GEOMETRIC TOLERANCING AND GAUGING [3 0 0 -]

Course Outcomes: On completion of this course student shall be able to –

1. Contrast between conventional and GD&T tolerance zones related to standards.
2. Explain Tolerance – Unilateral, Bilateral, Compound concepts.
3. Explain Taylor's principle of gauging.

Introduction, Types of Standards – Various International Standards, Primary, Secondary and Tertiary Standards, Interchangeability -- Selective Assembly Approach, Attributes and Functionality, Tolerance – Unilateral, Bilateral, Compound, Geometric – Uses and reading of tolerance on blueprints of various mechanical engineering parts. Fits – Types, System and Applications. Case Studies, Gauges – Types and Principles. Designing of Gauges—Case Studies Real time designing by solving problems, Industrial Projects related to Gauging. Current advancements using Industry 4.0 approach in Metrology.

Reference Books:

1. A.K. Bewoor, V. Kulkarni, *Metrology & Measurement*, McGraw Hill Publication, 2012.
2. N.V. Raghavendra, L. Krishnamurty, *Engineering Metrology & Measurements*, Oxford Publications, 2013.
3. R.K. Jain, *Engineering Metrology*, Khanna Publishers, 1997.
4. A.K. Sawhney, *Mechanical Measurement & Instrumentation*, Dhanpat Rai & Co, 2002.
5. I.C. Gupta, *Engineering Metrology*, Dhanpat Rai Publications, 1997.

ENERGY AUDIT [3 0 0 -]

Course Outcomes: On completion of this course student shall be able to –

1. Understand Energy Audit procedure along with relevant technologies like HVAC.
2. Understand Energy Conservation measures undertaken across different user segments using case studies.
3. Develop Energy Audit and management skills concepts.

Energy Conservation: Energy Scenario, Thermodynamic basis of energy conservation, Energy Conservation Act and policies, Energy conservation in HVAC systems and thermal power plants, Energy conservation in buildings. Energy Audit: Definition, Energy audit-need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Benchmarking, Energy audit instruments, case studies, Energy Management: Definition and Objective of Energy Management, General Principles of Energy Management. Energy Management Skills, Energy Management Strategy. Financial Analysis: Simple Payback, IRR, NPV, Discounted Cash flow.

Reference Books:

1. W.C. Turner, Energy Management Handbook, Fairmont Press Inc., 6th Edition 2007.
2. D. R. Patrick, S.W. Fardo, Energy Conservation Guidebook, CRC Press, 2nd Edition 2007.
3. C.B. Smith, Energy Management Principles, Pergamon Press, 2nd Edition, 2015.

AIR-CONDITIONING SYSTEM DESIGN [3 0 0 -]

Course Outcomes: On completion of this course student shall be able to –

1. Explain of the principles of air conditioning design and air conditioning loads.
2. Apply basic design skills to be able to estimate life-cycle costing and green building for energy efficiency.
3. Explain the role of ASHARE.
4. Explain plant design and safety issues related to air conditioning.

Psychrometric properties and processes, Air-conditioning loads, effective temperature & chart, Energy conservations Measures, and air-conditioning for special applications: waste heat recovery, Economiser, Cogeneration system, passive cooling and heating system examples (geothermal, earth air tunnel heat exchanger-EATHE, solar chimney, Radiant Cooling etc). Green Building Guidelines for Energy Efficiency in Buildings, Green Building Certification, Best Practices in Green Buildings for Energy Efficiency in Air-conditioning, ASHRAE Fundamentals, basics of ASHARE 901., ASHRAE 62.1, ECBC 2017, ASHRAE 55, new & eco-friendly refrigerants (low or no GWP -Global Warming Potential refrigerants), National standardization bodies, Process of adoption, Use of International Standards, Safety issues related to refrigeration and air-conditioning, Industrial and field applications.

Reference Books:

1. W. F. Stoecker, J. P. Jones, *Principles of Refrigeration and Air Conditioning,* Tata McGraw Hill Publications.
2. C. P. Arora, *Refrigeration and Air Conditioning*, Tata McGraw Hill Publications.
3. Manohar Prasad, *Refrigeration and Air Conditioning*, New Age International, 3rd edition, 2011.
4. Roger, Haines, Michael, Myers, *HVAC Systems Design Handbook*, McGraw-Hill Education, 5th Edition 2010

DESIGN THINKING AND GLOBAL START-UP [3 0 0 -]

Course Outcomes: On completion of this course student shall be able to –

1. Remember the design thinking concepts
2. Analyse the 3 D printing methods.
3. Define the global IR pitch and lean canvas.

Lean “Prototype and Test” stages in Stanford Design Thinking, Stanford Design Thinking & Lean Startup I, Stanford Design Thinking & Lean Startup II, Stanford Design Thinking & Lean Startup III, Novel Manufacturing Methodology by using 4th Industrial Revolution technology such as FaaS (Factory as a service) with AI, Bigdata, and 3D Printing Design Thinking with 3D Printing, Introduction to Singapore and Silicon-V Startup Ecosystem and Strategy, Global IR Pitch Deck & Case Study, one-liner, lean-canvas.

Reference Books:

1. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperCollins Publishers Ltd.
2. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage",Harvard Business Press , 2009.
3. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.