and hot pressing.

Introduction to composite materials, basic concepts, constituent materials for composites, advantages, limitations of composites and application of composites. Manufacturing of Composites: Introduction, molding process for polymer matrix composites, metal matrix composites, ceramic matrix composites.

**Assignments:**

1. At least five numerical questions based on LMTD, NTD and mass transfer.
2. At least five theory questions based on sheet metal working.
3. At least five theory questions based on jigs and fixtures.
4. At least five theory questions based on non-conventional machining.
5. At least five theory questions based on CNC machine tools and robotics.
6. At least five theory questions based on heat treatment of steels and alloys.
7. At least five numerical questions based on calculations of clearances in sheet metal working.
8. At least five numerical questions based on design of simple blanking die.
9. At least five numerical questions based on design of drilling jigs.
10. At least five numerical questions based on design of milling and turning fixtures.
11. At least five theory questions based on economic justification of robot.
12. At least five theory questions based on powder metallurgy.
13. At least five theory questions based on ceramics &composite manufacturing.

**Text Books**


1. Kodgere V. D., "Material Science and Physical Metallurgy", Everest Publication, Pune
2. Donaldson, Lacain and Goold, "Tool Design", Tata McGraw Hill
3. Kempster M. H. A., "Introduction to Jigs and Fixtures Design", Viva Books Ltd.
4. ASTME, "Tools Engineering Handbook"
5. Sharma P. C., "Production Engineering", Khanna Publication
6. Hoffman, "Introduction to Jigs and Fixture", Galgotia Publishers
7. Radhakrishnan P. and Subramanyan CAD/ CAM/CIM Wiley Eastern Ltd.
8. Rao P. N., Tewari N. K. and Kundra T. K., "Computer Aided Manufacturing", Tata McGraw Hill
9. Groover M. P., "Automation, Production System and Computer Integrated Manufacturing",


**Reference Books**


1. Amstead B. H., Philip F, Ostwald and Myron L, Begeman, "Manufacturing Processes" John Wiley and sons, eighth edition.
2. Benidict G. F., "Advanced Manufacturing Processes": Marcel Deker Publisher
3. Cook N. "Manufacturing Analysis", Addison- Wesley Publishing Co., 1966.
4. Weller, "Non-traditional Machining Process": SME Publications.
5. Mishra P. K., "Non-Conventional Machining Process", Narosa Publication.
6. "Production Technology: HMT Ltd", McGraw-Hill Pub. 1986.
7. "Machining Data Handbook: 3rd (Third) edition" Machinability Data Center Technical Staff, 1980


**Unit Tests-**

| | |
|---|---|
| Unit Test-I | Unit-I, II and III |
| Unit Test-II | Unit-IV, V and VI |

## Professional Skill Development-V

**(Course No: C306)**

| Teaching Scheme: | Examination Scheme: | | Credits Allotted |
|---|---|---|---|
| Theory:- 04 Hours / Week | End Semester Examination | 100 Marks | 04 |
| Practical:- -- Hours / Week | Unit Test<br>Assignments<br>Internal Evaluation | -- Marks<br>-- Marks<br>-- Marks | |
| | Total | 100 Marks | 04 |

**Course Prerequisite:-** Student should have knowledge of

1. Basic knowledge of PSD-I, PSD-II, PSD-III and PSD-IV
2. Knowledge of advance vocabulary
3. Awareness of public speaking
4. Basic knowledge of writing skills
5. Basic knowledge of handling criticism and teamwork

**Course Objective:-**

1. To acquaint students with the advance skills in aptitude and reasoning whereby enhancing the employability skills
2. To develop the skills of advance professional communication through advance vocabulary
3. To promote grooming skills in graduates through mock group discussions, mock presentations and mock interviews

**Course Outcomes:-** Learner will able to-

1. Understand advance short tricks of the aptitude and reasoning and apply them in recruitment and competitive examinations
2. Understand the mnemonics for writing a convincing paragraph and apply them in the presentation while handling complex topics in group discussion
3. Understand the various strategies of conflict resolution through amicable way to settle team conflicts/disputes and apply them in handling criticism
4. Understand the various strategies of problem-solving skills and apply them in handling group and team problems
5. Understand the effective time management strategies- Pareto principle (the 80-20 rule of time management) and apply them in the corporate life.
6. Understand the handling Case studies effectively and incorporate the right approach towards Case Studies asked during the recruitment process

**Unit 1 Aptitude (Maths, Logical Reasoning, English) (24 Hrs)**

**Maths**

- Time, Speed & Distance
- Time & Work
- Simple Interest & Compound Interest in continuation
- Maths Revision

**Logical Reasoning**

- Data Interpretation
- Data Sufficiency
- Set Theory & Syllogisms
- Reasoning Revision

**English**

- Grammar – II – (Adjective, Verb, Sub- Verb Agreement)
- Grammar- (Tenses)
- Vocabulary
- Verbal Ability- Revision

| **Unit 2** | **Soft Skills & English Communication** | **(24 Hrs)** |
|---|---|---|

- Situational Conversation
- Situational Writing
- GD Orientation
- Mock GD-1
- Mock GD-2
- Mock GD-3
- Conflict Resolution
- Problem Solving Skills
- Time- Management Skills
- Handling Case Studies
- Management Games
- Business Meeting Etiquettes

**Textbooks**

1. APAART: Verbal Ability
2. APAART: Logical Reasoning
3. APAART: Quantitative Aptitude
4. APAART: Speak Well 1 (English Language and Communication)
5. APAART: Speak Well 2 (Soft Skills)

# B. TECH. MECHANICAL: SEMESTER- VI

# Machine Design II
**(Course No: C307)**

| Teaching Scheme: | Examination Scheme: | | Credits Allotted |
|---|---|---|---|
| Theory:- 04 Hours / Week | End Semester Examination | 60 Marks | 04 |
| Practical:- 02 Hours / Week | Unit Test<br>Assignments<br>Internal Evaluation | 20 Marks<br>10 Marks<br>10 Marks | |
| | Term Work / Oral | 50 Marks | 01 |
| | Total | 150 Marks | 05 |

**Course Prerequisite:-** Student should have knowledge of

1. Solid Mechanics
2. Theory of Machines
3. Machine Design-I

**Course Objective:-**

1. To design and analyze spur and helical gear.
2. To analyze and selection rolling and sliding contact bearings for required application.
3. To study belt, rope and chain drive and evaluate forces acting on it.

**Course Outcomes:-** Learner will be able to-

1. Understand the concepts of design for various manufacturing process and apply it for different mechanical process.
2. Understand the concepts of designing spur gear and apply it to design a spur gear.
3. Understand the concepts of designing Helical gear and apply it to design a helical gear.
4. Understand the concepts of different types of rolling contact bearings and apply selection procedure different applications.
5. Understand the concepts of different types of sliding contact bearings and evaluate parameters of bearing design.
6. Understand technical details about belt, rope and chain drive and evaluate forces acting on belt drive.

## Unit 1 Design For Manufacture (08 Hrs)

General principles of design for manufacture & assembly (DFM & DFME), Principles of design of casting & forging, Design for machining, Design for powder metallurgy, Design for welding.

## Unit 2 Design of Spur Gears (08 Hrs)

Gear drives, Classification of gears, Selection of types of gears, Standard system of gear tooth. Spur Gears: Number of teeth & face width, Types of gear tooth failure, Desirable properties & selection of gear materials, Force analysis, Beam strength, Velocity factor, Service factor, Load concentration factor, Effective load on gear, Wear strength, Estimation of module based on beam & wear strength, Gear design for maximum power capacity, Estimation of dynamic tooth load by velocity factor, Spott's equation, Buckingham's equation, Methods of gear lubrication. Introduction to Gear design standards like AGMA, IS.

**Unit 3 Design of Helical Gears (08 Hrs)**

Transverse & normal module, virtual number of teeth, Force analysis, Beam & wear strength, Effective load on gear tooth, Estimation of dynamic load by velocity factor, Spott's equation, Buckingham's equation.

**Unit 4 Rolling Contact Bearing (08 Hrs)**

Equivalent bearing load, Load life relationship, Selection of bearing life, Selection from manufacturer's catalog, Taper roller bearing, Design for cyclic load & speed, Bearing with probability of survival other than 90%, Lubrication & mounting construction materials, Selection of oil seals & gaskets, Pre loading, Types of failure of bearings and its remedies.

**Unit 5 Sliding Contact Bearing (08 Hrs)**

Basic modes for lubrication, Viscosity. Effect of temperature on viscosity, Viscosity index, Additives, Greases, Selection of lubricants. Viscous flow through rectangular slot, Load carrying capacity & flow requirement of hydrostatic step bearing, Energy losses, Hydrodynamic lubrication, Reynolds equation, Summerfield number, Raimondi & Boyd's method, Temperature rise in hydrodynamic bearings, Parameters of bearing design, Length to diameter ratio, Unit bearing pressure, Radial clearance, Minimum oil film thickness, Constructional details of bearings, Bearing materials & their selection, Sintered metal bearings, Comparison of rolling & sliding contact bearing.

**Unit 6 Belts, Ropes and Chain Drives (08 Hrs)**

Materials and construction of flat and V belts, geometric relationships for length of belt, power rating of belts, concept of slip & creep, initial tension, effect of centrifugal l tension, maximum power condition, selection of flat and V belts from manufacturer's catalogue, belt tensioning methods, relative advantages and limitations of flat and V belts, construction and applications of timing belts .Wire Ropes (Theoretical Treatment Only): Construction of wire ropes, lay of wire ropes, stresses in wire rope, selection of wire ropes, rope drum construction and design. Chain Drives (Theoretical Treatment Only**)**: Types of power transmission chains, Geometry of chain Polygonal effect of chain, Modes of failure for chain, Lubrication of chains.

**Assignments:**

1. At least five theory questions based on basics of design for manufacture.
2. At least five theory questions based on design of spur gears.
3. At least five theory questions based on design of helical gears.
4. At least five theory questions based on rolling contact bearing.
5. At least five theory questions based on sliding contact bearing.
6. At least five theory questions based on belts and ropes drive.
7. At least five theory questions based on chain drives.
8. At least five numerical questions based on design of spur gears.
9. At least five numerical questions based on design of helical gears.
10. At least five numerical questions based on rolling contact bearing.

11. At least five numerical questions based on sliding contact bearing.
12. At least five numerical questions based on belts, ropes and chain drives.
13. At least one design project comprising of machine elements by using Auto CAD.

**Term Work:**

1. Term work shall consist of two design projects by using AUTOCAD/manually. Design projects should be in the form of system design comprising of machine elements studied in syllabus. Design data book should be used extensively.
2. Four assignments- based on remaining topics.
3. Report- Industrial visit to gear manufacturing unit.

**Text Books**


1. Shigley J. E. and Mischke C.R., "Mechanical Engineering Design", McGraw Hil Publication Co. Ltd.
2. Spotts M. F. and S houp T. E., "Design of Machine Elements", P rentice Hall International.
3. Bhandari V. B, "Design of Machine Elements", Tata McGraw Hill Publication Co. Ltd.
4. Juvinal R. C, "Fundamentals of Machine Components Design", John Wiley and Sons.


**Reference Books**


1. Black P. H. and O. Eugene Adams, "Machine Design", McGraw Hill Book Co. Inc.
2. Willium C. Orthwein, "Machine Components Design", West Publishing Co. and Jaico Publications House.
3. Hall A.S., Holowenko A.R. and Laughlin H.G, "Theory and Problems of Machine Design", Schaum's Outline Series.
4. Sharma C. S. and Kamlesh Purohit, Design of Machine Elements, PH I Learing Pvt. Ltd.
5. Aggarwal D. K. & Sharma P.C., "Machine Design", S. K. Kataria and Sons
6. P. C. Gope, "Machine Design: Fundamentals and Applications", PHI Learing Pvt. Ltd.
7. "Design Data - P.S.G." College of Technology, Coimbatore.
8. Bhandari, V. B., "Machine Design data book", Tata McGraw Hill Publication Co. Ltd.
9. Mahadevan K., Balveera Reddy K., "Design Data Handbook for Mechanical Engineers",CBS Publishers


**Unit Tests-**

| | |
|---|---|
| Unit Test-I | Unit-I, II and III |
| Unit Test-II | Unit-IV, V and VI |

## Refrigeration and Air Conditioning
**(Course No: C308)**

| Teaching Scheme: | Examination Scheme: | | Credits Allotted |
|---|---|---|---|
| Theory:- 03 Hours / Week | End Semester Examination | 60 Marks | 03 |
| Practical:- 02 Hours / Week | Unit Test | 20 Marks | |
| | Assignments | 10 Marks | |
| | Internal Evaluation | 10 Marks | |
| | Term Work / Oral | 50 Marks | 01 |
| | Total | 150 Marks | 04 |

**Course Prerequisite:-**

1. Knowledge of basic concepts in heat transfer.
2. Basic information of thermodynamics.
3. Basic knowledge of fluid mechanics.

**Course Objective:-**

1. To study fundamental principles and different methods of refrigeration and air conditioning.
2. Study of various refrigeration cycles and evaluate performance using Mollier charts and/ or Refrigerant property tables.
3. Comparative study of different refrigerants with respect to properties, applications and Environmental issues.
4. Understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.
5. Study of the various equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems.

**Course Outcomes:-**

Able to understand-

1. Different methods of refrigeration systems.
2. Simple vapour compression system and different multi-pressure systems
3. Vapour absorption system and different types of refrigerants
4. Various psychrometric processes used in air conditioning
5. Different components of refrigeration and air conditioning systems
6. Details of ducts for air conditioning system

### Unit 1 Methods of Refrigeration (06 Hrs)

Ice refrigeration, evaporative refrigeration, refrigeration by expansion of air, refrigeration by throttling of gas, vapour refrigeration system, steam jet refrigeration system, refrigeration by using liquid gases, Thermoelectric and ultrasound refrigeration.

**Air refrigeration system:** Definition, refrigeration load, unit of refrigeration, Reverse Carnot cycle, Bell Coleman cycle, Methods of air refrigeration systems, simple air cooling system, boot strap system, reduced ambient system, regenerative system.

**Unit 2 Simple Vapour Compression System (06 Hrs)**

Limitations of air refrigeration system, development of vapour compressor cycle, effect of operating parameters on VCC, use of P-H charts, actual vapour compression cycle.

**Multi Pressure Systems** Introduction to multistage compression, two stage compression with flash gas removal, with liquid intercooler, Cascade systems.

**Unit 3 Vapour Absorption System (06 Hrs)**

Introduction, Simple Vapour absorption system, practical vapour absorption system, COP of an ideal vapour absorption system, Water ammonia system, Electrolux refrigerator, Lithium-Bromide absorption System, Comparison between VCC and VAC (no mathematical treatment).

Refrigerants: Desirable properties of refrigerants, classification of refrigerants, secondary refrigerants, alternative refrigerants for CFC's, HCFC'S, ozone depletion potential (ODP), Global warming Potential (GWP).

**Unit 4 Psychrometry (06 Hrs)**

Introduction, Psychrometric terms, Use of Psychrometric charts, Psychrometric processes, adiabatic saturation temperature, evaporative cooling, by pass factor of coil, efficiency of coil, adiabatic mixing of two air streams, Air washers, Thermodynamics of human body with environment effective temperature, comfort chart, factors influencing human comfort.

**Unit 5 Air Conditioning Systems (06 Hrs)**

Definition, factors, equipment used, classification, all air system, all water system, air water system, unitary and central air conditioning, in filtration and ventilation loads, concepts of SHF, RSHF, ERSHF, ADP.

**Components of Refrigeration and Air Conditioning System:** Compressors, condensers, evaporators, expansion devices such as capillary tubes, automatic expansion valves, thermostatic expansion valves and controls such as thermostats, humidistat, Solenoid, Installation, charging, testing and maintenance, study of modern trends in RAC

**Unit 6 Ducts (06 Hrs)**

Introduction, classification of ducts, duct material, pressure in ducts, flow through duct, pressure losses in duct, friction losses, dynamic losses, air flow through simple duct system, equivalent diameter, for determination of duct size.

**Food Preservation:** Cold storage, control and modified atmosphere (CAMA) storages, mobile refrigeration and air conditioning, refrigerant piping selection, pressure drop, valves, fitting, insulating materials.

**Term Work:**

The term work shall consist of record of any eight experiments from the following:

1. Test on vapour compression test rig.
2. Test on air conditioning test rig.
3. Test on ice plant test rig.
4. Study of non-conventional refrigeration system.
5. Determination of cooling load of air conditioning system (case study).
6. Determination of refrigeration load in cold storage (case study / visit).
7. Study of installation /operation/maintenance practices for refrigeration system.
8. Visit to any refrigeration or air conditioning plant.
9. Trial on heat pump test rig
10. Test on vapour absorption test rig.
11. Market survey of various refrigerating & air conditioning systems which include the equipments with related specifications, manufacturer, cost. ( minimum 3 to 4 equipments)
12. Determination of energy efficiency of refrigeration or air conditioning system.

**Text Books/ Reference Books**


1. Arora C. P., "Refrigeration and Air Conditioning", Tata McGraw Hill
2. Arora S. C., Domkundwar S., "Refrigeration and Air Conditioning", Dhanpat Rai and Company
3. Dossat Ray I, "Principal of Refrigeration", Wiley Eastern Limited
4. Manohar Prasad, "Refrigeration and Air Conditioning", Wiley Eastern Limited
5. Khurmi R. S. and Gupta J. K., "Refrigeration and Air Conditioning", Eurasia Publication House (P) Ltd. New Delhi
6. Stocker W. F. and Jones J. W., "Refrigeration and Air Conditioning", McGraw Hill International Editions


**Unit Tests-**

| | |
|---|---|
| Unit Test-I | Unit-I,II and III |
| Unit Test-II | Unit-IV,V and VI |

# Internal Combustion Engines

**Course No. C309**

| Teaching Scheme: | Examination Scheme: | | Credits Allotted |
|---|---|---|---|
| Theory:- 03 Hours / Week | End Semester Examination | 60 Marks | 03 |
| Practical:- 02 Hours / Week | Unit Test<br>Assignments<br>Internal Evaluation | 20 Marks<br>10 Marks<br>10 Marks | |
| | Term Work / Pract. | 50 Marks | 01 |
| | Total | 150 Marks | 04 |

**Course Prerequisite:-**

1. Knowledge of basic concept heat transfer.
2. Basic information of thermodynamics.

**Course Objective:-**

To provide the knowledge of

1. constructional features of IC engines and air standard cycles
2. various systems used in IC engines for their smooth operations
3. Performance analysis of IC engines.
4. phenomenon of combustion, fuels, emmissions and pollution control in IC engines

**Course Outcomes:-**

Able to -

1. Understand constructional features of IC engines and analyze air standard cycles.
2. Understand fuel supply systems in SI and CI engines and analyze performance of a simple carburetor.
3. Understand IC engine systems viz. ignition, cooling, governing and lubrication.
4. Understand terms related to IC engine testing and analyze their performance.
5. Understand phenomenon of combustion in SI and CI engines.
6. understand details of fuels, emmissions and pollution control in IC engines

**Unit 1 Constructional Features of Reciprocating I. C. Engine (06 Hrs)**

Engine components, Engine classification

**Cycle Analysis of I. C. Engines:**

Fuel air cycle analysis, Comparison of P-V diagram of air standard cycles, Fuel air cycle & actual cycle

**Unit 2 Fuel Supply Systems (06 Hrs)**

**S. I. Engines:**

Carburetion, Mixture requirements, Essential parts of modern carburetor, Carburetors used on automobiles, Calculation of A/F ratio, M.P.F.I. system for modern automobile engines.

**C. I. Engines:**

Functional requirements of an injection system, Typical arrangement of solid injection system, Types of fuel injection system, Fuel pump & fuel injectors, Quantity of fuel & size of nozzle orifice.

**Unit 3 I. C. Engine Systems (06 Hrs)**

**Ignition System:**

Battery & coil ignition system, Magneto ignition system, Electronic ignition system, Advantage over mechanical contact breaker point system.

**Engine Cooling System:**

Air cooling, Water cooling, Thermostatic radiators

**Lubrication System:**

Dry sump lubrication, Wet sump lubrication – Fully pressurized, Oil filters

**Governing System:**

Quality governing, Quantity governing, Hit & miss governing

**Unit 4 Testing & Performance of I. C. Engine (06 Hrs)**

Determination of brake power, Indicated power, Friction power, Determination of brake thermal efficiency, Mechanical efficiency, Volumetric efficiency, Energy balance, Performance characteristics.

**Supercharging:**

Objects of supercharging, Effects on performance, Limits, Methods of Supercharging & turbocharging, Limitation of turbocharging.

**Unit 5 Combustion in S. I. Engines (06 Hrs)**

Stages of combustion, Effect of engine variables on ignition lag & flame propagation, Abnormal combustion: Theories, Effects & Controlling measures, Combustion chambers for S. I. engines.

**Combustion in C. I. Engines:**

Stages of combustion, Ignition delay & factors influencing delay period, Diesel knock & its control, Combustion chambers for C. I. engines.

**Unit 6 Emissions & Pollution Control (06 Hrs)**

Emissions from S. I. and C. I. engines & their harmful effects, Catalytic convertors, Contemporary & proposed emission norms, BHARAT STAGE-I to IV emission norms, EGR system.

**Fuels:**

Types of fuels for I. C. engines, Rating of S. I. & C. I. engine fuels, Alternative fuels for I. C. engines & future trends, Hybrid vehicles.

**Assignment:**

1. At least five theory questions based on constructional features of I.C. engines &cycle analysis of I.C. engine.
2. At least five theory questions based on fuel supply system.
3. At least five theory questions based on I.C. engine system
4. At least five theory questions based on engine testing & performance.

5. At least five theory questions based on combustion of SI Engine.
6. At least five theory questions based on combustion of CI Engine.
7. At least five theory questions based on emissions & pollution control.
8. At least five numerical questions based on constructional features of I.C. engines &cycle analysis of I.C. engine.
9. At least five numerical questions based on fuel supply system.
10. At least five numerical questions based on I.C. engine system
11. At least five numerical questions based on engine testing & performance.
12. At least five numerical questions based on combustion of SI Engine.
13. At least five numerical questions based on combustion of CI Engine.
14. At least five numerical questions based on emissions & pollution control.

**Term Work:**

1. Study of carburetor / MPFI system
2. Study of fuel pump & injector.
3. Trial on multi cylinder petrol engine – Morse Test.
4. Trial on diesel engine to determine energy balance & variable load performance.
5. Variable speed trial on petrol / diesel engine.
6. Trial on computerized I. C. engine to plot P – è diagram.
7. Trial / demonstration of smoke meter & exhaust gas analyzer.
8. Study of battery, magneto & electronic ignition system.
9. Study of superchargers & turbochargers.
10. Study of combustion chambers in S. I. & C. I. engines.
11. Study of recent hybrid cars in market

**Reference Books**


1. Ganesan V., Internal Combustion Engines, Tata McGraw Hill Publishing House
2. M. L. Mathur& R. P. Sharma, A Course in I. C. Engines, DhanpatRai& Sons
3. V. M. Domkundwar, A Course in I. C. Engines, DhanpatRai& Co.
4. Shrinivasan, Automobile Engines, Tata McGraw Hill Publishing House – CBS Publication


**Unit Tests-**

| | |
|---|---|
| Unit Test-I | Unit-I, II and III |
| Unit Test-II | Unit-IV, V and VI |

## Mechanical Measurement & Metrology
**(Course No: C310)**

| Teaching Scheme: | Examination Scheme: | | Credits Allotted |
|---|---|---|---|
| Theory:- 04 Hours / Week | End Semester Examination | 60 Marks | 04 |
| Practical:- 02 Hours / Week | Unit Test<br>Assignments Internal<br>Evaluation | 20 Marks<br>10 Marks<br>10 Marks | |
| | Term Work / Pract. | 50 Marks | 01 |
| | Total | 150 Marks | 05 |

**Course Prerequisite:-** Student should have knowledge of

1. Students should have Basic knowledge of Mechanical terms Force, Pressure, Temperature, and Electronics terms like as Voltage, Resistance and Current.
2. Students should have Basic knowledge of Measuring Units, Mathematics, and Various Measurement terms.

**Course Objective:-** Student should be able to

1. Use various precision measuring instruments *viz.* Vernier caliper, micrometer *etc.*
2. Acquire knowledge of different sensors and transducers
3. Acquire knowledge of tolerances, gauges and measurement of surface finish

**Course Outcomes:-** Learner will be able to…

1. Understand static and dynamic characteristics of measurement systems
2. Know different devices used for linear and angular measurement
3. Measure temperature, pressure, strain and fluid flow using different sensors for various applications
4. Using of concepts like limits, fits and tolerances for designing the limit gauges.
5. Use displacement, velocity, position, force, torque, level sensors for specific applications
6. Measure various screw thread or gear tooth parameters using specific equipment's.

**Unit 1 Introduction to Measurement systems (08 Hrs)**

Significance of Measurements, Mechanical Measurements, Classification of Measuring Instruments, Generalized Measurements Systems.

**Static Characteristics of Measurement Systems**: Sensitivity, Calibration, Accuracy, Linearity, Static Error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span, Range.

**Dynamic Characteristics of Measurement Systems**: Speed of response and measuring lag, fidelity and dynamic error, overshoot, dead time and dead zone. Standard test inputs: Step. Ramp, Impulse and Sinusoidal Inputs.

**Errors in Measurements**: Types & Sources of Errors and Uncertainty Analysis in Measurements. Probable Errors.

**Unit 2 Introduction to Metrology (08 Hrs)**

Meaning of metrology & its Importance.

**Linear Measurement :**

Standards - line standard, end standard, wave length standard, classification of standards, precision, and non-precision measuring instrument, slip gauges, Different types of Vernier, Micrometer, Dial Gauges. Concept of Magnification.

**Angular Measurement:**

Sine bar, Sine center, Uses of sine bar, angle gauge, Auto Collimator, Angle Dekkor, angle slip gauges, Constant Deviation Prism.

**Unit 3 Sensors and Transducers (08 Hrs)**

Concept of sensors and transducers. Significance of Transducers in Measurement and Instrumentation System. Classification and Selection Parameters of Transducers. Basic components of DAQ, Concept of signal conditioning.

**Strain Measurement:** Theory & Classification of Strain gauges, Gauge Factor, Temperature compensation, Wheatstone Bridge Circuit.

**Temperature measurement:** Resistance Temperature Detector(RTD), Thermocouples & Laws of thermocouples, Resistance Thermometers & Thermistors, Optical Pyrometers

**Pressure measurement:** Diaphragm Pressure Gauge, Bourdon Tube, Bellows, McLeod Gauge, Piezoelectric Sensor, Tactile Sensor

**Flow measurement:** Hot Wire anemometer, Thermal flow meters, Electromagnetic flow meter, Ultrasonic Flow meter, Turbine Meter

**Unit 4 Tolerances and Gauging (08 Hrs)**

**Limits, Fits, Tolerances:**

Meaning of limit, Fits and Tolerance, Cost-Tolerance relationship, concept of Interchangeability, Indian Standard System (ISS).

**Design of Limits Gauges:**

Types, Uses, Taylor's principle, Design of limit gauges. Inspection of geometric parameters: Straightness, Parallelism, Concentricity, Squareness and circularity.

**Comparators:** Uses, types, advantages and disadvantages of various types of comparators.

**Advances in Metrology**: Introduction of CMM, Types of CMM

**Unit 5 Displacement, Velocity and Position Sensors, Force and Torque, Level Thickness Measurement (08 Hrs)**

**Displacement, Velocity and Position Sensors:** Potentiometer, LVDT, Hall Effect Sensor, optical encoders, Proximity Sensors, Tachogenerator.

**Force and Torque Measurement:** Load Cell and its different types, Torque measurement using strain gauges, Torsion Meter.

**Acceleration Sensors:** Displacement Seismic Accelerometer, Strain gauge Accelerometer, Piezoelectric Accelerometer, Potentiometric Accelerometer

**Level measurement & Thickness Measurement:** Electrical Methods (Resistive & Capacitive), Laser Level Sensor, Ultrasonic Liquid Level Detector. Thickness measurement using contact and non-contact type devices

**Unit 6 Measurement of Surface finish, Screw Thread, Gear Metrology (08 Hrs)**

**Surface Finish Measurement:**

Surface texture, Meaning of RMS and CLA values, Tomlinson's Surface meter, Taylor-Hobson surface meter, grades of roughness, specifications

**Screw Thread Metrology:**

External screw threads terminologies, floating carriage instruments, pitch and flank measurement of external screw thread, application of Tool Makers Microscope, use of profile projector.

**Gear Metrology:**

Spur gear parameters, gear tooth thickness measurement, gear tooth Vernier caliper, constant chord method, span micrometer, base tangent comparator.

**Interferometry:**

Introduction, flatness testing by interferometry, NPL flatness interferometer. Study of measuring machines, recent trends in engineering metrology.

**Assignments:**

1. At least five theory questions based on static & dynamic characteristics of measurement systems measurement system
2. At least five theory questions based on errors in measurements measurement system
3. At least five theory questions based on linear measurement in metrology
4. At least five theory questions based on angular measurement in metrology
5. At least five theory questions based on strain and temperature measurement sensors.
6. One small project based on strain measurement and temperature measurement using sensors.
7. At least five theory questions based on pressure & flow measurement sensors.
8. At least five theory questions based on tolerances, gauging & comparators.
9. At least five numerical questions based on tolerances & gauging.
10. At least five theory question based on velocity and displacement sensors.
11. At least five theory question based on force, torque sensors.
12. One small project based on force measurement for different applications.
13. At least five theory question based on level & acceleration sensors.
14. One small project based on level measurement for different applications.
15. At least five theory question based on level measurement & thickness measurement sensors.
16. At least five theory question based on surface finish measurement.
17. At least five theory question based onscrew thread metrology.
18. At least five theory question based on gear metrology.
19. At least five theory question based on interferometry.

**Term Work:**

1. Study & Calibration of Thermocouples (J & K-Type)/RTD(PT-100)
2. Study & Calibration of Pressure Measurement, & Vacuum Measurement
3. Measurement of Load/Force using Load Cells
4. Displacement & Angle measurement using LVDT & Encoder Sensor
5. Study of Different Switches & Relays
6. Vibration Measurement using Accelerometer.
7. Level Measurement using Capacitive Transducer.
8. Study of Data Acquisition System and Interfacing of sensors with computer using DAQ Cards (NI DAQ Card)

9. Study of Linear and Non Linear Measuring Instruments.
    i) Measurement of the surface roughness.
    ii) Measurement of angle by sine bar/sine center.
    iii) Measurement of optical surface using Interferometer.
    iv) Measurements of screw tread parameters using Floating Carriage Micrometer.
    v) Measurement of gear tooth thickness using gear tooth vernier caliper and span micrometer
    vi) Study and experiment on profile projector/Tool makers microscope
    vii) Industrial visit to Automation Company and Inspection & Quality control division of any Industry with detail report.

**Text Books**


1. Ramchandran K. P., Vijyaraghavan G. K., Balasundaram M. S., "Mechatronics: Integrated Mechanical Electronic Systems", John Wiley & Sons, 2008.
2. Bolton W., "Mechatronics - A Multidisciplinary approach", 4th Edition, Prentice Hall, 2009.
3. Kumar D. S., "Mechanical Measurement & Control", Metropolitan Book Co. Pvt. Ltd. New Delhi, 2007
4. Singh M. D. and Joshi J. G., "Mechatronics", 3rd Edition, Prentice Hall, New Delhi, 2009.
5. Beckwith T. G., Marangoni R. D., Lienhard J. H., "Mechanical Engineering Measurements", Pearson Prentice Hall, 2007
6. Jain R. K., "Engineering Metrology", Khanna Publishers
7. Hume K. J., "Engineering Metrology", Macdonald, 1950
8. Sharp K. W. B., "Practical Engineering Metrology", Pitman Publication, 1970
9. Kuber S. S., "Metrology and Quality Control", Nirali Prakashan


**Reference Books**


1. Doebelin Ernesto, "Measurement Systems", McGraw Hill International Publication Co. New York, 4th Edition,1990.
2. Sawhney A. K. and Sawhney P., "Mechanical Measurement and Control", Dhanpat Rai and Company Pvt. Ltd., New Delhi, 12th Edition,2010.
3. Figliola R. S., Beasley D. E., "Theory and design for mechanical measurements", , Wiley India Edition.
4. Alciatore & Histand, "Introduction to Mechatronics and Measurement System", 4th Edition, Mc-Graw Hill publication, 2011.
5. Bishop (Editor), "Mechatronics – An Introduction", CRC Press, 2006.


**Unit Tests-**

| | |
|---|---|
| Unit Test-I | Unit-I,II and III |
| Unit Test-II | Unit-IV,V and VI |

# Machine Tool Design
**(Course No: C311)**

| Teaching Scheme: | Examination Scheme: | | Credits Allotted |
|---|---|---|---|
| Theory:- 03 Hours / Week | End Semester Examination | 60 Marks | 03 |
| | Unit Test | 20 Marks | |
| | Assignments | 10 Marks | |
| | Internal Evaluation | 10 Marks | |
| | Total | 100 Marks | 03 |

**Course Prerequisite:-**

1. Fundamentals of Mechanical Engineering
2. Production Practice- I, Production Practice- II, Manufacturing Process Production Practice – III Advanced Manufacturing Processes
3. Material Science, Theory of Machines, Machine Design -I

**Course Objective:-** To study

1. Introduction to machine tool drive, mechanisms and regulation of speed and feed rates.
2. Design of machine tool structures, guide ways and power screws
3. Design of spindle, spindle supports and acceptance test for machine tools
4. Automatic drives for machine tools and maintenance /repair of machine tools

**Course Outcomes:-** Students should be able to

1. Understand the fundamentals of machine tool design
2. Understand and apply concepts in multispeed gear box to get required speed steps in machine tool applications
3. Understand the design considerations for machine tool structures
4. Analyze the guide ways and use of the power screws in machine tool applications
5. Analyze spindles, bearings for spindle supports and understand use of standard acceptance tests
6. Understand mechanization of automatic drives and basics of maintenance , restoration techniques of machine tools

## Unit 1 Introduction to Machine Tool Drives and Mechanisms (06 Hrs)

General Principles of Machine Tool Design: Working and Auxiliary Motions in Machine Tools. Parameters Defining. Working Motions of a Machine Tool. Machine Tool Drives. Hydraulic Transmission and its Elements. Mechanical Transmission and its Elements. Techno-Economical Prerequisites for Undertaking the Design of New Machine Tool. General Requirements of Machine Tool Design. Engineering Design Process Applied to Machine Tools. Layout of Machine Tools, Modular Concept of Machine tool design.

**Unit 2 Regulation of Speed and Feed Rates (06 Hrs)**

Aim of speed and feed rate regulation. Stepped regulation of Speed: Design of speed box – Design of Feed Box – Machine Tool Drives using Multiple Speed Motions– Special Cases of Gear Box Design–General

Recommendations for Developing the Gearing Diagram–Step less Regulation of Speed and Feed Rates, VFD and VVFD drives-Design Considerations. Motors: three phase induction motors-stepper motor, servo motor and universal motor.

**Unit 3 Design of Machine Tool Structures (06 Hrs)**

Functions of Machine Tool Structures and their requirements – Design criteria for machine tool structures – Materials of machines Tools structures
– Static and Dynamic stiffness – Profiles of machine tool structures – Basic Design procedure of machine tool structures – Design of Beds – Design of Columns – Design of Housings – Design of Bases and Tables – Design of Cross Rails, Arms, Saddles and carriages – Design of Rams.

**Unit 4 Design of Guide-ways and Power Screws (06 Hrs)**

Functions and types of Guide-ways – Design of Slide-ways – Design criteria and calculations for slide-ways – Guide-ways operative under liquid friction conditions. Design of Anti-Friction Guide-ways – Combination Guide ways – Protecting devices for slide-ways Design of power screws (Sliding & Rolling friction), Preloading of power screws. Design with reference to advanced machine tools.

**Unit 5 Design of Spindles and Spindle Supports (06 Hrs)**

Functions of Spindle Unit and requirements – Materials of Spindles – Effect of machine tool compliance on machining accuracy- Design calculations of spindles Anti friction bearing – Sliding bearings. Preloading of bearings. Bearings selection for machine tools.

**Acceptance tests for Machine Tools:**
Acceptance tests: Object and Procedure for acceptance test, Instruments required, sequence of acceptance test, standard acceptance test chart.ISO 230-1: 1996, ISO-2:2014.

**Unit 6 Automatic Drives for Machine Tools (06 Hrs)**

Principles of automation. Automatic lathes with mechanical control. Design of cams for automatic screw cutting machines. Automatic loading and feeding of work pieces. Transfer devices in automatic machine tool systems. Modular design and unit heads for machine tools. Automatic in- process gauging.

**Maintenance and repair of Machine Tools:**
Types of Maintenance, Break down and preventive Maintenance, Organization of Maintenance department, Economic aspects of Preventive Maintenance, Restoration techniques.

**Assignments:**

1. At least five theory questions based on machine tool drives & mechanisms.
2. At least five theory questions based on layout of machine tool.
3. At least five theory questions based on regulation of speed & feed rates.
4. At least five theory questions based on design of feed box.
5. At least five theory questions based on types of motors used in machine tool.
6. At least five theory questions based on VFD and VVFD drives.
7. At least five theory questions based on design of machine tool structure.
8. At least five theory questions based on design of guide ways and power screws.
9. At least five theory questions based on design of spindles.
10. At least five theory questions based on design of spindle supports.
11. At least five theory questions based on acceptance tests for machine tools.
12. At least five theory questions based on automatic drives for machine tools.
13. At least five theory questions based on transfer devices in automatic machine tool systems.

**Text Books / Reference Books**


1. Basu S. K., "Design of Machine Tools", Allied Publisher, 1989.
2. Sen G. S. & Bhattacharya, "Principles of Machine Tools", New Central Book Agency, Calcutta – 1986.
3. Acherkan N., "Machine Tool Design", Vol. 2 & 3 Mir publishers, Moscow, 1968.
4. Mehta N. K., "Machine Tool Design", TMII.
5. Russe W. Henke, "Introductionto Fluid Power Circuits and Systems", Addison Wesley, 1970
6. Koenigs Berger & Tlusty, "Design of Machine Tools", Pergaman Press 1970.


**Unit Tests-**

| | |
|---|---|
| Unit Test-I | Unit-I, II and III |
| Unit Test-II | Unit-IV, V and VI |

## Energy Audit and Management
**(Course No: C312)**

| Teaching Scheme: | Examination Scheme: | | Credits Allotted |
|---|---|---|---|
| Theory:- 03 Hours / Week | End Semester Examination | 60 Marks | 03 |
| | Unit Test<br>Assignments<br>Internal Evaluation | 20 Marks<br>10 Marks<br>10 Marks | |
| | Total | 150 Marks | 03 |

**Course Prerequisite:-** Student should have knowledge of

1. Fundamentals of Electrical Engineering
2. Engineering Thermodynamics
3. Heat and Mass Transfer

**Course Objective:-** To provide the knowledge of

1. energy conservation, management, economics and Audit
2. material and energy balance
3. thermal and electrical energy management

**Course Outcomes:-** Students should be able to

1. Understand the concepts of energy conservation, audit and management
2. Understand the concepts of material and energy balance and perform analysis of systems.
3. understand the concepts of economics, retrofit and analyze systems using energy economics
4. understand the concepts of electrical energy management and analyze electrical systems using these concepts
5. understand the concepts of thermal energy management and analyze thermal systems using these concepts
6. understand the concepts of energy audit instruments and apply the concepts of energy audit and management to real life problems

**Unit 1 Energy Conservation: (06 Hrs)**

Energy Conservation and its Importance; Energy Strategy for the Future; The Energy Conservation Act, 2001 and its Features
**Energy Management:** Definition & Objectives of Energy Management; Importance; Indian need of Energy Management; Duties and responsibilities of energy managers.

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|---|---|---|
| **Unit 2** | **Material and Energy Balance** | **(06 Hrs)** |

Basic Principles, Sankey diagrams, Material balances for different processes, Energy balances, heat balances, Methods for preparing process flow chart, Procedure to carry out the material and energy balance in different processes.

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|---|---|---|
| **Unit 3** | **Economic Analysis of Energy Conservation Measures** | **(06 Hrs)** |

Retrofit: Power plant retrofit, Home energy retrofit.
Economics:
Fundamentals: Cash flows, Inflation Rates, Time Points and Periods, Discount Rates, Cost of Capital, Present value, Taxes, Uncertainty and Risk
Economic Measures: Net Present Value, Total Life-Cycle Cost, Revenue Requirements, Internal Rate of Return, Modified Internal Rate of Return, Simple Payback Period, Discounted Payback Period, Benefit-to-Cost Ratios, Savings-to-Investment Ratios, Profitability index estimation

| | | |
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| **Unit 4** | **Electrical Energy Management** | **(06 Hrs)** |

Supply side: Methods to minimize supply-demand gap, renovation and modernization of power plants, reactive power management, HVDC, and FACTS.
Demand side: conservation in motors, pumps and fan systems; energy efficient motors.
Case Studies on Electrical Energy Management

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| **Unit 5** | **Thermal energy Management** | **(06 Hrs)** |

Energy conservation in boilers, steam turbines and industrial heating systems; Application of FBC; Cogeneration and waste heat recovery; Thermal insulation; Heat exchangers and heat pumps; Building Energy Management. Case Studies on Thermal Energy Management

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|---|---|---|
| **Unit 6** | **Energy Audit** | **(06 Hrs)** |

Energy Audit: Types and Methodology; Scope of Energy Audit, Energy Audit Reporting Format; Understanding Energy Costs; Benchmarking and Energy Performance; Matching Energy Usage to Requirement; Maximizing System Efficiency; Fuel and Energy Substitution; Energy Audit Instruments; Duties and responsibilities of energy auditors. Energy Management of Buildings and Energy Audit of Buildings. - Energy management matrix monitoring and targeting
Case Studies

**Assignments:**

1. At least five theory questions based on energy conservation.
2. At least five theory questions based on energy management.
3. At least five theory questions based on material and energy balance.
4. At least five theory questions based on economic analysis of energy conservation measures.
5. At least five theory questions based on economic measures of energy conservation.
6. At least five theory questions based on electrical energy management.
7. At least five theory questions based on thermal energy management

8. At least five theory questions based on concept of energy audit.
9. At least five theory questions based on case studies of electrical energy management.
10. At least five theory questions based on building energy management.
11. At least five theory questions based on case studies of thermal energy management.
12. At least five theory questions based on case studies of energy audit.

**Reference Books**


1. Amlan Chakrabarti, "Energy Engineering and Management", PHI Learning, New Delhi 2012
2. Mirjana Golusin, Sinisa Dodic, Stevan Popov, "Sustainable Energy Management", Academic Press
3. Shaligram Pokharel, "Energy Analysis for Planning and Policy", CRC Press, 2014
4. Trivedi P R, Jolka K R, "Energy Management", Commonwelth Publications, New Delhi
5. Y P Abbi, Shashank Jain, "Handbook on Energy Audit and Environment Management", TERI
6. General Aspects of Energy Management and Energy Audit, Buro of Energy Efficiency
7. Frank Krieth, D Yogi Goswami, "Energy Management and Conservation Handbook", CRC Press
8. Alburt Thumann, William J Younger, Terry Niehus, "Handbook of Energy Audits", 9th Ed, Better World Books


**Unit Tests-**

| | |
|---|---|
| Unit Test-I | Unit-I, II and III |
| Unit Test-II | Unit-IV, V and VI |

# Reliability Engineering

**(Course No. C313)**

| Teaching Scheme: | Examination Scheme: | | Credits Allotted |
|---|---|---|---|
| Theory:- 03 Hours / Week | End Semester Examination | 60 Marks | 03 |
| | Unit Test<br>Assignments<br>Internal Evaluation | 20 Marks<br>10 Marks<br>10 Marks | |
| | Term Work / Oral | -- Marks | |
| | Total | 100 Marks | 03 |

**Course Prerequisite:-**

Student should have knowledge of-

1. Engineering Mathematics
2. Engineering Science
3. Mechanical Measurement and Metrology

**Course Objective:-**

1. To provide a well-founded introduction to system reliability practices critically
2. To introduce various methods of reliability analysis with real time problems with constraints and basic concepts of maintenance and reliability.
3. To construct models for the estimation and improvement of reliability parameters of manufactured products and components.
4. To introduce the principles and techniques of Statistical Quality Control and their practical uses in product/process design and monitoring.

**Course Outcomes:-**

Student should be able to

1. Understand the concept of reliability, common reliability functions, parameters and evaluate reliability measures.
2. Understand the importance of statistical distributions and apply it for failure data analysis.
3. Understand the concept of Reliability Systems and evaluate redundancy by various methods.
4. Understand the concepts of maintainability and availability of product/component systems and evaluate Reliability allocation using different methods.
5. Understand the concept of reliability functions and parameters of product/component systems apply it for fault tree analysis.
6. Understand different methods for reliability testing of a system.

## Unit 1 Fundamental Concepts of Reliability and Reliability Measures (06 Hrs)

Brief history, concepts, terms and definitions, applications, the life cycle of a system, concept of failure, typical engineering failures and their causes

**Reliability Measures:** Reliability function–R(t), cumulative distribution function (CDF)–F(t), probability density function (PDF) – f(t), hazard rate function-λ(t), Mean time to failure (MTTF) and Mean time between failures (MTBF), typical forms of hazard rate function, bathtub curve

**Unit 2 Probability Concepts and Failure Data Analysis (06 Hrs)**

Theory of probability, rules of probability, Introduction to independence, mutually exclusive, conditional probability random variables, discrete and continuous probability distributions. Binomial, normal Comparison of probability distributions - , lognormal, Weibull, exponential, Standard deviation, variance, mean, mode and Central Limit Theorem.

**Failure Data Analysis:** Data collection and empirical methods, estimation of performance measures for ungrouped complete data, grouped complete data, analysis of censored data, fitting probability distributions graphically (Exponential and Weibull) and estimation of distribution parameters.

**Unit 3 Reliability Evaluation of Systems (06 Hrs)**

Reliability Improvement Redundancy, element redundancy, unit redundancy, standby redundancy -types of stand by redundancy, parallel components single redundancy, multiple redundancies, cut and tie set approach for reliability evaluation. Star and delta method, matrix method (Numerical).

**Unit 4 Maintainability and Availability (06 Hrs)**

Concept of maintainability, measures of maintainability, mean time to repair (MTTR), analysis of downtime, repair time distributions, stochastic point processes, maintenance concept and procedures, availability concepts and definitions, important availability measures.

Introduction to Reliability allocation or apportionment, reliability apportionment techniques- equal apportionment, AGREE, ARINC, Minimum effort method (Numerical)

**Unit 5 Design for Reliability and Maintainability (06 Hrs)**

Reliability design process and design methods, reliability allocation, failure modes, effects and criticality analysis (FMECA), fault tree and success tree methods, symbols used, maintainability design process, quantifiable measures of maintainability, repair versus replacement.

**Unit 6 Reliability Testing (06 Hrs)**

Introduction to reliability testing, Stress strength interaction, Introduction to Markov model, Testing for Reliability and Durability - Accelerated Life Testing and Highly Accelerated Life Testing (HALT), highly accelerated stress Screening (HASS)

**Assignments:**

1. At least five theory questions based on fundamental concepts of reliability.
2. At least five theory questions based on reliability measures.
3. At least five theory questions based on probability concepts
4. At least five theory questions based on failure data analysis.
5. At least five theory questions based on reliability evaluation systems
6. At least five theory questions based on maintainability & availability
7. At least five theory questions based on design for reliability& maintainability.
8. At least five theory questions based on reliability testing.
9. At least five numerical questions based on fundamental concepts of reliability.
10. At least five numerical questions based on reliability measures.
11. At least five numerical questions based on probability concepts
12. At least five numerical questions based on failure data analysis.
13. At least five numerical questions based on reliability evaluation systems
14. At least five numerical questions based on maintainability & availability
15. At least five numerical questions based on design for reliability & maintainability.
16. At least five numerical questions based on reliability testing.

**Reference Books**


1. Ebling C. E., 2004, "An Introduction to Reliability and Maintainability Engineering", Tata McGraw Hill Education Private Limited, New Delhi.
2. Srinath L. S., 1991, "Reliability Engineering", East West Press, New Delhi.
3. Birolini A., 2010, "Reliability Engineering: Theory and Practice", Springer.
4. Parkhi R. M., "Market Leadership by Quality and Reliability", Vidyanand Publications 2012.
5. Roy B. and Allan R. N., 1992, "Reliability evaluation of engineering systems: concepts and techniques", Springer.
6. Patrick D. T. Newton O'Conner, D., Bromley R., 2002, "Practical Reliability Engineering", John Wiley and Sons.
7. Rao S. S., 1992, "Reliability Based Design. Mcgraw-hill
8. Andrew Kennedy, Skilling Jardine, Albert H. C. Tsang, 2006, "Maintenance, Replacement and Reliability: Theory and Applications", CRC/Taylor and Francis.
9. Nachlas Joel A., 2005, "Reliability Engineering: Probabilistic Models and Maintenance Methods" Taylor and Francis.
10. Dhillon B. S., Singh C., 1981, "Engineering Reliability – New Techniques and Applications", John Wiley and Sons.
11. Dhillon B. S., 1999, "Engineering Maintainability", Prentice Hall of India.


**Unit Tests-**

| | |
|---|---|
| Unit Test-I | Unit-I, II and III |
| Unit Test-II | Unit-IV, V and VI |

## Design of Pumps, Blowers and Compressors
**(Course No: C314)**

| Teaching Scheme: | Examination Scheme: | | Credits Allotted |
|---|---|---|---|
| Theory:- 03 Hours / Week | End Semester Examination | 60 Marks | 03 |
| | Unit Test<br>Assignments<br>Internal Evaluation | 20 Marks<br>10 Marks<br>10 Marks | |
| | Total | 100 Marks | 03 |

**Course Prerequisite:-** Student should have knowledge of
1. Engineering Thermodynamics
2. Turbomachinery
3. Machine Design I

**Course Objective:-** To provide the knowledge of
1. concepts of fluid machinery
2. theory and design of centrifugal pumps and compressors
3. theory and design of fans and blowers.

**Course Outcomes:-** Student must be able to understand-
1. understand the concepts of fluid machinery and analyze their performance
2. understand the theory of centrifugal pumps and analyze their performance.
3. understand the design considerations for centrifugal pumps and apply them for basic pump design.
4. understand the theory of fans, blowers and analyze their performance.
5. understand the design considerations for fans, blowers and apply them for their basic design. understand the theory and design considerations of rotary compressors and apply them for basic compressor design

**Unit 1 Review of Principles of Fluid Machinery (06 Hrs)**

- Basic equations of energy transfer between fluid and rotor.
- Performance characteristics.
- Dimensionless parameters, specific speed, stage velocity triangles, work and efficiency.

**Unit 2 Theory of Centrifugal Pumps (06 Hrs)**

- **C**alculation of tangential and axial thrust methods to minimize axial thrust.
- Impellers, casings, volutes, vane velocity vector diagrams, work done and head developed by pumps.
- Efficiency and losses in pumps (mechanical, hydraulic etc.), specific speed.
- Calculation of power requirement, NPSH for pump selection, effects of cavitation on pump performance, operating characteristics.

**Unit 3 Design of Pumps (06 Hrs)**

- Introduction to design procedure of pumps.
- Thermal design- selection of materials for high temperature and corrosive fluids.
- Hydraulic design- selection of impeller and casing dimension using industrial manuals.

**Unit 4 Theory of Fans and Blowers (06 Hrs)**

- Classification of blowers, basics of stationary and moving air, Euler's characteristics, velocity triangles and operating pressure conditions.
- Equations for blowers, losses and hydraulic efficiency, flow through impeller casing inlet nozzle, volute, diffusers, mechanical losses.
- Rotor design, airfoil theory, vortex theory, cascade effects, degree of reaction.
- Blade twist stage design, surge and stall, stator and casing, mixed flow impellers, applications of blowers and fans.

**Unit 5 Design of Fans and Blowers (06 Hrs)**

- Design procedure for selection of blowers, stage pressure rise, stage parameters and design parameters.
- Design of impeller and casing dimension in aerodynamic design.

**Unit 6 Theory and Design of Compressors (06 Hrs)**

- Basic theory, classification and application, working with enthalpy- entropy diagram, construction and approximate calculation of centrifugal compressors.
- Impeller flow losses, slip factor, diffuser analysis, performance curves of centrifugal compressors.
- Basic design features of axial flow compressors; velocity triangles, enthalpy-entropy diagrams, stage losses and efficiency, work done factor, simple stage of axial flow compressors, applications of compressors.

**Assignments:**

1. At least five theory questions based on principles of fluid machinery.
2. At least five theory questions based on centrifugal pump.
3. At least five theory questions based on design of procedure of pump.
4. At least five theory questions based on fans.
5. At least five theory questions based on blowers.
6. At least five theory questions based on design of compressors.
7. At least five numerical questions based on fluid machinery for work and efficiency calculations.
8. At least five numerical questions based on calculation of tangential and axial thrust methods to minimize axial thrust of centrifugal pump.
9. At least five numerical questions based on calculations of power requirement and selection of centrifugal pump.
10. At least five numerical questions based on hydraulic and thermal design of pump.
11. At least five numerical questions based on fans and blowers.
12. At least five numerical questions based on design of impeller.
13. At least five numerical questions based on design of centrifugal compressor.
14. At least five numerical questions based on axial flow compressors.

**Reference Books**


1. Shepherd, D. G., “Principles of Turbomachinery”, Macmillan, 1969.
2. Chruch A. H., “Centrifugal pumps and blowers”, John wiley and Sons, 1980.
3. Yahya S. M., “Turbine, Compressors and Fans”, Tata Mc-Graw Hill Publishing Company, 1996
4. Labanoff V. S. and Ross R., “Centrifugal Pumps Design and Applications”, Jaico P House.
5. Karassik I., “Pump Hand Book”, McGraw-Hill International Edition.
6. Sahu G. K. “Pump” New age international publishers.
7. Tuzson J., “Centrifugal Pump Design”, Wiley Publication.
8. Stepanff, A. J., "Blowers and Pumps", John Wiley and Sons Inc., 1965.


**Unit Tests-**

| | |
|---|---|
| Unit Test-I | Unit-I, II and III |
| Unit Test-II | Unit-IV,V and VI |

## Management Information System
**(Course No: C315)**

| Teaching Scheme: | Examination Scheme: | | Credits Allotted |
|---|---|---|---|
| Theory:- 03 Hours / Week | End Semester Examination | 60 Marks | 03 |
| | Unit Test<br>Assignments<br>Internal Evaluation | 20 Marks<br>10 Marks<br>10 Marks | |
| | Total | 100 Marks | 03 |

**Course Prerequisite: -**

1. Computer Programming and Simulation
2. Numerical Methods and Optimization Techniques
3. Manufacturing Process

**Course Objective: -**

To Study

1. Fundamental principles of Operations management and Information System
2. Basics of decision making and database management system
   Applications of management techniques and system implementation in manufacturing sector

**Course Outcomes: -**

Students should be able to

1. Understand various basic concepts related to operations management and information system
2. Understand computer aided information system and the concept of information communication
3. Analyze the different decision-making tools in Management Information System
4. Understand knowledge of data base management system and Database models
5. Understand and apply the Management Information System in different manufacturing sectors
6. Understand and apply various software design techniques and quality management for implementation of management information system.

**Unit 1 Introduction** **(06 Hrs)**

**Operations management**: concept, meaning, definition, scope and functions. Optimization: concept, meaning, definition, need and scope. Types of production, their merits and demerits. Types of operations layouts:
- types, features, applications. Types of resources (7M). Data-meaning and types. Information-meaning and types.

**Information system**: need, concept, definition, features, objectives and examples. Need to integrate information systems and optimum utilization of 7M resources.

**Unit 2 Information Systems** **(06 Hrs)**

Role of computers in information systems. Management Information System (MIS); concept, definition, need & applications.

Computer aided information systems: (such as inventory records, operation schedule, consumables issues, tools issues, inspection and quality control reports, failure frequencies with reasons, efficiency and utility reports,

maintenance records, produced power units per day, temperature at certain interval, etc.) need, importance, design considerations, software selection criteria, examples.

Information communication: Communication process; computer networks and its types, structures, need and applications, protocols - types, features, applications.

**Unit 3 Decision Making (06 Hrs)**

Concept, process behavioral decision making, organizational decision making, MIS and decision making. Building blocks of information system- Input, output, models, technology, database and control blocks. System development life cycle (SDLC) and its approach.

**Unit 4 Data Base Management System (06 Hrs)**

Data management-concept, need, basic terminology used.

Data base: definition, meaning, importance, approach and architecture. Objectives of database organizations.

Data models: meaning, relationship and association, drawing schema, bubble chart &tree structure for suitable mechanical engineering application. Data Base Management System (DBMS) - definition, scope, importance, awareness about current software packages & their features, Relational Data Base Management System. (RDBMS) - concept, definition, features and applications. Preparation steps/ procedure for creating, storing, editing & retrieval of database on latest available database management software package.

**Unit 5 Applications in Manufacturing Sectors (06 Hrs)**

Application in Manufacturing sectors- Personnel management, financial management, production management, material management, marketing management, supply chain management.

**Unit 6 System implementation (06 Hrs)**

Modern software design techniques, verification and validation, methods, performance of software systems, software matrix and models, software standards, introduction to Capability maturity model (CMM), and quality management in software organization.

**Assignments:**

1. At least five theory questions based on operation management.
2. At least five theory questions based on types of resources(7M)
3. At least five theory questions based on role of computer in MIS.
4. At least five theory questions based on information communication.
5. At least five theory questions based on system development life cycle(SDLC) and its approach.
6. At least five theory questions based on decision making
7. At least five theory questions based on database management system.
8. At least five theory questions based on relational database management system.
9. At least five theory questions based on application of MIS in manufacturing system
10. At least five theory questions based on system implementation.
11. At least five theory questions based on capability maturity model (CMM).

12. At least five theory questions based on supply chain management
13. At least five theory questions based on different software for implementation of MIS in industries.

**Text Books/ Reference Books**


1. Jawadekar W. S., "Management Information System 4/e".
2. O Brien J. A., "Management Information System 4/e"
3. Burch and Gruditski, "Information system-Theory and practice 5/e".
4. Ian Sommerville, "Software Engineering 6/e".
5. Turban E., Leidner P., et. al., "Information Technology for Management 6/e".
6. Laudon and Laudon, "Management Information System11/e"
7. Sadagopan S., "Management information system", PHI publication
8. Charry S. N., "Production and operations management". TMGH publication.
9. Buffa E. S. and Sarin R. K., "Modern production & operations management", John willy & sons publication


**Unit Tests-**

| | |
|---|---|
| Unit Test-I | Unit-I, II and III |
| Unit Test-II | Unit-IV, V and VI |

## Professional Skill Development-VI

**(Course No: C316)**

| Teaching Scheme: | Examination Scheme: | | Credits Allotted |
|---|---|---|---|
| Theory:- 04 Hours / Week | End Semester Examination | 100 Marks | 04 |
| Practical:- -- Hours / Week | Unit Test<br>Assignments<br>Internal Evaluation | -- Marks<br>-- Marks<br>-- Marks | |
| | Total | 100 Marks | 04 |

**Course Prerequisite:-** Student should have knowledge of

1. Concepts of Maths, Logical reasoning and English Grammar taught in the last semester.
2. A basic knowledge of Group Discussion, DO's and Don'ts done in the previous sem.
3. Basic knowledge of writing skills, importance of professionalism in emails and letters.
4. Knowledge on the concepts of criticism, feedback and conflicts.
5. Awareness of the interpersonal skills like team work and introduction to Leadership taught during the last semester.
6. Brief idea about professional and business meeting etiquettes.

**Course Objective:-**

1. To acquaint them with the level of complexity presented in recruitment tests and also provide them techniques
2. To solve such question with tricks/methods in a very short period
3. To focuses on the other important aspects of soft skills training students such as techniques of effectively handling Personal Interviews during placement process and understand the dynamics of structured Resume and Pis

**Course Outcomes:-** Learner will able to-

1. Understand the concepts of Maths, Logical reasoning and English grammar and apply short cuts/ tricks to solve questions in less time.
2. Understand how to apply vocabulary questions such as synonyms and analogies in recruitment test and other competitive exams
3. Understand effective strategies for applying interview techniques, to win personal interviews during recruitment process.
4. Understand the differences between CV, Bio- Data and Resume and apply its correct format, methods and styles.
5. Understand various rules, appropriate tones and words to apply in business writing communication.
6. Understand the importance of social and corporate etiquettes to create the impressive Professional life.

| Unit 1 | Aptitude (Maths, Logical Reasoning, English) | (24 Hrs) |
|---|---|---|

**Maths**

- Permutation & Combination
- Probability
- Maths Revision -1
- Maths Revision - 2

**Logical Reasoning**

- Matching, Selection & Arrangement
- Clocks & Calendars, Visual Reasoning
- Input, Output & Flow Chart.
- Reasoning Revision- 1
- Reasoning Revision-2

**English**

- Grammar – III– (Prepositions& Conjunctions)
- Grammar- (Articles & Parallelism)
- Verbal Ability Revision- I

| Unit 2 | Soft Skills & English Communication | (24 Hrs) |
|---|---|---|

- Resume-I
- Resume- II
- Mock GD
- Mock GD
- Personal Interviews-I
- Personal Interviews-II
- Mock PI
- Mock PI
- Extempore Speeches, Group Interviews
- Written Skills- Revision
- Stress Management
- Business Writing Tones

**Textbooks**

6. APAART: Verbal Ability
7. APAART: Logical Reasoning
8. APAART: Quantitative Aptitude
9. APAART: Speak Well 1 (English Language and Communication)
10. APAART: Speak Well 2 (Soft Skills)

## Rules regarding ATKT, Continuous Assessment and award of Class A. T. K. T.

- A candidate who is granted term for B. Tech. Semester-I will be allowed to keep term for his/her B. Tech. Semester-II examination even if he/she appears and fails or does not appear at B. Tech. Semester-I examination.
- A candidate who is granted term for B. Tech. Semester - III will be allowed to keep term for his/her B. Tech. Semester-IV examination even if he/she appears and fails or does not appear at B. Tech. Semester-III examination.
- A candidate who is granted term for B. Tech. Semester-V will be allowed to keep term for his/her B. Tech. Semester-VI examination if he/she appear and fails or does not appear at B. Tech. Semester-V examination.
- A candidate who is granted term for B. Tech. Semester-VII will be allowed to keep term for his/her B. Tech. Semester-VIII examination if he/she appears and fails or does not appear at B. Tech. Semester-VII examination.
- A candidate shall be allowed to keep term for the B. Tech. Semester-III course if he/she has a backlog of not more than 3 Heads of passing out of total number of Heads of passing in theory examination at B. Tech. Semester-I & II taken together.
- A candidate shall be allowed to keep term for the B. Tech. Semester-V of respective course if he/she has no backlog of B. Tech Semester-I & II and he/she has a backlog of not more than 3 Heads of passing in theory examination and not more than 3 heads of passing in term work and practical examination or term work and oral examination.
- A candidate shall be allowed to keep term for the B. Tech. Semester-VII course if he/she has no backlog of B. Tech. Semester-III & IV and he/she has a backlog of not more than 3 Heads of passing in theory examination and not more than 3 Heads of passing in term work and practical examination or term work and oral examination.

### CONTINUOUS ASSESSMENT

- In respect of Term work at B. Tech. Semester-I & II, B. Tech. Semester-III & IV and B. Tech. Semester-V & VI, target date shall be fixed for the completion of each job, project experiment or assignment as prescribed in the syllabus and the same shall be collected on the target date and assessed immediately at an affiliated college by at least one pair of the concerned teachers for the subject and the marks shall be submitted at the end of each term to the Principal of the college.
- Termwork and performance of Practical/Oral examination shall be assessed on the basis of the depth of understanding of the principles involved, correctness of results and not on ornamental or colorful presentation.
- For B. Tech. Semester-VII & VIII, term work assessment will be done by external and internal examiners jointly during the examination schedule declared by the university. The record of continuous assessment shall be made available to the examiners during Term work and practical and Term work and oral

examinations. Examiner shall use this record for overall assessment of the performance of the student. Every practical/term work assignment shall be assessed on the scale of 25 marks and weightage of 25 marks shall be distributed as follows:

| Sr. No. | Activity | Marks |
|---|---|---|
| 1 | Timely Submission | 07 |
| 2 | Presentation | 06 |
| 3 | Understanding | 12 |

- Marks obtained out of 25 for all assignments together will be converted on scale of marks assigned to term work of respective subject in the structure of the course.

**CLASS**

The class should be awarded to the student on the basis of aggregate marks obtained together in both the semesters of the respective year by him. The award of class shall be as follows.

| | | |
|---|---|---|
| A | Aggregate 66% or more marks | First Class with Distinction |
| B | Aggregate 60% or more marks but less than 66% | First Class |
| C | Aggregate 55% or more marks but less than 60% | Higher Second Class |
| D | Aggregate 50% or more marks but less than 55% | Second Class |
| E | Aggregate 40% or more marks but less than 50% | Pass Class |