23A554TANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES::RAJAMPET

(An Autonomous Institution)

Department of Mechanical Engineering

R23 Regulations B.Tech. Mechanical Engineering III YEAR Course Structure

III Year I Semester							
S.No.	**Category**	**Code**	**Title**	**L**	**T**	**P**	**Credits**
1	PC	23A0351T	Machining Processes	3	0	0	3
2	PC	23A0352T	Thermal Engineering	3	0	0	3
3	PC	23A0353T	Metrology and Measurements	3	0	0	3
4	PC	23A0554T	Introduction to Quantum Technologies and Applications	3	0	0	3
5	PE	23A035AT 23A035BT 23A035CT 23A035DT 23A035ET	**Professional Elective-I** 1. Tool Design 2. Automobile Engineering 3. Mechanical behaviour of Materials 4. Work study and Ergonomics 5. Nano Technology	3	0	0	3
6	OE		**Open Elective-I**	3	0	0	3
7	PC	23A0352L	Thermal Engineering Lab	0	0	3	1.5
8	PC	23A0354L	Dynamics lab	0	0	3	1.5
9	SEC	23A0355L	Machine Tools & Metrology lab	0	1	2	2
10	SEC	23A0356L	Tinkering Lab for Mechanical Engineers	0	0	2	1
11	INTERN	23A0357I	Evaluation of Community Service Internship	-	-	-	2
			Total	18	1	10	26

Category	**Credits**
Professional Core	15
Professional Elective	3
Open Elective	3
Skill Enhancement Courses	2
Engineering Sciences	1
Internship	2
Total Credits	**26**

Open Elective – I

S. No.	**Course Code**	**Course Name**	**Offered by the Dept.**
1	23A015DT	Green Buildings	Civil
2	23A015ET	Construction Technology and Management	
3	23A025ET	Electrical Safety Practices and Standards	EEE
4	23A045DT	Electronic Circuits	ECE
5	23A045ET	Communication Systems	
6	23A055ET	Java Programming	CSE & Allied/IT
7	23A055FT	Fundamentals of Artificial Intelligence	
8	23A055GT	Quantum Technologies and Applications	
9	23AHS51T	Mathematics for Machine Learning and AI	Mathematics
10	23AHS52T	Materials Characterization Techniques	Physics
11	23AHS53T	Chemistry of Energy Systems	Chemistry
12	23AHS54T	English for Competitive Examinations	Humanities
13	23AHS56T	Entrepreneurship and New Venture Creation	

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES::RAJAMPET
(An Autonomous Institution)
Department of Mechanical Engineering
R23 Regulations Open Electives Offered by Department of Mechanical Engineering

Open Elective – I (Offered to the other departments)

III Year I Semester							
S.No.	**Category**	**Code**	**Title**	**L**	**T**	**P**	**Credits**
1	OE	23A035FT	Sustainable Energy Technologies	3	0	0	3

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

Title of the Course: Machining Processes
Category: Professional Core
Couse Code: 23A0351T
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
1. To gain knowledge on working principle of different metal cutting processes and familiarize with cutting forces, machining calculations and cutting fluids.
2. To make the student learn about principles of lathe and Drilling machines.
3. To make the student learn about principles of Grinding and Milling machines.
4. To acquire knowledge in the elementary mechanism and machinability of materials with different mechanical and Electrical energy-based Machining Processes.
5. To make student familiar with various advanced machining operations.

Course Outcomes:
At the end of the course, the student will be able to
1. Operate various machines like lathe, drilling, grinding, slotting, shaping, etc
2. Explain the working principles, types, operations, and tooling of conventional machine tools and perform basic machining time calculations.
3. Illustrate advanced machining processes, cutting tools and cutting fluids for a specific material and part features.
4. Differentiate Electrical Energy Based machining processes, mechanism of metal removal, machine tool selection.
5. Describe the principles, process parameters, applications, advantages, and limitations of chemical, electrochemical, and thermal energy-based machining processes.

Unit 1 Elementary treatment of metal cutting theory 10

Elementary treatment of metal cutting theory – Elements of cutting process – Geometry of single point tool and angles, chip formation and types of chips – built up edge and its effects, chip breakers. Mechanics of orthogonal cutting –Merchant's Force diagram, cutting forces – cutting speeds, feed, depth of cut, heat generation, tool life, coolants, machinability –economics of machining. cutting Tool materials and cutting fluids –types and characteristics.

Unit 2 Lathe and Reciprocating Machine Tools 09

Engine lathe – Principle of working- specification of lathe – types of lathes – work holders and tool holders – Taper turning, thread cutting operations and attachments for Lathes. Drilling, Boring Machines, Shaping, Slotting and planning machines - Principles of working, specifications, types, Tools and tool holding devices – operations performed, machining time calculation.

Unit 3 Milling & Abrasives Machining 12

Milling machine – Principles of working – specifications – classifications of milling machines – methods of indexing, milling cutters - machining operation, Accessories to milling machines. Grinding machine –Theory of grinding – classification– cylindrical and surface grinding machine – Tool and cutter grinding machine – Grinding wheel specification - types of abrasives – bonds, Truing and Dressing of wheels. Lapping, Honing and Broaching machines – comparison of grinding, lapping and honing. Principles of design of Jigs and fixtures and uses, Classification of Jigs & Fixtures – Principles of location and clamping –types.

Unit 4 Mechanical Energy Based Processes 10

Mechanical Energy Based Processes: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultra Sonic Machining – Working Principle, Description of Equipment, Process Parameters, Metal

Removal Rate, Applications, Advantages and Limitations. Electrical Energy Based Processes: Electric Discharge Machining – Wire cut EDM - Working Principles, Process Parameters, Applications Advantages and Limitations.

Unit 5 Chemical and Electro Chemical Energy Based Processes 10

Chemical and Electro Chemical Energy Based Processes: Chemical Machining and Electro Chemical Machining – Working Principle, Etchants, Maskants, Techniques of Applying - Process Parameters, Electro Chemical Grinding, Electro Chemical Honing, Applications, Advantages and Limitations. Thermal Energy Based Processes: Laser Beam Machining and Drilling, Plasma Arc Machining, Electron Beam Machining – Working Principle, Process Parameters, Applications, Advantages and Limitations.

Prescribed Textbooks:

1. Manufacturing Technology-Kalpakzian- Pearson Seventh edition. (2018)
2. Production Technology by R.K. Jain and S.C. Gupta, Khanna Publishers, 17th edition.

Reference Books:

1. Pandey P.C and Shan H.S., Modern Machining Processes, 1/e, McGraw Hill, New Delhi, 2007.
2. Benedict G.F., Non-traditional Manufacturing Processes, 1/e, CRC Press, 1987.
3. Production Technology by H.M.T. (Hindustan Machine Tools), TMH, 1st edition, 2001
4. Manufacturing Technology Vol II by P.N. Rao, Tata McGraw Hill, 4th edition, 2013
5. Machine Technology Machine tools and operations by Halmi A Yousuf & Harson, CRC Press Taylor and Francies.
6. Workshop Technology – Vol II, B.S.Raghu Vamshi, Dhanpat Rai & Co, 10th edition, 2013
7. Jain V.K., Advanced Machining Processes, 1st Edition, Allied Publishers Pvt. Ltd., New Delhi, 2007.

Online Learning Resources:

- https://nptel.ac.in/courses/112/107/112107078/
- https://youtu.be/t3y_Ys3LgGM
- https://www.youtube.com/watch?v=E4VZ_rFqpG4&t=1s
- https://youtu.be/-tcaR7oSx_w
- https://youtu.be/Uybg6VDLoRQ
- https://youtu.be/Uybg6VDLoRQ

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0351T.1	3	2	2	1	1	-	-	-	2	1	1	2	3	2
23A0351T.2	2	3	2	2	1	-	-	-	2	1	1	2	3	3
23A0351T.3	3	2	3	2	1	-	1	-	1	2	1	3	3	2
23A0351T.4	3	3	2	2	2	-	1	-	1	2	1	2	2	3
23A0351T.5	3	2	2	2	2	-	1	-	1	2	2	2	2	3

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

Title of the Course: Thermal Engineering
Category: Professional Core
Couse Code: 23A0352T

Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To Gain knowledge on basic concepts of an I C Engine.
2. To Impart the knowledge of Engine subsystems.
3. To Acquaint with concept of combustion in SI & CI engines.
4. To Familiarize about various methods for measurement of engine performance.
5. To Provide insight on Air compressors.

Course Outcomes:

At the end of the course, the student will be able to

1. Summarize the concepts of IC engines.
2. Comprehend the Various engine subsystems.
3. Comprehend the combustion in SI & CI engines.
4. Calculate the performance of IC Engines.
5. Calculate the performance of air compressors.

Unit 1 Introduction to I.C. Engines 06

Definition of Engine and Heat Engine, I.C Engine Classification – Parts of I.C. Engines, Working of I.C. Engines, Two Stroke & Four Stroke I.C. Engines SI & CI Engines, Valve and Port Timing Diagrams.

Unit 2 Fuel, Cooling & Lubrication systems 10

Fuel System: S.I. Engine: Fuel Supply Systems, carburettor types Air Filters, Mechanical and Electrical Fuel Pump – Filters– Gasoline Injection Systems.

Cooling & Lubrication Systems: Cooling Requirements, Air Cooling, Liquid Cooling, Thermo Syphon, Water and Forced Circulation System, Lubrication Systems-Flash, Pressurized and Mist Lubrication. Ignition **System:** Function of an Ignition System, Battery coil Ignition System, Magneto Coil Ignition System, Electronic Ignition System using Contact Breaker, Electronic Ignition using Contact Triggers – Spark Advance and Retard Mechanism.

Unit 3 Combustion in SI & CI Engines 10

Combustion in SI engine: Normal Combustion and Abnormal Combustion – Importance of Flame Speed and Effect of Engine Variables – Type of Abnormal Combustion, Pre-Ignition and Knocking (Explanation) – Fuel Requirements and Fuel Rating, Anti Knock Additives, Combustion Chambers.

Combustion in CI Engines: Stages of Combustion – Delay Period and Its Importance – Effect of Engine Variables – Diesel Knock– Combustion Chambers (DI And IDI), Fuel Requirements and Fuel Rating.

Unit 4 Testing and performance of IC engines. 10

Testing and Performance: Parameters of Performance - Measurement of Cylinder Pressure, Fuel Consumption, Air Intake, Exhaust Gas Composition, Brake Power – Determination of Frictional Losses and Indicated Power – Performance Test – Heat Balance Sheet and Chart.

Unit 5 Air Compressors 12

Reciprocating Compressors, Effect of Clearance volume in Compressors, Volumetric Efficiency, Single Stage and Multi Stage Compressors, Effect of Inter cooling and Pressure Drop in Multi - Stage Compressors, Problems Related to Reciprocating Compressors, Working principles of Roots blower, Vane type Blower, Centrifugal Compressor - Axial Flow Compressors.

Textbooks:

1. I.C. Engines - V. Ganesan- TMH- 4th edition -2017- ISBN-13. 978-1259006197
2. Thermal Engineering-Rajput-Lakshmi Publications -11th edition -2020- ISBN-13. 978-8131808047.

Reference Books:

1. Internal Combustion Engine Fundamentals- John B. Heywood- TMH-2018-ISBN: 9781260116106
2. IC Engines – Mathur& Sharma – DhanpathRai & Sons -2017-ISBN-13: 978-9383182428
3. Engineering fundamentals of IC Engines – Pulkrabek- Pearson- PHI 2nd edition -2015- ISBN-13: 978-9332549494
4. Thermal Engineering-Rudra Moorthy – TMH 1st edition -2017-ISBN-13: 978-0070494985
5. Thermodynamics & Heat Engines- B. Yadav- Central Book Depot., Allahabad -2002-ISBN-13: 978-8185444031

Online Learning Resources:

- https://nptel.ac.in/courses/112103316
- https://youtube.com/playlist?list=PLwdnzlV3ogoWV-_n1YItO933MxgPXfEiM&si=QcuZlil5MRIdeTiD
- https://youtu.be/FDmYCI_xYIA?si=vS1kdhqc5WCRnl21
- https://youtube.com/playlist?list=PLfq4fiRrJSn5leKEZoUF-2vBkMG37iGs8&si=nZVdvgmACy-lVvSC

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0352T.1	3	2	-	-	-	-	-	-	-	-	-	1	2	-
23A0352T.2	3	2	-	-	-	-	-	-	-	-	-	1	2	1
23A0352T.3	3	3	2	1	-	-	1	-	-	-	-	1	2	2
23A0352T.4	3	3	2	2	-	-	-	-	-	-	-	1	2	2
23A0352T.5	3	3	2	2	-	-	-	-	-	-	-	1	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
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Department of Mechanical Engineering

Title of the Course: Metrology and Measurements
Category: Professional Core
Couse Code: 23A0353T
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To explain the system of limits, fits &tolerances and design of gauges
2. To identify the use of flatness and surface gauges
3. To know the measurement of screw thread, Gear profiles
4. To describe the Measurement of Displacement and Strain
5. To illustrate the measuring process of Pressure, Force and Torque

Course Outcomes:

At the end of the course, the student will be able to

1. Summarize the concepts of limits, fits, limit gauges and linear & angular measuring instruments
2. Explain the concepts of flatness and surface roughness measurements.
3. Describe the measurement of screw thread and Gear profiles.
4. Summarize the measuring process of Displacement and Strain
5. Summarize the measuring process of Pressure, Force and Torque

Unit 1 Concept of measurement **15**

Concept of Measurement: Concept of feedback Control systems -generalized measurement system, units and standards, measuring instruments, sensitivity, readability, range of accuracy, precision, static and dynamic response, repeatability, systematic and random errors, correction, calibration, terminology and limits fits and tolerances, hole basis and shaft basis system, interchangeability.

Linear and Angular Measurement**:** Linear measuring instruments: Vernier instruments, micrometers, slip gauges, tool makers microscope. Comparators: Mechanical, pneumatic and electrical. Angular measurements: Sine bar, bevel protractor and angle dekkor, rollers and spheres used to determine the tapers.

Limit Gauges and Gauge Design**:** Plug, Ring, Snap, Gap, Taper gauges. Taylor's principle. Design of Go and No-Go gauges.

Unit 2 Screw Thread and Gear Measurement **07**

Screw thread measurements: Elements of threads, errors in screw threads, various methods for measuring external and internal screw threads, screw thread gauges.

Gear Measurement**:** Gear tooth terminology, measurement of gear elements-run out, lead, pitch backlash, profile, pressure angle, tooth thickness, diameter of gear, constant chord and base tangent method.

Coordinate Measuring Machine (CMM)- Construction and features.

Unit 3 Flatness and Surface Roughness measurement **08**

Flatness Measurement: Measurement of flatness – straight edges – surface plates, optical flat and autocollimators, interferometers and their applications.

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

Unit 4 Measurement of Displacement and Strain **08**

Measurement of Displacement: Theory and construction of various transducers to measure displacement – Piezo-electric, inductive, capacitance, resistance, ionization and photoelectric transducers, calibration

procedures.
Measurements of Strain**:** Various types of electrical strain gauges, gauge factor, method of usage of resistance strain gauge for bending, compressive and tensile strains, usage for measuring torque, strain gauge rosettes.

Unit 5 Measurement of Force, Torque and Pressure 10

Measurement of Force: Direct method - analytical balance, platform balance; elastic members – load cells, cantilever beams and proving rings.
Measurement of Torque: Torsion bar dynamometer, servo controlled dynamometer and absorption dynamometer.
Measurement of Pressure: Standards and calibration, basic methods of pressure measurement, dead weight gauges and manometers, High- and low-pressure measurement, Elastic transducers.

Textbooks:

1. Engineering Metrology, R.K. Jain, Khanna Publishers, special edition 2022. ISBN-13 : 978-8174091536
2. Basic Principles - Measurements and Control Systems. S.Bhaskar, Anuradha Publications, 2007. ISBN-13 : 978-8189638900

Reference Books:

1. Mechanical Measurements, Beckwith, Marangoni, Linehard, , PHI, 2013, ISBN-13 : 978-9332518520
2. Metrology & Measurement, Anand K Bewoor & Vinay A Kulkarni, 15/e, McGrawHill, 2017 . ISBN-13 : 978-0070140004
3. Mechanical Measurements & Control, D.S. Kumar, Metropolitan Publishers, 5/e, 2015.

Online Learning Resources:

- https://www.digimat.in/nptel/courses/video/112104250/L47
- https://www.digimat.in/nptel/courses/video/112106138/L01
- https://www.digimat.in/nptel/courses/video/112106179/L01
- https://www.youtube.com/watch?v=tczyyM4Dykc
- https://www.youtube.com/watch?v= UsAiZ mRC1M
- https://www.youtube.com/watch?v=oCkax I19X8

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0353T.1	3	2	1	1	-	-	-	-	-	-	-	-	2	2
23A0353T.2	3	2	1	1	-	-	-	-	-	-	-	-	2	2
23A0353T.3	3	2	1	1	-	-	-	-	-	-	-	-	2	2
23A0353T.4	3	2	1	1	-	-	-	-	-	-	-	-	2	2
23A0353T.5	3	2	1	1	-	-	-	-	-	-	-	-	2	2

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

Title of the Course: Introduction To Quantum Technologies and Applications
Category: Professional Core
Couse Code: 23A0554T
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To introduce fundamental quantum concepts like superposition and entanglement.
2. To understand theoretical structure of qubits and quantum information.
3. To explore conceptual challenges in building quantum computers.
4. To explain principles of quantum communication and computing.
5. To examine real-world applications and the future of quantum technologies.

Course Outcomes:

At the end of the course, the student will be able to

1. Explain core quantum principles in a non-mathematical manner.
2. Compare classical and quantum information systems.
3. Identify theoretical issues in building quantum computers.
4. Discuss quantum communication and computing concepts.
5. Recognize applications, industry trends, and career paths in quantum technology.

Unit 1 Introduction to Quantum Theory and Technologies 12

The transition from classical to quantum physics, Fundamental principles explained conceptually: Superposition, Entanglement, Uncertainty Principle, Wave-particle duality, Classical vs Quantum mechanics – theoretical comparison, Quantum states and measurement: nature of observation, Overview of quantum systems: electrons, photons, atoms. The concept of quantization: discrete energy levels, Why quantum? Strategic, scientific, and technological significance. A snapshot of quantum technologies: Computing, Communication, and Sensing, National and global quantum missions: India‘s Quantum Mission, EU, USA, China

Unit 2 Theoretical Structure of Quantum Information Systems 08

What is a qubit? Conceptual understanding using spin and polarization, Comparison: classical bits vs quantum bits, Quantum systems: trapped ions, superconducting circuits, photons (non-engineering view),Quantum coherence and decoherence – intuitive explanation, Theoretical concepts: Hilbert spaces, quantum states, operators – only interpreted in abstract, The role of entanglement and non-locality in systems, Quantum information vs classical information: principles and differences, Philosophical implications: randomness, determinism, and observer role

Unit 3 Building a Quantum Computer – Theoretical Challenges and Requirements 08

What is required to build a quantum computer (conceptual overview)?,Fragility of quantum systems: decoherence, noise, and control, Conditions for a functional quantum system: Isolation, Error management, Scalability, Stability, Theoretical barriers: Why maintaining entanglement is difficult, Error correction as a theoretical necessity, Quantum hardware platforms (brief conceptual comparison),Superconducting circuits, Trapped ions, Photonics, Vision vs reality: what‘s working and what remains elusive. The role of quantum software in managing theoretical complexities

Unit 4 Quantum Communication and Computing – Theoretical Perspective 08

Quantum vs Classical Information, Basics of Quantum Communication, Quantum Key Distribution (QKD), Role of Entanglement in Communication, The Idea of the Quantum Internet – Secure Global Networking, Introduction to Quantum Computing, Quantum Parallelism (Many States at Once), Classical vs Quantum Gates, Challenges: Decoherence and Error Correction, Real-World Importance and Future Potential.

Unit 5 Applications, Use Cases, and the Quantum Future 10

Real-world application domains: Healthcare (drug discovery), Material science, Logistics and optimization, Quantum sensing and precision timing, Industrial case studies: IBM, Google, Microsoft, Psi Quantum, Ethical, societal, and policy considerations, Challenges to adoption: cost, skills, standardization, Emerging careers in quantum: roles, skillsets, and preparation pathways, Educational and research landscape – India's opportunity in the global quantum race

Textbooks:

1. Michael A. Nielsen, Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 10th Anniversary Edition, 2010.
2. Eleanor Rieffel and Wolfgang Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.
3. Chris Bernhardt, Quantum Computing for Everyone, MIT Press, 2019.

Reference Books:

1. David McMahon, Quantum Computing Explained, Wiley, 2008.
2. Phillip Kaye, Raymond Laflamme, Michele Mosca, An Introduction to Quantum Computing, Oxford University Press, 2007.
3. Scott Aaronson, Quantum Computing Since Democritus, Cambridge University Press, 2013.
4. Alastair I.M. Rae, Quantum Physics: A Beginner's Guide, Oneworld Publications, Revised Edition, 2005.
5. Eleanor G. Rieffel, Wolfgang H. Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.
6. Leonard Susskind, Art Friedman, Quantum Mechanics: The Theoretical Minimum, Basic Books, 2014.
7. Bruce Rosenblum, Fred Kuttner, Quantum Enigma: Physics Encounters Consciousness, Oxford University Press, 2nd Edition, 2011.
8. GiulianoBenenti, GiulioCasati, GiulianoStrini, Principles of Quantum Computation and Information, Volume I: Basic Concepts, World Scientific Publishing, 2004.
9. K.B. Whaley et al., Quantum Technologies and Industrial Applications: European Roadmap and Strategy Document, Quantum Flagship, European Commission, 2020.
10. Department of Science & Technology (DST), Government of India, National Mission on Quantum Technologies & Applications – Official Reports and Whitepapers, MeitY/DST Publications, 2020 onward.

Online Learning Resources:

- IBM Quantum Experience and Qiskit Tutorials
- Coursera – Quantum Mechanics and Quantum Computation by UC Berkeley
- edX – The Quantum Internet and Quantum Computers
- YouTube – Quantum Computing for the Determined by Michael Nielsen
- Qiskit Textbook – IBM Quantum

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
23A0554T.1	3	2	1	1	2	1	1	1	1	2	1	3	3	2
23A0554T.2	3	3	1	2	2	1	1	1	1	2	1	3	3	2
23A0554T.3	3	3	1	2	3	2	1	1	1	2	1	3	3	3
23A0554T.4	3	3	1	2	3	2	1	1	1	3	1	3	3	3
23A0554T.5	2	2	1	1	2	3	2	2	2	3	2	3	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES RAJAMPET
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Department of Mechanical Engineering

Title of the Course: Tool Design
Category: Professional Elective-I
Couse Code: 23A035AT
Branch/es: Mechanical Engineering
Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To understand the fundamentals of tool engineering and the role of tool design in manufacturing
2. To analyze the principles of metal cutting and apply them to cutting tool design
3. To design various jigs and fixtures using proper locating and clamping principles
4. To evaluate and design different types of press tool dies for sheet metal operations.
5. To develop tooling and fixture strategies suitable for CNC machining systems.

Course Outcomes:

At the end of the course, the student will be able to

1. Understand tool design fundamentals, select appropriate materials, and design effective tools to develop durable, precise tools for various manufacturing applications.
2. Analyze the principles of metal cutting and apply them to cutting tool design.
3. Design various jigs and fixtures using proper locating and clamping principles.
4. Evaluate and design different types of press tool dies for sheet metal operations
5. Develop tooling and fixture strategies suitable for CNC machining systems.

Unit 1 Introduction To Tool Design 08

Introduction –Tool Engineering – Tool Classifications– Tool Design Objectives – Tool Design in manufacturing- Challenges and requirements- Standards in tool design-Tool drawings -Surface finish – Fits and Tolerances - Tooling Materials- Ferrous and Nonferrous Tooling Materials- Carbides, Ceramics and Diamond –Nonmetallic tool materials-Designing with relation to heat treatment.

Unit 2 Design Of Cutting Tools 08

Mechanics of Metal cutting –Oblique and orthogonal cutting- Chip formation and shear angle - Single-point cutting tools – Milling cutters – Hole making cutting tools- Broaching Tools - Design of Form relieved and profile relieved cutters-Design of gear and thread milling cutters.

Unit 3 Design Of Jigs and Fixtures 10

Introduction – Fixed Gages – Gage Tolerances –selection of material for Gauges – Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – General considerations in the design of drill jigs – Drill bushings – Methods of construction –Types of Fixtures – Vice Fixtures – Milling Fixtures – Boring Fixtures – Broaching Fixtures.

Unit 4 Design Of Press Tool Dies 06

Types of Dies –Method of Die operation–Clearance and cutting force calculations- Blanking and Piercing die design – Pilots – Strippers and pressure pads- Presswork materials – Centre of pressure -Strip layout – Short-run tooling for Piercing – Bending dies – Drawing dies-Design and drafting.

Unit 5 Tool Design For CNC Machine Tools 08

Introduction –Tooling requirements for Numerical control systems – Fixture design for CNC machine tools-Sub plate and tombstone fixtures-Universal fixtures– Cutting tools– Tool holding methods– Automatic tool changers and tool positioners – Tool presetting– General explanation of the Brown and Sharp machine.

Prescribed Textbooks:

1. Tool Design, Cyrll Donaldson, George H.LeCain, V.C. Goold, Tata McGraw Hill Publishing Company Ltd., 2000.
2. Jig and Fixture Design, E.G.Hoffman, Thomson Asia Pvt Ltd, Singapore, 2004.

Reference Books:

1. A Text book of Production Engineering, P.C.Sharma, S.Chand Publications, 1999.
2. Tooling data‖, Prakash Hiralal Joshi, —Wheeler Publishing, 2000
3. Design of Jigs, Fixtures and Press tools, Venkataraman K., — TMH, 2005.
4. Manufacturing Technology, Haslehurst M., — The ELBS, 1978.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**

23A035AT.1	3	2	3	2	2	-	-	1	1	-	1	3	2
23A035AT.2	3	3	3	2	2	-	-	1	1	-	1	3	2
23A035AT.3	3	2	3	2	2	-	-	1	1	-	1	3	2
23A035AT.4	3	2	3	2	2	-	-	1	1	-	1	3	2
23A035AT.5	3	3	3	2	3	-	-	1	1	-	1	3	3

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

Title of the Course: Automobile Engineering
Category: Professional Elective-I
Couse Code: 23A035BT
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
1. To impart the knowledge on I C Engine, Automobile chassis and Body.
2. To familiarize different fuel systems and types of ignitions systems.
3. To gain knowledge on Principles of Steering system and Suspension system.
4. To awareness about on wheels, Tyres and braking system.
5. To provide insight on Automobile electrical system.

Course Outcomes:
At the end of the course, the student will be able to
1. Summarize the different parts and develop the automobile systems to analyze engine components
2. Identify the working of various parts in ignition system to apply the different vehicles and design the ignition and fuel injection systems.
3. Demonstrate how the steering and the suspension systems works, types of steering and suspension systems and its applications.
4. Recognize the different types of wheels and braking systems. Choose the suitable tyres and brakes for different applications.
5. Utilize different electrical systems in automobiles. Apply advanced electrical circuits. Create advanced Global Positioning System (GPS), Hybrid vehicle, Fuel Cell.

Unit 1 Introduction to vehicle structure and engine components 10

Vehicle construction -Chassis and body - Specifications - Engine - Types - Construction - Location of engine - Cylinder arrangement - Construction details - Cylinder block - Cylinder head - Cylinder liners - Piston – piston rings - Piston pin - Connecting rod - Crankshaft - Valves. Lubrication system - Types - Oil pumps - Filters. Crankcase ventilation.

Unit 2 Ignition and fuel supply systems 09

Ignition system -Coil and Magneto - Spark plug - Distributor – Electronic ignition system - Fuel system - Carburetor - Fuel pumps - Fuel injection systems - Mono point and Multi point – Unit Injector – Nozzle types - Electronic Fuel Injection system (EFI) – GDI, MPFI, DTSI.

Unit 3 Steering and suspension system 09

Principle of steering -Steering Geometry and wheel alignment - Steering linkages – Steering gearboxes - Power steering - front axle - Suspension system - Independent and Solid axle – coil, leaf spring and air suspensions - torsion bar - shock absorbers.

Unit 4 Wheels, Tyres and Braking System 09

Wheels and Tyres - Construction - Type and specification - Tyre wear and causes - Brakes - Needs – Classification –Drum and Disc Mechanical - Hydraulic and pneumatic - Vacuum assist – Retarders – Anti-lock Braking System (ABS).

Unit 5 Automobile electrical systems and advances in automobile engineering 09

Battery-General electrical circuits- Active Suspension System (ASS) - Electronic Brake Distribution (EBD) – Electronic Stability Program (ESP), Traction Control System (TCS) - Global Positioning System (GPS), Hybrid

vehicle, Fuel Cell.

Textbooks:

1. Automotive Mechanics, William. H. Crouse, 10/e, McGraw-Hill, 2006.
2. Automobile Engineering, Kirpal Singh, Vol.1&2, Standard Publications, 13/e, 2020.

Reference Books:

1. Automotive Hand Book, Bosch, 6/e, SAE Publications, 2007.
2. The motor vehicle, K. Newton and W. Steeds, 13/e, Butterworth-Heinemann Publishing Ltd, 1989.
3. Automotive Mechanics Principles and Practices, Joseph Heitner, 2/e, CBS publishing 2004.
4. Automotive Engineering Fundamentals" Richard Stone, Jeffrey K. Ball, SAE International, 2004.
5. Automotive Engineering: Powertrain, Chassis System and Vehicle Body, David A. Corolla, Butterworth-Heinemann Publishing Ltd, 2009.

Online Learning Resources:

- https://nptel.ac.in/courses/107106088
- https://nptel.ac.in/courses/107106080
- https://hindustanuniv.ac.in/assets/pdf/ug/CBCS/cbcs-automobile-2018.pdf
- https://ed.iitm.ac.in/~shankarram/Course_Files/ED5160/ED5160.htm
- https://dbatu.ac.in/wp-content/uploads/2020/07/B-Tech-Automobile_Final-Yr_22.06.2020-pdf
- https://www.youtube.com/channel/UCGLlbmSTaLNUPhDwsMe-SgQ

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
23A035BT.1	2	2	2	2	-	-	-	1	-	1	-	1	2	1
23A035BT.2	2	2	2	2	-	-	-	1	-	1	-	1	2	1
23A035BT.3	2	2	2	2	-	-	-	1	-	1	-	1	2	1
23A035BT.4	2	2	2	2	-	-	-	1	-	1	-	1	2	1
23A035BT.5	2	2	2	2	-	-	-	1	-	1	-	1	2	1

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

Title of the Course: Mechanical Behaviour of Materials
Category: Professional Elective-I
Course Code: 23A035CT
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To explain the structure of material over the effects of mechanical properties.
2. To analyze the defects inside the structure and their effects on the mechanical properties.
3. To train the methods for characterization of the mechanical behavior of materials.
4. To impart knowledge about strengthening mechanisms of materials.
5. To explain mechanisms of failures of materials (fracture, fatigue and creep) and their relationship with the different types of stress.

Course Outcomes:

At the end of the course, the student will be able to

1. Analyze the elastic behaviour of engineering materials, recall Hooke‘s law and apply the dislocation theory, forces on and between dislocations.
2. Apply dispersion strengthening and fiber strengthening mechanisms, differentiate strain aging and dynamic strain aging and create grain size strengthening and solid solution strengthening
3. Identify the various modes of fracture and clarify the basic mechanism of ductile and brittle fracture, Identify importance of Griffith‘s theory. Calculate factors effecting on DBTT.
4. Explain fatigue behaviour and testing. Discuss the factors affecting fatigue. Apply fracture mechanics in design.
5. Identify the various structural changes during creep and predict the metallurgical factors affecting creep and creep different testing.

Unit 1 Elastic and plastic behavior **10**

Elastic behavior of materials – Hooke‘s law, plastic behavior: dislocation theory – Burger‘s vectors and dislocation loops, dislocations in FCC, HCP and BCC lattice, stress fields and energies of dislocations, forces on and between dislocations, slip and twinning.

Unit 2 Strengthening mechanisms **09**

Cold Working, Grain Size Strengthening, Solid Solution Strengthening, Martensitic Strengthening, Precipitation Strengthening, Dispersion Strengthening, Fiber Strengthening, Examples. Yield Point Phenomenon, Strain aging and Dynamic strain aging.

Unit 3 Fracture and fracture mechanics **09**

Types of Fracture, Basic Mechanism of Ductile and Brittle Fracture, Griffith‘s Theory of Brittle Fracture, Ductile to Brittle Transition Temperature (DBTT), Factors Affecting DBTT, Determination of DBTT. Fracture Mechanics-Introduction, Modes of Fracture, Stress Intensity Factor, Strain Energy Release Rate, Fracture Toughness and Determination of KIC.

Unit 4 Fatigue behaviour and testing **09**

Stress Cycles, S-N Curves, Effect of Mean Stress, Factors Affecting Fatigue, Structural Changes Accompanying Fatigue, Cumulative Damage, HCF / LCF, Thermo-mechanical Fatigue, Application of Fracture Mechanics to Fatigue Crack Propagation-Paris law- Fatigue Testing Machines.

Unit 5 Creep behavior and testing **10**

Creep Curve, Stages in Creep Curve and Explanation, Structural Changes during Creep, Creep Mechanisms,

Metallurgical Factors Affecting Creep, High Temperature Alloys, Stress Rupture Testing, Creep Testing Machines.

Textbooks:

1. Mechanical Metallurgy, Dieter, G.E., —McGraw-Hill, SI Edition, 2017, ISBN-13: 978-1259064791
2. The Testing of Engineering Material, Davis. H. E., Troxell G.E., Hauck.G. E. W., — McGraw-Hill, 2015. ISBN: 0-70-015656-5

Reference Books:

1. The Structure & Properties of Materials, vol-3: Mechanical Behavior, H W & John Wulff Hayden, John Wiley and Sons, 1983, ISBN: 047136469X
2. The Plastic Deformation of Materials, Honey Combe R. W. K., Edward Arnold Publishers, 2022, ISBN-10:0713134682
3. Testing of Metallic Materials‖, Suryanarayana, A. V. K., —BS Publications, 2018. ISBN: 9788178001340

Online Learning Resources:

- https://nptel.ac.in/courses/113104105
- https://nptel.ac.in/courses/113104104
- https://youtube.com/playlist?list=PLyqSpQzTE6M9QPU_tubmtQ97e7zRpaMlD&si=H5qNNyv3nYL8jztY
- https://youtube.com/playlist?list=PLxQw8LdroTlPNimLKW-MWldJQHVLBESGs&si=ULCr6KGQwMPXhNC2
- https://youtube.com/playlist?list=PL-g1KbXtGBBvF3G4lQuY0zSGBFHh4-5kF&si=47R1eQ_zAWcO-9A

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A035CT.1	3	2	2	2	-	-	-	1	-	1	-	1	1	2
23A035CT.2	3	3	2	2	-	-	-	1	-	1	-	1	2	2
23A035CT.3	3	3	2	2	-	-	-	1	-	1	-	1	3	2
23A035CT.4	3	2	2	3	-	-	-	1	-	1	-	1	1	3
23A035CT.5	3	2	2	2	-	-	-	1	-	1	-	1	2	2

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

Title of the Course: Work Study and Ergonomics
Category: Professional Elective-I
Couse Code: 23A035DT
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To develop concepts related to principles of productivity & work study as a tool for increasing the efficiency and effectiveness in organizational systems.
2. To study the existing method, compare and propose a new method.
3. To provide the usage of the various tools and techniques used in work measurement
4. To develop basic ideas of ergonomics and its design.
5. To develop concepts related Man-Machine Interfaces and Design of Displays and controls.

Course Outcomes:

At the end of the course, the student will be able to

1. Describe the basic concepts of productivity, work content and work study and define the objective and scope of Work Study.
2. Describe the various charts and to construct the charts on the basis of present method and develop a new / proposed method and identify the unnecessary movements.
3. Explain the basic work measurement techniques and to gain knowledge of measurement of work, rating and imbibe the concept of allowance in estimating Standard Time
4. Evaluate the basic concepts of Ergonomics and demonstrate a sound knowledge of Ergonomics in engineering applications.
5. Describe a sound knowledge of Man-Machine Interfaces and design of displays and controls in engineering systems

Unit 1 Productivity and Work Study **08**

Productivity and Work Study: Definition of productivity, task of management, productivity of materials, land, building, machine and power, factors affecting the productivity, work content, basic work content, excess work content, how manufacturing job is made up, work content due to excess product and process, ineffective time due to short comings on part of the management. Definition, Objective and scope of Work Study: Work study and management, work study and work.

Unit 2 Method Study & Work Measurement **10**

Method Study: Definition, objective and scope of method study, activity recording and tools, recording tools: Out Line Process Chart, Flow Process Chart, Flow diagram, String Diagram, Travel Chart, Multiple Activity Chart, Two- Handed process chart. Principles of Motion Economy: Introduction, Classification of movements. Two- hand process chart, Micromotion study, Therbligs, SIMO Chart. Special Charts: Cycle graph and Chrono cycle graph - development, definition and installation of the improved method.

Work Measurement: Definition, objectives, work measurement techniques. Work sampling – Need, confidence levels, and sample size determination, conducting study with problems

Unit 3 Time study **08**

Time study - Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information. Rating: Systems of rating, standard rating, standard performance, scales of rating. Allowances: Standard time determination, predetermined motion time study (PMTS), factors affecting rate of working, problems on allowances.

Unit 4 Introduction to Ergonomics **08**

Human factors and ergonomics, psychology, engineering, bio mechanics, industrial design, graphics design, statistics, operation research and anthropometry Morphology of design and its relationship with cognitive

abilities of human being. Physical Ergonomics: human anatomy, and some of the anthropometric, physiological and bio mechanical characteristics as they relate to physical activity. Cognitive: mental processes, such as perception, memory, reasoning, and motor response, mental workload, and decision-making. Organizational ergonomics: optimization of socio-technical systems, including their organizational structures, policies, processes. Communication, work design, design of working times, teamwork, cooperative work, and new work programs. Environmental ergonomics: human interaction with the environment- characterized by climate, temperature, pressure, vibration, light.

Unit 5 Man-Machine Interaction 08

Man-Machine Interaction; Man-Machine interaction cycle, Man-machine interfaces, displays factors that control choice of display, visual displays- qualitative displays; moving pointer displays, moving scale displays, digital displays Indicators, auditory displays, tactile displays. Factors affecting effectiveness of displays. Quantitative displays, check- reading displays, representational displays. Types of controls and their integration with displays. Design guidelines for displays and controls: viewing distance, Illumination, angle of view, reach etc., general design checklist for displays and controls. Standards for ergonomics in engineering and design, displays and controls.

Textbooks:

1. Introduction to Work Study – ILO, George Kanawaty, 4th edition 1992, ISBN: 9221071081
2. Human Factor in Engineering and Design, Mark. S. Sanders and Ernest. J McCornick. McGraw- Hill Book Co., Inc., New York, 1993, ISBN:978-0070549012

Reference Books:

1. Work Study and Ergonomics. S. Dalela and Sourabh, —Standard publishers 2013
2. Human Factors Design Handbook, Wesley Woodson, Peggy Tillman and Barry Tillman, McGraw-Hill; 2ndedition, 1992
3. Motion and Time Study, Ralph M. Barnes, —Wiley International, 7th Edition.
4. Human Factors in Engineering Design, Mark S. Sanders and Ernest J. McCormick, —4th ed. 2013.
5. Methods Standards and Work Design, B. Niebel and Freivalds, Niebel 's McGraw-Hill, 12th Ed. 2009

Online Learning Resources:

- https://youtu.be/b05FPBjFH6A?si=dWB1YOLOmSMRBSX7
- https://youtube.com/playlist?list=PLLy_2iUCG87BbIF6sF5sy_ZZLFoUcnncb&si=n1NAnFTtiocc9vtK
- https://youtube.com/playlist?list=PLuF8VVHesRxXBZzQpQSzvJI7eM_SduxwR&si=j2vyTNYybgvXrDiy

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A035DT.1	3	3	3	3	-	-	-	-	-	-	-	2	2
23A035DT.2	2	2	2	2	-	-	-	-	-	-	-	2	2
23A035DT.3	3	3	3	3	-	-	-	-	-	-	-	2	2
23A035DT.4	2	2	2	2	-	-	-	-	-	-	-	1	1
23A035DT.5	3	3	3	3	-	-	-	-	-	-	-	2	2

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

Title of the Course: Nano Technology
Category: Professional Elective-I

Couse Code: 23A035ET
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To understand the fundamentals of nano science and nanotechnology, including the history, classification and analyze the structural aspects of nanomaterials.
2. To gain knowledge of the synthesis and fabrication techniques used in nano science, and methods for realizing semiconductor nanostructures.
3. To understand advanced characterization techniques used for analysing the structural, morphological, and electronic properties of nanomaterials.
4. To explore carbon nanomaterials properties and wide-ranging applications.
5. To familiarize with the diverse applications of nanotechnology, with emphasis on nanostructured thin films and quantum dots.

Course Outcomes:

At the end of the course, the student will be able to

1. Define and classify nanomaterials. Explain the historical development and scope of Nano science, and nanotechnology. Analyze the band structure and electronic behavior of nanomaterials.
2. Explain the synthesis processes for bulk polycrystalline and single crystal materials. Differentiate between bottom-up and top-down fabrication approaches. Identify and select the requirements for semiconductor nanostructure fabrication and techniques.
3. Understand and explain the principles and applications of X-ray diffraction (XRD). Analyze optical properties of nanomaterials. Evaluate appropriate characterization technique.
4. Discuss and characterize various carbon nanomaterials and its applications to analyze the types, synthesis methods, and evaluate the impact of carbon nanomaterials in emerging technologies.
5. Identify and describe major applications, evaluate the impact in energy production, conversion, and environmental sustainability and analyze their applications and explore interdisciplinary applications of nano materials**.**

Unit 1 Introduction and Properties of Materials 10

History of nano science, definition of nano meter, nano materials, nano technology. Classification of nano materials. Crystal symmetries, crystal directions, crystal planes. Band structure.

Properties of Materials: Mechanical properties, electrical properties, dielectric properties, thermal properties, magnetic properties, opto electronic properties. Effect of size reduction on properties, electronic structure of nano materials.

Unit 2 Synthesis and Fabrication 10

Synthesis of bulk polycrystalline samples, growth of single crystals. Synthesis techniques for preparation of nano particle – Bottom-Up Approach – sol gel synthesis, hydro thermal growth, thin film growth, PVD and CVD; Top-Down Approach – Ball milling, micro fabrication, lithography. Requirements for realizing semiconductor nano structures, growth techniques for nano structures.

Unit 3 Characterization Techniques 09

X-Ray diffraction and Scherrer method, scanning electron microscopy, transmission electron microscopy, scanning probe microscopy, atomic force microscopy, piezoresponse microscopy, X-ray photoelectron spectroscopy, XANES and XAFS, angle resolved photoemission spectroscopy, diffuse reflectance spectra, photoluminescence spectra, Raman spectroscopy.

Unit 4 Carbon Nano Technology 08

Characterization of carbon allotropes, synthesis of diamond – nucleation of diamond, growth and morphology. Applications of nano crystalling diamond films, grapheme, and applications of carbon nano

tubes.

Unit 5 Applications of Nano Technology **09**

Applications in material science, biology and medicine, surface science, energy and environment. Applications of nano structured thin fins, applications of quantum dots.

Prescribed Textbooks:

1. Nano science and nano technology / M.S Ramachandra Rao, Shubra Singh/Wiley publishers.
2. Introduction to Nanotechnology by Risal Singh, Shipra Mital Gupta, Oxford Higher Education, First Publication 2016.

Reference Books:

1. Introduction to Nano Technology /Charles P. Poole, Jr., Frank J.Owens/Wiley publishers.
2. Nanotechnology /Jermy J Ramsden/Elsevier publishers (2015)
3. Nano Materials/A.K.Bandyopadhyay/ New Age
4. Nano The Essentials, T.Pradeep, McGrawHill, 2014
5. Nanotechnology the Science of Small / M.A Shah, K.A Shah/Wiley Publishers.

Online Learning Resources:

- https://youtube.com/playlist?list=PLyqSpQzTE6M8682dGkNTN8936vSY4CbqZ&si=8S682KjXK7_xITpT
- https://youtu.be/OLa8DQkKlyU?si=I6R1Of59MArQyPUb
- https://youtu.be/u1ojNgPCHGs?si=mIIgQm4OdwZnHUo3

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A035ET.1	3	2	1	2	2	0	0	0	1	1	1	2	2	2
23A035ET.2	3	2	2	3	2	0	1	0	1	1	1	2	3	3
23A035ET.3	3	3	2	3	3	1	1	0	1	2	1	2	3	2
23A035ET.4	2	2	2	2	3	1	1	0	1	2	1	2	3	2
23A035ET.5	2	3	3	2	2	2	3	1	2	3	2	3	3	3

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

Title of the Course: Thermal Engineering Lab
Category: PC
Couse Code: 23A0352L
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:

- To impart knowledge on working principles of various thermal equipment's like compressors, IC Engines, Boilers etc.,
- To study the working principle of IC engines, performance and characteristics in terms of heat balancing, economical speed variations, air fuel ratio etc.,

Course Outcomes:

At the end of the course, the student will be able to

1. Calculate the performance of 4-Stroke Diesel and Petrol engine.
2. Calculate the Engine friction of 4-Stroke Multi cylinder Engine and Air/Fuel ratio and Volumetric efficiency of I.C. Engines.
3. Calculate the heat balance of the IC Engines.
4. Calculate the efficiencies and performance characteristics of the engines.
5. Study the boilers and identify of the engine parts.

List of Experiments:

1. Draw the Valve / Port Timing Diagrams of an I.C. Engines
2. Performance Test on a 4 -Stroke Diesel Engines
3. Performance Test on a 4-Stroke Petrol engine
4. Performance Test on a 4-Stroke Multi cylinder Petrol engine
5. Evaluation of Engine friction by conducting Morse test on 4-Stroke Multi cylinder Engine
6. Retardation and motoring test on 4- stroke engine
7. Heat balance sheet on four stroke single cylinder diesel engine.
8. Heat balance sheet on four stroke single cylinder petrol engine.
9. Heat balance sheet on four stroke multi cylinder petrol engine.
10. Air/Fuel Ratio and Volumetric Efficiency of an I.C. Engines.
11. Performance Test on Reciprocating Air – Compressor Unit
12. Dismantling / Assembly of Engines to identify the parts and their position in an engine.
13. Performance test on refrigeration test rig.
14. Viscosity of the oil through saybolt viscometer apparatus
15. (a) Calorific value of fuel using bomb calorimeter.
    (b) Flash and fire point by Cleveland open cup apparatus.
16. Exhaust Emission test on IC Engines
17. Performance Test on Variable Compression Ratio Engines, economical speed test.

Study Experiment:

1. Study of Boilers

Note: Any 14 out of 17 Experiments can be conducted.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
23A0352L.1	3	2	3	1	-	1	1	1	2	2	1	2	3	2
23A0352L.2	3	3	3	1	-	1	1	1	2	2	1	2	3	2
23A0352L.3	3	2	3	1	-	1	1	1	2	2	1	2	3	2
23A0352L.4	3	3	3	1	-	1	1	1	2	2	1	2	3	2
23A0352L.5	2	1	2	1	-	2	2	1	2	2	1	2	2	2

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

Title of the Course: Dynamics Lab
Category: PC
Couse Code: 23A0354L
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:
1. To supplement the principles learnt in kinematics and Dynamics of Machinery.
2. To understand how certain measuring devices are used for dynamic testing.

Course Outcomes:
At the end of the course, the student will be able to
1. Ability to demonstrate the principles of kinematics and dynamics of machinery
2. Determine the Mass moment of inertia, Range sensitivity.
3. Drawing of Cam profile, determination of torsional, undamped and damped natural frequencies.
4. Determining of influence of coefficient and balancing of rotating , reciprocating masses.
5. Verify the laws of springs and forced vibration of cantilever beam.

List of Experiments:
1. To study Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms
2. Determination of Mass moment of inertia of Fly wheel and Axle system
3. Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors
4. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
5. Determination of torsional natural frequency of single Rotor systems. Un damped and Damped Natural frequencies
6. Determination of torsional natural frequency of Double Rotor systems. Un damped and Damped Natural frequencies
7. Multi degree freedom suspension system – Determination of influence coefficient
8. Balancing of rotating masses
9. Balancing of reciprocating masses
10. Determination of natural Frequency and verification of Laws of springs
11. Forced Vibration of Cantilever beam – Mode shapes and natural frequencies
12. To find experimentally the Gyroscopic couple on Motorized Gyroscope and compare with applied couple
13. To determine critical speed or whirling speed of a rotating shaft and to verify the value theoretically
14. To study Different types of Gears and Gear Trains
15. To study various types of steering mechanisms

Note: Any 10 experiments need to be performed

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
23A0354L.1	3	3	2	3	-	-	-	1	-	-	-	-	3	3
23A0354L.2	2	3	2	3	-	-	-	-	-	-	-	-	3	3
23A0354L.3	3	3	2	3	-	-	-	-	-	-	-	-	2	2
23A0354L.4	3	2	2	3	-	-	-	-	-	-	-	-	3	3
23A0354L.5	3	3	2	3	-	-	-	-	-	-	-	-	2	2

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

Title of the Course: Machine Tools & Metrology lab
Category: SEC
Couse Code: 23A0355L
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	1	2	2

Course Objectives:
1. To understand the parts of various machine tools and about different shapes of products that can be produced on them.
2. To measure bores, angles and tapers.
3. To perform alignment tests on various machines.

Course Outcomes:
At the end of the course, the student will be able to
1. Gain knowledge about the parts of various machine tools and about different shapes of products that can be produced on them.
2. Measure bores, angles and tapers.
3. Perform alignment tests on various machines

Machine Tools Lab
1. Introduction of general-purpose machines -Lathe, drilling machine, Milling machine, Shaper, Planing machine, Slotting machine, cylindrical grinder, Surface grinder and Tool and cutter grinder.
2. Operations on Lathe machines- Step turning, Knurling, Taper turning, Thread cutting and Drilling.
3. Operations on Drilling machine - Drilling, reaming, tapping, rectangular drilling, circumferential drilling.
4. Operations on Shaping machine - (i) Round to square (ii) Round to Hexagonal.
5. Operations on Slotter - (i) Keyway (T –slot) (ii) Keyway cutting.
6. Operations on milling machines - (i) Indexing (ii) Gear manufacturing.

Metrology Lab
1. Calibration of vernier callipers, micrometers, vernier height gauge and dial gauges.
2. Measurement of bores by internal micrometers and dial bore indicators.
3. Use of gear tooth vernier calliper for tooth thickness inspection and flange micrometer for checking the chordal thickness of spur gear.
4. Machine tool alignment test on the lathe.
5. Machine tool alignment test on drilling machine.
6. Machine tool alignment test on milling machine.
7. Angle and taper measurements with bevel protractor, Sine bar, rollers and balls.
8. Use of spirit level in finding the straightness of a bed and flatness of a surface.
9. Thread inspection with two wire/ three wire method & tool makers microscope.
10. Surface roughness measurement with roughness measuring instrument.

Online Learning Resources:
1. https://www.youtube.com/watch?v=sG6GCfX7L3c&pp=ygUeTWFjaGluZSBUb29scyAgbGFiIGV4cGVyaW1lbnRz
2. https://www.youtube.com/watch?v=mafthRhz1iM&pp=ygUeTWFjaGluZSBUb29scyAgbGFiIGV4cGVyaW1lbnRz
3. https://www.youtube.com/watch?v=5--saq-oYBE&list=PLrcSDk_gQ7jiQCfWEzw93ZMaxHkg2v-CC
4. https://www.youtube.com/watch?v=m60m2TcbTgc&pp=ygUZbWV0cm9sb2d5IGxhYiBleHBlcmltZW50cw%3D%3D

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
23A0355L.1	3	2	2	1	1	0	0	0	2	1	1	2	3	2
23A0355L.2	2	3	1	2	2	0	1	0	2	1	1	2	2	3
23A0355L.3	2	2	2	3	2	0	1	0	2	2	2	3	3	2

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

Title of the Course: Tinkering Lab
Category: ES
Couse Code: 23A0356L
Branch/es: Mechanical Engineering
Year & Semester: III Year I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	2	1

Course Objectives:
1. To encourage Innovation and Creativity
2. To provide Hands-on Learning and Impart Skill Development
3. To foster Collaboration and Teamwork
4. To enable Interdisciplinary Learning, Prepare for Industry and Entrepreneurship.
5. To impart Problem-Solving mind-set

Course Outcomes:
At the end of the course, the student will be able to
1. Apply fundamental engineering concepts to design, develop, and implement prototypes using electronic, mechanical, and programming tools for real-world applications.
2. Integrate hardware and software components such as sensors, actuators, microcontrollers, and 3D printing technologies to build functional systems
3. Demonstrate problem-solving skills and creativity in developing innovative solutions for societal, industrial, and environmental challenges.
4. Collaborate effectively in interdisciplinary teams to plan, execute, and present prototype-based projects.
5. Evaluate the performance of developed prototypes through testing, analysis, and iterative improvement, ensuring functionality, reliability, and sustainability.

List of Experiments:
1. Make your own parallel and series circuits using breadboard for any application of your choice
2. Design and 3D print a Walking Robot
3. Design and 3D Print a Rocket
4. Temperature & Humidity Monitoring System (DHT11 + LCD)
5. Water Level Detection and Alert System
6. Automatic Plant Watering System
7. Bluetooth-Based Door Lock System
8. Smart Dustbin Using Ultrasonic Sensor
9. Fire Detection and Alarm System
10. RFID-Based Attendance System
11. Voice-Controlled Devices via Google Assistant
12. Heart Rate Monitoring Using Pulse Sensor
13. Soil Moisture-Based Irrigation
14. Smart Helmet for Accident Detection
15. Milk Adulteration Detection System
16. Water Purification via Activated Carbon
17. Solar Dehydrator for Food Drying
18. Temperature-Controlled Chemical Reactor
19. Ethanol Mini-Plant Using Biomass
20. Smart Fluid Flow Control (Solenoid + pH Sensor)
21. Portable Water Quality Tester
22. AI Crop Disease Detection
23. AI-based Smart Irrigation
24. ECG Signal Acquisition and Plotting

25. AI-Powered Traffic Flow Prediction
26. Smart Grid Simulation with Load Monitoring
27. Smart Campus Indoor Navigator
28. Weather Station Prototype
29. Firefighting Robot with Sensor Guidance
30. Facial Recognition Dustbin
31. Barcode-Based Lab Inventory System
32. Growth Chamber for Plants
33. Biomedical Waste Alert System
34. Soil Classification with AI
35. Smart Railway Gate
36. Smart Bin Locator via GPS and Load Sensors
37. Algae-Based Water Purifier
38. Contactless Attendance via Face Recognition

Applied Robot Control Lab:

39. Perform an experiment on igus robot arm for pick and place operation in an industrial application.
40. Perform an experiment on igus robot arm for food supply in restaurant applications.
41. Perform an experiment on igus robot arm for palletization operation in warehouse applications.

- **Note:** The students can also design and implement their own ideas, apart from the list of experiments mentioned above
- **Note:** A minimum of 8 to 10 experiments must be completed by the student

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
23A0356L.1	3	2	3	2	3	1	2	1	2	2	1	3	3	3
23A0356L.2	3	3	3	3	3	1	2	1	2	2	1	3	3	3
23A0356L.3	2	3	3	2	3	2	3	2	3	3	2	3	3	2
23A0356L.4	1	2	3	2	2	2	2	2	3	3	3	2	2	2
23A0356L.5	2	3	3	3	3	2	3	1	2	2	2	3	3	3

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

Title of the Course: Sustainable Energy Technologies
Category: Open Elective – I
Couse Code: 23A035FT
Branch/es: CE, EEE, ECE, CSE, AIDS, AIML, CSE-DS, CSE-AI
Year & Semester: III B.Tech. I Semester

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:
- To demonstrate the importance the impact of solar radiation, solar PV modules.
- To understand the principles of storage in PV systems.
- To discuss solar energy storage systems and their applications.
- To get knowledge in wind energy and bio-mass.
- To gain insights in geothermal energy, ocean energy and fuel cells.

Course Outcomes:
At the end of the course, the student will be able to
6. Illustrate the importance of solar radiation and solar PV modules.
7. Discuss the storage methods in PV systems.
8. Explain the solar energy storage for different applications.
9. Understand the principles of wind energy, and bio-mass energy.
10. Attain knowledge in geothermal energy, ocean energy and fuel cells.

Unit 1 **09**

SOLAR RADIATION: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems.

SOLAR PV MODULES AND PV SYSTEMS: PV Module Circuit Design, Module Structure, Packing Density, Interconnections, Mismatch and Temperature Effects, Electrical and Mechanical Insulation, Lifetime of PV Modules, Degradation and Failure, PV Module Parameters, Efficiency of PV Module, Solar PV Systems-Design of Off Grid Solar Power Plant. Installation and Maintenance.

Unit 2 **09**

STORAGE IN PV SYSTEMS: Battery Operation, Types of Batteries, Battery Parameters, Application and Selection of Batteries for Solar PV System, Battery Maintenance and Measurements, Battery Installation for PV System.

Unit 3 **09**

SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentrating collectors, orientation.

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, solar cookers, central power tower concept and solar chimney

Unit 4 **09**

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement.

BIO-MASS: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.

Unit 5 **09**

GEOTHERMAL ENERGY: Origin, Applications, Types of Geothermal Resources, Relative Merits.

OCEAN ENERGY: Ocean Thermal Energy; Open Cycle & Closed Cycle OTEC Plants, Environmental Impacts, Challenges.

FUEL CELLS: Introduction, Applications, Classification, Different Types of Fuel Cells Such as Phosphoric Acid Fuel Cell, Alkaline Fuel Cell, PEM Fuel Cell, MC Fuel Cell.

Prescribed Textbooks:

3. Solar Energy – Principles of Thermal Collection and Storage/Sukhatme S.P. and J.K.Nayak/TMH.
4. Non-Conventional Energy Resources- Khan B.H/ Tata McGraw Hill, New Delhi, 2006.

Reference Books:

4. Principles of Solar Engineering - D.Yogi Goswami, Frank Krieth& John F Kreider / Taylor & Francis.
5. Non-Conventional Energy - Ashok V Desai /New Age International (P) Ltd.
6. Renewable Energy Technologies -Ramesh & Kumar /Narosa.
7. Non-conventional Energy Source- G.D Roy/Standard Publishers.

Online Learning Resources:

- https://nptel.ac.in/courses/112106318
- https://youtube.com/playlist?list=PLyqSpQzTE6M-ZgdjYukayF6QevPv7WE-r&si=-mwIa2X-SuSiNy13
- https://youtube.com/playlist?list=PLyqSpQzTE6M-ZgdjYukayF6QevPv7WE-r&si=Apfjx6oDfz1Rb_N3
- https://youtu.be/zx04Kl8y4dE?si=VmOvp_OgqisILTAF

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and	Life-long learning	PSO1	PSO2
23A035FT.1	3	2	2	2	2	1	3	1	1	1	1	2	1	1
23A035FT.2	3	2	2	2	2	1	2	1	1	1	1	2	1	1
23A035FT.3	3	2	2	2	2	2	3	1	1	1	1	2	1	1
23A035FT.4	3	2	2	2	2	1	3	1	1	1	1	2	1	1
23A035FT.5	3	2	2	2	2	1	3	1	1	1	1	2	1	1