

Department of Mechanical Engineering  
**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
(An Autonomous Institution)

Title of the Course : Applied Thermodynamics – II  
Category : PC  
Course Code : 19A351T  
Year : III Year  
Semester : I Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| 2             | 1              | -         | 3       |

Course Objectives:

- To gain knowledge on thermodynamic vapour cycle used in thermal power plants.
- To become familiar with various boilers and draught.
- To understand functioning of nozzle, its types, and the study of nozzle characteristics.
- To provide a sound knowledge on condensers and cooling towers.
- To give better understanding on steam turbines and their performance characteristics.

Unit 1 Introduction to Steam Power Plant 10  
Rankine's cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance – Regeneration – reheating- combined- cycles, Steam engines (elementary treatment).

Unit 2 Boilers 14  
Classification based on Working principles - Fire tube boilers, water tube boilers – High pressure Boilers, boiler Mountings & Accessories. Performance of Boilers - Boilers horse power, equivalent evaporation, efficiency and heat balance – Draught: classification – Height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney – artificial draught, induced and forced draught.

Unit 3 Steam Nozzles 08  
Function of nozzle – applications - types, Flow through nozzles, thermodynamic analysis – assumptions -velocity of nozzle at exit- Ideal and actual expansion in nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio. Criteria for design of nozzle shape: Super saturated flow, its effects, degree of super saturation and degree of under cooling - Wilson line –Shock at the exit

Unit 4 Steam Condensers 08  
Requirements of steam condensing plant, rare fraction – Classification of condensers – working principle of different types – vacuum efficiency and condenser efficiency – air leakage, sources and its effects, air pump- cooling water requirement. Cooling towers – Types-listing.

Unit 5 Steam Turbines 08  
Steam Turbines - Impulse and reaction Turbines, Pressure and Velocity compounding of steam turbines, multistage reaction Turbines, reheat factor and Efficiency, degree of reaction.

Prescribed Text Books:

1. Rathore, Thermal Engineering. TMH.1st Ed.2010 - ISBN-13: 978-0070681132
2. P.K. Nag, Basic and Applied Thermodynamics.TMH. 2nd Ed.2010 - ISBN-10: 0070151318
3. M.L. Mathur& Mehta, Thermal Engineering. Jain bros. 3rd Ed.2013 - ISBN-10: 8183600832

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Reference Books:

1. R. Yadav, Thermodynamics and Heat Engines. Central Book Depot. 6th ed. 2012, ISBN 8185444021
2. R. S Khurmi & JS Gupta, Thermal Engineering. S.Chand. 14th Ed. 1997. ISBN 9788121925730
3. Claus Borgnakke, Richard Edwin Sonntag, Fundamentals of Thermodynamics, Wiley, 7th Ed. 2009

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |   |            |
|---|------------|
| 1. Evaluate the efficiency of steam power plant and recommend efficiency enhancement methods in improving the overall efficiency of the plant | L1, L2, L3 |
| 2. Identify different types of boilers and their working, draughts and can calculate the chimney height for maximum discharge.                | L1, L2, L3 |
| 3. Evaluate the performance characteristics of steam nozzles and different nozzles used in steam power plants.                                | L1, L2, L3 |
| 4. Evaluate the efficiency of steam condensers and the importance of cooling towers requirement in steam power plant                          | L1, L2, L3 |
| 5. Calculate the performance parameters of turbines and can demonstrate the influence of governing mechanisms in steam power plants.          | L1, L2, L3 |

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A351T.1 | 3   | 3   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 3    | -    | -    | -    |
| 19A351T.2 | 3   | 3   | 3   | -   | -   | 1   | 1   | -   | -   | -    | -    | 3    | -    | 2    | -    |
| 19A351T.3 | 3   | 3   | 3   | -   | -   | -   | -   | -   | -   | -    | -    | 3    | -    | -    | -    |
| 19A351T.4 | 3   | 3   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 3    | -    | -    | -    |
| 19A351T.5 | 3   | 3   | 3   | -   | -   | -   | -   | -   | -   | -    | -    | 3    | -    | -    | -    |

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
(An Autonomous Institution)

Title of the Course : Machine Tools  
 Category : PC  
 Course Code : 19A352T  
 Year : III Year  
 Semester : I Semester

|               |                |           |         |
|---------------|----------------|-----------|---------|
| Lecture Hours | Tutorial Hours | Practical | Credits |
| 2             | 1              | -         | 3       |

Course Objectives:

- To get the basic knowledge of metal cutting theory and Learn about the geometry of cutting tools, chip formation, different forces acting on cutting tool and different cutting tool materials
- To become familiar with the different types of machines for machining with various constructional features and operations performed
- To become familiar with reciprocating machine tools, construction and its operations
- To become familiar with various grinding and super finishing operations by using different machining processes
- To become familiar with various work holding and tool holding devices

Unit 1 Fundamentals of Machining 12

Introduction to orthogonal and oblique cutting, Mechanics of Machining, types of chip, single point, Nomenclature (ORS & ASA) and multi-point cutting tools, forces in turning process; Cutting tool materials, tool wear, tool life and cutting fluids, Thermal aspects in machining – Economics of machining.

Unit 2 Lathe and Lathe operations 10

Centre lathe, constructional features, specifications, lathe operations – taper turning methods, thread cutting – calculations of machining time. Capstan and turret lathes-tool layout – Automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle

Unit 3 Reciprocating machine tools 10

Shaper, Planer and Slotter- Construction, Types and operations.  
 Drilling machines -construction, specifications, types, and operations performed – Reaming and Boring  
 Milling machines: types, working principle, Dividing head and Index, methods of indexing – Simple Indexing, Milling cutters types

Unit 4 Grinding and Super finishing process 10

Grinding wheel – Specification of grinding wheel and selection, types of grinding process– cylindrical grinding, surface grinding, Center less grinding, internal grinding- micro finishing methods - Typical applications – concepts of surface integrity.

Broaching machines: broach construction, types – push, pull broach.

Super finishing: Honing (Types and Construction), Lapping, Buffing, Burnishing and polishing process.

Unit 5 Jigs & Fixtures 06

Materials used in Jigs & Fixtures, Principles of work holding, design of Jigs and fixtures and uses, Classification of Jigs & Fixtures – Principles of location and clamping– Types of clamping - Typical examples of jigs and fixtures.

Prescribed Text Books:

1. Rao. P.N “Manufacturing Technology,” Metal Cutting and Machine Tools, Tata McGraw- Hill, New Delhi, 2003,

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ISBN - 9780070087699

2. Kalpakjian & Schmid, "Manufacturing Engineering & Technology", Pearson, 2005, ISBN - 8177581708
3. Joshi PH, "Jigs & Fixtures", New Delhi – Tata McGraw Hill Pub. Co. Ltd., 11<sup>th</sup> Print 1999. ISBN - 9780070680739

Reference Books:

1. Roy. A. Lindberg, "Process and materials of manufacture," PHI/Pearson Education fourth, Edition 2006, ISBN - 9788120306639
2. Geoffrey Boothroyd, Fundamentals of Metal Machining and Machine Tools, McGraw Hill, 1984, ISBN - 1574446592
3. Hajra Choudhury & Nirjhar Roy S.K "Elements Of Workshop Technology -Volume II - Machine Tools" Media promoters and publishers Pvt Ltd, ISBN - :81850991541

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |   |  |
|---|--|
| <ol style="list-style-type: none"> <li>1. Understand the fundamentals of metal cutting, chip formation, cutting forces involved in orthogonal metal cutting, and different cutting forces, tool materials and cutting fluids will be learned</li> <li>2. Analyze the classification of cylindrical work parts and their operations performed on turning machines.</li> <li>3. Analyze the classification of various non-rotational work part machines with their constructional features and operations</li> <li>4. Evaluate the surface finishing operations with abrasive processes such as grinding and broaching machines, types and working principle.</li> <li>5. Analyzing the constructional features and the terminologies related to various types of Jigs and Fixtures.</li> </ol> | <p style="text-align: right;">L2</p> <p style="text-align: right;">L4</p> <p style="text-align: right;">L4</p> <p style="text-align: right;">L5</p> <p style="text-align: right;">L4</p> |
|---|--|

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A352T.1 | 3   | 3   | 3   | 3   | -   | 3   | 3   | 3   | -   | -    | -    | -    | -    | 3    | -    |
| 19A352T.2 | 2   | -   | 2   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | -    |
| 19A352T.3 | 2   | -   | 2   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | -    |
| 19A352T.4 | 2   | -   | 2   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | -    |
| 19A352T.5 | 1   | 1   | 1   | 1   | -   | 1   | 1   | 1   | -   | -    | -    | 1    | -    | 1    | -    |

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
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Title of the Course : Design of Machine Elements-I  
 Category : PC  
 Course Code : 19A353T  
 Year : III Year  
 Semester : I Semester

|               |                |           |         |
|---------------|----------------|-----------|---------|
| Lecture Hours | Tutorial Hours | Practical | Credits |
| 2             | 1              | -         | 3       |

Course Objectives:

- To provide an introduction to design of machine elements.
- To familiarize with fundamental approaches to failure prevention for static and dynamic loading.
- To explain design procedures to different types of joints.
- To familiarize with various theories related the design of machine elements for different loading conditions.

Unit 1 Introduction, Design for Static Loads 12  
 Introduction: General considerations of design, design process. Selection of Engineering materials - properties – Manufacturing considerations in the design. BIS codes of materials. Preferred numbers.  
 Design for static loads: Modes of failure, Design of components subjected to axial, bending, torsional and impact loads. Theories of failure for static loads.

Unit 2 Design for Dynamic Loads 10  
 Stress concentration –notch sensitivity, Types of fluctuating loads– Design for fluctuating stresses –finite life - Endurance limit - Estimation of Endurance limit – Soderberg, Goodman and Modified Goodman criterion for fatigue failure.

Unit 3 Design of Bolted, Rivetted and Welded joints 10  
 Design of Bolted Joints: Preload of bolts, various stresses induced in the bolts, torque requirement for bolt tightening, eccentrically loaded joints.  
 Design of Riveted joints: Design of lap, butt and eccentrically loaded joints, efficiency of Riveted joints.  
 Design of Welded Joints: Stresses of lap and butt welds, eccentrically loaded welded joints. Joints subjected to bending and torsion.

Unit 4 : Design of Keys, Cotter and Knuckle Joints 08  
 Keys: Design of sunk, saddle, Kennedy and woodruff keys.  
 Cotter and Knuckle Joints: Socket and spigot joint, Sleeve and Cotter joints, Gib and Cotter joint, Knuckle joint.

Unit 5 : Design of Shafts and Couplings 08  
 Shafts: Design of solid and hollow shafts bending, torsion, axial and combined bending and axial loading.  
 Shaft Couplings: Design of Rigid couplings-Muff, Split muff and Flange couplings-Flexible couplings: bushed pin type.

Prescribed Text Books:

1. V B Bhandari, Design of machine elements, 4<sup>th</sup> edition, TMH, 2017. ISBN 9780070611412
2. Pandya & Shah, Machine design, 20<sup>th</sup> edition, Charotar Publishers, 2009. ISBN : 978-93-85039-10-2
3. R.S. Khurmi & J.S.Gupta, Machine Design, S.Chand Publications, 2014. ISBN-13: 978-8121905015

Reference Books:

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1. J.E. Shigley, Machine design, TMH, 2015. ISBN-10: 9780073398204
2. T. Krishna Rao, Design of Machine Elements-I. I.K. International, 2010. ISBN 9789381141373
3. M.F. Spotts, Design of Machine Elements. PHI, 2006. ISBN 9788177584219
4. Kanniah, Machine Design. Scietech, 2009. ISBN 13: 9788183711517
5. Machine Design, Schaum series, ISBN 13: 9780070255951.

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |  |            |
|--|------------|
| 1. Identify the suitable materials for machine elements, apply the codes and standards in design, and apply theories of failures in designing of machine elements subjected to static loads. | L1, L3     |
| 2. Apply theories of failures in designing of machine elements subjected to dynamic loads.   | L3         |
| 3. Identify different types of joints; analyze stresses induced in joints subjected to different loads, and design different joints subjected to combined loading.                           | L1, L4, L6 |
| 4. Design keys, cotter and knuckle joints subjected to various loads.  | L6         |
| 5. Design of shafts subjected to various loads, selection of shaft couplings for a given application and outline the design procedure.   | L3, L6     |

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A353T.1 | 3   | 2   | -   | -   | -   | -   | -   | -   | 2   | -    | -    | -    | -    | -    | -    |
| 19A353T.2 | 3   | 3   | -   | -   | -   | -   | -   | -   | 2   | -    | -    | -    | -    | -    | -    |
| 19A353T.3 | 3   | 3   | -   | -   | -   | -   | -   | -   | 3   | -    | -    | -    | -    | -    | -    |
| 19A353T.4 | 3   | 3   | -   | -   | -   | -   | -   | -   | 3   | -    | -    | -    | -    | -    | -    |
| 19A353T.5 | 3   | 3   | -   | -   | -   | -   | -   | -   | 3   | -    | -    | -    | -    | -    | -    |

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
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Title of the Course : IC ENGINES  
 Category : PE  
 Course Code : 19A35AT  
 Year : III Year  
 Semester : I Semester

|               |                |           |         |
|---------------|----------------|-----------|---------|
| Lecture Hours | Tutorial Hours | Practical | Credits |
| 3             | -              | -         | 3       |

Course Objectives:

- To familiarize with the working of S.I. and C.I. engines and its important systems
- To acquaint with the various methods for measurement of engine performance
- To provide insight into the harmful effects of engine pollutants and its control
- To familiarize with the latest technological developments in engine technology

Unit 1 : Introduction 07

I.C. ENGINES :Introduction Classification of I.C. Engines; Parts of I.C. Engine and their materials, Cycle of operation in Four stroke and Two-stroke IC engines and their comparative study; Fuel air cycles and their analysis, Actual working cycle, Valve Timing Diagram- Homogeneous charge compression Ignition, Rotary engine-Six stroke engine concept.

Unit 2 : Combustion in SI ,Fuel Supply and Ignition System Engines 12

Combustion in SI Engines: Combustion phenomenon in SI Engines, Ignition delay, Flame propagation, Pressure Crank angle diagram, Abnormal combustion, Auto ignition, Detonation and Knocking, Factors affecting combustion and detonation& its control , Types of combustion chambers.

Fuel Supply System: Spark ignition Engine mixture requirements, Fuel-Air ratio, Simple carburetor and auxiliary circuits (excluding mathematical analysis of carburetors)

Injection systems: Single-point and Multipoint injection, Gasoline Direct Injection.

Ignition System: need of Ignition System, Working of Battery Ignition System, Magneto Ignition System and Electronic Ignition Systems.

Unit 3 : Combustion in CI Engines and Fuel Supply System 12

Combustion in CI Engines: Combustion phenomenon in CI engines, Stages of combustion, Delay period, Knocking, Pressure-Crank angle diagram, Factors affecting combustion and knocking, Types of combustion chambers.

Fuel Injection Systems: Air injection systems, Airless/solid injection systems, Common rail, individual pump, distributor and unit systems. Injection pumps, Fuel injector, Types of nozzle, Electronically controlled unit fuel injection system.

Engine Cooling: Necessity of engine cooling, disadvantages of overcooling, Cooling systems and their comparison: Air cooling, Liquid cooling.

Engine lubrication: Types of lubricants and their properties, SAE rating of lubricants, Types of lubrication systems.

Supercharging/Turbo-charging: Objectives, Limitations, Methods and Types, Different arrangements of turbochargers and superchargers.

Unit 4 : Engine Testing and Performance 08

Engine Testing and Performance: Measurement of Brake Power, Indicated Power, Frictional Power, Fuel Consumption, Air flow, BMEP, Performance characteristic of SI and CI Engine Effect of load and speed on Mechanical, Indicated Thermal, Brake Thermal and Volumetric efficiencies, Heat balance sheet.

Unit 5 : Engine Exhaust Emission and its control and Alternative Fuels for IC Engines

06

Engine Exhaust Emission and its control: Constituents of exhaust emission at its harmful effect on environment and human health, Formation of NO<sub>x</sub>, HC, CO and particulate emissions, Methods of controlling emissions; Catalytic converters, particulate traps, Exhaust Gas Recirculation, EURO and BHARAT norms

Alternative Fuels :Alcohol, Hydrogen, Natural Gas and Liquefied Petroleum Gas ,Biodiesel, Biogas, Producer Gas ,Properties, Suitability ,Engine Modifications, Merits and Demerits as fuels.

Prescribed Text Books:

1. V. Ganesan, I.C. Engines. TMH.6th edition, 2018. ISBN: 9781259006197
2. Thermal engineering, Rathore. TMH, 2018. ISBN: 9789353160845, 9353160847
3. Heywood, I.C. Engines. McGrawHill. 2nd edition, 2018. ISBN: 9781260116113, 1260116115

Reference Books:

1. Mathur& Sharma, IC Engines. DhanpathRai& Sons, 2016. ISBN: 9788170237440, 8170237440
2. Pulkrabek, Engineering fundamentals of IC Engines. Pearson, PHI, 4th edition, 2013. ISBN:9781292054971
3. Rajput, Thermal Engineering. Lakshmi Publications. 8th edition, 2010. ISBN: 9788131808047
4. R.S. Khurmi&J.K.Gupta, Thermal Engineering. S.Chand, 16th edition, 2016. ISBN: 9788121925730
5. Applied thermodynamics by Omkar Singh, 4th edition, New age Int pub, 2015. ISBN: 9788122417630
6. B.Srinivasulu Reddy, Thermal engineering data book. JK International Pub, 2016. ISBN:978-81-89866-32-7
7. Rudramoorthy, Thermal Engineering. TMH, 2003. ISBN: 9780070494985

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |  |        |
|--|--------|
| 1. Gain the knowledge on type of application of various engine systems used in I.C engines.                          | L1, L2 |
| 2. Understand the concept of combustion and Ignition system in SI engine.  | L2     |
| 3. Understand the concept of combustion and Fuel Supply system in SI engine  | L2     |
| 4. Conduct the performance test & estimating the performance of an I.C engines.                                      | L2, L3 |
| 5. Show their ability to Justify Engine Exhaust Emission and its Control in IC Engine by Choosing Alternative Fuels. | L1, L2 |

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A35AT.1 | 3   | 3   | 3   | 3   | -   | -   | -   | -   | -   | -    | -    | -    | -    | -    | -    |
| 19A35AT.2 | 3   | 3   | 3   | 3   | -   | -   | 1   | -   | -   | -    | -    | -    | -    | 2    | -    |
| 19A35AT.3 | 3   | 3   | 3   | -   | -   | -   | -   | -   | -   | -    | -    | 3    | -    | 2    | -    |
| 19A35AT.4 | 3   | 3   | 3   | 3   | -   | -   | -   | -   | -   | 1    | -    | 3    | -    | 2    | -    |
| 19A35AT.5 | 3   | 3   | 3   | 3   | -   | 1   | -   | -   | -   | -    | -    | 3    | -    | 2    | -    |



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
(An Autonomous Institution)

Title of the Course : Design and Transmission System  
 Category : PE  
 Course Code : 19A35BT  
 Year : III Year  
 Semester : I Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| 3             | -              | 0         | 3       |

Course Objectives:

- To gain knowledge on the principles and procedure for the design of Mechanical power transmission components.
- To understand the standard procedure available for Design of Transmission of Mechanical elements
- To learn to use standard data and catalogues (Use of P S G Design Data Book permitted)

Unit 1 Design Of Flexible Elements 08  
 Design of Flat belts and pulleys – Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys – Design of Transmission chains and Sprockets.

Unit 2 Spur Gears And Parallel Axis Helical Gears 10  
 Speed ratios and number of teeth-Force analysis -Tooth stresses – Dynamic effects – Fatigue strength – Factor of safety – Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces for helical gears.

Unit 3 Bevel, Worm And Cross Helical Gears 10  
 Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology-helix angles- Estimating the size of the pair of cross helical gears.

Unit 4 Gear Boxes 10  
 Geometric progression – Standard step ratio – Ray diagram, kinematics layout -Design of sliding mesh gear box – Design of multi speed gear box for machine tool applications – Constant mesh gear box – Speed reducer unit – Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications.

Unit 5 Clutches And Brakes 10  
 Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches- Electromagnetic clutches. Band and Block brakes – external shoe brakes – Internal expanding shoe brake.

NOTE: Usage of Design Data Book is permitted in the University examination

Prescribed Text Books:

1. Bhandari V, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2016. ISBN 10: 9339221125 ISBN 13: 9789339221126
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008. ISBN: 9780070668614, 0070668612

Reference Books:

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1. Sundararaja moorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003. ISBN: 9788184721188
2. Shigley J.E and Mischke C. R., "Mechanical Engineering Design", Sixth Edition, Tata McGraw - Hill , 2009. ISBN-10-007-14679-9
3. Data Books: (i) P.S.G. College of Technology (ii) BalaveerSwamy and Mahadevan

Tables/Codes: Design data books are to be supplied in examination

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |   |    |
|---|----|
| 1. Apply the concepts of design to belts, chains and rope drives. | L3 |
| 2. Apply the concepts of design to spur, helical gears.           | L3 |
| 3. Apply the concepts of design to worm and bevel gears           | L3 |
| 4. Apply the concepts of design to gear boxes                     | L3 |
| 5. Apply the concepts of design to cams, brakes and clutches      | L3 |

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A35BT.1 | 3   | 3   | 3   | 3   | -   | -   | -   | -   | -   | -    | -    | -    | -    | -    | -    |
| 19A35BT.2 | 3   | 3   | 3   | 3   | -   | -   | -   | -   | -   | -    | -    | -    | -    | -    | -    |
| 19A35BT.3 | 3   | 3   | 3   | 3   | -   | -   | -   | -   | -   | -    | -    | -    | -    | -    | -    |
| 19A35BT.4 | 3   | 3   | 3   | 3   | -   | -   | -   | -   | -   | -    | -    | -    | -    | -    | -    |
| 19A35BT.5 | 3   | 3   | 3   | 3   | -   | -   | -   | 3   | 2   | 2    | -    | -    | -    | -    | -    |

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
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Title of the Course : Industrial Management  
 Category : PE  
 Course Code : 19A35CT  
 Year : III Year  
 Semester : I Semester

|               |                |           |         |
|---------------|----------------|-----------|---------|
| Lecture Hours | Tutorial Hours | Practical | Credits |
| 3             | -              | -         | 3       |

Course Objectives:

- To create awareness to learn principles, concepts, functions of management and also to design organizational structures.
- To gain knowledge on plant location, layouts and analyze concepts of network techniques.
- To familiarize the students regarding work study and work sampling
- To train with materials and marketing management concepts in organizational context
- To get awareness on Human Resource Management and its functions

Unit 1 : Management and Organization 9

Concepts of Management and Organization – Functions of Management – Evolution of Management Thought  
 Taylor’s Scientific Management, Fayol’s Principles of Management - Systems Approach to Management  
 Basic concepts related to Organization - Departmentation and Decentralization, Types of organization, Line organization, Line and staff organization, functional organization, Committee organization, matrix organization and their merits and demerits

Unit 2 : Plant Location & Project Management 12

Plant location, definition, factors affecting the plant location, comparison of rural and urban sites-methods for selection of plant. Plant Layout – definition, objectives, types of production, types of plant layout  
 PERT & CPM Project management, network modeling-probabilistic model, various types of activity-times estimation-programme evaluation review techniques- Critical Path-probability of completing the project, deterministic model, critical path method -critical path calculation- crashing and Resource Leveling

Unit 3 : Work Study 11

WORK STUDY: Definition, objectives, Method study - definition, objectives, steps involved- various types of associated charts-difference between micro-motion and memo-motion studies. Work measurement- definition, time study, steps involved-equipment, different methods of performance rating- allowances, standard time calculation. Work Sampling – definition, steps involved, standard time calculations, differences with time study- Applications. Predetermined motion time study – Method time measurement (MTM), introduction to ergonomics.

Unit 4 : Materials Management 10

MATERIALS MANAGEMENT: Objectives, Inventory – functions, types, associated costs, inventory classification techniques. Stores Management and Stores Records. Purchase management, duties of purchase manager, associated forms. Marketing, selling, marketing mix, product life cycle.

Unit 5: Human Resource Management 6

HUMAN RESOURCE MANAGEMENT: Functions of HRM, Job Evaluation, different types of evaluation methods. Job description, Merit Rating- difference with job evaluation, different methods of merit ratings, wage incentives, different types of wage incentive schemes.

Department of Mechanical Engineering

Prescribed Text Books:

1. Armine, Manufacturing Organization and Management. Pearson, 2009, 6<sup>th</sup>ed. ISBN-10: 8177582755
2. O.P. Khanna, Industrial Engineering and Management, DhanpatRai, 2018, 17<sup>th</sup>ed ISBN-10: 818992835X
3. Stoner, Freeman, Gilbert, Management, Pearson Edu., 2007, 6<sup>th</sup> Ed. ISBN: 9788131707043
4. Pannerseivam, Production and Operations Management. PHI, 2010 ISBN-10: 9788120345553

Reference Books:

1. Ralph M Barnes, Motion and Time Studies. John Wiley and Sons, 2007. ISBN: 978-0-471-05905-9
2. Chase, Jacobs, Aquilano, Operations Management TMH, 2007, 10<sup>th</sup> Ed. ISBN-10: 0071215557
3. L.S. Srinath, PERT/CPM. East-West Press, 2005. ISBN 10: 8185336202

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |   |             |
|---|-------------|
| 1. Discuss the principles and functions of management & decide the competitive strategy that works best for the organization              | L3 & L4     |
| 2. Understand the importance of plant locations and develop effective project management techniques                                       | L3, L4 & L5 |
| 3. Understand the concept of work study, method study and types of associated charts, the work measurement, work sampling and their steps | L3          |
| 4. Learn the concepts of material management and apply the knowledge of inventory management and marketing strategies in work setting     | L3          |
| 5. Discuss the importance of various sub systems of HRM   | L3          |

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A35CT.1 | 3   | -   | -   | -   | -   | -   | -   | -   | 3   | 3    | -    | 3    | -    | -    | -    |
| 19A35CT.2 | 3   | 3   | -   | 3   | -   | -   | -   | -   | -   | -    | 3    | -    | -    | 2    | -    |
| 19A35CT.3 | 3   | 3   | -   | 3   | -   | -   | -   | -   | -   | -    | -    | 3    | -    | -    | -    |
| 19A35CT.4 | 3   | 3   | -   | -   | -   | 1   | -   | -   | 3   | 3    | 3    | 3    | -    | -    | -    |
| 19A35CT.5 | -   | -   | -   | -   | -   | -   | -   | 1   | 3   | 3    | -    | -    | -    | -    | -    |

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
(An Autonomous Institution)

Title of the Course : Optimization Techniques through MATLAB  
 Category : PE  
 Course Code : 19A35DT  
 Year : III Year  
 Semester : I Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| 3             | -              | -         | 3       |

Course Objectives:

- To Introduce basics of MATLAB
- To Familiarize the fundamentals of optimization
- To Explain single variable optimization using various methods
- To Implement multi variable optimization using various methods
- To Train various evolutionary algorithms.

Unit 1 Introduction to MAT LAB 08  
 Introduction to MAT LAB: Overview, MATLAB Preliminaries, Basics of MATLAB, Beyond the Basics of MATLAB, Popular Functions and Commands, Plotting using MATLAB, Optimization with MATLAB.

Unit 2 Introduction to Optimization 08  
 Introduction to Optimization: Statement of an optimization problem, Classifications of optimization Problems: Single variable optimization, Multi variable optimization with no constraints, Multi variable optimization with equality constraints, Multi variable optimization.

Unit 3 Single Variable Optimization 08  
 Single Variable Optimization: Finite difference method, Central difference method, Runge-Kutta method, interval halving method, golden section method with MATLAB code.

Unit 4 Multi Variable Optimization 09  
 Multi Variable Optimization: Conjugate gradient method, Newton's method, Powell's method, Fletcher- Reeves method, Hook and Jeeves method, interior penalty function with MATLAB code.

Unit 5 Evolutionary Algorithms 09  
 Evolutionary Algorithms: Overview, Genetic Algorithms: Basics of Genetic Algorithms, Options in MATLAB, Multi Objective Optimization using Genetic Algorithms, Ant Colony Optimization, Simulated Annealing, Particle Swarm Optimization.

Prescribed Text Books:

1. Rao V. Dukkupati, MATLAB: An Introduction with Applications, Anshan, 2010. ISBN 1848290438, 9781848290433
2. Achille Messac, Optimization in practice with MATLAB, Cambridge University Press, 2015. ISBN 1107109183, 9781107109186
3. Jasbir S Arora, Introduction to optimum design, 2/e. Elsevier, 2004. Hardcover. ISBN: 9780120641550, eBook ISBN: 9780080470252

Reference Books:

Department of Mechanical Engineering

1. Cesar Perez Lopez, MATLAB Optimization Techniques, Academic press, Springer publications, 2014. ISBN: 1484202929, 9781484202920
2. Steven C. Chapra, Applied Numerical Methods with MATLAB for Engineers and scientists, 4/e, McGraw-Hill Education, 2018. ISBN-10: 0073397962. ISBN-13: 978-0073397962

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |  |    |
|--|----|
| 1. use optimization terminology and concepts, and understand how to classify an optimization problem | L4 |
| 2. apply optimization methods to engineering problems  | L3 |
| 3. Implement optimization algorithms.  | L3 |
| 4. Compare different genetic algorithms.   | L5 |
| 5. Solve multivariable optimization problems.  | L4 |

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A35DT.1 | 3   | 2   | 2   | 3   | 2   | 2   | -   | -   | 2   | -    | 3    | 2    | 2    | 2    | 2    |
| 19A35DT.2 | 3   | 2   | 2   | 3   | 2   | 2   | -   | -   | 2   | -    | 3    | 2    | 2    | 2    | 2    |
| 19A35DT.3 | 3   | 2   | 2   | 3   | 2   | 2   | -   | -   | 2   | -    | 3    | 2    | 2    | 2    | 2    |
| 19A35DT.4 | 3   | 2   | 2   | 3   | 2   | 2   | -   | -   | 2   | -    | 3    | 2    | 2    | 2    | 2    |
| 19A35DT.5 | 3   | 2   | 2   | 2   | 2   | 2   | -   | -   | 2   | -    | 3    | 2    | 2    | 2    | 2    |

Department of Mechanical Engineering  
**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
 (An Autonomous Institution)

Title of the Course : Automobile Engineering  
 Category : PE  
 Course Code : 19A35ET  
 Year : III Year  
 Semester : I Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| 3             | -              | -         | 3       |

Course Objectives:

- To gain the basic knowledge on automobile components and its electrical systems.
- To understand various fuel supply systems and their emission control techniques.
- To acquire knowledge on cooling and ignition systems used in automobiles.
- To obtain knowledge on power transmission systems.
- To get the basic idea on steering, suspension, and braking systems employed in automobiles.

Unit 1 Introduction 10

Introduction: Components of a four wheeler automobile – chassis and body – power unit – power transmission – rear wheel drive, front wheel drive, 4 wheel drive – types of automobile engines, engine construction, turbo charging and super charging – oil filters, oil pumps – crank case ventilation.

Electrical System :Charging circuit, generator, current – voltage regulator – starting system, Bendix drive, mechanism of Solenoid switch, Lighting systems, Horn, wiper, Fuel gauge – oil pressure gauge, Engine temperature indicator.

Unit 2 Emissions And Its Control 09

Emissions And Its Control: Pollution standards National and international – formation of emissions - Pollution Control Techniques – Common rail diesel injection Emissions from alternative energy sources, Exhaust gas recirculation, HCCI engine, particulate traps and Selective catalytic converter – hydrogen, Biomass, alcohols, LPG, CNG - their merits and demerits.

Unit 3 Transmission System 09

Transmission System: Clutches- Principle- types: cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear box- types: sliding mesh, constant mesh, synchromesh, epi-cyclic, over drive, torque converter. Propeller shaft – Hotch – Kiss drive, Torque tube drive, universal joint, differential, rear axles.

Unit 4 Steering System, Suspension System and Braking System 10

Steering System: Steering geometry – camber, castor, king pin rake, combined angle toe-in, center point steering. Steering gears – types, steering linkages.

Suspension System: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.

Braking System: Mechanical brake system, Hydraulic brake system, Pneumatic and vacuum brake systems, Antilock braking system and Traction control.

Unit 5 Safety System 08

Safety System: Antilock braking system, air bag restraint system, voice warning system, seat belt system, road navigating system, anti theft system.

Prescribed Text Books:

Department of Mechanical Engineering

1. Kirpal Singh, Automotive Mechanics –Vol.1&Vol.2., standard publisher's distributors, 13th Ed.2013. ISBN: 9788180142062
2. John Heywood, Internal combustion engine fundamentals, McGraw-hill 1988. ISBN: 9781260116106
3. William Crouse, Automobile Engineering. 10th Ed.2006. ISBN: 9780070634350

Reference Books:

1. K.K. Ramalingam, Automobile Engineering. SciTech Publ.3rdEd.2011. ISBN: 9788188429486
2. Newton, Steeds & Garret, Automotive Engines. ISBN 10: 1560918985
3. Richard Stone, Jeffrey K. Ball, (2004), Automotive Engineering Fundamentals" SAE International. ISBN: 9780768009873
4. G.B.S. Narang, Automobile Engineering (2009), Khanna Publishers. ISBN :9789387394254
5. S. Srinivasan, Automotive Mechanics, 2nd Ed., Tata McGraw Hill 2003. ISBN: 9780070494916
6. Judge. A.W., Modern Electrical Equipment of Automobiles, Chapman & Hall, London, 1992. ISBN :9789401168816
7. R.B. Gupta, Automobile Engineering (2011-12), Tech India Publications. ISBN: 9788176848589, 8176848581

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |   |    |
|---|----|
| 1. To gain the knowledge on components and electrical system on four wheeler automobile.              | L2 |
| 2. Enrich the standards in emission and its control techniques in automobiles.                        | L2 |
| 3. Acquire knowledge on transmission system of an automobile.   | L2 |
| 4. Understand purpose of steering system, suspension system, braking system and their identification. | L2 |
| 5. Show their ability to identify different safety system used in automobile.                         | L2 |

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19AC11T.1 | -   | -   | 3   | -   | 3   | -   | -   | -   | -   | -    | -    | 3    | -    | -    | -    |
| 19AC11T.2 | -   | -   | 3   | 1   | 3   | -   | 1   | -   | -   | -    | -    | 3    | -    | -    | -    |
| 19AC11T.3 | -   | -   | 3   | -   | 3   | -   | -   | -   | -   | -    | -    | 3    | -    | -    | -    |
| 19AC11T.4 | -   | -   | 3   | -   | 3   | -   | -   | -   | -   | 1    | -    | 3    | -    | -    | -    |
| 19AC11T.5 | -   | -   | -   | -   | -   | 1   | -   | -   | -   | -    | -    | 3    | -    | -    | -    |



Department of Mechanical Engineering  
**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
(An Autonomous Institution)

Title of the Course : Design For Manufacturing  
Category : PE  
Course Code : 19A35FT  
Year : III Year  
Semester : I Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| 3             | -              | -         | 3       |

Course Objectives:

- To explain the product development cycle and manufacturing issues to be considered in design.
- To familiarize manufacturing consideration in cast, forged, and weld components.
- To describe the manufacture of sheet metal components.
- To impart knowledge plastics as substitution to metallic parts.

Unit 1 Introduction 10

Introduction: Design philosophy-steps in design process-general design rules for manufacturability-basic principles of designing for economical production-creativity in design.

Materials: Selection of materials for design-developments in material technology-criteria for material selection-material selection interrelationship with process selection-process selection charts

Unit 2 : Machining processes 09

Machining processes: Overview of various machining processes-general design rules for machining-dimensional tolerance and surface roughness-Design for machining – ease –redesigning of components for machining ease with suitable examples. General design recommendations for machined part

Unit 3 Metal casting and Metal joining 12

Metal casting: Appraisal of various casting processes, selection of casting process,-general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting.

Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints-design of brazed joints.

Unit 4 Forging, Extrusion & Sheet metal work 08

Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

Extrusion & Sheet metal work: Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

Unit 5 : Plastics 10

Plastics: Visco elastic and creep behavior in plastics-design guidelines for plastic components-design considerations for injection moulding – design guidelines for machining and joining of plastics.

Prescribed Text Books:

1. George E Dieter and Linda Schmidt, Engineering Design, 4<sup>th</sup> Edition, McGraw Hill (2015) ISBN: 9780073398143
2. A.K.Chitale and R.C.Gupta, Product Design and Manufacturing, 5<sup>th</sup> Edition, PHI Learning (2011). ISBN-10: 8120342828
3. David M Anderson, Design for Manufacturability, CRC Press (2013). ISBN: 9781482204926

## Department of Mechanical Engineering

### Reference Books:

1. James G Bralla, Design For Manufacturability Handbook, 2<sup>nd</sup> Edition, McGraw Hill (2004). ISBN: 9780070071391
2. Dr. P.C.Sharma, Production Technology, S.Chand & Company (2009). ISBN-10 : 8121911141

### Course Outcomes:

Student will be able to

Blooms Level of Learning

- |   |    |
|---|----|
| 1. Design mechanical components with economical consideration   | L1 |
| 2. Select materials and machining processes.  | L1 |
| 3. Identify the necessity for redesigning components out of manufacturing considerations.                 | L1 |
| 4. Consider the manufacturing considerations while designing cast, forged weld and sheet metal components | L1 |
| 5. Design plastic parts with manufacturing considerations   | L1 |

### CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A35FT.1 | 1   | -   | 3   | 1   | -   | -   | -   | 1   | -   | -    | -    | -    | 1    | 2    | -    |
| 19A35FT.2 | 1   | -   | 2   | 1   | 1   | -   | -   | 1   | -   | -    | -    | -    | 1    | 2    | -    |
| 19A35FT.3 | 1   | -   | 2   | 1   | -   | -   | -   | 1   | -   | -    | -    | -    | 1    | 2    | 3    |
| 19A35FT.4 | 1   | -   | 2   | 1   | 1   | -   | -   | -   | -   | -    | -    | -    | 1    | -    | 3    |
| 19A35FT.5 | 1   | -   | 3   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | -    | -    |

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
(An Autonomous Institution)

Title of the Course : Non-Destructive Testing  
 Category : PE  
 Course Code : 19A35GT  
 Year : III Year  
 Semester : I Semester

|               |                |           |         |
|---------------|----------------|-----------|---------|
| Lecture Hours | Tutorial Hours | Practical | Credits |
| 3             | -              | -         | 3       |

Course Objectives:

- To introduce basic concepts of nondestructive testing.
- To familiarize with characteristics of ultrasonic test, transducers, rejection and effectiveness.
- To describe concept of liquid Penetrant, eddy current and magnetic particle tests, its applications and limitations.
- To explain the principles of infrared and thermal testing, applications and honey comb and sandwich structures case studies.
- To impart NDE and its applications in pressure vessels, casting and welded constructions

Unit 1: Introduction to non-destructive testing 06  
 Radiographic test, Sources of X and Gamma Rays and their interaction with Matter, Radiographic equipment, Radiographic Techniques, Safety Aspects of Industrial Radiography.

Unit 2: Ultrasonic Testing 10  
 Principle of Wave Propagation, Reflection, Refraction, Diffraction, Mode Conversion and Attenuation, Sound Field, Piezo-electric Effect, Ultrasonic Transducers and their Characteristics, Ultrasonic Equipment and Variables Affecting Ultrasonic Test, Ultrasonic Testing, Interpretations and Guidelines for Acceptance, Rejection - Effectiveness and Limitations of Ultrasonic Testing.

Unit 3 : Liquid Penetrant, Eddy Current & Magnetic Particle Testing 12  
 Liquid Penetrant Test, Basic Concepts, Liquid Penetrant System, Test Procedure, Effectiveness and Limitations of Liquid Penetrant Testing. Principle of Eddy Current, Eddy Current Test System, Applications of Eddy Current-Testing Effectiveness of Eddy Current Testing. Magnetic Materials, Magnetization of Materials, Demagnetization of Materials, Principle of Magnetic Particle Test, Magnetic Particle Test Equipment, Magnetic Particle Test Procedure, Standardization and Calibration, Interpretation and Evaluation, Effective Applications and Limitations of the Magnetic Particle Test

Unit 4 : Infrared and Thermal Testing: 10  
 Introduction and fundamentals to infrared and thermal testing—Heat transfer—Active and passive techniques—Lock in and pulse thermography—Contact and non-contact thermal inspection methods—Heat sensitive paints—Heat sensitive papers—thermally quenched phosphors liquid crystals—techniques for applying liquid crystals—other temperature sensitive coatings—Inspection methods—Infrared radiation and infrared detectors—thermo mechanical behavior of materials—IR imaging in aerospace applications, electronic components, Honey comb and sandwich structures—Case studies.

Unit 5 : Industrial Applications of NDE 08  
 Span of NDE Activities Railways, Nuclear, Non-nuclear and Chemical Industries, Aircraft and Aerospace Industries, Automotive Industries, Offshore Gas and Petroleum Projects, Coal Mining Industry, NDE of pressure vessels, castings, welded constructions

Department of Mechanical Engineering

Prescribed Text Books:

1. J Prasad, GCK Nair , Nondestructive test and evaluation of Materials, Tata mcgraw-Hill Education Publishers, 2008. ISBN:9780070620841
2. Josef Krautkrämer, Herbert Krautkrämer, Ultrasonic testing of materials, 3/e, Springer-Verlag, 1983. ISBN 978-3-662-10680-8
3. X. P. V. Maldague, Non destructive evaluation of materials by infrared thermography, 1/e, Springer-Verlag, 1993. ISBN 978-1-4471-1995-1

Reference Books:

1. Gary L. Workman, Patrick O. Moore, Doron Kishoni, Non-destructive, Hand Book, Ultrasonic Testing, 3/e, Amer Society for Nondestructive, 2007. ISBN-10: 1571171630
2. ASTM Standards, Vol 3.01, Metals and alloys. ISBN 978-1-6822-1620-0

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |   |    |
|---|----|
| 1. Gain knowledge of the basic principles, techniques, applications and limitations of basic NDT methods. | L3 |
| 2. Understand the basic principles of Ultrasonic Testing.   | L3 |
| 3. Apply relevant non-destructive testing method different applications                                   | L2 |
| 4. Explain various methods of Infrared and Thermal testing.   | L2 |
| 5. Outline the applications, limitations and disadvantages of NDE   | L2 |

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A35GT.1 | 3   | 3   | -   | -   | 3   | 3   | -   | -   | -   | -    | -    | -    | -    | -    | 2    |
| 19A35GT.2 | 3   | 3   | -   | -   | 3   | 3   | -   | -   | -   | -    | -    | -    | -    | -    | 2    |
| 19A35GT.3 | 3   | 3   | -   | -   | 3   | 3   | -   | -   | -   | -    | -    | -    | -    | -    | 2    |
| 19A35GT.4 | 3   | 3   | -   | -   | 3   | 3   | -   | -   | -   | -    | -    | -    | -    | -    | 2    |
| 19A35GT.5 | 3   | 3   | -   | -   | 3   | 3   | -   | -   | -   | -    | -    | -    | 1    | -    | -    |

Department of Mechanical Engineering  
**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
 (An Autonomous Institution)

Title of the Course : Automation and Robotics  
 Category : PE  
 Course Code : 19A35HT  
 Year : III Year  
 Semester : I Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| 3             | -              | -         | 3       |

Course Objectives:

- To acquire basic knowledge on automation and automated flow lines in automatic manufacturing systems.
- To learn about the line balancing methods and automated assembly systems.
- To learn about the robotics and fundamentals of robots with their needs in present trend.
- To understand robot kinematics, dynamics and to acquire knowledge on importance of trajectory planning in robots.
- To learn about the sensors, actuators and robot programming methods used in robots.

Unit 1 Introduction to Automation 07

Need, Types, Basic elements of an automated system, levels of automation, hardware components for automation and process control, automation principles, Automation strategies

AUTOMATED FLOW LINES: Part transfer methods and mechanisms, types of Flow lines, flow line with/without buffer storage

Unit 2 Assembly Systems and Line Balancing 08

The Assembly Process, Assembly Systems, Manual Assembly Lines, The Line Balancing Problem, Methods of Line Balancing, Computerized Line Balancing Methods, Other ways to improve the Line Balancing, Flexible Manual Assembly Lines. Automated Assembly Systems: Design for Automated Assembly, Types of Automated Assembly Systems, Part Feeding Devices, Analysis of Multi-station Assembly Machines, Analysis of a Single Station Assembly Machine

Unit 3 : Introduction to Industrial Robots 07

Need for robots in Present customization, Classification, laws of robots. Robot configurations, Functional line diagram, Degrees of Freedom, Components, common types of arms, joints, grippers, applications.

Unit 4 : Manipulator Kinematics, Dynamics & Trajectory Planning 08

Manipulator Kinematics: Homogeneous transformations as applicable to rotation and translation - D-H notation, Forward and inverse kinematics

Manipulator dynamics: Differential transformation, Jacobians. Lagrange – Euler

Trajectory Planning: Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion – straight line motion.

Unit 5 : Robot- Actuators, Sensors, Programming 07

Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison Position sensors – potentiometers, resolvers, encoders – Velocity sensors, tactile sensors, Proximity sensors.

Robot Programming: Types – features of languages and software packages.

Prescribed Text Books:

Department of Mechanical Engineering

1. M.P.Groover, Automation, Production systems and CIM. Pearson Edu 2004. ISBN-10: 9789332572492, ISBN-13: 978-9332572492
2. M.P. Groover, Industrial Robotics. TMH 2003. ISBN-10 : 007024989X

Reference Books:

1. Fu KS, Robotics. McGraw Hill. 2014. ISBN: 9780071822282
2. Coiffet and M.Chaironze, An Introduction to Robot Technology. Kogam Page Ltd. London, 1983. ISBN 978-94-011-6100-8
3. Richard D.Klaffer, Robotics Engineering. Prentice Hall. 1989. ISBN-10 : 0134687523
4. Ashitave Ghosal, Robotics, fundamental Concepts and analysis. Oxford Press, 2006. ISBN-10 : 0195673913
5. Mittal RK &Nagrath IJ, Robotics and Control. TMH 2003. ISBN-10 : 9780070482937
6. Saha, S.K., Introduction to Robotics, Second Edition McGraw Hill New Edition 2014. ISBN: 9789332902800.
7. Niku Saeed B., Introduction to Robotics:Analysis, systems, Applications, PHI New Delhi. ISBN-10: 0130613096
8. John J. Craig, Introduction to Robotics. Pearson Edu 2017. ISBN: 0133489795

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |  |    |
|--|----|
| 1. Understand and apply the knowledge on automation and the automated flow lines in real working environment   | L2 |
| 2. Learn the importance of line balancing methods and are able to design the assembly work stations in industrial assembly plants.                                     | L3 |
| 3. Understand the robotics and the fundamental concepts of robots.   | L2 |
| 4. learn concept of robot kinematics, dynamics and trajectory planning methods and are able to apply this concept in academic research                                 | L3 |
| 5. Understand the sensors, actuators and robot programming methods used in robots and can develop a suitable program and create the solutions for contemporary issues. | L2 |

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | P9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|----|------|------|------|------|------|------|
| 19A35HT.1 | 3   | 3   | -   | -   | -   | -   | -   | -   | -  | -    | -    | 3    | -    | -    | 3    |
| 19A35HT.2 | 3   | 3   | 2   | -   | 2   | -   | -   | -   | -  | -    | -    | 3    | 2    | 2    | 3    |
| 19A35HT.3 | 3   | 3   | -   | -   | -   | -   | -   | -   | -  | -    | -    | 3    | -    | -    | 3    |
| 19A35HT.4 | 3   | 3   | 2   | -   | 2   | -   | -   | -   | -  | -    | -    | 3    | 2    | 2    | 3    |
| 19A35HT.5 | 3   | 3   | -   | -   | -   | -   | 1   | -   | -  | -    | -    | 3    | 1    | 1    | 3    |

Department of Mechanical Engineering  
**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
 (An Autonomous Institution)

Title of the Course : Rapid Prototyping  
 Category : OE  
 Course Code : 19A35IT  
 Year : III Year  
 Semester : I Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| 3             | -              | -         | 3       |

Course Objectives:

- To familiarize techniques for processing of CAD models for rapid prototyping
- To explain fundamentals of rapid prototyping techniques
- To demonstrate appropriate tooling for rapid prototyping process
- To focus Rapid prototyping techniques for reverse engineering
- To train Various Pre – Processing, Processing and Post Processing errors in RP Processes

Unit 1 10

Introduction: Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP.

RP Software: Need for RP software, MIMICS, Magics, Surgi Guide, 3-matic, 3D-Doctor, Simplant, Velocity2, VoXim, Solid View, 3DView, etc., software, Preparation of CAD models, Problems with STL files, STL file manipulation, RP data formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP.

Unit 2 08

Solid and Liquid Based RP Systems:

Stereo lithography (SLA): Principle, Process, Materials, Advantages, Limitations and Applications.

Solid Ground Curing (SGC): Principle, Process, Materials, Advantages, Limitations, Applications.

Fusion Deposition Modeling (FDM): Principle, Process, Materials, Advantages, Limitations, Applications. Laminated

Object Manufacturing (LOM): Principle, Process, Materials, Advantages, Limitations, Applications.

Unit 3 08

Powder Based RP Systems: Principle and Process of Selective Laser Sintering (SLS), Advantages, Limitations and Applications of SLS, Principle and Process of Laser Engineered Net Shaping (LENS), Advantages, Limitations and Applications of LENS, Principle and Process of Electron Beam Melting (EBM), Advantages, Limitations and Applications of EBM.

Other RP Systems:

Three-Dimensional Printing (3DP): Principle, Process, Advantages, Limitations and Applications.

Ballistic Particle Manufacturing (BPM): Principle, Process, Advantages, Limitations, Applications.

Shape Deposition Manufacturing (SDM): Principle, Process, Advantages, Limitations, Applications.

Unit 4 08

Rapid Tooling: Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.

Reverse Engineering (RE): Meaning, Use, RE – The Generic Process, Phases of RE Scanning, Contact Scanners and Noncontact Scanners, Point Processing, Application Geometric Model, Development





Department of Mechanical Engineering  
**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
(An Autonomous Institution)

Title of the Course : Industrial Robotics  
Category : OE  
Course Code : 19A35JT  
Year : III Year  
Semester : I Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| 3             | -              | -         | 3       |

Course Objectives:

- To learn about the robotics and fundamentals of robots with their needs in present trend.
- To understand robot kinematics and robot dynamics, able to acquire knowledge on importance of trajectory planning in robots.
- To learn about the sensors, actuators and robot programming methods used in robots, and the applications of robots.

Unit 1 Introduction To Industrial Robots 10  
Classification. Robot configurations, Functional line diagram, Degrees of Freedom. Components, common types of arms, joints, grippers.

Unit 2 Manipulator Kinematics 10  
Homogeneous transformations as applicable to rotation and translation - D-H notation, Forward and inverse kinematics.  
Manipulator Dynamics: Differential transformation, Jacobians. Lagrange – Euler

Unit 3 Trajectory Planning 10  
Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion – straight line motion.

Unit 4 Robot Actuators And Feedback Components 10  
Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison Position sensors – potentiometers, resolvers, encoders – Velocity sensors, tactile sensors, Proximity sensors.

Unit 5 Robot programming 10  
Types – features of languages and software packages.  
Robot Application In Manufacturing: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

Prescribed Text Books:

1. M.P.Groover, Automation, Production systems and CIM. Pearson Edu. ISBN-13: 9780133499612.
2. M.P. Groover, Industrial Robotics. TMH. ISBN 10: 1259006212 ISBN 13: 9781259006210
3. Saeed B Niku, Introduction to robotics : analysis, control, applications. 2019. ISBN: 978-1-119-52760-2

Reference Books:

1. Benedict G.F. "Nontraditional Manufacturing Processes" Marcel Dekker Inc., New York. 2019. ISBN 9780367403393
2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw- Hill, New Delhi (1980). ISBN: 9780070965539

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3. Mc Geough, "Advanced Methods of Machining" Chapman and Hall, London (1998) 42 Industrial Robotics 3.0, 2014. ISBN: 9789400784826

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |  |        |
|--|--------|
| 1. Understand the robotics and the fundamental concepts of robots.   | L2, L3 |
| 2. Learn concept of robot kinematics, dynamics and are able to apply these concept in academic research.   | L2, L3 |
| 3. Learn concept of robot trajectory planning methods and are able to apply these concept in academic research.  | L2, L3 |
| 4. Understand the sensors, actuators and create the solutions for contemporary issues.   | L2, L3 |
| 5. Understand the robot programming methods used in robots and the applications of robots can develop a suitable program and create the solutions for contemporary issues. | L2, L3 |

CO-PO Mapping:

| CO         | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A35JT .1 | 3   | 2   | -   | 3   | -   | -   | -   | -   | -   | -    | -    | 2    | -    | -    | -    |
| 19A35JT.2  | 3   | 3   | 3   | 3   | 1   | -   | -   | -   | -   | -    | -    | 2    | -    | -    | -    |
| 19A35JT .3 | 3   | 2   | -   | 3   | -   | -   | -   | -   | -   | -    | -    | 2    | -    | -    | -    |
| 19A35JT .4 | 3   | 3   | 3   | 3   | 1   | -   | -   | -   | -   | -    | -    | 2    | -    | -    | -    |
| 19A35JT.5  | 3   | 3   | -   | 3   | -   | -   | 3   | -   | -   | -    | -    | 2    | -    | -    | -    |

Department of Mechanical Engineering  
**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
 (An Autonomous Institution)

Title of the Course : Entrepreneurship Development  
 Category : OEC  
 Course Code : 19A35KT  
 Year : III Year  
 Semester : I Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| 3             | -              | -         | 3       |

Course Objectives:

- To develop and strengthen entrepreneurial quality and motivation in students
- To impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.

Unit 1 Entrepreneurship 09  
 Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

Unit 2 Motivation 09  
 Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self-Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

Unit 3 Business 10  
 Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

Unit 4 Financing And Accounting 09  
 Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.

Unit 5 Support To Entrepreneurs 09  
 Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures  
 - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting

Prescribed Text Books:

1. Khanka. S.S., "Entrepreneurial Development" S.Chand& Co. Ltd., Ram Nagar, New Delhi, 2013. ISBN : 81-219-1801-4
4. Donald F Kuratko, "Entrepreneurship – Theory, Process and Practice", 9th Edition, Cengage Learning, 2014. ISBN-10: 1285051750

Reference Books:

1. Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013. ISBN 1843769964
2. Mathew J Manimala, "Entrepreneurship theory at cross roads: paradigms and praxis" 2nd Edition Dream tech, 2005. ISBN 81-297-0260-6
3. Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University Press, 2011. ISBN 10: 0198072635
4. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship

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Development", Institute of India, Ahmadabad, 1986. ISBN 0-07-026694-8

Course Outcomes:

Student will be able to

1. Understand the basic concepts of entrepreneurship
2. Understand the importance of motivation for entrepreneur
3. Gain knowledge and skills needed to run a business successfully.
4. Learn the concepts of financing and accounting
5. Understand the basic concepts of various supporting process

Blooms Level of Learning

L2

L2 & L3

L3, L4 & L5

L3

L2

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A35KT.1 | 3   | -   | -   | -   | -   | -   | -   | -   | 3   | 3    | -    | 2    | -    | -    | -    |
| 19A35KT.2 | 3   | -   | -   | -   | -   | -   | -   | -   | -   | 3    | -    | -    | -    | 2    | -    |
| 19A35KT.3 | 3   | -   | -   | -   | -   | 2   | -   | 2   | 2   | 3    | -    | 3    | -    | -    | -    |
| 19A35KT.4 | 3   | 3   | -   | -   | -   | -   | -   | -   | 3   | 3    | -    | -    | -    | -    | -    |
| 19A35KT.5 | 3   | -   | -   | -   | -   | -   | -   | -   | 3   | 3    | -    | -    | -    | -    | -    |

Department of Mechanical Engineering  
**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
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Title of the Course : Thermal Engineering Lab  
 Category : PC  
 Course Code : 19A351L  
 Year : III Year  
 Semester : I Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| -             | -              | 2         | 1       |

Course Objectives:

- To understand various engine components and demonstrate the ability to assemble / disassemble the IC engine
- To understand the concept of valves / ports actuating mechanism.
- To study the performance characteristics of I.C engine classification, Vapour compression Refrigeration system and reciprocating air compressor.
- To understand the energy dissipation and importance of heat balance sheet in IC engine.
- To understand the working principle of various boilers used for power generation

List of Experiments:

1. Disassembly/assembly of given engine.
2. Performance test on air compressor test rig.
3. Study load test on 4-stroke diesel engine
4. Load test on 4-stroke petrol engine
5. Load test on 2-stroke petrol engine.
6. (a) valve timing diagram (vtd)  
(b) port timing diagram (ptd)
7. Performance test on refrigeration test rig.
8. Heat balance sheet on 4-stroke diesel engine.
9. Heat balance sheet on 2-stroke petrol engine.
10. Study heat balance sheet on 4-stroke petrol engine.
11. Study Morse test on 4-stroke petrol engine.
12. Motoring test on 2-stroke petrol engine.
13. Demonstration of boiler
14. (a) flash and fire point by Cleveland and (open) cup apparatus.  
(b) calorific value of fuel using bomb calorimeter.
15. Viscosity of the oil through Saybolt viscometer apparatus.

Note: Any 12 experiments of the above 15 experiments are to be conducted.

Course Outcomes:

| Student will be able to  | Blooms Level of Learning |
|--|--------------------------|
| 1. An ability to understand performance, heat balance sheet and Morse test on I.C engines.   | L3                       |
| 2. Study Component of I.C engine.  | L2                       |
| 3. Identifying and study of the boiler models  | L2                       |
| 4. An ability to understand the working principle of Vapour compression Refrigeration system and evaluate the Coefficient of performance | L3                       |

5. Determine the fluid properties.

L3

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A351L.1 | 3   | 3   | 1   | 3   | 2   | 1   | 1   | -   | 3   | 2    | 1    | 1    | 2    | 1    | -    |
| 19A351L.2 | 2   | -   | 2   | 3   | 3   | -   | -   | -   | -   | -    | -    | -    | 2    | 2    | -    |
| 19A351L.3 | 3   | 3   | 1   | 3   | 3   | 2   | 2   | -   | 3   | 2    | 1    | 1    | 2    | 1    | -    |
| 19A351L.4 | 3   | 3   | 3   | 3   | -   | 1   | 2   | -   | -   | -    | -    | 2    | 1    | 2    | -    |
| 19A351L.5 | -   | -   | 1   | 3   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 1    | -    |

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**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
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Title of the Course : Heat Transfer  
 Category : PC  
 Course Code : 19A361T  
 Year : III Year  
 Semester : II Semester

|               |                |           |         |
|---------------|----------------|-----------|---------|
| Lecture Hours | Tutorial Hours | Practical | Credits |
| 2             | 1              | 0         | 3       |

Course Objectives:

- To impart the basic laws of conduction, convection, radiation heat transfer and their applications.
- To provide knowledge about heat flow in various systems.
- To familiarize the convective heat transfer concepts.
- To understand the principles of phase change processes and radiation heat transfer.
- To make conversant about heat transfer in various heat exchangers.

Unit 1 Introduction to conduction heat transfer 6

Introduction: Modes and mechanisms of heat transfer – Basic laws of heat transfer –General applications of heat transfer. Conduction Heat Transfer: Fourier heat transfer equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates. Simplification and forms of the field equation – steady, unsteady and periodic heat transfer – boundary and Initial conditions.

Unit 2 One dimensional steady state & transient heat conduction 12

One Dimensional Steady State Heat Conduction: In homogeneous slabs, hollow cylinders and spheres – overall heat transfer coefficient – electrical analogy – Critical radius/thickness of insulation–System with internal heat generation (elementary treatment-Plane Wall-Uniform). Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature.

One Dimensional Transient Heat Conduction: Systems with negligible internal resistance – Significance of Biot and Fourier Numbers - Chart solutions of transient conduction systems- Problems on semi-infinite body.

Unit 3 Convective heat transfer 10

Convective Heat Transfer: Forced Convection: External Flows-Concepts of hydrodynamic and thermal boundary layer and use of empirical correlations for flow over-flat plates, cylinders. Internal Flows:-Division of internal flow through concepts of Hydrodynamic and Thermal entry lengths – Use of empirical relations for horizontal pipe flow, annular flow. Free Convection: -Development of Hydrodynamic and thermal boundary layer along a vertical plate – Use of empirical relations for plates and cylinders in horizontal and vertical orientation. Dimensional analysis Buckingham  $\pi$  Theorem- examples- Free & Forced convection.

Unit 4 Heat transfer with phase change & Radiation 12

Heat Transfer with Phase Change: Boiling- Pool boiling – Regimes, determination of heat transfer coefficient in Nucleate boiling, Critical Heat flux and Film boiling. Condensation: -Film wise and drop wise condensation.

Radiation Heat Transfer: Emission characteristics and laws of black-body radiation – Irradiation – Total and Monochromatic quantities–Laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann– Heat exchange between two black bodies – Concepts of shape factor – Emissivity –Heat exchange between gray bodies – Radiation shields– Electrical analogy for radiation networks.

Unit 5 Heat Exchangers 8

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Heat Exchangers: Classification of heat exchangers – Overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

Prescribed Text Books:

1. R.C. Sachdeva, Fundamentals of Engg. Heat and Mass Transfer. New Age International, 5th Ed.2017, ISBN-13: 978-1781831038.
2. P.K.Nag, Heat Transfer. TMH, 3rd Ed. 2011, ISBN-13: 978-0070702530.
3. J.P.Holman, Heat Transfer. TMH, 10th Ed. 2010, ISBN-13: 978-0073529363.

Reference Books:

1. Incropera, Fundamentals of Heat and Mass transfer. Wiley India, 8th Ed,2017 ISBN: 978-1-119-35388-1.
2. M. Thirumaleswar, Fundamentals of Heat and Mass Transfer. Pearson Edu. 2006 ISBN 13: 9788177585193.
3. Arora and Domkundwar/ A course in Heat and Mass transfer /Dhanpathrai and sons.2007, ISBN-13: 978-8177000290
4. C.P.kothandaraman & S.Subramanyam, Heat and Mass transfer data hand book, New Age Publications, 2014, ISBN-13: 978-8122435955.

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |  |    |
|--|----|
| 1. Identify different modes of heat transfer.                                | L3 |
| 2. Apply the knowledge of conduction heat transfer for different phenomenon. | L3 |
| 3. Interpret forced and free convection heat transfer                        | L5 |
| 4. Determine the heat transfer rates in phase change process and radiation   | L5 |
| 5. Measure the heat exchanger performance for a given application            | L5 |

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A361T.1 | 3   | 3   | -   | -   | -   | -   | 1   | -   | -   | -    | -    | 2    | 1    | -    | -    |
| 19A361T.2 | 3   | 3   | 1   | -   | -   | -   | 1   | -   | -   | -    | -    | 2    | 1    | -    | -    |
| 19A361T.3 | 3   | 3   | 2   | -   | -   | -   | 1   | -   | -   | -    | -    | 2    | 1    | -    | -    |
| 19A361T.4 | 3   | 3   | 2   | -   | -   | 1   | 2   | -   | -   | -    | -    | 2    | 1    | -    | -    |
| 19A361T.5 | 3   | 3   | 3   | -   | -   | 1   | 1   | -   | -   | -    | -    | 2    | 1    | -    | -    |



Department of Mechanical Engineering  
**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
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Title of the Course : Engineering Metrology  
Category : PC  
Course Code : 19A362T  
Year : III Year  
Semester : II Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| 2             | 1              | 0         | 3       |

Course Objectives:

- To understand the Limits and Fits, linear measurements and angular measurements, gauges, comparators, optical measuring methods, measurement of flatness and roughness of surface. And also learn about the screw thread and gear measuring methods.
- To ensure that the students can apply/analyze relevant quantitative models to solve real world problems.
- To make the students capable of appraising real life business situations and suggest solution alternatives as related to operations management techniques.

Unit 1 09

Systems of Limits and Fits: Introduction, Definitions, fits and their types – unilateral and bilateral tolerance system, Tolerance analysis .Hole and shaft basis systems – interchangeability and selective assembly. Indian Standard Institution system – International Standard system for plain and work. Limit Gauges: Plug, Ring, Snap, Gap, Taper, Profile and Position gauges. Taylor's principle. Design of Go and No Go gauges.

Unit 2 09

Linear Measurement Length standard, line, ends & wavelength standards slip gauges – calibration of the slip gauges, Dial indicator, micrometers.

Measurement Of Angles And Tapers: Different methods – Bevel protractor –angle gauges – spirit levels – sine bar – Sine plate.

Flatness Measurement: straight edge– surface plate – optical flat and their uses, optical projector, interferometers and auto collimator.

Unit 3 08

Surface Roughness Measurement: Differences between surface roughness and surface waviness- Numerical assessment of surface finish – CLA, R.M.S Values – Ra , Rz values, Methods of measurement of surface finish profilograph, Talysurf, BIS symbols for indication of surface finish.

Measurement Through Comparators: Comparators – Mechanical, Optical, Electrical, Electronic, Pneumatic comparators and their uses.

Unit 4 08

Screw Thread Measurement Elements of measurement – errors in screw threads – measurement of effective diameter – one wire, two wire, three wire and best size methods, angle of thread and thread pitch- Tool maker's microscope.

Gear Measurement Gear measuring instruments, Gear tooth profile measurement, Measurement of diameter, pitch, pressure angle and tooth thickness.

Unit 5 08

Inspection And Quality Control: Types of inspections – Difference between inspection & quality control. Acceptance sampling plan- single sampling and double sampling plans.

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Coordinate Measuring Machines: Types of CMM and Applications of CMM.

Surface Engineering: Surface treatment processes and their characteristics and applications. (a) Overlay coatings (b) Thermal or mechanical modification of Surfaces.

Prescribed Text Books:

1. Measurement systems: Application and design, Doeblin Earnest O. Adaptation by Manik and Dhanesh, TMH, 2012. ISBN 0-07-017338-9.
2. Engineering Metrology, R.K. Jain, Khanna Publishers, 20th edition, 2013. ISBN: 9788174091536 817409153X
3. Statistical Quality Control by EL Grantt, McGrawhil. 2001. ISBN-10 : 0078443547; ISBN-13 : 978-0078443541

Reference Books:

1. Engineering Metrology, Mahajan, Dhanpat Rai, 2nd edition, 2010. ISBN-10 : 8177000519
2. BIS standards on Limits & Fits
3. Fundamentals of Dimensional Metrology, Connie Dotson , 4e, Thomson. ISBN-10 : 0766820718
4. Metrology & Measurement by Anand K Bewoor, vinay A kulkarni, Mc Graw Hill, 2017. ISBN-10 : 9780070140004; ISBN-13 : 978-0070140004
5. Instrumentation, measurement & analysis, B.C.Nakra & KK Choudhary, TMH, 6th edition, 2011. ISBN 0070482969
6. Mechanical Measurements ,Beckwith, Marangoni, Linehard, PHI, PE. ISBN-10: 0201847655.
7. Alan s.morris "the essence of measurement", prentice hall of india, 2004. ISBN 1-86058-073.

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |   |    |
|---|----|
| 1. Understand the Limits, Fits and Tolerance.   | L2 |
| 2. Apply the fundamentals of linear, angular and flatness measurement techniques for measuring the engineering components.  | L3 |
| 3. Use the different types of comparators for measuring engineering components dimensions and surface roughness.  | L4 |
| 4. Use the different types of instruments for measuring Screw thread elements and Gear tooth profile.   | L4 |
| 5. Understand the concepts of inspection, quality control, types of acceptance sampling plan, CMM and its applications, surface treatment processes and surface coatings. | L2 |

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A362T.1 | 3   | 3   | 3   | 1   | 3   | 1   | -   | -   | -   | 1    | -    | -    | -    | -    | -    |
| 19A362T.2 | 3   | 2   | 1   | 1   | 3   | 1   | -   | -   | -   | -    | -    | 3    | 2    | -    | -    |
| 19A362T.3 | 3   | 2   | 1   | 1   | 3   | 1   | -   | -   | -   | -    | -    | 3    | -    | -    | -    |
| 19A362T.4 | 3   | 2   | 1   | 2   | 3   | 1   | -   | -   | -   | -    | -    | 3    | -    | -    | -    |
| 19A362T.5 | 3   | 2   | 2   | 1   | 1   | 1   | -   | -   | -   | -    | -    | 3    | 1    | -    | -    |

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
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Title of the Course : Applied Thermodynamics-III  
 Category : PC  
 Course Code : 19A363T  
 Year : III Year  
 Semester : II Semester

|               |                |           |         |
|---------------|----------------|-----------|---------|
| Lecture Hours | Tutorial Hours | Practical | Credits |
| 2             | 1              | 0         | 3       |

Course Objectives:

- To understand the principle and operation of gas turbines and jet propulsions.
- To understand the Basic principles of refrigeration and the applications of air refrigeration and vapour compression refrigeration systems
- To understand the basic components and working of a different vapour absorption refrigeration systems and refrigerants used for different refrigeration systems.
- To familiarize the students in understanding the psychometric process and operation of various air conditioning systems
- To gain knowledge on different Air conditioning equipment and heat pump circuits.

Unit 1 Gas Turbines and Jet Propulsions 12

Gas Turbines: Simple gas turbine plant – Ideal cycle, essential components – parameters of performance – actual cycle – regeneration, inter cooling and reheating – Closed and Semi-closed cycles – merits and demerits.

Jet Propulsion: Principle of Operation – Classification of jet propulsive engines – Working Principles with schematic diagrams and representation on T-S diagram - Thrust, Thrust Power and Propulsion Efficiency – Turbo jet engines – Turbo jet, Turbo prop, Pulse jet – Schematic Diagram. Introduction to Rocket propulsion.

Unit 2 Air Refrigeration And Vapour Compression Refrigeration 10

Introduction To Refrigeration: Necessity and applications – Unit of refrigeration and C.O.P. – Different refrigeration methods - Air Refrigeration- Ideal and Actual cycles, Open and Dense air systems – Refrigeration needs of Air craft's. Types. (Simple air cooling system and Boot Strap air cooling system- problems).

Vapour Compression Refrigeration: Basic cycle - working principle and essential components of the plant – COP – Representation  $\eta$  of cycle on T-S and P-h charts – Expander vs. Throttling, effect of sub cooling and super heating – cycle analysis – Actual cycle- Influence of various parameters on system performance – Construction and Use of P-h charts – numerical Problems.

Unit 3 Vapour Absorption Refrigeration System 08

Description of vapour absorption refrigeration system and working of (NH<sub>3</sub>) – water system and Li Br –water ( Two shell & Four shell) System -Calculation of max COP. Principle of operation of three Fluid absorption.

Refrigerants : Properties, Classification of Refrigerants, Ozone Depletion, Global Warming.

Unit 4 Introduction To Air Conditioning 11

Psychometric Properties & Processes – Characterization of Sensible and latent heat loads — Need for Ventilation, Consideration of infiltrated air – Heat Load concepts: RSHF, GSHF- Problems. Requirements of human comfort and concept of Effective Temperature- Comfort chart – Comfort Air Conditioning-Summer, winter & year round air conditioning- simple problems.

Unit 5 : Air Conditioning Equipment 07

Humidifiers – Dehumidifiers – air filters, fans and blowers.

Heat Pump:- Heat sources – different heat pump circuits.

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### Prescribed Text Books:

1. V. Ganesan, Gas Turbines, TMH Publishers, New Delhi. 2010. ISBN: 978-0-07-068192-7
2. A Course in Refrigeration and Air conditioning, SC Arora & Domkundwar, Dhanpat Rai & Co 2015. ISBN-13 : 978-1111644475
3. Refrigeration and Air Conditioning by R.K Rajput & S K Kataria & sons 3 rd Edition 2012. ISBN-10 : 9350142554.

### Reference Books:

1. Gas dynamics and Jet Propulsion, S.L. Somasundaran, NAI Publishers, New Delhi. 1996. ISBN: 9788122409925.
2. A text book of Refrigeration and Air Conditioning, R.S.Khurmi & J.K.Gupta,S.Chand& Co 2015. ISBN: 9788121927819.
3. Refrigeration and Air Conditioning. P.L.Ballaney, Khanna Publication 7th edition. ISBN: 9788174091369.
4. Refrigeration and Air Conditioning. R.C.Arora, PHI 2010. ISBN: ISBN-10 : 9788120339156.
5. Basic Refrigeration and Air Conditioning, Ananthanarayanan, TMH 3rd Edition. 2013. ISBN: 9781259062704
6. Refrigeration and Air Conditioning, Manohar Prasad, New Age, 3rd Ed,2011. ISBN: 9788122414295.

### Data Hand Book:

- Refrigeration and air conditioning data book by Domkundwar & Domkundwar, Dhanpath Rai & co.

### Course Outcomes:

| Student will be able to   | Blooms Level of Learning |
|---|--------------------------|
| 1. Understand the basic cycle, working principle and classification, performance of gas turbines, Jet propulsion and rocket propulsion system.                          | L1                       |
| 2. analyze the purpose and functioning of various components in the domestic refrigerator, analyzing the concept of sub-cooling and super heating in improving the COP. | L2                       |
| 3. Analyze the basic cycle, working principle of various types of vapour absorption refrigeration systems, its calculation of COP And Refrigerant properties.           | L2                       |
| 4. Evaluate various Psychrometric Properties, calculations of heat loads for various applications and selection of air-conditioning system based on climatic Seasons.   | L3                       |
| 5. Understand different heat pump circuits and Air conditioning equipment   | L1                       |

### CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A363T.1 | 3   | 3   | 2   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | 3    | 1    | -    |
| 19A363T.2 | 3   | 3   | 2   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | 3    | 1    | -    |
| 19A363T.3 | 3   | 3   | 2   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | 2    | -    | -    |
| 19A363T.4 | 3   | 3   | 2   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | 2    | 1    | -    |
| 19A363T.5 | 3   | 3   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | 1    | 1    | -    | -    |

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
(An Autonomous Institution)

Title of the Course : Design of Machine Elements– II  
 Category : PC  
 Course Code : 19A364T  
 Year : III Year  
 Semester : II Semester

|               |                |           |         |
|---------------|----------------|-----------|---------|
| Lecture Hours | Tutorial Hours | Practical | Credits |
| 3             | -              | 0         | 3       |

Course Objectives:

- To learn the basic concepts of design of power transmission elements.
- To understand the design concepts of various types of springs, bearings and gears
- To help the students in applying design concepts of IC engine parts like Piston, cylinder, connecting rod and crank shaft.

Unit 1 Sliding Contact Bearings 08  
 Introduction, Types of Journal bearings – Lubrication – Petroff's equation, McKee's investigation, nomenclature, Bearing Modulus –bearing materials – journal bearing design.

Unit 2 Rolling Contact Bearings 08  
 Types of rolling contact bearings – Selection of bearing type, Static loading of ball & roller bearings Stribeck's equation, Dynamic load carrying capacity, equivalent bearing load, selection of bearing life, design for cyclic loads and speeds, bearing with a probability of survival other than 90%.

Unit 3 Engine Parts 10  
 Pistons, Forces acting on piston – Construction Design and proportions of piston - Thrust in connecting rod – stress due to whipping action on Connecting rod ends – Cranks and Crank shafts, strength and proportions of center cranks.

Unit 4 Mechanical Springs 10  
 Mechanical Springs: Introduction- types of Springs– Stress and deflection of closed under axial pull and axial couple. Springs for fatigue loading - Leaf springs.  
 Power Transmissions Systems: Design of Flat belt drives & V-belt drives.

Unit 5 Spur & Helical Gears 10  
 Spur Gears: Introduction, classification of gears, terminology of spur gears Force analysis, beam strength of gear tooth, effective load on gear tooth, Design analysis of spur gears – Estimation of module and face width, check for plastic deformation. Check for dynamic and wear considerations for spur gears  
 Helical Gears: Introduction, terminology of helical gears, Force analysis, beam strength of gear tooth, effective load on gear tooth, Design analysis of helical gears – Estimation of module and face width, check for plastic deformation. Check for dynamic and wear considerations for helical gears.

Prescribed Text Books:

1. V.B.Bhandari, Machine Design. TMH, 2016. ISBN-10 : 9789339221126; ISBN-13 : 978-9339221126
2. R.S. Khurmi & J.S.Gupta, Machine Design. S.Chand Publications. 2005. ISBN: 9788121925372

Reference Books:

1. JE Shigley, Mech. Engg. Design. McGraw-Hill Education; 10 edition. 2014. ISBN-10 : 9780073398204



Department of Mechanical Engineering  
**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
 (An Autonomous Institution)

Title of the Course : Turbo machinery  
 Category : PE  
 Course Code : 19A36AT  
 Year : III Year  
 Semester : II Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| 3             | -              | 0         | 3       |

Course Objectives:

- To impart the basic knowledge of turbo machinery
- To familiarize various power absorbing devices and its key parameters.
- To understand the flow characteristics of Centrifugal compressors
- To make conversant with the flow characteristics of Axial compressors
- To provide preliminary design on turbo machines.

Unit 1 Principles 8  
 Energy transfer between fluid and rotor, classification of fluid machinery, dimensionless parameters, specific speed, applications, stage velocity triangles, work and efficiency for compressors and turbines.

Unit 2 Centrifugal Fans and Blowers 8  
 Types, stage and design parameters, flow analysis in impeller blades, volute and diffusers, losses, characteristics curves and selection, fan drives and fan noise.

Unit 3 Centrifugal Compressor 9  
 Construction details, types, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.

Unit 4 Axial Flow Compressor 9  
 Stage velocity triangles, enthalpy-entropy diagrams, stage losses and efficiency, work done factor, simple stage design problems and performance characteristics.

Unit 5 Axial and Radial Flow Turbines 14  
 Stage velocity diagrams, reaction stages, losses and coefficients blade design principles, testing and performance characteristics.

Prescribed Text Books:

1. Turbines, Compressors & Fans, S. M. Yahya, Tata McGraw Hill & Co. Ltd., 4th edition, 2010. ISBN 13: 9780070707023
2. V. Kadambi and Manohar Prasad, "An Introduction to Energy Conversion, Volume III, Turbo machinery", New Age International Publishers, reprint 2008. ISBN-13: 978-1781830086
3. Fundamentals of Turbo machinery: William W Perg, John Wiley & Sons, Inc. 2008. ISBN: 9780470124222

Reference Books:

1. S. L. Dixon, "Fluid Mechanics & Thermodynamics of Turbo machines", Elsevier (2005). ISBN-13: 978-0124159549
2. Fundamentals of turbo machinery, B.K. Venkanna PHI, New Delhi 2009. ISBN 13: 9788120337756
3. M. S. Govindgouda and A. M. Nagaraj, "A Text Book of Turbomachines", M. M. Publications, 10th Ed, 2014.

Department of Mechanical Engineering

ISBN-135551234003189.

4. Earl Logan, Jr. Publisher: CRC Press; 2 edition (1 May 2003) ISBN-13: 978-0824709952
5. D. G. Shepherd, "Principals of Turbo machines", the Macmillan Company (1964). ISBN-13: 978-0024096609

Course Outcomes:

| Student will be able to   | Blooms Level of Learning |
|---|--------------------------|
| 1. Classify Turbo machines and discuss the importance of dimensionless numbers in turbo machines.           | L2                       |
| 2. Explain various losses and calculate the stage & design parameters in centrifugal fans and blowers.      | L2                       |
| 3. Assess air angle, pressure ratio and power required in centrifugal compressor.                           | L5                       |
| 4. Determine stage losses, stage efficiency and pressure ratio in axial flow compressor.                    | L5                       |
| 5. Evaluate the flow coefficient, loading coefficient and stage parameters in axial & radial flow turbines. | L5                       |

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A36AT.1 | 3   | 3   | 1   | -   | -   | 1   | 1   | -   | -   | -    | -    | 2    | 1    | -    | -    |
| 19A36AT.2 | 3   | 3   | 1   | -   | -   | 1   | 1   | -   | -   | -    | -    | 2    | 1    | -    | -    |
| 19A36AT.3 | 3   | 3   | 2   | -   | -   | 1   | 1   | -   | -   | -    | -    | 2    | 1    | -    | -    |
| 19A36AT.4 | 3   | 3   | 2   | -   | -   | 1   | 1   | -   | -   | -    | -    | 2    | 1    | -    | -    |
| 19A36AT.5 | 3   | 3   | 2   | -   | -   | 1   | 1   | -   | -   | -    | -    | 2    | 1    | -    | -    |



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
(An Autonomous Institution)

Title of the Course : Tribology  
 Category : PE  
 Course Code : 19A36BT  
 Year : III Year  
 Semester : II Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| 3             | -              | 0         | 3       |

Course Objectives:

- To understand the lubricant principles, types of lubricants and their properties
- To understand the mechanisms of friction and wear in materials
- To analyse the friction force and power loss in hydrodynamic and hydrostatic lubrication.
- To understand the preparation of bearing materials.

Unit 1 Introduction to Tribology: 08  
 Properties of oils and equation of flow: Viscosity, Newton's Law of viscosity, Hagen-Poiseuille Law, Flow between parallel stationary planes, viscosity measuring apparatus. Purpose of lubrication, properties and characteristics of lubricants, types of lubricants (oils, greases, solid lubricants), lubrication systems, Lubricant Additives.

Unit 2 Friction and Wear 08  
 Friction: Material properties influencing friction, laws of friction, causes/theories of friction, Types of friction, Elastic and Visco-elastic effects in friction, effects of friction.  
 Wear: Causes/sources of wear, types of wear (adhesive, abrasive, corrosive, erosive, fretting), wear of polymers, wear of ceramic materials, effects of wear, steps for wear prevention/resistance, Wear measurement Effects of speed, temperature and pressure. Tribological measures, Material selection.

Unit 3 Hydrodynamic Lubrication and Mechanism of Pressure Development in an Oil Film 07  
 Hydrodynamic Lubrication:: Friction forces and power loss in lightly loaded bearing, Petroff's law, Tower's experiments, idealized full journal bearings.  
 Mechanism of Pressure Development in an Oil Film: Reynold's investigations, Reynold's equation in two dimensions. Partial journal bearings, end leakages in journal bearing, numerical problems.

Unit 4 Slider / Pad Bearing with a Fixed and Pivoted Shoe 07  
 Pressure distribution, Load carrying capacity, coefficient of friction, frictional resistance in a pivoted shoe bearing, influence of end leakage, numerical examples.

Unit 5 Hydrostatic Lubrication and Bearing Materials 07  
 Hydrostatic Lubrication: Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing.  
 Bearing Materials: Commonly used bearings materials, properties of typical bearing materials.

Prescribed Text Books:

1. Lubrication of Bearings – Theoretical Principles and Design by Redzimonvskay E I., Oxford press Company 2014. ISBN: 978-0073398204.
2. Principles and Applications of Tribology by Moore, Pergamaon press 2013. ISBN: 9781483157283.



Department of Mechanical Engineering  
**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
 (An Autonomous Institution)

Title of the Course : Instrumentation and control systems  
 Category : PE  
 Course Code : 19A36CT  
 Year : III Year  
 Semester : II Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| 3             | -              | 0         | 3       |

Course Objectives:

- To understand generalized measurement system and its functional elements.
- To know about Sensors, Transducers and their working principles.
- To gain knowledge about the instruments, working principles of pressure, flow and temperature.
- To get knowledge on Measurement and their working of Force, Torque, Acceleration, Vibrations.
- To know about application of strain gauges for different measurements.
- To gain knowledge about Control Systems, Mathematical Models and Transfer Function.

Unit 1 Measurement And Instrumentation 09

Measurement, measurement methods, generalized measurement system and its functional elements, classification of instruments, error and its classification, static and dynamic characteristics, Sensors and Transducers: Introduction, transducers classification and description, transducer sensitivity, variable resistance transducers, variable inductance transducers, capacitive transducers, LVDT, piezo electric and photo electric transducers.

Unit 2 Measurement Of Pressure, Flow And Temperature 11

Pressure measurement terms, measurements of low pressure gauges such as McLeod gauge, thermal conductivity gauge, Ionization gauge, measurement of high pressure such as Bourdon gauge and bellows, resistance gauge, Classification of flow measurement techniques, special flow meters such as Turbine flow meter, Magnetic flow meter, Hot wire anemometer, Ultrasonic flow meter. Temperature measurement instruments, thermocouples, resistance thermometers and thermistors, radiation and optical Pyrometers.

Unit 3 Measurement of Force, Torque, Acceleration, Vibrations 09

Basic force measurement methods such as elastic load cells, elastic strain gauge load cells, hydraulic and pneumatic load cells, Torque measurement, different types of torsion meters, piezo electric accelerometer, Strain gauge accelerometer. Mechanical type vibration instruments - Seismic instruments as an accelerometer and vibrometer, Calibration of vibration pickups.

Unit 4 Strain Gauges And Measurement 09

Strain measuring techniques, requirement of strain gauges, resistance strain gauges, strain gauges alloys and material, bonded and unbonded strain gauges, bonding techniques, temperature compensation in strain gauges.

Unit 5 Control Systems, Mathematical Models And transfer Function 10

Introduction, examples of control systems, classification of control systems, open loop and closed loop control systems, control system terminology, servomechanism. Physical system and mathematical models, mechanical systems, thermal systems, electrical systems, hydraulic and pneumatic systems, linear control system, transfer function, block diagram and its reduction process, signal flow graphs, mason's rule.

Prescribed Text Books:

Department of Mechanical Engineering

1. Beckwith and Buck, Mechanical Measurements. Narosa Publication. 2012. ISBN 9332518521
2. S. Ghosh, Control Systems – Theory & Applications. Pearson Education, New Delhi, 2014. ISBN 9781299446427
3. Er.R.K. Rajput, Mechanical Measurements and Instrumentation, S.K. Kataria, New Delhi 2019. ISBN 978-93-5014-285-1

Reference Books:

1. D.S. Kumar, Mechanical Measurements and Control. Metropolitan Books, New Delhi, 2015. ISBN 8120002728
2. B.S. Manke, Linear Control Systems. Khanna Publishers, New Delhi, 2009. ISBN 9788174093103
3. Nagarathan and Gopal, Control System Engineering, Narosa Publishers. 2020. ISBN 9781781833070
4. Naresh K. Sinha, Control Systems, NAI Publishers, New Delhi, 2013. ISBN 9788122433531

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |   |    |
|---|----|
| 1. Understand the working of generalized measurement system and its functional elements.                                | L2 |
| 2. Apply the working principles of various instruments used for measuring pressure, flow and temperature.               | L3 |
| 3. Apply the working principle of various instruments used for measuring force, torque, acceleration, vibrations.       | L3 |
| 4. Analyze about measurement methods of strain gauges.  | L4 |
| 5. Evaluate a control system to meet a specified performance using analytic, graphical, empirical and computer methods. | L5 |

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A36CT.1 | 3   | -   | -   | -   | -   | 3   | 1   | 3   | 3   | 3    | -    | -    | 2    | -    | -    |
| 19A36CT.2 | 3   | -   | -   | -   | -   | 3   | -   | 3   | 3   | 3    | -    | -    | 2    | -    | -    |
| 19A36CT.3 | 3   | -   | -   | -   | -   | 3   | -   | 3   | 3   | 3    | -    | -    | 2    | -    | -    |
| 19A36CT.4 | 3   | -   | -   | -   | -   | 3   | -   | 3   | 3   | 3    | -    | -    | 2    | -    | -    |
| 19A36CT.5 | 3   | 1   | -   | -   | -   | 3   | -   | 3   | 3   | 3    | -    | -    | 2    | -    | -    |

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
(An Autonomous Institution)

Title of the Course : Additive Manufacturing  
 Category : PE  
 Course Code : 19A36DT  
 Year : III Year  
 Semester : II Semester

|               |                |           |         |
|---------------|----------------|-----------|---------|
| Lecture Hours | Tutorial Hours | Practical | Credits |
| 3             | -              | 0         | 3       |

Course Objectives:

- To understand the fundamentals of various Additive Manufacturing Technologies for application to various industrial needs.
- To convert part file into STL format
- To understand the method of manufacturing of liquid based, powder based and solid based techniques.
- To understand the manufacturing procedure of a prototype using FDM technique.
- To understand the 3-D printing specifications, process and uses.

Unit 1 Introduction 09  
 Prototyping fundamentals, Historical development, Advantages of AMT, Commonly used terms, process chain, 3D modelling, Data Conversion, and transmission, Checking and preparing, Building, Post processing, RP data formats, Classification of AMT process, Applications to various fields

Unit 2 Liquid based systems 10  
 Stereo lithography apparatus (SLA): Models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. Solid ground curing (SGC): Models and specifications, process, working, principle, applications, advantages and disadvantages, case studies.

Unit 3 Solid based systems 09  
 Laminated object manufacturing (LOM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies. Fused Deposition Modelling (FDM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies, practical demonstration

Unit 4 Powder Based Systems 09  
 Selective laser sintering (SLS): Models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

Unit 5 Three dimensional printing (3DP) 08  
 Models and specification, process, working principle, applications, advantages and disadvantages, case studies.

Prescribed Text Books:

1. Chua C.K., Leong K.F. and LIM C.S Rapid prototyping: Principles an Applications, World Scientific publications, 3rdEd., 2010. ISBN-10 : 9812778985; ISBN-13 : 978-9812778987
2. D.T. Pham and S.S. Dimov, "Rapid Manufacturing", Springer, 2001. ISBN-13: 978-1-4471-0703-3

Reference Books:

1. Terry Wohlers, " Wholers Report 2000", Wohlers Associates, 2000. ISBN 978-0-9913332-6-4

Department of Mechanical Engineering

2. Paul F. Jacobs, "Rapid Prototyping and Manufacturing", ASME Press, 1996. ISBN. 0-9640233-3-4
3. Ian Gibson, Davin Rosen, Brent Stucker "Additive Manufacturing Technologies, Springer, 2nd Ed, 2014. ISBN 978-1-4939-2113-3

Course Outcomes:

| Student will be able to  | Blooms Level of Learning |
|--|--------------------------|
| 1. Understand the fundamentals of Additive Manufacturing Technologies for engineering applications.  | L2                       |
| 2. Understand the methodology to manufacture the products using SLA and SGC technologies and study their applications, advantages and case studies | L2                       |
| 3. Understand the methodology to manufacture the products using LOM and FDM technologies and study their applications, advantages and case studies | L2                       |
| 4. Understand the methodology to manufacture the products using SLS technologies and study their applications, advantages and case studies.        | L2                       |
| 5. Understand the 3D Printing technologies and study their applications, advantages and case studies.  | L2                       |

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A36DT.1 | 3   | -   | 3   | 3   | -   | 3   | 3   | -   | -   | -    | -    | -    | -    | -    | -    |
| 19A36DT.2 | 3   | 3   | -   | 3   | -   | 3   | 3   | 2   | -   | -    | -    | -    | -    | -    | 2    |
| 19A36DT.3 | 3   | 3   | 3   | -   | -   | 3   | 3   | -   | -   | -    | -    | 1    | -    | 1    | -    |
| 19A36DT.4 | 3   | 3   | 3   | 3   | -   | 3   | 3   | -   | -   | -    | -    | -    | -    | 1    | -    |
| 19A36DT.5 | 3   | -   | 3   | -   | -   | 3   | 3   | 2   | -   | -    | 1    | -    | -    | -    | 2    |

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
(An Autonomous Institution)

Title of the Course : Heat Transfer Lab  
 Category : PC  
 Course Code : 19A361L  
 Year : III Year  
 Semester : II Semester

|               |                |           |         |
|---------------|----------------|-----------|---------|
| Lecture Hours | Tutorial Hours | Practical | Credits |
| -             | -              | 2         | 1.5     |

Course Objectives:

- To acquire Knowledge of the principle of mode of heat transfer
- To design and applications of heat exchanger
- To gain knowledge transient heat conduction and heat pipe
- To provide practical knowledge to determine heat transfer coefficient in boiling and condensation

List of Experiments:

1. Thermal Conductivity of metal (conductor)
2. Thermal conductivity of insulating powder through Concentric Sphere
3. Overall heat transfer co-efficient through Composite Slab
4. Heat transfer coefficient in natural convection
5. Heat transfer coefficient in forced convection
6. Heat transfer from pin-fin
7. Emissivity of a gray body through Emissivity apparatus
8. Experiment on Stefan Boltzman Apparatus
9. Experiment on Parallel and counter flow heat exchanger
10. Experiment on Critical Heat flux apparatus
11. Thermal conductivity of insulating material through lagged pipe apparatus
12. Experiment on Transient Heat Conduction
13. Heat transfer in drop and film wise condensation
14. Heat pipe demonstration

Note: 1. Any 12 experiments of the above 14 experiments are to be conducted.

2. Heat Transfer data Books and Steam Tables data books are permitted in the examinations.

Course Outcomes:

| Student will be able to  | Blooms Level of Learning |
|--|--------------------------|
| 1. Determine thermal conductivity in metal bars, insulating powder, lagged pipe and composite slab.        | L3                       |
| 2. Evaluate the fin efficiency and fin effectiveness.  | L1,L3                    |
| 3. Evaluate convective heat transfer coefficient by performing experiments in free and forced convections. | L3                       |
| 4. Determine Stefan Boltzmann constant and emissivity of gray body.  | L2                       |
| 5. Demonstrate practical understanding on unsteady state heat conduction, Heat pipe and Two phase flow.    | L1                       |
| 6. Determine convective heat transfer coefficient in drop and film wise condensation                       | L2                       |
| 7. Determine Critical heat flux for pool boiling   | L2                       |





**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
(An Autonomous Institution)

|                     |   |                               |
|---------------------|---|-------------------------------|
| Title of the Course | : | Metrology & Machine Tools Lab |
| Category            | : | PC                            |
| Course Code         | : | 19A365L                       |
| Year                | : | III Year                      |
| Semester            | : | II Semester                   |

|               |                |           |         |
|---------------|----------------|-----------|---------|
| Lecture Hours | Tutorial Hours | Practical | Credits |
| -             | -              | 2         | 1       |

Course Objectives:

1. To learn the Step turning and taper turning and thread cutting on lathe machine
2. To learn the operations of Drilling, Tapping, Shaping, Slotting and milling.
3. To demonstrate the usage of metrology lab equipment
4. To know the working principles of different instruments
5. To learn the measurement of the Angle and taper s by Bevel protractor, Sine bar, etc

List of Experiments: Machine Tools Lab

1. Demonstration of construction & operations of general purpose machines: Lathe, Drilling machine, Milling machine, Shaper, Planning machine, Slotting machine, Cylindrical Grinder, Surface grinder and Tool & cutter grinder.
2. Job on Step turning and taper turning on lathe machine
3. Job on Thread cutting and knurling on -lathe machine.
4. Job on Drilling and Tapping
5. Job on Shaping and Planning
6. Job on Slotting
7. Job on Milling Job on Cylindrical Surface Grinding
8. Job on Grinding of Tool angles.

List of Experiments: Metrology Lab

1. Measurement of lengths, heights, diameters by Vernier calipers, micrometers etc.
2. Measurement of bores by internal micrometers and dial bore indicators.
3. Use of gear teeth, Vernier calipers and checking the chordal addendum and chordal height of spur gear.
4. Alignment test on the lathe.
5. Alignment test on milling machine.
6. Study of Tool makers microscope and its application
7. Angle and taper measurements by Bevel protractor, Sine bars, etc.
8. Use of spirit level in finding the flatness of surface plate.
9. Thread measurement by two wire/ three wire method.
10. Surface roughness measurement by Talysurf instrument

Course Outcomes:

|   |                          |
|---|--------------------------|
| Student will be able to   | Blooms Level of Learning |
| 1. Demonstrate knowledge of different machine tools used in machine shop.                                 | L4                       |
| 2. Perform step, taper turning, knurling and threading operations on lathe.                               | L3                       |
| 3. Have Practical exposure on Flat Surface machining, Shaping, Slotting, Milling and grinding operations. | L3                       |
| 4. Apply the procedures to measure length, width, depth, bore diameters,                                  | L5                       |

Department of Mechanical Engineering

external tapers, tool angles, and surface roughness by using different instruments.

5. Measure the angle and taper using Bevel protractor and Sine bar L4
6. Conduct different machine alignment tests L4

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A365L.1 | 3   | 3   | 3   | 3   | 3   | -   | -   | -   | 3   | -    | -    | -    | 3    | -    | -    |
| 19A365L.2 | 3   | 2   | -   | -   | 2   | -   | -   | -   | 2   | -    | -    | -    | 1    | 2    | 3    |
| 19A365L.3 | 3   | 3   | -   | -   | 3   | -   | -   | -   | 3   | -    | -    | -    | 1    | 2    | 3    |
| 19A365L.4 | 3   | 3   | -   | 3   | 3   | -   | -   | -   | 3   | -    | -    | -    | 3    | 1    | -    |
| 19A365L.5 | 3   | -   | -   | -   | 3   | -   | -   | -   | 3   | -    | -    | -    | 1    | 3    | -    |
| 19A365L.6 | 3   | -   | -   | -   | 3   | -   | -   | -   | 3   | -    | -    | -    | 1    | 2    | 3    |

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
(An Autonomous Institution)

Title of the Course : CAD/CAM  
 Category : PC  
 Course Code : 19A371T  
 Year : IV Year  
 Semester : I Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| 2             | -              | -         | 2       |

Course Objectives:

- To understand the basic concepts of CAD/CAM and Transformations.
- To understand the different geometric modeling techniques like solid modeling, surface modeling, feature based modeling etc. and to visualize how the components look like before its manufacturing or fabrication
- To develop NC and CNC programs to manufacture industrial Components.
- To understand the importance of Group Technology and Flexible Manufacturing System
- To understand the elements of an automated manufacturing environment

Unit 1 Introduction To Computer Graphics 10

Introduction: Introduction to CAD and CAM- Elements of CAD-Computers in Industrial Engineering-Product Cycle- CAD/CAM Hardware-Basic Structure of CPU-Input and Output Devices-Display Devices (CRT and DVST)-Raster Scan Graphics Coordinate System-Representation of Line and Circles, Database Structure for Graphics Modeling- Transformation -2D and 3D

Unit 2 Curve Representation 10

Geometric Modeling-Classification of wireframe entities, Curve representation methods, Parametric representation of analytic curves: line, circle, arc, conics, Parametric representation of synthetic curves: Hermite cubic curve, Bezier curve, B-Spline curve-Representation of surface modelling, -Hermite bicubic surface patch-Bezier and B-spline Surfaces, Solid modelling techniques, CSG and B-rep.

Unit 3 Numerical Control 08

NC, NC modes, NC elements, NC machine tools, structure of CNC machine tools, features of Machining center, turning center, CNC Part Programming: fundamentals, manual part programming methods, Computer Aided Part Programming.

Unit 4 Group Technology And Flexible Manufacturing System 10

Group Technology: Part family, coding and classification, production flow analysis, advantages and limitations, Computer Aided Processes Planning, Retrieval type and Generative type.  
 Flexible Manufacturing System: Introduction to FMS – Material Handling System – Computer Control Systems – Human Labor in Manufacturing system – Applications – Advantages and Limitations

Unit 5 : Computer Integrated Production Planning And Computer Aided Quality Control 10

Computer Aided Quality Control (CAQC): Capacity planning, shop floor control, MRP-I, MRP-II, CIMS benefits, JIT approach. Terminology in quality control, the computer in QC, contact inspection methods, non-contact inspection methods-optical and non-optical, and computer aided testing, integration of CAQC with CAD/CAM.

Prescribed Text Books:

1. P N Rao, CAD/CAM – Principle and Applications. 2010. ISBN: 9780070681934

Department of Mechanical Engineering

2. A Zimmer & P Groover, CAD/CAM. PE,PHI. ISBN: 9788177584165.
3. RadhaKrishnan and Subramaniah, CAD/CAM/CIM. New Age. 2008. ISBN: 8122422365, 9788122422368.

Reference Books:

1. Groover, P.E, Automation, Production systems & Computer integrated Manufacturing. ISBN-10: 0132393212.
2. Farid Amirouche, Principles of Computer Aided Design and Manufacturing. Pearson Hall. 2004. ISBN, 0130646318, 9780130646316.
3. CSP Rao, A text book of CAD/CAM, Hitech Publ. (2002) ISBN 81-7764-294-4

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |  |       |
|--|-------|
| 1. Identify the importance of CAD/CAM in modern manufacturing systems and explain the hardware used for CAD/CAM systems. | L1&L2 |
| 2. Able to understand and develop the Mathematical representations of curves.  | L2    |
| 3. Find the difference between conventional and NC techniques and to develop a simple program.                           | L3    |
| 4. Describe the use of GT and CAPP for the product development.  | L3    |
| 5. To identify the various elements involved in the computer aided manufacturing system                                  | L4    |

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A371T.1 | 2   | -   | -   | -   | -   | -   | -   | -   | 3   | -    | -    | -    | -    | -    | -    |
| 19A371T.2 | 2   | 2   | 3   | 2   | -   | -   | -   | -   | 3   | -    | -    | -    | 3    | -    | -    |
| 19A371T.3 | -   | -   | 3   | 2   | 1   | -   | -   | -   | 3   | -    | -    | -    | 3    | -    | -    |
| 19A371T.4 | -   | 2   | 3   | -   | -   | -   | -   | -   | 3   | -    | -    | -    | 3    | -    | -    |
| 19A371T.5 | -   | -   | 3   | -   | -   | -   | -   | -   | 3   | -    | -    | -    | -    | -    | -    |

Department of Mechanical Engineering  
**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
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Title of the Course : Operations Research  
 Category : PC  
 Course Code : 19A372T  
 Year : IV B.Tech  
 Semester : I Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| 2             | 1              | 0         | 3       |

Course Objectives:

- To enable the students to the nature and scope of various decision making situations within business contexts, understand and apply operations research techniques to industrial applications.
- To learn the fundamental techniques of Operations Research and to choose a suitable OR technique to solve problem.

Unit 1 10

Development – Definition– Characteristics and Phases – Types of operation and Research models– applications.  
 Linear Programming Problem Formulation – Graphical solution – Simplex method –Artificial variables techniques -  
 Two–phase method, Big-M method – Duality Principle.

Unit 2 10

Transportation Problem: Formulation – Optimal solution, unbalanced transportation problem –Degeneracy.  
 Assignment Problem – Formulation – Optimal solution - Variants of Assignment Problem-Travelling Salesman  
 problem

Unit 3 10

Replacement Models: Introduction – Replacement of items that deteriorate with time – with change in money value -  
 without change in money value – Replacement of items that fail completely, group replacement  
 Theory Of Games: Introduction – Minimax - Maximin – Criterion and optimal strategy – Solution of games with saddle  
 points – Rectangular games without saddle points – 2 X 2 games – m X 2, 2 X n & m x n games -Graphical method,  
 Dominance principle.

Unit 4 08

Waiting Lines: Introduction – Single Channel – Poisson arrivals – exponential service times – with infinite queue  
 length models.  
 Simulation: Definition – Types of simulation models – phases of simulation– applications of simulation – Queuing  
 problems – Advantages and Disadvantages – Simulation Languages.

Unit 5 10

Inventory: Introduction – Single item – Deterministic models – Purchase inventory models with one price break and  
 multiple price breaks.  
 Dynamic Programming: Introduction – Bellman's Principle of optimality – Applications of dynamic programming-  
 shortest path problem – linear programming problem.

Prescribed Text Books:

1. PS Gupta, DS Hira, Operations Research, S Chand Publications, 10<sup>th</sup> Edition, 2016, ISBN-13978-8121902816.

- S.D. Sharma, Operations Research, Kedarnath and Ramnath Publications, 2012, ISBN-135551234001596

Reference Books:

- Taha, Introduction to Operations Research. PHI, 10 th edition, 2016, ISBN-13978-0134444017
- R. Panneerselvam, Operations Research. PHI Publ, 2nd edition, 2004, ISBN: 9788120319233

Course Outcomes:

Student will be able to

Blooms Level of Learning

- Create mathematical models of the real life situations and capable of obtaining best solution using Graphical Method and Simplex Method, Big M method and the student must be able to implement the theory of duality for simplifying the solution procedure for certain LPPs. L3
- Solve the special cases of LPP such as Transportation, Assignment and Travelling Salesmen problems. L3
- Find optimal replacement period of a machine or group of parts. L3
- Have knowledge of choosing the best strategy out of the available strategies which is an essential skill for any business manager to successfully face the competition. L3
- Understand and will apply the fundamentals of waiting lines in real life situations. L3
- Simulate queuing models L3
- Have aware of applying Dynamic Programming technique to solve the complex problems by breaking them into a series of sub- problems. L3
- Understand and will apply the fundamentals of inventory in real life situations. L3

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A372T.1 | 3   | 3   | -   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | -    | -    |
| 19A372T.2 | 3   | 3   | 2   | -   | -   | -   | 3   | -   | -   | -    | -    | -    | 2    | -    | -    |
| 19A372T.3 | 3   | 3   | 2   | -   | -   | -   | 3   | -   | -   | -    | -    | -    | 2    | -    | -    |
| 19A372T.4 | 3   | 3   |     | -   | -   | -   | 3   | -   | -   | -    | -    | -    | 2    | -    | -    |
| 19A372T.5 | 3   | 3   | 2   | -   | -   | 1   | 3   | -   | -   | -    | -    | -    | 2    | -    | -    |
| 19A372T.6 | 3   | 3   | -   | -   | -   | 1   | 3   | -   | -   | -    | -    | -    | 2    | -    | -    |
| 19A372T.7 | 3   | 3   | -   | -   | -   | -   | 3   | -   | -   | -    | -    | -    | 2    | -    | -    |
| 19A372T.8 | 3   | 3   | -   | -   | 1   | -   | 3   | -   | -   | -    | -    | -    | 2    | -    | -    |

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
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Title of the Course : R&AC  
 Category : PE  
 Course Code : 19A37AT  
 Year : IV Year  
 Semester : I Semester

|               |                |           |         |
|---------------|----------------|-----------|---------|
| Lecture Hours | Tutorial Hours | Practical | Credits |
| 3             | -              | 0         | 3       |

Course Objectives:

- To equip the students to understand vapour compression refrigeration cycle, vapor absorption refrigeration cycle and air conditioning equipment
- To enable the students to design summer and winter air conditioning systems.
- To enable the students to understand the psychometric properties and their calculation using the psychometric charts and tables to design the comfort air conditioning system suitable to particular application.

Unit 1 Introduction To Refrigeration 09  
 Necessity and applications – Unit of refrigeration and C.O.P. – Different refrigeration methods - Air Refrigeration: Ideal and Actual cycles, Open and Dense air systems – problems – Refrigeration needs of Aircrafts.

Unit 2 Vapour Compression Refrigeration 10  
 Basic cycle - working principle and essential components of the plant – COP – Representation  $\eta$  of cycle on T-S and P-h charts – Expander vs. Throttling, effect of sub cooling and super heating – cycle analysis – Actual cycle Influence of various parameters on system performance – Construction and Use of P-h charts – numerical Problems. Refrigerants – Desirable Properties – Common refrigerants used – Nomenclature.

Unit 3 Vapor Absorption Refrigeration System 09  
 Description and working of NH<sub>3</sub> – water system and Li Br –water ( Two shell & Four shell) System -Calculation of max COP. Principle of operation of three Fluid absorption systems. Steam Jet Refrigeration System – Principle and operation of (i) Thermoelectric refrigerator (ii) Vortex tube or Hilsch tube.

Unit 4 Introduction To Air Conditioning 10  
 Psychometric Properties & Processes – Characterization of Sensible and latent heat loads — Need for Ventilation, Consideration of infiltrated air – Heat Load concepts: 152 | P a g e RSHF, GSHF- Problems. Requirements of human comfort and concept of Effective Temperature- Comfort chart –Comfort Air Conditioning- Summer, winter & year round air conditioning- simple problems.

Unit 5 : Air Conditioning Equipment 08  
 humidifiers – dehumidifiers – air filters, fans and blowers. Heat Pump – Heat sources – different heat pump circuits.

Prescribed Text Books:

1. CP Arora, Refrigeration and Air Conditioning. TMH, 2008, 3rd Ed. ISBN-10 : 0070083908
2. SC Arora & Domkundwar, A Course in Refrigeration and Air conditioning. Dhanpatrai. ISBN : 4567152026

Reference Books:

1. Manohar Prasad, Refrigeration and Air conditioning, Wiley Eastern Ltd., 2011. ISBN 10: 8122435033 / ISBN 13: 9788122435030





**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
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Title of the Course : Finite Element Methods  
 Category : PE  
 Course Code : 19A37BT  
 Year : IV Year  
 Semester : I Semester

|               |                |           |         |
|---------------|----------------|-----------|---------|
| Lecture Hours | Tutorial Hours | Practical | Credits |
| 3             | -              | 0         | 3       |

Course Objectives:

- To enable the students to understand fundamentals of finite element analysis.
- To learn the principles involved in the discretization of domain with various elements, polynomial interpolation and assembly of global arrays.
- To learn the application of FEM in various structural and non structural problems by incorporating boundary conditions.

Unit 1 14

Introduction to finite element methods for solving field problems, Stress and equilibrium, Boundary conditions, Strain-Displacement relations, Stress- strain relations for 2D and 3D Elastic problems, Potential energy and equilibrium.

One dimensional problem: Finite element modeling coordinates and shape functions. Assembly of global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, solution for displacements, reaction, stresses, temperature effects.

Unit 2 08

Analysis of trusses: Stiffness Matrix for plane truss element. Stress Calculations and Problems.

Analysis of beams: Element Stiffness Matrix for two noded, two degrees of freedom per node beam element and simple problems.

Unit 3 08

Two dimensional problems: Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Estimation of load Vector, Stresses. Finite element modeling of Axi-symmetric solids subjected to axi-symmetric loading with triangular elements.

Unit 4 12

Iso-Parametric Formulation: Concepts, sub parametric, super parametric elements, 2 dimensional 4 noded iso-parametric elements, and numerical integration.

Steady state heat transfer analysis: One dimensional analysis of slab and fin, two dimensional analysis of thin plate. Analysis of a uniform shaft subjected to torsion.

Unit 5 06

Dynamic analysis: Formulation of finite element model, element –mass matrices, evaluation of Eigen values and Eigen vectors for a stepped bar and Beam.

Prescribed Text Books:

1. Introduction to Finite elements in Engineering- Tirupathi.R. Chandrupatla and Ashok D. Belegundu-Pearson Education India -4<sup>th</sup> Edition 2015- ISBN-978-9332551824
2. Finite Element Analysis- Dr. S Senthil, R Paneerdhass – Lakshmi Publications-5<sup>th</sup> Edition 2013-ISBN-978-

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3. Finite Element Analysis in Engineering- S.Md. Jalaludeen- Anuradha Publications- 2016-ISBN-978-8184722376

Reference Books:

1. J N Reddy, An introduction to the Finite Element Method, McGraw – Hill, New York, 1993. ISBN-10 : 0072466855
2. R D Cook, D S Malkus and M E Plesha, Concepts and Applications of Finite Element Analysis, 3rd Edition, John Wiley, New York, 1989. ISBN 13: 9780471503194
3. K J Bathe, Finite Element Procedures in Engineering Analysis, Prentice-Hall, Englewood Cliffs, 1982. ISBN 978-0-9790049-5-7

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |  |        |
|--|--------|
| 1. Identify mathematical model to solve common engineering problems by applying the finite element method and able to solve one dimensional problems like bars | L3, L4 |
| 2. Derive element matrices to find stresses in beams and trusses   | L3     |
| 3. Formulate FE characteristic equations for two dimensional elements and analyze plain stress, plain strain, axi-symmetric problems.                          | L4     |
| 4. Formulate FE equations for iso-parametric elements and heat transfer problems   | L4     |
| 5. Solve dynamic problems where the effect of mass matters during the analysis   | L3     |

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A37BT.1 | 3   | 3   | 1   | 1   | 3   | -   | -   | -   | 1   | 1    | -    | 1    | 3    | -    | 2    |
| 19A37BT.2 | 3   | 3   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | -    | 2    |
| 19A37BT.3 | 3   | 3   | 1   | 1   | 3   | -   | -   | -   | -   | -    | -    | -    | -    | -    | 3    |
| 19A37BT.4 | 3   | 3   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | -    |
| 19A37BT.5 | 3   | 3   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 2    | 3    |

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
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Title of the Course : Unconventional machining process  
 Category : PE  
 Course Code : 19A37CT  
 Year : IV Year  
 Semester : I Semester

|               |                |           |         |
|---------------|----------------|-----------|---------|
| Lecture Hours | Tutorial Hours | Practical | Credits |
| 3             | -              | 0         | 3       |

Course Objectives:

- 1. The main objective of this subject is to provide students with an understanding of the latest technologies being used in manufacturing industries as part of modernization of industries.
- 2. The students shall also understand and appreciate the importance of basic principles of Manufacturing Systems and also they will know about the differences between conventional and un-conventional machining process with the help of various advanced manufacturing techniques like USM, AJM, ECM, CM, EDM, PAM, EBM & LSB.

Unit 1 Introduction 10

Need for non-traditional machining methods- Classification of modern machining processes – considerations in process selection. Importance of smart, HSTR and Composite materials in ucmp, Applications. Ultrasonic machining – Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent development, Hybrid technologies used in UCM P

Unit 2 Mechanical Processes 10

Abrasive jet machining, Water jet machining and abrasive water jet machining Basic principles, equipments, process variables, mechanics of metal removal, MRR, application and limitations. (AJM and WJM). Working Principles – equipment used – Process parameters –MRR-Variation in techniques used – Applications

Unit 3 Electro – Chemical Processes 10

Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring process, metal removal rate in ECM, Tool design, Surface finish and accuracy economic aspects of ECM – Fundamentals of chemical machining, advantages and applications.

Unit 4 Thermal Metal Removal Processes – I 10

General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes – Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM, principle, applications.

Unit 5 Thermal Metal Removal Processes –II 08

Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes –General Principle and application of laser beam machining – thermal features, cutting speed and accuracy of cut. Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries. Chemical machining principle-maskants –etchants- applications. Magnetic abrasive finishing, Abrasive flow finishing.

Prescribed Text Books:

Department of Mechanical Engineering

1. Vijay.K. Jain “Advanced Machining Processes” Allied Publishers Pvt. Ltd., New Delhi(2002) ISBN 81-7764-294-4.

Reference Books:

1. Benedict G.F. “Nontraditional Manufacturing Processes” Marcel Dekker Inc., New York (1987). ISBN, 0824773527.
2. Pandey P.C. and Shan H.S. “Modern Machining Processes” Tata McGraw- Hill, New Delhi (1980). ISBN: 0070965188, 9780070965188
3. Mc Geough, “Advanced Methods of Machining” Chapman and Hall, London (1998) 42 Industrial Robotics 3.0, ISBN 978-0-412-31970-9

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |   |       |
|---|-------|
| 1. Understand the knowledge on need for unconventional machining process and can perform experiments on USM process and are able to apply these concepts in academic research.                | L2,L3 |
| 2. Learn the working of AJM, WAJM and WJM, can perform experiments on those processes and are able to apply these concepts in academic research.  | L2,L3 |
| 3. Understand the fundamental concepts of CM, ECM process and can perform experiments on those processes and are able to apply these concepts in academic research.                           | L2,L3 |
| 4. Understand the fundamental concepts of EDM and WEDM process and can perform experiments on those processes and are able to apply these concepts in academic research.                      | L2,L3 |
| 5. Understand the fundamental concepts of LBM, PAM and other surface finish process and can perform experiments on those processes and are able to apply these concepts in academic research. | L2,L3 |

CO-PO Mapping:

| CO         | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A37CT .1 | 3   | 2   | -   | 3   | -   | -   | -   | -   | -   | -    | -    | 2    | -    | -    | -    |
| 19A37CT.2  | 3   | 3   | 3   | 3   | 1   | -   | -   | -   | -   | -    | -    | 2    | -    | -    | -    |
| 19A37CT .3 | 3   | 2   | -   | 3   | -   | -   | -   | -   | -   | -    | -    | 2    | -    | -    | -    |
| 19A37CT .4 | 3   | 3   | 3   | 3   | 1   | -   | -   | -   | -   | -    | -    | 2    | -    | -    | -    |
| 19A37CT .5 | 3   | 3   | -   | 3   | -   | -   | 3   | -   | -   | -    | -    | 2    | -    | -    | -    |

Department of Mechanical Engineering  
**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
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Title of the Course : Mechatronics  
 Category : PE  
 Course Code : 19A37DT  
 Year : IV Year  
 Semester : I Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| 3             | -              | 0         | 3       |

Course Objectives: This course will

- Familiarize the technologies behind modern mechatronic systems.
- Explain fundamentals for the development of fully automated system.
- Develop a robotic or automated systems focusing on the hardware and software integration.
- Demonstrate the development of mechatronic system and MEMS.

Unit 1 Introduction 09

Definition of Mechatronics, Need for Mechatronics in Industry, Objectives of mechatronics, mechatronics design process, Mechatronics key elements, mechatronics applications–Computer numerical control(CNC) machines, Tool monitoring systems, Flexible manufacturing system(FMS), Industrial Robots, Automatic packaging systems, Automatic inspection systems.

Unit 2 : Sensors 09

Static characteristics of sensors, Displacement, Position and Proximity sensors, Force and torque sensors, Pressure sensors, Flow sensors, Temperature sensors, Acceleration sensors, Level sensors, Light sensors, Smart material sensors, Micro and Nano sensors, Selection criteria for sensors.

Unit 3 Actuators 09

Mechanical, Electrical, Hydraulic and Pneumatic Actuation systems, Characteristics and their limitations, Design of Hydraulic and Pneumatic circuits, Piezo electric actuators, Shape memory alloys, Selection criteria for actuators.

Unit 4 Microprocessors, Micro controllers and Programmable Logic Controllers 09

Architecture of of Microprocessor, Micro controller and Programmable Logic Controller, PLC Programming using ladder diagrams, logics, latching, sequencing, timers relays and counters, data handling, Analog input/output, selection of controllers.

Unit 5 Micro Electro Mechanical Systems(MEMS) 09

History, Effect of scaling, Fabrication Techniques: Oxidation, Physical Vapor disposition, Chemical Vapor Deposition, Lithography, Etching, Wafer bonding, LIGA, DRIE, and Applications: Labon chip.

Prescribed Text Books:

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, W. Bolton, 3/e Pearson Education Press, 2005. ISBN-10 : 0273742868; ISBN-13 : 978-0273742869
2. Devadas Shetty and Richard A Kolk, Mechatronic System Design, 2/e, Cengage learning, 2010. ISBN-10: 1-4390-6199-8
3. Clarence W. de Silva, Mechatronics an Integrated Approach, CRC Press, 2005. ISBN 9780849312748

Reference Books:



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
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Title of the Course : Non-conventional sources of energy  
 Category : PE  
 Course Code : 19A37ET  
 Year : IV Year  
 Semester : I Semester

|               |                |           |         |
|---------------|----------------|-----------|---------|
| Lecture Hours | Tutorial Hours | Practical | Credits |
| 3             | -              | 0         | 3       |

Course Objectives:

- To grasp the role and potential of new and renewable source
- To recognize the principle, storage and applications of solar energy
- To understand the sources and potentials of wind energy and also to comprehend the Principles of Bio-Conversion of bio-mass and bio-gas uses.
- To explain the principle, working procedure and types of geothermal energy, ocean energy and tidal & wave energy.
- To know the knowledge on direct energy conversion.

Unit 1 Principles Of Solar Radiation 09

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on tilted surface, instruments for measuring solar radiation, potential in India

Unit 2 Solar Energy Collectors 09

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors. Solar Energy Storage And Applications: Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion, potential in India.

Unit 3 Wind Energy 08

Sources and potential in India, horizontal and vertical axis wind mills, performance characteristics, Betz criteria. Bio-Mass: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, and economic aspects, potential in India

Unit 4 Geothermal Energy 08

Resources, types of wells, methods of harnessing the energy, potential in India.  
 Ocean Energy: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics, potential in India.

Unit 5 Direct Energy Conversion 09

Need for DEC, Carnot cycle, limitations, principles of DEC. Thermo-electric generators, Seebeck, Peltier and Joule Thomson effects, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD Engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cells, principles, faraday's law's, thermodynamic aspects, selection of fuels and operating conditions

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Prescribed Text Books:

1. Tiwari and MK.Ghosal, Renewable energy resources: Basic principles and applications, Narosa publications 2005, ISBN 10: 1842651250 ISBN 13: 9781842651254
2. G.D. Rai, Non-Conventional Energy Sources, khanna publications, 2011, ISBN 10: 8174090738, ISBN 13: 9788174090737

Reference Books:

1. Twidell & Weir, Renewable Energy Sources, Routledge , 3rd Ed.2015,ISBN 9780367200756
2. Non Conventional Energy Resources, B.H.Khan, McGrawHill, 2015, ISBN 1259081397, 9781259081392

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |   |    |
|---|----|
| 1. Create awareness on role and potential of new and renewable source and basics of solar energy.                     | L2 |
| 2. acquire the knowledge on different types of collectors and storage systems of solar energy and their applications. | L2 |
| 3. Able to achieve sufficient knowledge on Wind energy and Bio-mass energy.   | L2 |
| 4. Familiarize the student with the Geothermal and Ocean energy concepts and their potentiality                       | L2 |
| 5. Gain the knowledge on direct energy conversion   | L2 |

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A37ET.1 | 3   | 2   | -   | -   | -   | 3   | 3   | -   | -   | -    | -    | 3    | -    | -    | -    |
| 19A37ET.2 | 3   | 3   | -   | 1   | 3   | 3   | -   | -   | -   | -    | -    | 3    | -    | -    | -    |
| 19A37ET.3 | 3   | 2   | 3   | -   | -   | 3   | 3   | -   | -   | -    | -    | 3    | -    | -    | -    |
| 19A37ET.4 | 3   | 3   | -   | -   | 3   | 3   | -   | -   | -   | -    | -    | 3    | -    | -    | -    |
| 19A37ET.5 | 3   | 3   | -   | -   | 3   | 3   | -   | -   | -   | -    | -    | 3    | -    | -    | -    |



Department of Mechanical Engineering  
**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
(An Autonomous Institution)

Title of the Course : Mechanical Vibrations  
Category : PE  
Course Code : 19A37FT  
Year : IV Year  
Semester : I Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| 3             | -              | 0         | 3       |

Course Objectives:

- To understand the un-damped and damped free vibrations to mechanical systems.
- To know the sources of forced vibrations and Also transmissibility & isolation of vibrations.
- To understand the natural frequencies and modes of forced vibrations.
- To analyze the formulation and model analysis of vibrations and critical speeds of shafts.
- To learn the various vibration transducers and its applications

Unit 1                 Single Degree Freedom Systems   09  
Single Degree Freedom Systems: Un-damped free vibration: Classical method, Energy method, equivalent systems, And torsional systems. Damped free vibration- Viscous damping, under damping, critical damping, over damping. Coulomb damping, equivalent damping coefficient. Simple problems

Unit 2                 Forced vibrations of Single Degree Freedom Systems   10  
Forced vibrations of Single Degree Freedom Systems : Steady state forced vibration, sources of excitation, impressed harmonic force, resonance impressed force due to unbalance, motion excitation, transmissibility and isolation, performance of different type of isolators, power absorbed by viscous damping.

Unit 3                 Two Degree Freedom Systems   08  
Two Degree Freedom Systems: Formulation of Equation of motion, Natural frequencies and modes of vibration by classical method, coupled pendulum, forced vibration, dynamic vibration absorber.

Unit 4                 Multi Degree Freedom Systems & Whirling of shafts   10  
Multi Degree Freedom Systems: Lagrangian method for formulation of equation of motion Influence coefficient method, Lumped mass and distributed mass systems, Stodola method, Holzer's method, model analysis of free and forced vibrations.  
Whirling of shafts: Critical speed of shafts, Rayleigh's upper bound approximation, Dunkerley's lower bound approximation, critical speed of shafts with damping.

Unit 5                 Vibration measurement and Applications   10  
Vibration measurement and Applications: Transducers: variable resistance transducers, Piezoelectric transducers, electro dynamic transducers and linear variable differential transformer transducer; Vibration pickups: vibrometer, accelerometer, velometer and phase distortion; Frequency-measuring instruments; Vibration exciters- Mechanical exciters and electro dynamic shaker

Prescribed Text Books:

1. Singrasu S. Rao, Mechanical Vibrations, 6/e, Pearson Education, 2018, ISBN-13: 9780132128193
2. G.K. Groover, Mechanical Vibrations, 8/e, 2009, N.Chand & Bros, ISBN-13 : 9788185240565
3. Rao.V. Dukkipati & J.Srinivas, PHI 2010, ISBN-13 : 9788120345249



Department of Mechanical Engineering  
**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
(An Autonomous Institution)

Title of the Course : Total Quality Management  
Category : PE  
Course Code : 19A37GT  
Year : IV Year  
Semester : I Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| 3             | -              | 0         | 3       |

Course Objectives:

- To introduce the students, the basic concepts of Total Quality Management.
- To expose with various quality issues in Inspection.
- To gain Knowledge on quality control and its applications to real time.
- To know the extent of customer satisfaction by the application of various quality concepts.
- To understand the importance of Quality standards in Production.

Unit 1 Introduction 10  
Definition of Quality, Dimensions of Quality, Definition of Total quality management, Quality Planning, Quality costs – Analysis, Techniques for Quality costs, Basic concepts of Total Quality Management

Unit 2 Historical Review 09  
Quality council, Quality statements, Strategic Planning, Deming Philosophy, Barriers of TQM Implementation, Benefits of TQM, Characteristics of successful quality leader, Contributions of Gurus of TQM, Case studies.

Unit 3 TQM Principles 08  
Customer Satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment teams, Continuous Process Improvement – Juran Trilogy, PDCA Cycle, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure Case studies

Unit 4 TQM Tools 09  
Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA, The seven tools of quality, Process capability, Concept of Six Sigma, New Seven management tools, Case studies.

Unit 5 Quality Systems 08  
Need for ISO 9000 and Other Quality Systems, ISO 9000: 2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits, Case Studies.

Prescribed Text Books:

1. Dale H Besterfield, Total Quality Management, Fourth Edition, Pearson Education, 2018, ISBN: 9789332534452
2. Subburaj Ramaswamy, Total Quality Management, Tata Mcgraw Hill Education., 2012, ISBN: 1259001415, 9781259001413
3. Joel E. Ross, Total Quality Management, Third Edition, CRC Press, 2017, ISBN: 9781351407786

Reference Books:

Department of Mechanical Engineering

1. Narayana V and Sreenivasan N.S, Quality Management – Concepts and Tasks, NewAge International, 1996, ISBN-10: 8122416802.
2. Robert L.Flood, Beyond TQM , First Edition, John Wiley & Sons Ltd, 1993, ISBN: 9780471939672.
3. Richard S. Leavenworth & Eugene Lodewick Grant, Statistical Quality Control, Seventh Edition, Tata Mcgraw Hill, 2015, ISBN, 0070241147, 9780070241145.
4. Samuel Ho , TQM – An Integrated Approach, Kogan Page Ltd, USA, 1995, ISBN: 9780749415617.

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. Develop an understanding on quality Management philosophies and frameworks.</li> <li>2. Adopt TQM methodologies for continuous improvement of quality.</li> <li>3. Measure the cost of poor quality, process effectiveness and efficiency to identify areas for improvement</li> <li>4. Apply benchmarking and business process reengineering to improve management processes.</li> <li>5. Determine the set of indications to evaluate performance excellence of an organization.</li> </ol> | <p>L2</p> <p>L3</p> <p>L4</p> <p>L3</p> <p>L3</p> |
|---|---|

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A37GT.1 | 2   | -   | -   | -   | -   | 2   | 2   | -   | -   | -    | 2    | 1    | 1    | 1    | -    |
| 19A37GT 2 | 2   | 2   | -   | 2   | -   | 2   | -   | -   | -   | 1    | 2    | 1    | 1    | 1    | -    |
| 19A37GT 3 | 1   | 2   | -   | 2   | -   | -   | -   | 1   | 1   | 1    | 2    | 1    | 1    | 1    | -    |
| 19A37GT 4 | 1   | -   | -   | -   | -   | 1   | -   | -   | -   | -    | 2    | 1    | 1    | 1    | -    |
| 19A37GT 5 | 1   | -   | -   | -   | -   | -   | -   | -   | -   | -    | 2    | 2    | 1    | 1    | -    |

Department of Mechanical Engineering  
**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
(An Autonomous Institution)

Title of the Course : CNC and Adaptive Control  
Category : PE  
Course Code : 19A37HT  
Year : IV Year  
Semester : I Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| 3             | -              | 0         | 3       |

Course Objectives:

- To acquaint new technologies in machine tools
- To familiarize part programming mech
- To impart knowledge on CNC machine structure and system drivers
- To explain interpolation algorithms for control loops
- To cover latest developments in CNC system

Unit 1 08  
CNC Technology: An overview: Introduction to NC/CNC/DNC machine tools, Classification of NC /CNC machine tools, Advantage, disadvantages of NC /CNC machine tools, Application of NC/CNC.  
DNC systems: Classifications, Merits, Demerits and application.

Unit 2 08  
Design of CNC: Constructional features of NC/CNC machine tools, C.N.C. tooling and fixturing system, Designation of axis in CNC systems.

Unit 3 10  
Part programming: CNC programming and introduction, Manual part programming: Basic (Milling, turning etc..), Special part programming, Advanced part programming, Computer aided part programming (APT).

Unit 4 08  
System Drives and devices: Hydraulic and pneumatic motors, and their features, Electrical motors AC/DC and their features.  
Interpolators: Hardware Interpolators, Software Interpolators, NC/CNC controllers.

Unit 5 06  
Adaptive control systems: Adaptive control with optimizations (ACO), Adaptive control with constraints (ACC).  
Latest developments: Machining center, Turing center, Communication networking, recent developments of CNC systems, Virtual NC systems.

Prescribed Text Books:

1. Yoram Koren, Computer Control of Manufacturing Systems, McGraw Hill International, Singapore, 2006. ISBN 0070607435
2. John Stenerson and Kelly Curran, Computer Numerical Control: Operation and Programming, PHI, New Delhi, 2009. ISBN 0130119806
3. TC Chang, RA Wysk and HP Wang, Computer Aided Manufacturing, PHI, New Delhi, 2009. ISBN 0131429191

Reference Books:



Department of Mechanical Engineering  
**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
 (An Autonomous Institution)

Title of the Course : CAD/CAM Lab  
 Category : PC  
 Course Code : 19A371L  
 Year : IV Year  
 Semester : I Semester

|               |                |           |         |
|---------------|----------------|-----------|---------|
| Lecture Hours | Tutorial Hours | Practical | Credits |
| 0             | -              | 2         | 1       |

Course Objectives:

- To introduce the basics in modeling software.
- To get the knowledge on Analysis Package.
- To enable the student to develop and to write the part programs for CNC Machines.

Part Modeling:

1. Sketcher
2. Part Modeling

Analysis:

1. Structural analysis
2. Thermal analysis

CAM:

1. Developing CNC code by using CAM package
2. Machining of simple components on CNC Lathe.
3. Machining of simple components on CNC Mill.

Note: Use any convenient software for the content mentioned above

Course Outcomes:

Student will be able to

- |  | Blooms Level of Learning |
|--|--------------------------|
| 1. Develop a part model to visualize the components.   | L3                       |
| 2. Analyze the Structural and Thermal analysis on the various engineering structures or components.      | L3                       |
| 3. Create NC code and automated tool paths for a given engineering component and machine the components. | L3                       |

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A371L.1 | 3   | 3   | 3   | 3   | 3   | 3   | -   | -   | 3   | 3    | -    | 3    | -    | -    | 2    |
| 19A371L.2 | 3   | 3   | 3   | 3   | 3   | 3   | -   | -   | 3   | 3    | -    | 3    | -    | -    | 2    |
| 19A371L.3 | 3   | 3   | 3   | -   | 3   | -   | -   | -   | 3   | 3    | -    | 3    | -    | -    | 2    |

Department of Mechanical Engineering  
**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
 (An Autonomous Institution)

Title of the Course : Instrumentation/Optimization lab with MATLAB software lab  
 Category : PC  
 Course Code : 19A373L  
 Year : IV Year  
 Semester : I Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| 0             | -              | 2         | 1       |

Course Objectives:

- To understand the working of pressure gauge, LVDT, Strain gauge, transducers and anemometer
- To calibrate different types of thermocouple
- To familiarize the students with MATLAB interface, using MATLAB as sophisticated calculator with its syntax and semantics.
- Learn how to analyze and solve the engineering problems using programming techniques.

Instrumentation Lab

List of Experiments:

1. Calibration of Pressure Gauges.
2. Calibration of Transducer for Temperature measurement
3. Study and Calibration of LVDT Transducer for Displacement Measurement
4. Calibration of Strain Gauge for the measurement of Strain.
5. Calibration of Thermocouple for Temperature Measurement
6. Calibration of Capacitive Transducer for Angular Measurement
7. Calibration of Resistance Temperature Detector for Temperature Measurement
8. Study and Calibration of a Rotometer for flow measurement
9. Study and Calibration of Photo and Magnetic Speed Pickups for the measurement of speed
10. Study of anemometer

Optimization lab with MATLAB software

List of Experiments:

1. Fundamental of numerical computing in MATLAB
2. Graphics in MATLAB / Graphical user interface
3. Programming in MATLAB – I (Logical operators, functions and script files)
4. Programming in MATLAB – II (Conditional statements and loops)
5. Optimization (Linear and Non-linear)

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |  |    |
|--|----|
| 1. Understand different types of instruments and transducers   | L4 |
| 2. Understand the working principle of different types of transducers  | L4 |
| 3. Have aware of the use of numerical methods in modern scientific computing and finite precision computation                    | L4 |
| 4. Express programming techniques for solving engineering problems   | L4 |
| 5. Use math computations, simulation, modelling, data analysis and processing, graphical visualization and algorithm development | L4 |





**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
(An Autonomous Institution)

Title of the Course : Power Plant Engineering  
 Category : PE  
 Course Code : 19A38AT  
 Year : IV Year  
 Semester : II Semester

|               |                |           |         |
|---------------|----------------|-----------|---------|
| Lecture Hours | Tutorial Hours | Practical | Credits |
| 3             | -              | 0         | 3       |

Course Objectives:

- To understand the student present day energy demand.
- To understand the working and combustion phenomenon in steam power plant.
- To gain knowledge on the concept and the working of diesel power plants and gas turbines.
- To understand the function and operation of the basic components of a hydro-electric power plant & nuclear power station.
- To learn the concept of non-conventional sources and factors affecting the site selection for a power plant and concept of base load plant and peak load plant

Unit 1 : Introduction 09

Introduction to the Sources of Energy – Resources and Development of Power in India.

Steam Power Plant Plant Layout, Working of different Circuits, Fuel and handling equipment's, types of coals, coal handling, choice of handling equipment, coal storage, Ash handling systems.

Unit 2 : Steam Power Plant -Combustion Process 09

Properties of coal – overfeed and underfeed fuel beds, travelling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, Dust collectors, cooling towers and heat rejection. Corrosion and feed water treatment

Unit 3 : Internal Combustion Engine Plant-Diesel Power Plant 09

Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel supply system, air starting equipment, super charging.

Gas Turbine Plant Introduction – classification - construction – Layout with auxiliaries – Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparison.

Unit 4 : Hydro Electric Power Plant 10

Hydro Electric Power Plant Water power – Hydrological cycle / flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways.

Hydro Projects And Plant Classification – Typical layouts – plant auxiliaries – plant operation pumped storage plants.

Nuclear Power Station: Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation- radioactive waste disposal.

Boiling water reactor - Pressurized water reactor - Gas cooled reactor - Fast breeder reactor - Liquid metal cooled reactor-reactor materials - Radiation shielding.

Unit 5 : Power From Non-Conventional Sources 06

Power From Non-Conventional Sources: Utilization of Solar Collectors- Principle of Working, Wind Energy – types – HAWT, VAWT - Tidal Energy.

Power Plant Economics And Environmental Considerations: Capital cost, investment of fixed charges, operating

Department of Mechanical Engineering

costs, general arrangement of power distribution, Load curves, and load duration curve. Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor – related exercises. Effluents from power plants and Impact on environment – pollutants and pollution standards – Methods of Pollution control.

Prescribed Text Books:

1. P.K.Nag, Power Plant Engineering. TMH, 4 th Ed.2014. ISBN: 9789339204044, 9339204042
2. P.C.Sharma, Power Plant Engineering. S.K.Kataria& sons ,2014. ISBN 10: 9350143844 / ISBN 13: 9789350143841
3. Arora and S. Domkundwar.A Course in Power Plant Engineering, DhanpatRai& co (p) Ltd, 6 th Ed.2011. ISBN : 8177001957, 9788177001952

Reference Books:

1. Rajput. R.K., A Text Book of Power Plant Engineering. LaxmiPubl, 2015, 5th Ed. ISBN 10: 8131802558 / ISBN 13: 9788131802557
2. Hegde R.K. Power Plant Engineering. Person Publ, 2015. ISBN: 9789332558243
3. C. Elanchezian and L.Sravana Kumar, Power Plant Engineering. I.K. books, 2010. ISBN: 9788189866303
4. A B Gill, Power plant Performance, Butterworth and Co, Ltd.2016. ISBN: 9781483100005

Course Outcomes:

| Student will be able to  | Blooms Level of Learning |
|--|--------------------------|
| 1. Recognize the importance of power production suited to the demand. Student can have an idea of various power plants. Student can know the impact of power plants on the environment   | L2                       |
| 2. Understand the latest high pressure boilers, concept of fluidized bed combustion and importance of handling and storage. Student can able to learn the waste heat recovery methods. In addition, student can know various cooling towers and its application. | L2                       |
| 3. Grasp concepts of diesel power plant and gas turbine plants. Student can distinguish open cycle and closed cycle gas turbine cycles.  | L2                       |
| 4. Have knowledge on water power. Student can able to understand the methods of storing water and can have an idea over constructions of dams and spill ways. Student can enable to draw the layout of hydel power plant   | L2                       |
| 5. Understand about the power plant economics.   | L2                       |

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A38AT.1 | 3   | 2   | -   | -   | -   | 3   | 2   | -   | -   | -    | -    | 2    | -    | -    | -    |
| 19A38AT.2 | 3   | 2   | -   | -   | -   | 3   | 2   | -   | -   | -    | -    | -    | -    | -    | -    |
| 19A38AT.3 | 3   | -   | -   | -   | -   | 3   | -   | -   | -   | -    | -    | -    | -    | -    | -    |
| 19A38AT.4 | 3   | -   | -   | -   | -   | 3   | -   | -   | -   | -    | -    | 2    | -    | -    | -    |
| 19A38AT.5 | 3   | 2   | -   | -   | -   | 3   | -   | -   | -   | -    | 3    | 2    | -    | -    | -    |

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
(An Autonomous Institution)

Title of the Course : Composite Materials  
 Category : PE  
 Course Code : 19A38BT  
 Year : IV Year  
 Semester : II Semester

|               |                |           |         |
|---------------|----------------|-----------|---------|
| Lecture Hours | Tutorial Hours | Practical | Credits |
| 3             | -              | 0         | 3       |

Course Objectives:

- To understand the mechanical behavior of composite materials
- To get an overview of the methods of manufacturing composite materials
- Basic knowledge of composites will allow engineers to understand the issues associated with using these materials, as well as gain insight into how their usage differs from metals, and ultimately be able to use composites to their fullest potential.

Unit 1 : 08  
 Introduction to composites: Fundamentals of composites – Definition – classification– based on Matrix – based on structure – Advantages and applications of composites - Reinforcement – whiskers – glass fiber – carbon fiber - Aramid fiber – ceramic fiber – Properties and applications

Unit 2 : 12  
 Manufacturing of composite materials: PMC's: bag moulding, compression moulding, pultrusion, filament winding. Processing of MMC – Liquid state processes – solid state processes – Insitu processes. Processing of CMC's: Sintering - Hot pressing-solgel  
 Hooke's Law for Different Types of Materials, Hooke's Law for a Two Dimensional Unidirectional Lamina - Plane Stress Assumption, Reduction of Hooke's Law in Three Dimensions to Two Dimensions, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina.

Unit 3 : 08  
 Hooke's Law for a Two-Dimensional Angle Lamina, Engineering Constants of an Angle Lamina, Strength Failure theories of an angle lamina- Maximum stress Failure Theory, Tsai-Hill Failure Theory, Tsai-Wu Failure Theory. Macro mechanical analysis of a laminate: Stress–Strain Relations for a Laminate, InPlane and Flexural Modulus of a Laminate

Unit 4 : 10  
 Micro-Mechanical Analysis of a Lamina: Introduction, Volume and Mass Fractions, Density, and Void Content, Evaluation of the Four Elastic Moduli – Longitudinal young's modulus, Transverse young's modulus, Major Poisson's ratio and In-plane shear modulus by Strength of Materials Approach

Unit 5 : 10  
 Macro mechanical Analysis of Laminates: Introduction, Laminate code, Stress-strain relations for a laminate, In-plane and flexural modulus of a laminate. Failure criterion of laminates.

Prescribed Text Books:

1. Mechanics of Composite Materials- Autar K. Kaw, 2/e, CRC Press, 2005. ISBN: ISBN 0-8493-1343-0
2. Chawla K.K, Composite materials, 2/e, Springer – Verlag, 1998. ISBN 978-0-387-74365-3



Department of Mechanical Engineering  
**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
 (An Autonomous Institution)

Title of the Course : Production and Operations Management  
 Category : PE  
 Course Code : 19A38CT  
 Year : IV Year  
 Semester : II Semester

|               |                |           |         |
|---------------|----------------|-----------|---------|
| Lecture Hours | Tutorial Hours | Practical | Credits |
| 3             | -              | 0         | 3       |

**Course Objectives:**

- To make the students understand the functions of production planning & control, goods and services, issues in product design and to provide knowledge of determining the accurate demand forecasting.
- To provide the knowledge on facilities location, various types layouts, computerized layout planning, and assembly line balancing techniques.
- To make the students understand the concepts of capacity planning and aggregate planning and their planning strategies.
- To make the students understand the concepts of capacity planning and aggregate planning and their planning strategies,
- Able to make knowledge on lean management, concepts of JIT, six sigma, quality control.

Unit 1                  Production and Forecasting    10

Production – Products – types – design of goods & services – Functions of Production & Operations Management – Production Vs Productivity – Productivity measurement – Product design & analysis – new product development and its concepts.  
 Forecasting – Importance of forecasting – Types of forecasting, their uses – Forecasting techniques – qualitative methods and quantitative methods – accuracy of forecasting methods.

Unit 2                  Plant Layout    10

Factors affecting facilities location – Single facility location model – Types of facilities layouts: product layout process layout, group technology layout – Assembly line balancing – Computerized layout planning algorithms: ALDEP, CRAFT, and CORELAP.

Unit 3                  Capacity Planning and Aggregate Planning    10

Capacity Planning – Plant capacity – strategies of capacity planning – equipment selection.  
 Aggregate Planning – Strategies of aggregate planning – O.R. models in aggregate planning – chase planning – expediting – controlling aspects.  
 MRP – Lot sizing techniques in MRP – Introduction to ERP – LOB (Line of Balance).

Unit 4                  Scheduling    10

Job Sequencing – Johnson’s rule, extension of Johnson’s rule, Palmer’s rule, and Graphical method.  
 Scheduling – Techniques – flow shop and job shop Scheduling.

Unit 5                  Quality Management    08

Quality Management Economics of quality assurance-Control charts for variables and for attributes-Acceptance sampling plans - Lean management- philosophy and creation of lean enterprise - JIT concepts - Kanban system - Total Quality Management-ISO 9000 series standards-Six sigma.

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Prescribed Text Books:

1. S.N. Chary, *Production and Operations Management*. 5th edition McGraw Hill Edu. Pvt. Ltd, 2012. (ISBN 10: 1259005100 ISBN 13: 9781259005107)
2. R. Panneerselvam, *Production and Operation Management*. PHI. 2012. (ISBN, 812034555, 9788120345553.)
3. *Operations Management Theory and Practice*: B.Mahadevan Pearson.( ISBN: 9788131730706)

Reference Books:

1. Kanishka Bedi, *Production & Operations Management*. Oxford Univ. Press. (ISBN: 9780195690873)
2. Martin K. Starr and David W. Miller. *Inventory Control Theory and practice*. (ISSN: 0925-5273)
3. Buffa and Sarin . *Modern Production / Operations Management 8ed* ,Wiley.. (ISSN: 1059-1478)

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. Describe the basic concepts of production systems, productivity, and design process new products including both goods and services, and determine the future demands by using forecasting techniques.</li> <li>2. Solve the facility location and layout planning problems using single facility location model, Assembly line balancing, and computerized techniques like CRAFT, CORELAP, and ALDEP.</li> <li>3. Apply the strategies of capacity planning and aggregate planning while solving O.R. models of production planning. and Lot sizing techniques in MRP, and recognize the importance of ERP and LOB.</li> <li>4. Produce optimal job sequences, can prepare the schedules of flow shop, job shop scheduling problems.</li> <li>5. Quality management, Lean philosophy, creation of Lean enterprise with JIT, Kanban system, TQM elements and Six-Sigma quality control.</li> </ol> | <p>L1</p> <p>L1</p> <p>L1</p> <p>L1</p> <p>L1</p> |
|---|---|

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A38CT.1 | 3   | 3   | 3   | -   | 3   | -   | -   | -   | 3   | -    | 3    | -    | 2    | -    | -    |
| 19A38CT.2 | 3   | 3   | 3   | -   | 3   | -   | -   | -   | 3   | -    | 3    | -    | 2    | -    | -    |
| 19A38CT.3 | 3   | 3   | 3   | -   | -   | -   | -   | -   | 3   | -    | 3    | -    | 2    | -    | -    |
| 19A38CT.4 | 3   | 3   | 3   | 1   | 3   | -   | -   | -   | 3   | -    | 3    | -    | 2    | 2    | -    |
| 19A38CT.5 | -   | 3   | 3   | -   | 3   | 1   | 1   | -   | 3   | 1    | 3    | -    | 2    | 2    | -    |

Department of Mechanical Engineering  
**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET**  
 (An Autonomous Institution)

Title of the Course : Supply chain Management  
 Category : PE  
 Course Code : 19A38DT  
 Year : IV Year  
 Semester : II Semester

| Lecture Hours | Tutorial Hours | Practical | Credits |
|---------------|----------------|-----------|---------|
| 3             | -              | -         | 3       |

Course Objectives:

- To get the knowledge on basic concepts of supply chain management, decision phases, process view and its strategies.
- To learn the concepts of distribution networks and supply chain network
- To acquire the skill of planning, managing safety stock in a supply chain, transportation.
- To know the concept of sourcing and pricing of products.
- To get the awareness on Bullwhip effect and Technology in the Supply Chain

Unit 1 Introduction to SCM: 10  
 Fundamentals of supply chain, Objective of supply chain and importance, concepts and definitions, Supply chain stages and decision phases, process view of a supply chain. Supply chain flows. Competitive and supply chain strategies, strategic fit, Supply chain Drivers, Examples of supply chains

Unit 2 Designing the Supply Chain Network: 08  
 Distribution Networks (DN) – Role, Factors, Design of Distribution Networking, e-Business and the Distribution Network.  
 Supply Chain Network (SCN) – Role, Factors, Framework for Design Decisions. Models for facility location and capacity allocation.

Unit 3 Planning and Managing Inventories in a SCM: 10  
 The Role of cycle Inventory in a Supply Chain, Managing Multi-Echelon Cycle Inventory, Safety inventory determination. Optimum level of product availability, Managerial levers to improve supply chain profitability.  
 Transportation: Role of Transportation, Factors affecting transportation decisions. Modes of Transportation and their performance characteristics.

Unit 4 : Sourcing Decisions in Supply Chain: 08  
 Role of sourcing, supplier – scoring & assessment, selection and contracts. Design collaboration, procurement, source planning and analysis.  
 Pricing and Revenue Management in SCM: Role of pricing and Revenue Management in the Supply Chain.

Unit 5 Managing Bullwhip Effect: 08  
 Co-ordination in a supply chain - Bullwhip effect. The Effect on performance of Lack of co-ordination, Obstacles to coordination. Managerial levers to achieve co-ordination.  
 Technology in the Supply Chain: The Role of IT supply Chain, The Supply Chain IT Framework, CRM, Internal SCM, SRM. The role of E-Business in a supply chain.

Prescribed Text Books:

1. Sunil Chopra & Peter Meindl; Supply Chain Management-Strategy, Planning & Operation. Pearson Edu. Asia,



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2001, ISBN: 81-7808-272-1.

Reference Books:

1. Robert B Handfield, Ernest L Nichols, Jr., Supply Chain Redesign – Transforming Supply Chains into Integrated Value Systems. Pearson Edu. Inc, 2002, ISBN: 81-297-0113-8.
2. Jeremy F Shapiro, Duxbury; Modelling the Supply Chain. Thomson Learning, 2002, ISBN 0-534-37363.
3. David Simchi Levi, Philip Kaminsky& Edith Simchi Levi; Designing & Managing the Supply Chain.McGraw Hill. 2007. ISBN-10 : 9780070666986
4. Dr. Dale S. Rogers, Dr. Ronald S. Tibben-Lembke, Going Backwards Reverse Logistics Trends and Practices. University of Nevada, Reno, Center for Logistics Management. 1999. ISBN, 0967461901, 9780967461908
5. Donald J.Bowersox; supply chain logistics management. Tata McGraw – Hill, 2008, ISBN: 978-0-07-066703-7.

Course Outcomes:

Student will be able to

Blooms Level of Learning

- |  |    |
|--|----|
| 1. Understanding to align the management of Supply Chain with corporate goals and strategies.  | L2 |
| 2. Apply problem solving and decision making frame works that propose defensible solutions to organizational opportunities, challenges, change and risk. | L3 |
| 3. Understand the fundamental role of logistics as it relates to inventory and transportation.   | L4 |
| 4. Design co-ordinate and collaborative processes and activities emerging technologies.  | L6 |
| 5. Apply knowledge to evaluate and mange an effective supply chain information systems.  | L3 |

CO-PO Mapping:

| CO        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 19A38DT.1 | 3   | 3   | -   | -   | 3   | -   | -   | 3   | -   | 3    | 3    | 3    | 2    | -    | -    |
| 19A38DT.2 | 3   | -   | 3   | 3   | 3   | -   | -   | 3   | -   | 3    | 3    | 3    | -    | -    | 3    |
| 19A38DT.3 | 3   | 3   | -   | 3   | 3   | -   | -   | 3   | -   | 3    | -    | 3    | -    | 2    | -    |
| 19A38DT.4 | 3   | 3   | 3   | 3   | 3   | -   | -   | 3   | -   | 3    | 3    | 3    | -    | 2    | -    |
| 19A38DT.5 | -   | -   | 3   | -   | 3   | 1   | -   | -   | -   | -    | 3    | 3    | -    | -    | 3    |