# LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

**(AUTONOMOUS)**
**Accredited by NAAC & NBA (Under Tier - I), ISO 9001:2015 Certified Institution**
**Approved by AICTE, New Delhi. and Affiliated to JNTUK, Kakinada**
**L.B. REDDY NAGAR, MYLAVARAM, KRISHNA DIST., A.P.-521 230.**
Phone: 08659-222933, Fax: 08659-222931

## DEPARTMENT OF AEROSPACE ENGINEERING


## COURSE HANDOUT

## PART-A

**Name of Course Instructor:** Mr. A. PRATYUSH/Mrs.B.UDAYA LAKSHMI
**Course Name & Code** : INDUSTRIAL MANAGEMENT & 23HS03
**L-T-P Structure** :2-0-0 **Credits:** 2
**Program/Sem/Sec** : B.Tech/IV **A.Y.:** 2025-26
**PREREQUISITE: Engineering physics**

**Course Objective:** The students completing this course are expected to

1. Introduce the scope and role of industrial engineering and the techniques for optimal design of layouts
2. Illustrate how work study is used to improve productivity.
3. Explain TQM and quality control techniques
4. Introduce financial management aspects and
5. Discuss human resource management and value analysis.

**COURSE OUTCOMES (COs):** At the end of the course, student will be able to

| | |
|---|---|
| **CO1** | Design the key factors and techniques for optimizing and maintaining plant layouts. **(Applying-L3)** |
| **CO2** | Demonstrate various work study techniques and evaluate the principles of ergonomics and tools. **(Applying-L3)** |
| **CO3** | Investigate statistical quality control methods and value the concepts of total quality management. **(Applying-L3)** |
| **CO4** | Investigate the scope and nature of financial management techniques. **(Applying-L3)** |
| **CO5** | Integrate human resource management, personnel management, and industrial relations concepts and functions. **(Applying-L3)** |

**COURSE ARTICULATION MATRIX** (Correlation between COs, POs & PSOs):

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | | 3 | | 1 | 2 | 1 | 3 | 2 | | 3 | |
| CO2 | | | | | | 3 | | 1 | 2 | 1 | 3 | 2 | | 3 | |
| CO3 | | | | | | 3 | | 1 | 2 | 1 | 3 | 2 | | 3 | |
| CO4 | | | | | | 3 | | 1 | 2 | 1 | 3 | 2 | | 3 | |
| CO5 | | | | | | 3 | | 1 | 2 | 1 | 3 | 2 | | 3 | |
| **1** - Low | | | | | | **2** –Medium | | | | | | | **3** - High | | |

**TEXTBOOKS:**

**T1** O.P Khanna, Industrial Engineering and Management, Dhanpat Rai Publications (P) Ltd, 2018.

**T2** Mart and Telsang, Industrial Engineering and Production Management, S.Chand &Company Ltd. New Delhi, 2006

**REFERENCE BOOKS:**

| | |
|---|---|
| **R1** | Bhattacharya DK, Industrial Management,S.Chand, publishers, 2010 |
| **R2** | J.G Monks, Operations Management,3/e, McGraw Hill Publishers1987. |
| **R3** | T.R. Banga, S.C.Sharma, N. K. Agarwal, Industrial Engineering and Management Science, Khanna Publishers, 2008. |
| **R4** | KoontzO' Donnell, Principles of Management, 4/e, McGraw Hill Publishers, 1968. |
| **R5** | R.C. Gupta, Statistical Quality Control, Khanna Publishers, 1998 |
| **R6** | NVS Raju, Industrial Engineering and Management,1/e, Cengage India Private Limited, 2013. |


# PART-B

## COURSE DELIVERY PLAN (LESSON PLAN):

## UNIT-I: INTRODUCTION & PLANT LAYOUT

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 1. | Definition Of Industrial Engineering (I.E), Development, Applications, Role of An Industrial Engineer | 1 | 02/12/2025 | | TLM2 | |
| 2. | Differences Between Production Management and Industrial Engineering, Quantitative Tools of IE And Productivity Measurement | 1 | 06/12/2025 | | TLM2 | |
| 3. | Concepts Of Management, Importance, Functions of Management | 1 | 09/12/2025 | | TLM2 | |
| 4. | Scientific Management, Taylor's Principles, Theory X And Theory Y | 1 | 13/12/2025 | | TLM2 | |
| 5. | Fayol's Principles of Management. | 1 | 16/12/2025 | | TLM2 | |
| 6. | Factors Governing Plant Location | 1 | 20/12/2025 | | TLM2 | |
| 7. | Types of Plant Layouts | 1 | 23/12/2025 | | TLM2 | |
| 8. | Advantages And Disadvantages of Process Layout and Product Layout, Applications | 1 | 27/12/2025 | | TLM2 | |
| 9. | Quantitative Techniques for Optimal Design of Layouts | 1 | 30/12/2025 | | TLM1 | |
| 10. | Plant Maintenance, Preventive and Break Down Maintenance. | 1 | 03/01/2026 | | TLM2 | |
| **No. of classes required to complete UNIT-I: 10** | | | | **No. of classes taken:** | | |

## UNIT-II: WORK STUDY

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 11. | Importance, Types of Production, Applications | 1 | 06/01/2026 | | TLM2 | |
| 12. | Work Study, Method Study and Time Study | 2 | 10/01/2026 | | TLM2 | |
| 13. | Work Sampling, PMTS, | 1 | 13/01/2026 | | TLM1 | |
| 14. | Micro-Motion Study, Rating Techniques, | 1 | 17/01/2026 | | TLM1 | |
| 15. | MTM, Work Factor System, | 1 | 20/01/2026 | | TLM2 | |
| 16. | Principles Of Ergonomics, | 1 | 24/01/2026 | | TLM2 | |
| 17. | Flow Process Charts | 2 | 03/02/2026 | | TLM1 | |
| 18. | String Diagrams and Therbligs. | 1 | 07/02/2026 | | TLM1 | |
| **No. of classes required to complete UNIT-II: 10** | | | | **No. of classes taken:** | | |

## UNIT-III: STATISTICAL QUALITY CONTROL & TOTAL QUALITY MANAGEMENT

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 19. | Quality control, Queuing assurance and its importance, | 1 | 10/02/2026 | | TLM2 | |
| 20. | SQC | 1 | 14/02/2026 | | TLM2 | |
| 21. | Attribute Sampling Inspection with Single And Double Sampling | 1 | 17/02/2026 | | TLM2 | |
| 22. | Control charts - $\bar{X}$ and $R$ -Charts | 1 | 21/02/2026 | | TLM1 | |
| 23. | X and S charts and their applications, | 1 | 24/02/2026 | | TLM1 | |
| 24. | numerical examples. | 1 | 28/02/2026 | | TLM1 | |
| 25. | TOTAL QUALITY MANAGEMENT: zero defect concept, quality circles, | 1 | 28/02/2026 | | TLM2 | |
| 26. | implementation, applications | 1 | 03/03/2026 | | TLM2 | |
| 27. | ISO quality systems. | 1 | 03/03/2026 | | TLM2 | |
| 28. | Six Sigma–definition, basic concepts | 1 | 07/03/2026 | | TLM2 | |
| **No. of classes required to complete UNIT-III: 11** | | | | **No. of classes taken:** | | |

## UNIT-IV: FINANCIAL MANAGEMENT

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 29. | Scope and nature of financial management, Sources of finance | 1 | 07/03/2026 | | TLM2 | |
| 30. | Ratio analysis, Management of working capital, | 1 | 10/03/2026 | | TLM2 | |
| 31. | estimation of working capital requirements, | 1 | 10/03/2026 | | TLM2 | |
| 32. | stock management, | 1 | 14/03/2026 | | TLM2 | |
| 33. | Cost accounting and control, budget and budgetary control, | 1 | 14/03/2026 | | TLM2 | |
| 34. | Capital budgeting – Nature of Investment Decisions | 1 | 17/03/2026 | | TLM2 | |
| 35. | Investment Evaluation criteria- NPV, IRR, PI, Payback Period, and ARR | 1 | 17/03/2026 | | TLM1 | |
| 36. | numerical problems. | 2 | 21/03/2026 | | TLM1 | |
| **No. of classes required to complete UNIT-IV: 9** | | | | **No. of classes taken:** | | |

## UNIT-V: HUMAN RESOURCE MANAGEMENT & VALUE ANALYSIS

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 37. | Concept of human resource management, | 1 | 21/03/2026 | | TLM2 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 38. | personnel management and industrial relations | 1 | 24/03/2026 | | TLM2 | |
| 39. | functions of personnel management, | 1 | 24/03/2026 | | TLM2 | |
| 40. | Job- evaluation, its importance and types | 1 | 28/03/2026 | | TLM2 | |
| 41. | Merit Rating, Quantitative Methods, | 1 | 28/03/2026 | | TLM2 | |
| 42. | Wage Incentive Plans, And Types. | 1 | 31/03/2026 | | TLM2 | |
| 43. | VALUE ANALYSIS: Value engineering, implementation procedure, | 1 | 31/03/2026 | | TLM2 | |
| 44. | Enterprise Resource Planning | 1 | 04/04/2026 | | TLM2 | |
| 45. | Supply Chain Management | 1 | 04/04/2026 | | TLM2 | |
| **No. of classes required to complete UNIT-V: 10** | | | | **No. of classes taken:** | | |

| **Teaching Learning Methods** | | | |
|---|---|---|---|
| **TLM1** | Chalk and Talk | **TLM4** | Demonstration (Lab/Field Visit) |
| **TLM2** | PPT | **TLM5** | ICT (NPTEL/Swayam Prabha/MOOCS) |
| **TLM3** | Tutorial | **TLM6** | Group Discussion/Project |

## PART-C

**VALUATION PROCESS (R23 Regulation):**

| **Evaluation Task** | **Marks** |
|---|---|
| Assignment-I (Units-I, II) | A1=5 |
| I-Descriptive Examination (Units-I, II ) | M1=15 |
| I-Quiz Examination (Units-I, II) | Q1=10 |
| Assignment-II (Unit-III , IV & V) | A2=5 |
| II- Descriptive Examination (UNIT-III , IV & V) | M2=15 |
| II-Quiz Examination (UNIT-III, IV & V) | Q2=10 |
| Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2+A2)) | M=30 |
| Cumulative Internal Examination (CIE): M | 30 |
| Semester End Examination (SEE) | 70 |
| Total Marks = CIE + SEE | 100 |

## PART-D

**PROGRAMME OUTCOMES (POs):**

| | |
|---|---|
| **PO 1** | Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| **PO 2** | Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. |
| **PO 3** | 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. |
| **PO 4** | 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. |
| **PO 5** | 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. |
| **PO 6** | 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. |
| **PO 7** | Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. |
| **PO 8** | Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| **PO 9** | Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| **PO 10** | 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. |
| **PO 11** | 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. |
| **PO 12** | 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. |

## PROGRAMME SPECIFIC OUTCOMES (PSOs):

| | |
|---|---|
| **PSO 1** | To apply the principles of thermal sciences to design and develop various thermal systems. |
| **PSO 2** | To apply the principles of manufacturing technology, scientific management towards improvement of quality and optimization of engineering systems in the design, analysis and manufacturability of products. |
| **PSO 3** | To apply the basic principles of mechanical engineering design or evaluation of performance of various systems relating to transmission of motion and power, conservation of energy and other process equipment. |

| Title | Course Instructor | Course Coordinator | Module Coordinator | Head of the Department |
|---|---|---|---|---|
| **Name of the Faculty** | **Mr.A.Pratyush** | | | **Dr.P.Lovaraju** |
| **Signature** | | | | |

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**FRESHMAN ENGINEERING DEPARTMENT**

# COURSE HANDOUT

## PART-A

**Name of Course Instructor: G. VIJAYA LAKSHMI**
**Course Name & Code** : Complex Variables, Probability and Statistics & 23FE13
**L-T-P Structure** : **2**-0 -0 **Credits: 2**
**Program/Sem/Sec** : II B.Tech/IV sem/ASE **A.Y.:** 2025– 26.

**PREREQUISITE:** Complex numbers, Partial Differentiation

**COURSE EDUCATIONAL OBJECTIVES (CEOs):**

- To familiarize the complex variables
- To familiarize the students with the foundations of probability and statistical methods
- To equip the students to solve application problems in their disciplines.

**COURSE OUTCOMES (COs):** Upon successful completion of the course, the student will be able to

| | |
|---|---|
| **CO1** | Apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic. (L3) |
| **CO2** | Make use of Cauchy, residue theorem to evaluate certain integrals. (L3) |
| **CO3** | Infer the statistical inferential methods based on small and large sample tests. (L4) |
| **CO4** | Find the differentiation and integration of complex functions used in engineering problems. (L3) |
| **CO5** | Design the components of a classical hypothesis test. (L4) |

**COURSE ARTICULATION MATRIX** (Correlation between COs, POs & PSOs):

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 2 | 1 | - | - | - | - | - | - | - | - | 1 | | | |
| CO 2 | 3 | 2 | 1 | - | - | - | - | - | - | - | - | 1 | | | |
| CO 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | - | 1 | | | |
| CO 4 | 3 | 2 | 1 | - | - | - | - | - | - | - | - | 1 | | | |
| CO 5 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | 1 | | | |
| **1** - Low | | | | | | | | **2** –Medium | | | | **3** - High | | | |

**TEXTBOOKS:**

| | |
|---|---|
| **T1** | Dr. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2015. |
| **T2** | Miller & Freund's "Probability and Statistics for Engineers", 7th edition. PHI, New Delhi, 2008. |

**REFERENCE BOOKS:**

| | |
|---|---|
| **R1** | J.W. Brown and R.V. Churchill, "Complex Variables and Applications", 9th edition, Mc.Graw Hill, 2013. |
| **R2** | S.C. Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics", 11thEdition, Sultan Chand and sons, New Delhi,2012. |
| **R3** | Jay L. DeVore, "Probability and Statistics for engineering and the sciences." , 8th edition, Cengage Learning India, 2012. |
| **R4** | Sharon L. Myers, Keying Ye, Ronald E Walpole, "Probability and Statistics for Engineers and Scientists, 8th edition, Pearson Education International, 2017. |
| **R5** | Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", 4th edition, Academic Foundation, 2011. |

## PART-B

**COURSE DELIVERY PLAN (LESSON PLAN):**

**UNIT-I: Functions of a Complex variable and complex Integration**

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 1. | Continuity | 1 | 01/12/2025 | | TLM1 | |
| 2. | Differentiability | 1 | 02/12/2025 | | TLM1 | |
| 3. | Analytic functions | 1 | 04/12/2025 | | TLM1 | |
| 4. | CR Equations – Cartesian form | 1 | 05/12/2025 | | TLM1 | |
| 5. | CR Equations – Polar form | 1 | 08/12/2025 | | TLM1 | |
| 6. | Harmonic and Conjugate Harmonic | 1 | 09/12/2025 | | TLM1 | |
| 7. | Milne Thompson method | 1 | 11/12/2025 | | TLM1 | |
| 8. | Line Integration | 1 | 12/12/2025 | | TLM1 | |
| 9. | Cauchy's Integral theorem – problems | 1 | 15/12/2025 | | TLM1 | |
| 10. | Cauchy's Integral formulas – problems | 1 | 16/12/2025 | | TLM1 | |
| 11. | Generalized Cauchy's Integral formula | 1 | 18/12/2025 | | TLM1 | |
| 12. | Tutorial I | 1 | 19/12/2025 | | TLM3 | |
| **No. of classes required to complete UNIT-I: 12** | | | | **No. of classes taken:** | | |

**UNIT-II: Numerical solutions of Equations and Numerical Integration**

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 13. | Radius of Convergence | 1 | 22/12/2025 | | TLM1 | |
| 14. | Expansion of function in Taylor series | 1 | 23/12/2025 | | TLM1 | |
| 15. | Expansion of function in Maclaurin's series | 1 | 26/12/2025 | | TLM1 | |
| 16. | Expansion of function in Laurent series | 1 | 29/12/2025 | | TLM1 | |
| 17. | Expansion of function in Laurent series | 1 | 30/12/2025 | | TLM1 | |
| 18. | Singularities and types of Singularities | 1 | 01/01/2026 | | TLM1 | |
| 19. | Singularities and types | 1 | 02/01/2026 | | TLM1 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | of Singularities | | | | | |
| 20. | Poles and Residues | 1 | 05/01/2026 | | TLM1 | |
| 21. | Residue theorem problems | 1 | 06/01/2026 | | TLM1 | |
| 22. | Evaluation of real integrals of Type-I | 1 | 08/01/2026 | | TLM1 | |
| 23. | Evaluation of real integrals of Type-I | 1 | 09/01/2026 | | TLM1 | |
| 24. | Evaluation of real integrals of Type-II | 1 | 20/01/2026 | | TLM1 | |
| 25. | Evaluation of real integrals of Type-II | 1 | 22/01/2026 | | TLM1 | |
| 26. | Tutorial 2 | 1 | 10/01/2026 | | TLM3 | |
| 27. | Revision on Unit-II | 1 | 23/01/2026 | | | |
| **No. of classes required to complete UNIT-II: 15** | | | | **No. of classes taken:** | | |

**I MID EXAMINATIONS (27-01-2026TO 31-01-2026)**

**UNIT-III: Multiple Integrals**

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 28. | Introduction | 1 | 03/02/2026 | | TLM1 | |
| 29. | Baye's theorem, problems | 1 | 05/02/2026 | | TLM1 | |
| 30. | Random variables, Expectations | 1 | 06/02/2026 | | TLM1 | |
| 31. | Problems on PMF | 1 | 09/02/2026 | | TLM1 | |
| 32. | Problems on PDF | 1 | 10/02/2026 | | TLM2 | |
| 33. | Mathematical Expectations and Variance | 1 | 12/02/2026 | | TLM1 | |
| 34. | Binomial distribution | 1 | 13/02/2026 | | TLM1 | |
| 35. | Poisson distribution | 1 | 16/02/2026 | | TLM1 | |
| 36. | Uniform distribution | 1 | 17/02/2026 | | TLM1 | |
| 37. | Normal distribution | 1 | 19/02/2026 | | TLM1 | |
| 38. | TUTORIAL - III | 1 | 20/02/2026 | | TLM3 | |
| 39. | Normal distribution | 1 | 23/02/2026 | | TLM1 | |
| **No. of classes required to complete UNIT-III: 12** | | | | **No. of classes taken:** | | |

**UNIT-IV: Fourier Series**

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 40. | Introduction | 1 | 24/02/2026 | | TLM1 | |
| 41. | Sampling distribution, definitions | 1 | 26/02/2026 | | TLM1 | |
| 42. | Sampling distribution of mean, variance | 1 | 27/02/2026 | | TLM1 | |
| 43. | Problems | 1 | 02/03/2026 | | TLM1 | |
| 44. | Problems on central limit theorem | 1 | 03/03/2026 | | TLM1 | |
| 45. | Estimation | 1 | 05/03/2026 | | TLM1 | |
| 46. | Normal theory | 1 | 06/03/2026 | | TLM1 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | distributions | | | | | |
| 47. | Estimation using t distribution | 1 | 09/03/2026 | | TLM1 | |
| 48. | Estimation using $\chi^2$and F-distributions | 1 | 10/03/2026 | | TLM1 | |
| 49. | Tutorial-4 | 1 | 12/03/2026 | | TLM3 | |
| **No. of classes required to complete UNIT-IV: 10** | | | | **No. of classes taken:** | | |

**UNIT-V: Vector Differentiation**

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 50. | Z-test for means | 1 | 13/03/2026 | | TLM1 | |
| 51. | Z-test for proportions | 1 | 16/03/2026 | | TLM1 | |
| 52. | Z-test for proportions | 1 | 17/03/2026 | | TLM1 | |
| 53. | t-test for means | 1 | 23/03/2026 | | TLM1 | |
| 54. | F-test for variances | 1 | 24/03/2026 | | TLM1 | |
| 55. | $\chi^2$-test for goodness of fit | 1 | 27/03/2026 | | TLM1 | |
| 56. | $\chi^2$-test for goodness of fit | 1 | 30/03/2026 | | TLM1 | |
| 57. | $\chi^2$-test for independence of attributes | 1 | 31/04/2026 | | TLM1 | |
| 58. | Tutorial-5 | 1 | 02/04/2026 | | TLM3 | |
| **No. of classes required to complete UNIT-V: 9** | | | | **No. of classes taken:** | | |
| **II MID EXAMINATIONS (06-04-2026 TO 11-04-2026)** | | | | | | |

| **Teaching Learning Methods** | | | |
|---|---|---|---|
| **TLM1** | Chalk and Talk | **TLM4** | Demonstration (Lab/Field Visit) |
| **TLM2** | PPT | **TLM5** | ICT (NPTEL/Swayam Prabha/MOOCS) |
| **TLM3** | Tutorial | **TLM6** | Group Discussion/Project |

## PART-C

**EVALUATION PROCESS (R17 Regulation):**

| **Evaluation Task** | **Marks** |
|---|---|
| Assignment-I (Units-I, II & UNIT-III (Half of the Syllabus)) | A1=5 |
| I-Descriptive Examination (Units-I, II & UNIT-III (Half of the Syllabus)) | M1=15 |
| I-Quiz Examination (Units-I, II & UNIT-III (Half of the Syllabus)) | Q1=10 |
| Assignment-II (Unit-III (Remaining Half of the Syllabus), IV & V) | A2=5 |
| II- Descriptive Examination (UNIT-III (Remaining Half of the Syllabus), IV & V) | M2=15 |
| II-Quiz Examination (UNIT-III (Remaining Half of the Syllabus), IV & V) | Q2=10 |
| Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), | M=30 |

| | |
|---|---|
| (M2+Q2+A2)) | |
| Cumulative Internal Examination (CIE): M | 30 |
| Semester End Examination (SEE) | 70 |
| Total Marks = CIE + SEE | 100 |

## PART-D

**PROGRAMME OUTCOMES (POs):**

| | |
|---|---|
| **PO 1** | **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| **PO 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. |
| **PO 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. |
| **PO 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. |
| **PO 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. |
| **PO 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. |
| **PO 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. |
| **PO 8** | **Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| **PO 9** | **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| **PO 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. |
| **PO 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. |
| **PO 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. |

| **Title** | **Course Instructor** | **Course Coordinator** | **Module Coordinator** | **Head of the Department** |
|---|---|---|---|---|
| **Name of the Faculty** | **G. Vijaya Lakshmi** | **G. Vijaya Lakshmi** | **Dr. A. Rami Reddy** | **Dr. T. Satyanarayana** |
| **Signature** | | | | |

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
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Accredited by NBA under Tier - I, Accredited by NAAC
An ISO 21001:2018, 500001:2018, 14001:2015 Certified Institution
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## COURSE HANDOUT

## PART-A

**Name of Course Instructor:** Mr. G V SURYA NARAYANA
**Course Name & Code** : **23AE04-MATERIALS AND MANUFACTURING TECHNOLOGY**
**L-T-P Structure** : 3-0-0 **Credits:** 3
**Program/Sem/Sec** : B.Tech-IV SEM **A.Y.:** 2025-26

### COURSE OBJECTIVES:

- The objectives of this course are to acquire knowledge on structure of metals and alloys, understand the concept of alloys.
- To learn equilibrium diagrams and to learn primary manufacturing processes, working of basic machines and various operations to be performed.
- Teach conventional and unconventional machining processes.

### COURSE OUTCOMES (COs):

| COs | Statements | Blooms Level |
|---|---|---|
| CO1 | Understand the properties of the metals and alloys based on structures. | Understand |
| CO2 | Classify, construct and analyze equilibrium diagrams, various ferrous, non-ferrous metals and alloys. | Understand |
| CO3 | Acquire knowledge of the basic aspects of casting process. | Understand |
| CO4 | Know the various basic concepts of welding process, metal forming process and sheet metal operations in the manufacturing of products. | Understand |
| CO5 | Know different conventional and unconventional machining processes while manufacturing a product | Understand |

**COURSE ARTICULATION MATRIX** (Correlation between COs, POs & PSOs):

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | - | 2 | 2 | - | - | - | - | - | - | - | 1 | 3 | 3 |
| CO2 | 3 | - | 2 | 2 | - | - | - | - | - | - | - | 1 | 3 | 3 |
| CO3 | 3 | - | 2 | 2 | - | - | - | - | - | - | - | 1 | 3 | 3 |
| CO4 | 3 | - | 2 | 2 | - | - | - | - | - | - | - | 1 | 3 | 3 |
| CO5 | 3 | - | 2 | 2 | - | - | - | - | - | - | - | 1 | 3 | 3 |
| **1** - Low | | | | | **2** –Medium | | | | | | **3** - High | | | |

**TEXTBOOKS:**

**T1** V.D.Kotgire, S.V.Kotgire, Material Science and Metallurgy, Everest Publishing House, 42nd Edition, 2018

**T2** Rao. P. N, Manufacturing Technology, Volume 1 and 2 Tata McGraw-Hill, 2018.

**REFERENCE BOOKS:**

**R1** Ghosh. A, Malik. A. K, Manufacturing Science, Second Edition, East West Publisher, 2010.

**R2** Kalpakjain. S, Schmid. S. R, Manufacturing Processes for Engineering Materials, 6th Edition, Pearson Education, 2017

**R3** Richard A.Flinn, Paul K.Trojan, Engineering Materials and Their Applications, Jaico Publishing House, 4thEdition, 1999.

**R4** William and callister, Materials Science and engineering, Wiley India private Ltd., 2011.

**PART-B**

**COURSE DELIVERY PLAN (LESSON PLAN):**

**UNIT-I: STRUCTURE OF METALS:**

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 1. | **STRUCTURE OF METALS:** Crystal Structures- | 01 | 02-12-2025 | | TLM1, TLM2 | |
| 2. | Body-centered cubic, | 01 | 03-12-2025 | | TLM1, TLM2 | |
| 3. | Face-centered cubic, closed-packed hexagonal, | 01 | 06-12-2025 | | TLM1, TLM2 | |
| 4. | Mechanism of grain, grain boundaries | 01 | 08-12-2025 | | TLM1, TLM2 | |
| 5. | Effect of grain boundaries on the properties of metal/alloys, | 01 | 09-12-2025 | | TLM1, TLM2 | |
| 6. | Determination of grain size. | 01 | 13-12-2025 | | TLM1, TLM2 | |
| 7. | Solid solutions-Interstitial Solid Solutions | 01 | 15-12-2025 | | TLM1 | |
| 8. | Substitution Solid Solution, | 01 | 16-12-2025 | | TLM1 | |
| 9. | Hume Rothery rules. Assignment-1 | 01 | 20-12-2025 | | TLM1, TLM2 | |
| **No. of classes required to complete UNIT-I: 09** | | | | **No. of classes taken:** | | |

**UNIT-II: EQUILIBRIUM DIAGRAMS AND TRANSFORMATIONS, STEEL, CAST IRON AND NON-FERROUS METALS AND ALLOYS:**

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 10. | **EQUILIBRIUM DIAGRAMS AND TRANSFORMATIONS:** | 01 | 22-12-2025 | | TLM1, TLM2 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Classification of equilibrium diagrams- | | | | | |
| 11. | isomorphous, eutectic equilibrium diagrams. | 01 | 23-12-2025 | | TLM1, TLM2 | |
| 12. | partial eutectic equilibrium diagrams. | 01 | 27-12-2025 | | TLM1 | |
| 13. | Lever rule,Study of Cu-Ni equilibrium diagram | 01 | 29-12-2025 | | TLM1, TLM2 | |
| 14. | Iron-Iron carbide equilibrium diagram | 01 | 30-12-2025 | | TLM1, TLM2 | |
| 15. | **STEEL:** Classification of steels, structure, | 01 | 03-01-2026 | | TLM1 | |
| 16. | properties and applications of plain carbon steel, | 01 | 05-01-2026 | | TLM1, TLM2 | |
| 17. | low carbon steel, medium carbon steel, high carbon steel. | 01 | 06-01-2026 | | TLM1, TLM2 | |
| 18. | **CAST IRONS:** structure, properties and applications of white cast iron, | 01 | 10-01-2026 | | TLM1, TLM2 | |
| 19. | malleable cast iron, grey cast iron, | 01 | 12-01-2026 | | TLM1, TLM2 | |
| 20. | spheroidal graphite cast iron | 01 | 13-01-2026 | | TLM1, TLM2 | |
| 21. | **NON-FERROUS METALS AND ALLOYS:** structure, | 01 | 17-01-2026 | | TLM1, TLM2 | |
| 22. | properties and applications of copper and its alloys, | 01 | 19-01-2026 | | TLM1, TLM2 | |
| 23. | Aluminium and its alloys. Assignment-I | 01 | 20-01-2026 | | TLM1, TLM2 | |
| **No. of classes required to complete UNIT-II: 14** | | | | **No. of classes taken:** | | |

**UNIT-III: INTRODUCTION TO MANUFACTURING AND CASTING**

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 24. | **INTRODUCTION TO MANUFACTURING AND CASTING**: Classification of manufacturing processes | 01 | 02-02-2026 | | TLM1 | |
| 25. | Engineering materials, Steps involved in making a casting | 01 | 03-02-2026 | | TLM1 | |
| 26. | Advantages of castings and its applications | 01 | 07-02-2026 | | TLM1 | |
| 27. | Types of patterns, pattern allowances. | 01 | 09-02-2026 | | TLM1 | |
| 28. | principles of Gating ratio, types of raisers | 01 | 10-02-2026 | | TLM1 | |
| 29. | **Special casting processes**: Centrifugal casting, | 01 | 14-02-2026 | | TLM1, TLM2 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 30. | Die casting | 01 | 16-02-2026 | | TLM1, TLM2 | |
| 31. | Investment casting, Assignment-II | 01 | 17-02-2026 | | TLM1, TLM2 | |
| **No. of classes required to complete UNIT-III: 08** | | | | **No. of classes taken:** | | |

**UNIT-IV: WELDING, METAL FORMING PROCESSES, EXTRUSION OF METALS:**

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 32. | **WELDING:** Classification of Welding Process- | 01 | 21-02-2026 | | TLM1, TLM2 | |
| 33. | Types of Welds- Welded Joints,Principle and Applications- Gas Welding | 01 | 23-02-2026 | | TLM1 | |
| 34. | Arc Welding, Friction Welding, | 01 | 24-02-2026 | | TLM1 | |
| 35. | Soldering and Brazing. | 01 | 28-02-2026 | | TLM1, TLM2 | |
| 36. | **METAL FORMING PROCESSES:** Types of Rolling Mills and Products; | 01 | 02-03-2026 | | TLM1, TLM2 | |
| 37. | Principles of Forging, Types of Forging-Smith Forging, Drop Forging | 01 | 07-03-2026 | | TLM1, TLM2 | |
| 38. | **EXTRUSION OF METALS:** Hot Extrusion, Cold Extrusion | 01 | 09-03-2026 | | TLM1 | |
| 39. | Forward Extrusion, Backward Extrusion | 01 | 10-03-2026 | | TLM1, TLM2 | |
| 40. | Impact Extrusion, | 01 | 14-03-2026 | | TLM1, TLM2 | |
| 41. | Hydrostatic Extrusion. Assignment-II | 01 | 16-03-2026 | | TLM1, TLM2 | |
| **No. of classes required to complete UNIT-IV: 10** | | | | **No. of classes taken:** | | |

**UNIT-V: MACHINING PROCESSES, SHAPING, PLANNING, MILLING, AND DRILLING MACHINES (UNCONVENTIONAL MACHINING PROCESSES), AND INTRODUCTION TO UNCONVENTIONAL MACHINING PROCESSES:**

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 42. | **MACHINING PROCESSES**: Tool Geometry, Cutting Tool & Tool Wear | 01 | 17-03-2026 | | TLM1 | |
| 43. | Cutting Materials; Cutting Fluids; | 01 | 21-03-2026 | | TLM1 | |
| 44. | Introduction and Working Principle of | 01 | 23-03-2026 | | TLM1 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Lathe and Operations | | | | | |
| 45. | Principles of Working, Principal Parts, Specifications, Classification, Comparison and Operations Performed: SHAPING | 01 | 24-03-2026 | | TLM1, TLM2 | |
| 46. | Planning, Milling, Drilling Machines | 01 | 28-03-2026 | | TLM1, TLM2 | |
| 47. | **INTRODUCTION TO UNCONVENTIONAL MACHINING PROCESSES**: Classification of Unconventional Machining Processes. Abrasive Jet Machining | 01 | 30-03-2026 | | TLM1, TLM2 | |
| 48. | Ultrasonic Machining | 01 | 31-03-2026 | | TLM1, TLM2 | |
| 49. | Laser Beam Machining, Assignment II | 01 | 04-04-2026 | | TLM1, TLM2 | |
| **No. of classes required to complete UNIT-V: 08** | | | | **No. of classes taken:** | | |

**Contents beyond the Syllabus**

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 1. | Advanced Additive Manufacturing | 01 | 04-04-2026 | | TLM2 | |
| 2. | Advanced welding | | | | | |
| 3. | Advanced material removing process (CNC & NC Program) | | | | | |
| No. of classes required to complete for advanced topics | | **01** | | | | |

| **Teaching Learning Methods** | | | |
|---|---|---|---|
| **TLM1** | Chalk and Talk | **TLM4** | Demonstration (Lab/Field Visit) |
| **TLM2** | PPT | **TLM5** | ICT (NPTEL/Swayam Prabha/MOOCS) |
| **TLM3** | Tutorial | **TLM6** | Group Discussion/Project |

## PART-C

**EVALUATION PROCESS (R23 Regulation):**

| Evaluation Task | Marks |
|---|---|
| Assignment-I (Units-I, II & UNIT-III (Half of the Syllabus)) | A1=5 |
| I-Descriptive Examination (Units-I, II & UNIT-III (Half of the Syllabus)) | M1=15 |
| I-Quiz Examination (Units-I, II & UNIT-III (Half of the Syllabus)) | Q1=10 |
| Assignment-II (Unit-III (Remaining Half of the Syllabus), IV & V) | A2=5 |
| II- Descriptive Examination (UNIT-III (Remaining Half of the Syllabus), IV & V) | M2=15 |
| II-Quiz Examination (UNIT-III (Remaining Half of the Syllabus), IV & V) | Q2=10 |
| Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2+A2)) | M=30 |
| Cumulative Internal Examination (CIE): M | 30 |
| Semester End Examination (SEE) | 70 |
| Total Marks = CIE + SEE | 100 |

## PART-D

**PROGRAMME OUTCOMES (POs):**

| | |
|---|---|
| **PO 1** | **Engineering knowledge**: To apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems. |
| **PO 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. |
| **PO 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. |
| **PO 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. |
| **PO 5** | **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations |
| **PO 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 |
| **PO 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. |
| **PO 8** | **Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| **PO 9** | **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| **PO 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. |
| **PO 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. |
| **PO 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. |

**PROGRAMME SPECIFIC OUTCOMES (PSOs):**

| | |
|---|---|
| **PSO 1** | To apply the knowledge of Aerodynamics, Propulsion, Aircraft structures, and Flight Dynamics in Aerospace vehicle design. |
| **PSO 2** | To prepare the students to work effectively in Aerospace and Allied Engineering organizations. |

| **Title** | **Course Instructor** | **Module Coordinator** | **Head of the Department** |
|---|---|---|---|
| **Signature** | | | |
| **Name of the Faculty** | Mr. G V SURYA NARAYANA | Mr. I DAKSHINA MURTHY | Dr. P. LOVARAJU |

# LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

**(AUTONOMOUS)**

**Accredited by NAAC & NBA (Under Tier - I), ISO 9001:2015 Certified Institution**

**Approved by AICTE, New Delhi. and Affiliated to JNTUK, Kakinada**

**L.B. REDDY NAGAR, MYLAVARAM, KRISHNA DIST., A.P.-521 230.**

Phone: 08659-222933, Fax: 08659-222931

## DEPARTMENT OF AEROSPACE ENGINERRING


## COURSE HANDOUT

## PART-A

**Name of Course Instructor:** S.Indrasena Reddy

**Course Name & Code** **:** Solid Mechanics & 23AE05

**L-T-P Structure** **:3-0-0** **Credits:** 3

**Program/Sem/Sec** : B.Tech/IV Sem **A.Y.:** 2025-26

**PREREQUISITE:** **Engineering Mechanics**

**COURSE EDUCATIONAL OBJECTIVES (CEOs):**

- To learn the basic concepts of stress, strain and relations based on linear elasticity,
- Students can analyze beams and draw shear force and bending moment diagrams
- To learn theory of simple bending, Shear and torsion.
- Understand the principal stresses and shear stress distribution.
- Design and analysis of components subjected to deformation and internal pressure.

**COURSE OUTCOMES (COs):** At the end of the course, student will be able to

| | |
|---|---|
| **CO1** | Describe the concept of stress and strain to analyze and design structural members and machine parts under various loading conditions.(L2) |
| **CO2** | Evaluate stress, shear force, bending moment, under different loading conditions.(L3) |
| **CO3** | Analyze Bending and torsional stresses of different components.(L3) |
| **CO4** | Understand shear stress distributions over different cross sections and concept of Principle Stresses.(L2) |
| **CO5** | Model and analyze the behavior of basic structural members subjected to deflection and internal pressure.(L4) |

**COURSE ARTICULATION MATRIX** (Correlation between COs, POs & PSOs):

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | | | | | | | | | 2 | 2 | 2 |
| **CO2** | 2 | 3 | 1 | | | | | | | | | 2 | 2 | 3 |
| **CO3** | 3 | 2 | 1 | | | | | | | | | 2 | 2 | 3 |
| **CO4** | 3 | 2 | 1 | | | | | | | | | 2 | 2 | 2 |
| **CO5** | 3 | 1 | 2 | | | | | | | | | 2 | 2 | 2 |
| **1** - Low | | | | **2** –Medium | | | | | | | | **3** - High | | |

**TEXTBOOKS:**


**T1** Ramamrutham. S, Narayanan R, Strength of Materials, Dhanpat Rai & Sons, 2017.

**T2** B.C. Punmia, Strength of materials,10/e, Lakshmi publications Pvt. Ltd, New Delhi, 2018


**REFERENCE BOOKS:**


**R1** Popov. E. P, Mechanics of Materials, Prentice Hall Inc, 1976

**R2** Andrew. P, Singer F.L., Strength of Materials, Harper and Row Publishers, New York, 1987.

**R3** Gambhir. M. L, Fundamentals of Solid Mechanics, PHI Learning, 2009. Subramanian. R, Strength of Materials, Second Edition, Oxford University Press, 2010.

# PART-B

## COURSE DELIVERY PLAN (LESSON PLAN):

### UNIT-I: SIMPLE STRESSES AND STRAINS

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 1. | Introduction to Solid Mechanics | 1 | 01-12-25 | | TLM1 | |
| 2. | Properties of material | 1 | 03-12-25 | | TLM1 | |
| 3. | Types of stresses and strains | 1 | 04-12-25 | | TLM1 | |
| 4. | stepped bars, Bars of varying c/s | 1 | 08-12-25 | | TLM1 | |
| 5. | Composite bar problems | 1 | 10-12-25 | | TLM1 | |
| 6. | Temperature stresses | 1 | 11-12-25 | | TLM1 | |
| 7. | strain energy due to axial force | 1 | 15-12-25 | | TLM1 | |
| 8. | Change in Volume | 1 | 17-12-25 | | TLM1 | |
| 9. | stresses due to sudden loads and impact | 1 | 18-12-25 | | TLM1 | |
| 10. | Relation between elastic Constants | 1 | 22-12-25 | | TLM1 | |
| **No. of classes required to complete UNIT-I: 10** | | | | **No. of classes taken:** | | |

### UNIT-II: SHEAR FORCE AND BENDING MOMENT

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 11. | Introduction to SF and BM | 1 | 24-12-25 | | TLM1 | |
| 12. | Relationship Between SF and B.M | 1 | 29-12-25 | | TLM1 | |
| 13. | SFD & BMD for cantilever beam | 1 | 31-12-25 | | TLM1 | |
| 14. | cantilever beam subjected to UDL | 1 | 05-01-26 | | TLM1 | |
| 15. | SFD & BMD for S.S.B | 1 | 07-01-26 | | TLM1 | |
| 16. | Combination of loads for S.S.B | 1 | 08-01-26 | | TLM1 | |
| 17. | SFD and BMD for Overhang beams | 1 | 19-01-26 | | TLM1 | |
| 18. | Maximum Bending Moment | 1 | 21-01-26 | | TLM1 | |
| 19. | Point of contra flexure | 1 | 22-01-26 | | TLM1 | |
| **No. of classes required to complete UNIT-II: 09** | | | | **No. of classes taken:** | | |

### UNIT-III: STRESSES IN BEAMS

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 20. | Theory of simple bending | 1 | 02-02-26 | | TLM1 | |
| 21. | Derivation of Flexural equation | 1 | 04-02-26 | | TLM1 | |
| 22. | Section modulus of various cross section | 1 | 05-02-26 | | TLM1 | |
| 23. | Normal stresses due to flexure | 1 | 09-02-26 | | TLM1 | |
| 24. | Theory of pure torsion & Assumptions | 1 | 11-02-26 | | TLM1 | |
| 25. | Derivation of Torsion equations | 1 | 12-02-26 | | TLM1 | |
| 26. | Torsion problems | 1 | 16-02-26 | | TLM1 | |
| 27. | Power transmitted by shaft | 1 | 18-02-26 | | TLM1 | |
| 28. | Stresses in solid and hollow shafts | 1 | 19-02-26 | | TLM1 | |
| **No. of classes required to complete UNIT-III: 09** | | | | **No. of classes taken:** | | |

**UNIT-IV: SHEAR STRESSES, Principal STRESSES**

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 29. | Shear stress distribution across different C/S's | 1 | 23-02-26 | | TLM1 | |
| 30. | Shear stress distribution across I,T sections | 1 | 25-02-26 | | TLM1 | |
| 31. | Shear stress distribution problems | 1 | 26-02-26 | | TLM1 | |
| 32. | Principal Stresses | 1 | 02-03-26 | | TLM1 | |
| 33. | Normal & Tangential stresses on inclined planes | 1 | 04-03-26 | | TLM1 | |
| 34. | Member Subjected to Direct Stresses | 1 | 05-03-26 | | TLM1 | |
| 35. | Two Mutually Perpendicular Planes | 1 | 09-03-26 | | TLM1 | |
| 36. | Graphical Method (Mohr's Circle Method). | 1 | 11-03-26 | | TLM1 | |
| **No. of classes required to complete UNIT-IV: 08** | | | | **No. of classes taken:** | | |

**UNIT-V: DEFLECTION OF BEAMS**

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 37. | Differential equation of Elastic line | 1 | 12-03-26 | | TLM1 | |
| 38. | Deflection in statically determinate beams | 1 | 16-03-26 | | TLM1 | |
| 39. | Deflection of beams double integration | 1 | 18-03-26 | | TLM1 | |
| 40. | Macaulay's Method for prismatic members | 1 | 23-03-26 | | TLM1 | |
| 41. | Deflection of overhang beams | 1 | 25-03-26 | | TLM1 | |
| 42. | Hoop and longitudinal stresses thin cylinder | 1 | 26-03-26 | | TLM1 | |
| 43. | Hoop and longitudinal stresses thick | 1 | 30-03-26 | | TLM1 | |
| 44. | Spherical shells changes in dimensions | 1 | 01-04-26 | | TLM1 | |
| **No. of classes required to complete UNIT-V: 08** | | | | **No. of classes taken:** | | |

**Advanced Topics/ beyond Syllabus in SM**

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 1. | Statically indeterminate beams | 1 | 02-04-26 | | TLM1 | |

| **Teaching Learning Methods** | | | |
|---|---|---|---|
| **TLM1** | Chalk and Talk | **TLM4** | Demonstration (Lab/Field Visit) |
| **TLM2** | PPT | **TLM5** | ICT (NPTEL/Swayam Prabha /MOOCS) |
| **TLM3** | Tutorial | **TLM6** | Group Discussion/Project |

# PART-C

**EVALUATION PROCESS (R23 Regulation):**

| Evaluation Task | Marks |
|---|---|
| Assignment-I (Units-I, II) | A1=5 |
| I-Descriptive Examination (Units-I, II) | M1=15 |
| I-Quiz Examination (Units-I, II ) | Q1=10 |
| Assignment-II (Unit-III, IV & V) | A2=5 |
| II- Descriptive Examination (UNIT-III , IV & V) | M2=15 |
| II-Quiz Examination (UNIT-III, IV & V) | Q2=10 |
| Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2+A2)) | M=30 |
| Cumulative Internal Examination (CIE): M | 30 |
| Semester End Examination (SEE) | 70 |
| Total Marks = CIE + SEE | 100 |

# PART-D

**PROGRAMME OUTCOMES (POs):**

| | |
|---|---|
| **PO 1** | **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| **PO 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. |
| **PO 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. |
| **PO 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. |
| **PO 5** | **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations |
| **PO 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 |
| **PO 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. |
| **PO 8** | **Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| **PO 9** | **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| **PO 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. |
| **PO 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. |
| **PO 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. |

**PROGRAMME SPECIFIC OUTCOMES (PSOs):**

| | |
|---|---|
| **PSO 1** | To apply the knowledge of Aerodynamics, Propulsion, Aircraft structures and Flight Dynamics in the Aerospace vehicle design |
| **PSO 2** | To prepare the students to work effectively in Aerospace and Allied Engineering organizations |

| | | |
|---|---|---|
| Course Instructor | Module Coordinator | HOD |
| (S.Indrasena Reddy) | (S.Indrasena Reddy) | (Dr.P.Lovaraju) |

# LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
## (AUTONOMOUS)

**Accredited by NAAC & NBA (Under Tier - I),**
**ISO 21001:2018, 500001:2018, 14001:2015 Certified Institution**
**Approved by AICTE, New Delhi. and Affiliated to JNTUK, Kakinada**
**L.B. REDDY NAGAR, MYLAVARAM, N.T.R.DIST., A.P.-521 230.**
Phone: 08659-222933, Fax: 08659-222931

**DEPARTMENT OF AEROSPACE ENGINEERING**


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# COURSE HANDOUT
## PART-A

**PROGRAM** : B.Tech., IV-Sem., ASE

**ACADEMIC YEAR** : 2025-26

**COURSE NAME & CODE** : **Aerodynamics-23AE06**

**L-T-P STRUCTURE** : 3-0-0

**COURSE CREDITS** : 3

**COURSE INSTRUCTOR** : **Dr. P. Lovaraju**

**PRE-REQUISITE: Nil**

**Course Objective:**

- To learn the theoretical methods to solve the potential flow problems
- To familiarize potential flow theory to solve for airfoil characteristics
- To familiarize the finite wing theory and properties of viscous flows and boundary layer development over flat plate

**Course Outcomes:**

| COs | Statements | Blooms Level |
|---|---|---|
| CO1 | Apply Laplace equation for obtaining 2D and axisymmetric solutions | **Apply** |
| CO2 | Apply conformal transformation to form aerodynamic shapes | **Apply** |
| CO3 | Apply potential flow theory to solve airfoil characteristics | **Apply** |
| CO4 | Apply Prandtl's lifting line theory to predict finite wing properties | **Apply** |
| CO5 | Illustrate the effect of boundary layer on flow over objects | **Understand** |

.**COURSE ARTICULATION MATRIX (Correlation between COs&POs,PSOs):**

| Course Code | Cos | Program Outcomes | | | | | | | | | | | | PSOs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| 23AE06 | CO1 | 3 | 1 | 2 | 1 | 2 | - | - | 1 | 1 | 1 | - | 2 | 3 | 2 |
| | CO2 | 3 | 3 | 3 | 3 | 2 | - | - | 1 | 1 | 1 | - | 2 | 3 | 3 |
| | CO3 | 3 | 2 | 3 | 3 | 2 | - | - | 1 | 1 | 1 | - | 3 | 3 | 3 |
| | CO4 | 3 | 3 | 3 | 2 | 2 | - | - | 1 | 1 | 1 | - | 3 | 3 | 3 |
| | CO5 | 3 | 3 | 2 | 2 | 2 | - | - | 1 | 1 | 1 | - | 3 | 3 | 2 |
| 1 = Slight (Low) | | 2 = Moderate (Medium) | | | | | | | 3-Substantial(High) | | | | | | |

**Note:** Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-' 1-** Slight(Low), **2 -** Moderate(Medium), **3 -** Substantial (High).

**TEXT BOOKS:**


**T1** Anderson, J.D., Fundamentals of Aerodynamics", Sixth Edition, McGraw-Hill Book Co., New York, 2017

**T2** Rathakrishnan. E, Theoretical Aerodynamics, Wiley, 2013


**REFERENCE BOOKS:**


**R1** Houghton. E. L., Carpenter P. W, Collicott. C. H, Valentine. D. T, Aerodynamics for Engineering students, Seventh Edition, Elseveir, 2017

**R2** Milne-Thomson. L. H., Theoretical aerodynamics, Courier Corporation, 2012.

**R3** Clancy. J. L, Aerodynamics, Sterling Book House, 2006

# PART-B

**COURSE DELIVERY PLAN (LESSON PLAN):**

**UNIT-I: POTENTIAL FLOW**

| S.No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 1. | Overview of the course and course outcomes | 1 | 1-12-2025 | | TLM1 | |
| 2. | Introduction to the Potential flow, Basic Flows-Uniform parallel flow, Source and Sink Flows | 1 | 3-12-2025 | | TLM1 | |
| 3. | Source and Sink Pair-Doublet, Simple vortex | 2 | 5-12-2025<br>8-12-2025 | | TLM1 | |
| 4. | Combination of uniform flow and Source-Flow past half body | 1 | 10-12-2025 | | TLM1 | |
| 5. | Rankine oval | 1 | 12-12-2025 | | TLM1 | |
| 6. | Flow over circular Cylinder without circulation | 1 | 15-12-2025 | | TLM1 | |
| 7. | Flow over circular Cylinder with circulation | 1 | 17-12-2025 | | TLM1 | |
| 8. | Kutta-Joukowsky Theorem | 1 | 19-12-2025 | | TLM1 | |
| 9. | Tutorial | 1 | 22-12-2025 | | TLM3 | |
| **No. of classes required to complete UNIT-I** | | 10 | | **No. of classes taken:** | | |

**UNIT-II: CONFORMAL TRANSFORMATION**

| S.No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 12 | Conformal Mapping Introduction, Basic Principles, Methods for Performing Transformation | 2 | 24-12-2025<br>26-12-2025 | | TLM1 | |
| 13 | Examples of Simple Transformation | 1 | 29-12-2025 | | TLM | |
| 14 | Kutta-Joukowski Transformation | 1 | 31-12-2025 | | TLM1 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 15 | Transformation of Circle to Straight Line, Transformation of Circle to Ellipse | 1 | 02-01-2025 | | TLM1 | |
| 16 | Transformation of Circle to Symmetrical Aerofoil | 1 | 05-01-2025 | | TLM1 | |
| 17 | Transformation of Circle to Cambered Aerofoil | 2 | 07-01-2025, 09-01-2025 | | TLM1 | |
| 18 | Tutorial | 1 | 19-01-2025 | | TLM3 | |
| **No. of classes required to complete UNIT-II** | | 09 | | **No. of classes taken:** | | |

**I Mid Examination (26-01-2026 to 31-01-2026)**

**UNIT-III: THIN AEROFOIL THEORY**

| S.No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 19 | Introduction to Aerofoil Theory | 1 | 2-2-2026 | | TLM1 | |
| 20 | Airfoil Characteristics | 1 | 4-2-2026 | | TLM1 | |
| 21 | Vortex Sheet | 1 | 6-2-2026 | | TLM1 | |
| 22 | Kutta Condition, Kelvin's Circulation Theorem, Starting Vortex | 1 | 9-2-2026 | | TLM1 | |
| 23 | Thin Aerofoil Theory and its applications | 1 | 11-2-2026 | | TLM1 | |
| 24. | Application of thin aerofoil theory-Analysis of flow over symmetric airfoil | 2 | 13-02-2026 16-02-2026 | | TLM1 | |
| 25. | Application of thin aerofoil theory-Analysis of flow over cambered airfoil | 2 | 18-02-2026 20-02-2026 | | TLM1 | |
| 26. | Tutorial | 1 | 23-02-2026 | | TLM3 | |
| **No. of classes required to complete UNIT-III** | | 10 | | **No. of classes taken:** | | |

## UNIT-IV: FINITE WING THEORY

| S.No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 27. | Finite Wing Theory-Introduction | 1 | 25-02-2026 | | TLM1 | |
| 28. | Down wash and Induced drag, Trailing vortex | 1 | 27-02-2026 | | TLM1 | |
| 29. | Vortex filament, Biot-Savart's law, Infinite and semi-infinite vortex filament | 1 | 2-03-2026 | | TLM1 | |
| 30. | Helmholtz theorems | 1 | 6-03-2026 | | TLM1 | |
| 31. | Horseshoe Vortex, Prandtl's Classical Lifting Line Theory | 1 | 9-03-2026 | | TLM1 | |
| 32. | Elliptic Lift Distribution | 1 | 11-03-2026 | | TLM1 | |
| 33. | General Lift Distribution | 1 | 13-03-2026 | | TLM1 | |
| 34. | Tutorial | 1 | 16-03-2026 | | TLM3 | |
| **No. of classes required to complete UNIT-IV** | | 08 | | **No. of classes taken:** | | |

## UNIT-V: BOUNDARY LAYER

| S.No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|
| 35. | Introduction, Boundary Layer Development | 1 | 18-03-2026 | | TLM1 | |
| 36. | Boundary layer Thickness, Boundary layer Displacement Thickness | 1 | 20-03-2026 | | TLM1 | |
| 37. | Momentum Thickness, Energy Thickness | 1 | 23-03-2026 | | TLM1 | |
| 38. | Types of Boundary layer, Momentum Integral Estimates | 1 | 25-03-2026 | | TLM1 | |
| 39. | Karman Analysis of Flat plate | 1 | 27-03-2026 | | TLM1 | |
| 40. | Navier Stokes Equations-Boundary Layer Equations-2D | 1 | 30-03-2026 | | TLM1 | |
| 41. | Boundary layer growth on a Flat Plate, Blasius Solution, Boundary Layer with Pressure Gradient | 1 | 1-04-2026 | | TLM1 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 42. | Tutorial | | | | TLM3 | |
| 43. | Revision | | | | TLM2 | |
| **No. of classes required to complete UNIT-V** | | **07** | | **No. of classes taken:** | | |

**Content Beyond the Syllabus:**

| **Teaching Learning Methods** | | | |
|---|---|---|---|
| **TLM1** | Chalk and Talk | **TLM4** | Demonstration (lab or field visit) |
| **TLM2** | PPT | **TLM5** | ICT (NPTEL, Swayam Prabha, MOOCS) |
| **TLM3** | Tutorial | **TLM6** | Group Discussion/project |

## PART-C

**EVALUATION PROCESS (R23 Regulation):**

| **Evaluation Task** | **Marks** |
|---|---|
| Assignment-I (Units-I, II & UNIT-III (Half of the Syllabus)) | A1=5 |
| I-Descriptive Examination (Units-I, II & UNIT-III (Half of the Syllabus)) | M1=15 |
| I-Quiz Examination (Units-I, II & UNIT-III (Half of the Syllabus)) | Q1=10 |
| Assignment-II (Unit-III (Remaining Half of the Syllabus), IV & V) | A2=5 |
| II- Descriptive Examination (UNIT-III (Remaining Half of the Syllabus), IV & V) | M2=15 |
| II-Quiz Examination (UNIT-III (Remaining Half of the Syllabus), IV & V) | Q2=10 |
| Mid Marks =80% of Max ((M1+Q1+A1), (M2+Q2+A2)) + 20% of Min ((M1+Q1+A1), (M2+Q2+A2)) | M=30 |
| Cumulative Internal Examination (CIE): M | 30 |
| Semester End Examination (SEE) | 70 |
| Total Marks = CIE + SEE | 100 |

# PART-D

**PROGRAM OUTCOMES (POs)**

**Engineering Graduates will be able to:**

**PO1: Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

**PO2: 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.

**PO3: 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.

**PO4: Conduct Investigation 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.

**PO5: Modern Tool Usage:** Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including predictions and modeling to complex engineering activities with an understanding of the limitations.

**PO6: 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.

**PO7: 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.

**PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9: Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO10: 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.

**PO11: 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.

**PO12: 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.

**PROGRAM SPECIFIC OUTCOMES (PSOs)**

**PSO1:** To apply the knowledge of Aerodynamics, Propulsion, Aircraft structures and Flight Dynamics in the Aerospace vehicle design
**PSO2:** To prepare the students to work effectively in Aerospace and Allied Engineering organizations

| | | |
|---|---|---|
| **Course Instructor** | **Module Coordinator** | **HOD** |

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DEPARTMENT OF AEROSPACE ENGINEERING
Estd.: 1998 Website: https://www.lbrce.ac.in/ase/index.php Email: hodaero@lbrce.ac.in Phone:08659-222933 Ext:624/623

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# COURSE HANDOUT

## PART-A

**Name of Course Instructor:** Mr. G V SURYA NARAYANA
**Course Name & Code** : Manufacturing Technology Lab-23AE53 **Regulation**: R23
**L-T-P Structure** : **0-0-3** **Credits:** 1.5
**Program/Sem/Sec** : B.Tech/IV-SEM **A.Y.:** 2025-26

**Course Objectives:**

- To acquire basic knowledge of the casting process
- To demonstrate various joining processes using welding
- To demonstrate the lathe machine and special machine operations

**COURSE OUTCOMES (COs):**

| | |
|---|---|
| **CO1** | Develop various products using casting. **(Apply-L3)** |
| **CO2** | Fabricate machine components with suitable welding, lathe, and other machining operations. **(Apply-L3)** |
| **CO3** | Manufacture plastic components using various plastic processing techniques **(Apply-L3).** |

**COURSE ARTICULATION MATRIX** (Correlation between COs, POs & PSOs):

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 1 | 1 | - | - | - | - | - | - | - | 1 | 2 | 3 |
| CO2 | 3 | 1 | 1 | 1 | - | - | - | - | - | - | - | 1 | 2 | 3 |
| CO3 | 3 | 1 | 1 | 1 | - | - | - | - | - | - | - | 1 | 2 | 3 |
| **1** - Low | | | | | | **2** –Medium | | | | | | **3** - High | | |

## PART-B

## COURSE DELIVERY PLAN (LESSON PLAN):

| S. No. | Topics to be covered. (Experiment Name) | No. of Classes Required | Tentative Date of Completion | Actually Date of Completion | Tentative Date of Completion | Actually Date of Completion | Teaching Learning Methods | HOD Sign Weekly |
|---|---|---|---|---|---|---|---|---|
| | **Cycle-I** | | **BATCH-I** | | **BATCH-II** | | | |
| 1. | Introduction | 03 | 01-12-2025<br>08-12-2025 | | 06-12-2025 | | TLM4 | |
| 2. | Mould making and Sand Casting | 03 | 15-12-2025 | | 13-12-2025 | | TLM4 | |
| 3. | Pattern Design and making | 03 | 22-12-2025 | | 20-12-2025 | | TLM4 | |
| 4. | ARC Welding Butt Joint and Lap Joint | 03 | 29-12-2025 | | 27-12-2025 | | TLM4 | |
| 5. | Spot Welding (chain), Spot Welding (Zigzag) | 03 | 05-01-2026 | | 03-01-2026 | | TLM4 | |
| 6. | Injection Moulding | 03 | 19-01-2026 | | 10-01-2026 | | TLM4 | |
| 7. | Repetition | 03 | 03-01-2026 | | 24-01-2026 | | TLM4 | |
| | **Cycle-II** | | | | | | | |
| 8. | Introduction, Lathe Operations: step turning, Taper turning | 03 | 02-02-2026<br>09-02-2026 | | 07-02-2026<br>14-02-2026 | | TLM4 | |
| 9. | Lathe Operations: knurling, threading | 03 | 16-02-2026 | | 21-02-2026 | | TLM4 | |
| 10. | Special Machines: Shaping | 03 | 23-02-2026 | | 28-02-2026 | | TLM4 | |
| 11. | Special Machines: Milling | 03 | 02-03-2026 | | 07-03-2026 | | TLM4 | |
| 12. | Special Machines: Drilling, Surface Grinding | 03 | 09-03-2026 | | 14-03-2026 | | TLM4 | |
| 13. | Repetition | 03 | 23-03-2026 | | 28-03-2026 | | TLM4 | |
| 14. | Lab internal Exam | 03 | 30-03-2026 | | 04-04-2026 | | TLM4 | |
| **No. of classes required to complete 15** | | | | | | **No. of classes taken:** | | |

| **Teaching Learning Methods** | | | |
|---|---|---|---|
| **TLM1** | Chalk and talk | **TLM4** | Demonstration (Lab/Field Visit) |
| **TLM2** | PPT | **TLM5** | ICT (NPTEL/Swayam Prabha/MOOCS) |
| **TLM3** | Tutorial | **TLM6** | Group Discussion/Project |

## PART-C

**EVALUATION PROCESS (R23 Regulation):**

| **Evaluation Task** | **Expt. no's** | **Marks** |
|---|---|---|
| Day to Day work = **A** | 1,2,3,4,5,6,7,8,9,10. | A=10 |
| Record = **B** | 1,2,3,4,5,6,7,8,9,10. | B=05 |
| Internal Test = **C** | 1,2,3,4,5,6,7,8,9,10. | C =15 |
| **Cumulative Internal Examination: A + B + C = 30** | 1,2,3,4,5,6,7,8,9,10. | **30** |
| **Semester End Examinations = D** | 1,2,3,4,5,6,7,8,9,10. | **D = 70** |
| **Total Marks: A + B + C + D = 100** | 1,2,3,4,5,6,7,8,9,10. | **100** |

## PART-D

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):**

| | |
|---|---|
| **PO 1** | **Engineering knowledge**: To apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems. |
| **PO 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. |
| **PO 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. |
| **PO 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. |
| **PO 5** | **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations |
| **PO 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 |
| **PO 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. |
| **PO 8** | **Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| **PO 9** | **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| **PO 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. |
| **PO 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. |
| **PO 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. |

| | |
|---|---|
| **PEO 1** | To provide students with sound mathematical, engineering, and multidisciplinary knowledge to solve Aerospace and Allied Engineering problems. |
| **PEO 2** | To prepare students to excel in higher education programs and to succeed in industry/academia profession. |
| **PEO 3** | To inculcate ethical attitude, leadership qualities, problem solving abilities and life-long learning for a successful professional career. |

**PROGRAMME SPECIFIC OUTCOMES (PSOs):**

| | |
|---|---|
| **PSO 1** | To apply the knowledge of Aerodynamics, Propulsion, Aircraft structures and Flight Dynamics in the Aerospace vehicle design. |
| **PSO 2** | To prepare the students to work effectively in Aerospace and Allied Engineering organizations. |

| **Title** | **Course Instructor** | **Module Coordinator** | **Head of the Department** |
|---|---|---|---|
| **Signature** | | | |
| **Name of the Faculty** | Mr. G V Surya Narayana | Mr. I Dakshina Murthy | Dr. P. Lovaraju |

# LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

**(AUTONOMOUS)**

**Accredited by NAAC & NBA (Under Tier - I), ISO 9001:2015 Certified Institution**

**Approved by AICTE, New Delhi. and Affiliated to JNTUK, Kakinada**

**L.B. REDDY NAGAR, MYLAVARAM, KRISHNA DIST., A.P.-521 230.**

Phone: 08659-222933, Fax: 08659-222931

**DEPARTMENT OF AEROSPACE ENGINEERING**


## COURSE HANDOUT

## PART-A

**Name of Course Instructor:** S.Indrasena Reddy/ B.Udaya Lakshmi

**Course Name & Code** **:** Solid Mechanics Lab& 23AE54 **Regulation**: R23

**L-T-P Structure** **: 0-0-3** **Credits:** 1.5

**Program/Sem/Sec** : B.Tech/IV **A.Y.:** 2025-26

**Prerequisites:** Engineering Mechanics and Strength of Materials

**Course Educational Objectives:** To learn the methods to predict the response of a structure under loading and it susceptibility to various failure modes

**COURSE OUTCOMES (COs):** At the end of the course, students are able to

| | |
|---|---|
| **CO 1** | Analyze the various materials under different equilibrium loading conditions. (Analyze-L4) |
| **CO 2** | Perform tests and analyze materials subjected to tension, torsion, bending, and bucking (Apply-L3) |

**COURSE ARTICULATION MATRIX** (Correlation between COs, POs & PSOs):

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 1 | | | | | | | | 2 | 2 | 2 |
| CO2 | 3 | 3 | 2 | 1 | | | | | | | | 2 | 3 | 3 |

**Note:** Enter Correlation Levels **1** or **2** or **3.** If there is no correlation, **put '-'**

**1-** Slight (Low), **2 –** Moderate (Medium), **3 -** Substantial (High).

**PART-B**

**COURSE DELIVERY PLAN (LESSON PLAN)**

**Strength of Materials Lab**

**Batch-B (Monday)**

| S.No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | HOD Sign Weekly |
|---|---|---|---|---|---|
| 1. | Lab Demo | 3 | 01-12-25 | | |
| 2. | Experiment-I | 3 | 08-12-25 | | |
| 3. | Experiment-II | 3 | 15-12-25 | | |
| 4. | Experiment-III | 3 | 22-12-25 | | |
| 5. | Experiment-IV | 3 | 29-12-25 | | |
| 6. | Experiment-V | 3 | 05-01-26 | | |
| 7. | Repetition Lab | 3 | 19-01-26 | | |
| 8. | Experiment-VI | 3 | 02-02-26 | | |
| 9. | Experiment-VII | 3 | 09-02-26 | | |
| 10. | Experiment-VIII | 3 | 16-02-26 | | |
| 11. | Experiment-IX | 3 | 23-02-26 | | |
| 12. | Experiment-X | 3 | 02-03-26 | | |
| 13. | Repetition Lab | 3 | 09-03-26 | | |
| 14. | Internal Test | 3 | 16-03-26 | | |
| No. of classes required to complete: 14 | | | | | |

**Batch-A (Saturday)**

| S.No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | HOD Sign Weekly |
|---|---|---|---|---|---|
| 1. | Lab Demo (I-Cycle) | 3 | 06-12-25 | | |
| 2. | Experiment-I | 3 | 20-12-25 | | |
| 3. | Experiment-II | 3 | 27-12-25 | | |
| 4. | Experiment-III | 3 | 03-01-26 | | |
| 5. | Experiment-IV | 3 | 17-01-26 | | |
| 6. | Experiment-V | 3 | 24-01-26 | | |
| 7. | Experiment-VI | 3 | 07-02-26 | | |
| 8. | Experiment-VII | 3 | 21-02-26 | | |
| 9. | Experiment-VIII | 3 | 28-02-26 | | |
| 10. | Experiment-IX | 3 | 07-03-26 | | |
| 11. | Experiment-X | 3 | 28-03-26 | | |
| 12. | Internal Test | 3 | 04-04-26 | | |
| No. of classes required to complete: 12 | | | | | |

## PART-C

**EVALUATION PROCESS (R23 Regulations):**

| Evaluation Task | Marks |
|---|---|
| Day to Day work = **A** | A=10 |
| Record = **B** | B=05 |
| Internal Test = **C** | C = 15 |
| **Cumulative Internal Examination : A + B + C** | **30** |
| **Semester End Examinations = D** | **D = 70** |
| **Total Marks: A + B + C + D** | **100** |

## PART-D

**PROGRAMME OUTCOMES (POs):**

| | |
|---|---|
| **PO 1** | **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| **PO 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. |
| **PO 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. |
| **PO 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. |
| **PO 5** | **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations |
| **PO 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 |
| **PO 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. |
| **PO 8** | **Ethic**s: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| **PO 9** | **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| **PO 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. |
| **PO 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. |
| **PO 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. |

**PROGRAMME SPECIFIC OUTCOMES (PSOs):**

| | |
|---|---|
| **PSO 1** | To apply the knowledge of Aerodynamics, Propulsion, Aircraft structures and Flight Dynamics in the Aerospace vehicle design |
| **PSO 2** | To prepare the students to work effectively in Aerospace and Allied Engineering organizations |

| Title | Course Instructor | Module Coordinator | Head of the Department |
|---|---|---|---|
| **Name of the Faculty** | (S.Indrasena Reddy) | (S.Indrasena Reddy) | (Dr.P.Lovaraju) |
| **Signature** | | | |

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DEPARTMENT OF AEROSPACE ENGINEERING
Website: https://www.lbrce.ac.in/ase/index.php Email: hodaero@lbrce.ac.in Phone:08659-222933 Ext:624/623

# COURSE HANDOUTS

| | |
|---|---|
| PROGRAM | : B. Tech, IV Sem, Aerospace Engineering |
| ACADEMIC YEAR | : 2025-2026 |
| COURSE NAME AND CODE | : 23AES2- MATLAB APPLICATIONS IN ENGINEERING LAB |
| L-T-P STRUCUTRE | : 0-1-2 |
| COURSE CREDITS | : 2 |
| COURSE INSTRUCTOR | : Dr. Sreenadh Chevula |
| COURSE COORDINAOTR | : Dr. Sreenadh Chevula |

PRE-REQISITE

Course educational objectives : Engineering Mechanics and Numerical methods

COURSE OUTCOMES(CO's) : At the end of the course students are able to

| | |
|---|---|
| CO1 | Apply the basic MATLAB operations in basic engineering problems (Apply-L3) |
| CO2 | Solve the system of linear algebraic equation using matrix operation (Apply-L3) |
| CO3 | Apply the graphical user interface to write the code as more user friendly (Apply-L3) |

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 1 | 3 | - | - | - | - | - | - | 3 | 3 | 2 |
| CO2 | 3 | 3 | 2 | 2 | 3 | - | - | - | - | - | - | 3 | 3 | 2 |
| CO3 | 3 | 3 | 2 | 1 | 3 | - | - | - | - | - | - | 3 | 3 | 2 |

BOS APPROVED TEXTBOOKS

T1 Laboratory Manual & online MATLAB Help portal

## COURSE DELIVERY PLAN (LESSON PLAN)

| s.No | Experiment name | No of classes required | Tentative date of completion | Actual Date of completion | Teaching Learning method | Learning Outcomes | Text Book Followed | HoD Sign Weekly |
|---|---|---|---|---|---|---|---|---|
| | **Part I: Introduction to MATLAB** | | | | | | | |
| 1 | (a) Find the sum of first100 natural numbers (b) Perform Basic matric operations? | 3 | 02-Dec-25 | | TLM5 & TLM8 | CO1 | T1 | |
| 2 | (a) Write a MATLAB program that adds all elements of an array named S with even indices. (b) Perform double integration problems? | 3 | 09-Dec-25 | | TLM5 & TLM8 | CO1 | T1 | |
| 3 | Find the roots of a linear equation by using Newton's and secant Method | 3 | 16-Dec-25 | | TLM5 & TLM8 | CO1 | T1 | |
| 4 | (a) Introduction to basic plots 2D, 3D (b) MATLAB Graphical user interface addition and subtraction | 9 | 23,30-12-2025,6-01-2026 | | TLM5 & TLM8 | CO1 | T1 | |
| 5 | Write a MATLAB Code to determine Lift Curve Slope from the given parameters? | 3 | 20-Jan-26 | | TLM5 & TLM8 | CO2 | T1 | |
| | **26-01-2026 to 31-01-2026 MID-I Examination** | | | | | | | |
| | **Part II: Application of MATLAB** | | | | | | | |
| 6 | Solving of ordinary differential equation using Runge-Kutta method a numerical approach | 3 | 03-Feb-26 | | TLM5 & TLM8 | | | |
| 7 | (a) Write a MATLAB Code to determine Compute the Laplace transform of 1/sqrt(x) (b) Write a MATLAB Code to determine Eigenvalues and eigenvectors of a linear algebraic equations | 6 | 10,17-02-2026 | | TLM5 & TLM8 | CO2 | T1 | |
| 8 | (a) Solve System of Linear Equations (b) Solve system of nonlinear equations | 6 | 24-02-2026,3-03-2026 | | TLM5 & TLM8 | CO2 | T1 | |
| 9 | Graphics kinematics of particle position, velocity, and acceleration | 3 | 10-Mar-26 | | TLM5 & TLM8 | CO2 | T1 | |
| 10 | Develop the graphical user interface to identify the area moment of | 3 | 17-Mar-26 | | TLM5 & TLM8 | CO2 | T1 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | inertia of simple section trapezoidal and triangle. | | | | | | | |
| 11 | Identification of shear force and bending moment diagram of cantilever beam with point load | 3 | 24-Mar-26 | | TLM5 & TLM8 | CO3 | T1 | |
| 12 | MATLAB Graphical user interface: Design and develop a scientific calculator | 3 | 31-Mar-26 | | TLM5 & TLM8 | CO2 | T1 | |
| Total No of classes required | | 48 | No of Classes Taken : | | | | | |

**06 -04-2025 to 11-04-2026 MID-II Examination**

**20-04-2026 to 2-05-2026 Semester end examination**

| **Delivery Methods** | | | |
|---|---|---|---|
| **TLM1** | Chalk and Talk | **TLM4** | Assignment/Test/Quiz |
| **TLM2** | ICT Tools | **TLM5** | Laboratory/Field Visit |
| **TLM3** | Tutorial | **TLM6** | Web-based Learning |

**Teaching Learning Method**

| | |
|---|---|
| **TLM5** | Programming |
| **TLM8** | Lab Demo |

| **Title** | **Course Instructor** | **Head of the Department** |
|---|---|---|
| **Name of the Faculty** | **Dr. Sreenadh Chevula** | **Dr. P. Lovaraju** |
| **Signature** | | |

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**PART-A**

Name of Course Instructor : **Dr. Sreenadh Chevula**
Course Name & Code : **23ME57-DESIGN THINKING & INNOVATION**
Regulation : **R23**
L-T-P Structure : **1-0-2** Credits **: 2**
Program/Semester/Section : **B.Tech.–ASE/IV Semester** A.Y. **: 2025-26**

**PRE-REQUISITE: NO**

**COURSE EDUCATIONAL OBJECTIVE (CEO):**

Bring awareness on innovative design and new product development.

- Explain the basics of design thinking.
- Familiarize the role of reverse engineering in product development.
- Train how to identify the needs of society and convert into demand.
- Introduce product planning and product development process.

**COURSE OUTCOMES (COs):** At the end of the course, the student will be able to:

| | | |
|---|---|---|
| **CO1:** | Define the concepts related to design thinking. | Remember-L1 |
| **CO2:** | Explain the fundamentals of Design Thinking and innovation. | Understand-L2 |
| **CO3:** | Apply the design thinking techniques for solving problems in various sectors. | Apply-L3 |
| **CO4:** | Analyze to work in a multidisciplinary environment. | Analyze-L4 |
| **CO5:** | Evaluate the value of creativity. | Evalute-L5 |

**COURSE ARTICULATION MATRIX** (Correlation between COs, POs & PSOs):

| CO | Program Outcomes (POs) | | | | | | | | | | | | PSOs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| CO1 | 2 | 1 | | | 3 | | | | | | | 2 | | | |
| CO2 | 1 | 2 | 2 | | 3 | | | | | | | 2 | | | |
| CO3 | 3 | 3 | | 2 | 3 | | | | | | | 3 | | | |
| CO4 | 1 | 1 | | | 3 | | | | | | | 2 | | | |

**TEXTBOOKS:**

**T1:** Tim Brown, Change by design, 1/e, Harper Bollins, 2009.
**T2:** Idris Mootee, Design Thinking for Strategic Innovation, 1/e, Adams Media, 2014.

**REFERENCE BOOKS:**

**R1:** David Lee, Design Thinking in the Classroom, Ulysses press, 2018.
**R2:** Shrrutin N Shetty, Design the Future, 1/e, Norton Press, 2018.
**R3:** William Lidwell, Kritina Holden, &Jill butter, Universal principles of design, 2/e, Rockport Publishers, 2010.

**PART-B**

**COURSE DELIVERY PLAN (LESSON PLAN):**

| S. No. | Topics to be covered | No. of Classes Required | Tentative Date of Completion | Actual Date of Completion | Teaching Learning Methods | |
|---|---|---|---|---|---|---|
| **UNIT - I INTRODUCTION TO DESIGN THINKING** | | | | | | |
| 1. | Introduction to elements and principles of Design, Fundamental design components. **Activity**: To understand the importance of design | 3 | 05-12-2025 | | TLM2 TLM5 | |
| 2. | Basics of design-dot, line, shape, form as fundamental design components **Activity**: Developing sketches using dot, line and form | 3 | 12-12-2025 | | TLM2 TLM5 | |
| 3. | History of Design Thinking, New materials in Industry. **Activity:** To understand the importance of team work | 3 | 19-12-2024 | | TLM2 TLM5 | |
| **UNIT - II DESIGN THINKING** | | | | | | |
| 4. | Process Design thinking process (empathize, analyze, idea & prototype) Design thinking process: Empathy. **Activity**: To understand the significance of Empathy | 3 | 26-12-2025 | | TLM2 TLM5 | |
| 5. | Design thinking process: Define or Analyze **Activity:** To understand the significance of Define/analyze. | 3 | 02-01-2026 | | TLM2 TLM5 | |
| 6. | Design thinking process: Ideate, prototype **Activity:** To understand the significance of Ideate ,Prototype. | 3 | 09-01-2026 | | TLM2 TLM5 | |
| **7.** | Tools of design thinking in social innovations **Activity:** Students should present their understanding of DTI elements using example | 3 | 23-01-2026 | | TLM2 TLM5 | |
| **UNIT - III INNOVATION** | | | | | | |
| 8. | Art of innovation, Difference between innovation and creativity, Role of creativity and innovation in organizations. **Activity**: Debate on innovation and creativity ,Flow and planning from idea to innovation | 3 | 06-02-2026 | | TLM2 TLM5 | |
| 8. | Teams for innovation, Measuring the impact and value of creativity. **Activity:** Debate on value-based innovation. | 3 | 13-02-2026 | | TLM2 TLM5 | |
| **UNIT - IV PRODUCT DESIGN** | | | | | | |
| 9. | Problem formation, introduction to product design, Product strategies, Product value **Activity:** Importance of modeling, how to set specifications, | 6 | 20, 27-2-2026 | | TLM2 TLM5 | |
| 10. | Product planning, product specifications. Innovation towards product design Case studies. **Activity:** Explaining their own product design. | 6 | 06, 13-03-2026 | | TLM2 TLM5 | |

| UNIT V DESIGN THINKING IN BUSINESS PROCESSES DESIGN | | | | | | |
|---|---|---|---|---|---|---|
| 11. | Business & Strategic Innovation, Business challenges, Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes<br>**Activity:** Marketing strategies of our own product, its maintenance, Reliability and plan for startup | 9 | 20,27,03-04-2026 | | TLM2<br>TLM5 | |
| **I Mid Exams: 26-01-2026 to 31-01-2026** | | | | | | |
| **II Mid Exams: 06 -04-2026 to 11-04-2026** | | | | | | |
| **No. of classes required to complete 48** | | | **No. of classes taken:** | | | |

| Delivery Methods | | | |
|---|---|---|---|
| **TLM1** | Chalk and Talk | **TLM4** | Assignment/Test/Quiz |
| **TLM2** | ICT Tools | **TLM5** | Laboratory/Field Visit |
| **TLM3** | Tutorial | **TLM6** | Web-based Learning |

| **Title** | **Course Instructor** | **Head of the Department** |
|---|---|---|
| **Name of the Faculty** | **Dr. Sreenadh Chevula** | **Dr. P. Lovaraju** |
| **Signature** | | |