JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

Course Structure and syllabi for

M.Tech-ME-Production Engineering and Engineering Design

for affiliated Engineering Colleges 2017-18

I YEAR I Semester

S. No	Course code	Subject	L	T	P	C
1.	17D04101	Advanced Finite Element Methods	4	-	-	4
2.	17DBS101	Computational methods	4	-	-	4
3.	17D04103	Advances in Manufacturing Technology	4	-	-	4
4.	17D04201	Advanced Optimization Techniques	4	-	-	4
5.	17D04109 17D04208 17D87205	Elective-I a. Design for Manufacturing b. Rapid Prototyping c. Design and manufacturing of MEMS and MICRO systems	4	-	-	4
6.	17D15202 17D90101 17D90102	Elective II a. Mechanical Vibrations b. Mechanical Measurements c. Quality Engineering	4	-	-	4
7.	17D90103	Design Simulation Laboratory	-	-	3	2
		Total	24	-	3	26

I YEAR II Semester

S. No	Course code	Subject	L	T	P	C
1.	17D87204	Industrial Robotics	4	-	-	4
2.	17D87101	Automation in Manufacturing	4	-	-	4
3.	17D87201	Simulation & Modeling of Manufacturing systems	4	-	-	4
4	17D90201	Mechanics & Manufacturing Methods of Composites	4	-	-	
5.	17D04205 17D15104 17D90202	Elective-III a. Computer Graphics b. Material Technology c. Non-destructive Evaluation	4	-	-	4
6	17D15101 17D90203 17D90204	Elective IV a. Advanced Mechanisms b. Advanced Metal Forming c. Friction and Wear Machinery	4	-	-	4
7.	17D11211	Manufacturing Simulation Laboratory	-	-	3	2
		Total	24	-	3	26

III SEMESTER

S.No	Subject Code	Subject	L	T	P	C
1.	17D20301 17D20302 17D20303	Elective V a) Research Methodology b) Human Values and Professional Ethics c) Intellectual Property Rights	4	-	-	4
2.	17D90301	Elective VI (MOOCS)	-	-	-	-
3.	17D90302	Comprehensive Viva – Voice	-	-	-	2
4.	17D90303	Seminar	-	-	-	2
5.	17D90304	Teaching Assignment	-	-	-	2
6.	17D90305	Project work phase – I	-	-	-	4

IV SEMESTER

S.No	Subject Code	Subject	L	T	P	C
1.	17D90401	Project work Phase – II	-	-	-	12

Project Viva Voce Grades:

A: Satisfactory
B: Not Satisfactory

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M. Tech – I year I Sem. (PE&ED)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17D04101) ADVANCED FINITE ELEMENT METHODS

Course Objectives:

1. To provide the mathematical foundations of the finite element formulation for engineering applications (solids, heat, fluids).
2. To expose students to some of the recent trends and research areas in finite elements.

UNIT–I

Formulation Techniques: Methodology, Engineering problems and governing differential equations, finite elements., Variational methods-potential energy method, Raleigh Ritz method, strong and weak forms, Galerkin and weighted residual methods, calculus of variations, Essential and natural boundary conditions.

UNIT–II

One-dimensional finite element methods: Bar elements, temperature effects. Element matrices, assembling of global stiffness matrix, Application of boundary conditions, Elimination and penalty approaches, solution for displacements, reaction, stresses, temperature effects, Quadratic Element, Heat transfer problems: One-dimensional, conduction and convection problems. Examples: - one dimensional fin,

UNIT–III

Trusses: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses, temperature effects.

Beams and Frames: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses.

UNIT–IV

Two dimensional problems: CST, LST, four noded and eight nodded rectangular elements, Lagrange basis for triangles and rectangles, serendipity interpolation functions. Axisymmetric Problems: Axisymmetric formulations, Element matrices, boundary conditions. Heat Transfer problems: Conduction and convection, examples: - two-dimensional fin.

Isoparametric formulation: Concepts, sub parametric, super parametric elements, numerical integration.

UNIT–V

Finite elements in Structural Dynamics: Dynamic equations, eigen value problems, and their solution methods, simple problems.

Convergence: Requirements for convergence, h-refinement and p-refinement, complete and incomplete interpolation functions, pascal's triangle.

Course Outcomes:
Students can able to solve below following problems.

1. Heat Transfer problem
2. Simple non-linear problem
3. Projection tensor
4. Constitutive equations
5. Equilibrium equation

TEXT BOOK:
Finite element methods by Chandraputla & Belagondu.

REFERENCES:
1Finite element method in Heat transfer and fluid dynamics, . J.N.Reddy, CRC press,1994
2. Finite Element Method, Zienckiwicz O.C. & R. L. Taylor,McGraw-Hill,1983.
3Finite Element of Nonlinear continua, . J. N. Oden, McGraw-Hill, New York, 1971
4Finite element procedures, . K. J. Bathe, Prentice-Hall, 1996

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M. Tech – I year I Sem. (PE&ED)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17DBS101) COMPUTATIONAL METHODS

Course objectives:

1. Students will demonstrate aptitude in standard numerical techniques for solving various classes of problems.
2. Students will learn the theory underlying the derivation of standard numerical techniques and the development of algorithms.
3. Modeling of engineering problems drawn from different disciplines of mechanical engineering.

UNIT–I

Introduction to numerical methods applied to engineering problems: Examples, solving sets of equations – Matrix notation – Determinants and inversion – Iterative methods – Relaxation methods – System of non-linear equations – computer programs

Numerical integration: Newton-Cotes integration formulas – Simpson's rules, Gaussian quadrature. Adaptive integration

Unit – II

Optimization: One dimensional unconstrained optimization, multidimensional unconstrained optimization –direct methods and gradient search methods, constrained optimization

Boundary value problems and characteristic value problems: Shooting method – Solution through a set of equations – Derivative boundary conditions – Rayleigh – Ritz method – Characteristic value problems.

Unit – III

Numerical solutions of partial differential equations: Laplace's equations – Representations as a difference equation – Iterative methods for Laplace's equations – poisson equation – Examples – Derivative boundary conditions – Irregular and non – rectangular grids – Matrix patterns, sparseness – ADI method – Finite element method.

Unit – VI

Parabolic partial differential equations: Explicit method – Crank-Nickelson method – Derivative boundary condition – Stability and convergence criteria – Finite element for heat flow – computer programs.

Hyperbolic partial differential equations: Solving wave equation by finite differences-stability of numerical method –method of characteristics-wave equation in two space dimensions-computer programs.

Unit – V

Curve fitting and approximation of functions: Least square approximation fitting of non-linear curves by least squares –regression analysis- multiple linear regression, non linear regression - computer programs.

Course outcomes:

1. To enable students to formulate and solve engineering problems that are not amenable to analytical methods.
2. To demonstrate the application of numerical methods to data analysis and optimal design.

TEXT BOOKS:

1. "Numerical Methods for Engineers", Steven C.Chapra, Raymond P.Canale Tata Mc-Graw hill
2. "Applied numerical analysis", Curtis F.Gerald, partick.O.WheatlyAddison-wesley,1989
3. "Numerical methods", Douglas J..Faires,Riched BurdenBrooks/cole publishing company,1998.Second edition.

REFERENCES:

1. "Numerical mathematics and computing", Ward cheney &David Kincaid Brooks/Cole publishing company1999,fourth edition.
2. "Mathematical methods for physics and engineering"Riley K.F.M.P.Hobson.&.Bence S.J.Cambridge university press,1999.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M. Tech – I year I Sem. (PE&ED)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17D04103) ADVANCES IN MANUFACTURING TECHNOLOGY

Course Objectives:
This subject provides students with

1. Machining principles and processes in the manufacturing of precision components and products that use conventional, nonconventional, and surface engineering technologies;

2. A basic understanding of the machining capabilities, limitations, and productivity of advanced manufacturing processes.

Unit - I
Surface Processing Operations: Plating and Related Processes, Conversion Coatings, Physical Vapor Deposition, Chemical Vapor Deposition, Organic Coatings, Porcelain Enameling and other Ceramic coatings, Thermal and Mechanical Coating Processes.

Unit - II
Un-conventional Machining Methods
Abrasive jet machining - Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent developments. Ultrasonic machining: Elements of the process, machining parameters, effect of parameters on surface finish and metal removal rate, mechanics of metal removal process parameters, economic considerations, applications and limitations.

UNIT- III
Electro-Chemical Processes: Fundamentals of electro chemical machining, metal removal rate in ECM, Tool design, Surface finish and accuracy economics aspects of ECM.
Wire EDM Process: General Principle and applications of Wire EDM, Mechanics of metal removal, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy.

UNIT - IV
Electron Beam Machining: Generation and control of electron beam for machining, theory of electron beam machining, principle, advantages, limitations, comparison of thermal and non-thermal processes.
Plasma Arc Machining: Principle, machining parameters, effect of machining parameters on surface finish and metal removal rate, applications, limitations

Unit - V
Laser Beam Machining: Principle, effect of machining parameters on surface finish, applications, and limitations.
Rapid Prototyping: Working principle, methods-Steriolithography, Laser sintering, Fused deposition method, applications and limitations.

Course Outcomes:

Upon completion of the subject, students will be able to:

1. Apply the working principles and processing characteristics of ultra-precision machining, high-speed machining methods, and nontraditional machining to the production of precision components.
2. Determine the quality and surface integrity of products treated by surface engineering processes.
3. Determine the formability of a given material and geometric combination using fine-blanking processes.
4. Prescribe a laser materials processing technique suitable for a given product with material, size, precision, and surface quality requirements.

TEXT BOOKS:

1. Manufacturing Technology - P. N. Rao, TMH Publishers
2. Fundamentals of Modern Manufacturing, Mikell P. Groover, John Wiley & Sons Publishers

REFERENCES:

1. Production Technology - HMT
2. Manufacturing Science - Cambel
3. Welding Technology - R.S, Parmar,
4. Introduction to Nanotechnology - Poole and Owens, Wiley (2003).

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M. Tech – I year I Sem. (PE&ED)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17D04201) ADVANCED OPTIMIZATION TECHNIQUES

Course Objectives:

The general objectives of the course is

1. To introduce the fundamental concepts of Optimization Techniques;
2. To make the learners aware of the importance of optimizations in real scenarios;
3. To provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and multivariable.

UNIT - I

Integer programming- cutting plane method and branch and bound technique, mixed integer programming

UNIT - II

Classical optimization techniques: Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions.

Numerical methods for optimization: Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method.

UNIT - III

Genetic algorithm (GA) : Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA,

Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, solving differential equations using GP.

UNIT – IV

Multi-Objective Decision making: Introduction to goal programming , Non-dominated front, multi – objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems . Introduction to Analytical hierarchical process, analytical network process.

UNIT V

Applications of Optimization in Design and Manufacturing systems: Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

Course Outcomes:

Upon successful completion of this course, students will be able to

1. Formulate optimization problems;
2. Understand and apply the concept of optimality criteria for various type of optimization problems;
3. Solve various constrained and unconstrained problems in single variable as well as multivariable;
4. Apply the methods of optimization in real life situation.

Text Books:

1. Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers
2. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers
3. Engineering Optimization – S.S.Rao, New Age Publishers
4. Operation Research by Hamdy A. Taha, Pearson publications

REFERENCES:

1.Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers
2. Genetic Programming- Koza
3. Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers

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	4	**0**	**0**	**4**

(17D04109) DESIGN FOR MANUFACTURING

Elective-I

Course objectives:

1. Internalize the attributes along which the success or failure of a manufacturing process, machine, or system will be measured: quality, cost, rate and flexibility.
2. Provide exposure to a range of current industrial processes and practices used to manufacture products in high and low volumes. Focus in depth on a few selected processes.
3. Understand the impact of manufacturing constraints on product design and process planning.

UNIT – I

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-II

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 parts.

UNIT–III

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.

UNIT–IV

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–V

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.

Course Outcomes:

Concepts of Design for Manufacturing (DFM); Role of DFM in product specification and standardization, Methods of material, shape and process selections, Design rules for manufacturing and assembly processes, Design for quality and reliability, Approach towards robust design, Design for optimization, Case studies on design for manufacturing and assembly

Text Books:

1. Design for manufacture, John cobert, Adisson Wesley. 1995
2. Design for Manufacture by Boothroyd,

REFERENCES:

1. ASM Hand book Vol.20

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	4	**0**	**0**	**4**

(17D04208) RAPID PROTOTYPING
Elective-I

Course objectives:

At the end of this course the students would have developed a thorough understanding of the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Rapid Prototyping Technologies.

UNIT-I

Introduction: Need for the compression in product development, History of RP system, Survey of applications, Growth of RP industry and classification of RP system.

Stereo Lithography System: Principle, Process parameter, Process details, Data preparation, Data files and machine details, Applications.

UNIT–II

Fusion Decomposition Modeling: Principle, process parameter, Path generation, Applications.

Solid ground curing: Principle of operation, Machine details, Applications.

UNIT-III

Laminated Object Manufacturing: Principle of Operation, LOM materials, Process details, Applications.

Concepts Modelers: Principle, Thermal jet printer, Sander's model market, 3-D printer, Genesis Xs printer HP system 5, Object Quadra system.

UNIT-IV

LASER ENGINEERING NET SHAPING (LENS)

Rapid Tooling: Indirect Rapid tooling- Silicon rubber tooling- Aluminum filled epoxy tooling Spray metal tooling, Cast kriksite, 3Q keltool, etc, Direct Rapid Tooling Direct. AIM, Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft, Tooling vs. hard tooling.

Software for RP: STL files, Overview of Solid view, magics, imics, magic communication, etc. Internet based software, Collaboration tools.

UNIT-V

Rapid Manufacturing Process Optimization: Factors influencing accuracy, Data preparation error, Part building error, Error in finishing, Influence of build orientation.

COURSE OUTCOME: It helps the students to get familiarized with the various methods of rapid prototyping technologies and rapid tooling.

TEXT BOOKS:

1. " Stereo lithography and other RP & M Technologies**"**, Paul F.Jacobs, SME, NY 1996
2. " Rapid Manufacturing **",** Flham D.T & Dinjoy S.S, Verlog London 2001
3. "Rapid automated**"**, Lament wood, Indus Press New York.

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	4	**0**	**0**	**4**

(17D87205) DESIGN AND MANUFACTURING OF MEMS AND MICRO SYSTEMS
Elective-I

Course Objectives:
1. To introduce students to the basics MEMS and Microsystems
2. To help the students to design MEMS based structures
3. To make students understand the various methods of fabrication

UNIT - I

Overview and working principles of MEMS and Microsystems: MEMS and Microsystems, Evolution of Micro fabrication, Microsystems and Microelectronics, Microsystems and miniaturization, Applications of MEMs in Industries, Micro sensors, Micro actuation, MEMS with Micro actuators Micro accelerometers, Micro fluidics.

Atomic structure of Matter, Ions and Ionization, Molecular Theory of Matter and Intermolecular Forces, Doping of Semiconductors, The Diffusion Process, Plasma Physics, Electrochemistry, Quantum Physics.

UNIT - II

Engineering Mechanics for Microsystems Design: Static Bending of Thin plates, Mechanical Vibration, Thermo mechanics , Fracture Mechanics, Thin- Film Mechanics, Overview of Finite Element Stress Analysis.

Overview of Basics of Fluid Mechanics in Macro and Mesoscales, Basic equations in Continuum Fluid Dynamics, Laminar Fluid Flow in Circular Conduits, Computational Fluid Dynamics, Incompressible Fluid Flow in Micro conduits, Fluid flow in Sub micrometer and Nano scale,

UNIT- III

Overview of Heat conduction in Solids, Heat Conduction in Multilayered Thin films and in solids in sub micrometer scale, Design Considerations, Process Design

UNIT- IV

Mechanical Design, Mechanical design using FEM, Design of a Silicon Die for a Micro pressure sensor.

UNIT- V

Materials for MEMS and Microsystems and their fabrication: Substrates and Wafers, Active substrate materials, Silicon as a substrate material, Silicon compounds, Silicon Piezo resistors, Gallium Arsenide, Quartz, Piezoelectric Crystals and Polymers, Photolithography, Ion implantation, Diffusion and oxidation, Chemical and Physical vapor deposition, etching, Bulk micro manufacturing, Surface Micromachining, The LIGA Process.

Course Outcome:
Students who have successfully completed this course will be able to understand the basics of MEMS and analyze a MEMS based structure.

TEXT BOOK:

1. MEMS and Microsystems. Design and Manufacturing, Tia-Ran Hsu, TMH 2002
2. Foundation of MEMS, Chang Liu,Pearson, 2012

REFERENCES:

1. An Introduction to Microelectromechanical Systems Engineering. Maluf, M., Artech House, Boston 2000
2. "Micro robots and Micromechnaical Systems", Trimmer , W.S.N., Sensors & Actuators, Vol 19, 1989
3. Applied Partial Differential Equations, Trim., D.W., PWS-Kent Publishing, Boston, 1990

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M. Tech – I year I Sem. (PE&ED)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17D15202) MECHANICAL VIBRATIONS
Elective II

Course Objectives:

- Apply theoretical and numerical procedures to predict the dynamic response of discrete or continuous structural systems under the most diverse loading conditions.
- Develop reduced order models to treat systems with a large number of DOF.

UNIT-I

Single degree of Freedom systems: Undamped and damped free vibrations: forced vibrations ; coulomb damping; Response to harmonic excitation; rotating unbalance and support excitation ; Vibration isolation and transmissibility .

Response to Non Periodic Excitations: unit Impulse, unit step and unit Ramp functions; response to arbitrary excitations, The Convolution Integral; shock spectrum; System response by the Laplace Transformation method.

UNIT-II Vibration measuring instruments: Vibrometers, velocity meters & accelerometers

Two degree freedom systems: Principal modes – undamped and damped free and forced vibrations ; undamped vibration absorbers ;

UNIT-III

Multi degree freedom systems: Matrix formulation, stiffness and flexibility influence coefficients; Eigen value problem; normal modes and their properties; Free and forced vibration by Modal analysis; Method of matrix inversion; Torsional vibrations of multi – rotor systems and geared systems; Discrete-Time systems.

UNIT-IV

Numerical Methods: Rayliegh's, stodola's, Matrix iteration, Rayleigh-Ritz Method and Holzer's methods.

UNIT-V

Continuous systems: Free vibration of strings – longitudinal oscillations of bars-traverse vibrations of beams- Torsional vibrations of shafts.

Critical speeds of shafts: Critical speeds without and with damping, secondary critical speed.

Course outcomes: The course will cover fundamental concepts on the vibration of mechanical systems including, but not limited to, review of systems with one degree for freedom, Lagrange's equations of motion for multiple degree of freedom systems, introduction to matrix methods, transfer functions for harmonic response, impulse response, and step response, convolution integrals for response to arbitrary inputs, principle frequencies and modes, applications to critical speeds, measuring instruments, isolation, torsional systems, introduction to nonlinear problems.

TEXT BOOKS:

1. Elements of Vibration Analysis by Meirovitch.
2. Mechanical Vibrations by G.K. Groover.

REFERENCES:

1. Vibrations by W.T. Thomson
2. Mechanical Vibrations – Schaum series.
3. Vibration problems in Engineering by S.P. Timoshenko.
4. Mechanical Viabrations – V.Ram Murthy.

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	4	**0**	**0**	**4**

(17D90101) MECHANICAL MEASUREMENTS
Elective-II

Course objectives:

1. To educate students on different measurement systems and on common types of Errors.
2. To introduce different types of sensors, transducers and strain gauges used for measurement.
3. To give knowledge about thermocouples, thermometers and flow meters used for measurements.

UNIT-I

Introduction History and overview of measurement system, General system principles Fundamentals of Measurement system, Static and Dynamic, Characteristics of measurement systems: Systematic Characteristics, Generalized model, Calibration errors, Transfer function, Techniques for dynamic compensation Accuracy of measurement systems in steady state: Measurement error, Error probability function, Error reduction techniques, Reliability, Choice and Economics of measurement systems.

UNIT- II

Physics, Principles and Applications of sensing elements -Resistive and Capacitive sensing elements-Inductive and Electromagnetic sensing Element-Thermoelectric, and Elastic sensing elements Piezoelectric/Piezoresistive sensing elements-Electrochemical and Hall effect sensing elements.

UNIT -III

Pressure sensing elements: Barometers, McLeod gauge, Pirani gauge, Penning gauge and Ionization gauge, Signal Conditioning Elements: Deflection bridges, Amplifiers, AC carrier system, Current transmitters, Oscillators and Resonators.

UNIT -IV

Specialized measurement systems: Flow measurement systems:Measurement of velocity,volume and mass flow rate; Heat transfer effect in measurement systems: Characteristics of thermal sensors, Gas thermal conductivity and composition measurement.

UNIT -V

Ultrasonic measurement systems: Principles of ultrasonic transmission, Basic links, Examples of ultrasonic measurement system; Intelligent multivariable measurement system: Modeling methods for multivariable systems.

Course Outcomes:

1. Students will be able to work in Quality control and quality assurances divisions in industries.
2. Students will be able to design measuring equipments for the measurement of temperature and flow.
3. Students will be able to maintain quality in engineering products.

TEXT BOOKS:

1. E.O. Doebelin, D.N. Manik, Measurement systems, 6/E, Tata McGraw Hill, New Delhi, 2011
2. J.P. Bentley, Principles of Measurement systems, 4/E, Pearson education ltd, UK, 2005

REFERENCES:

1. G.C.M. Meijer, Smart Sensor Systems, Vol 10, John Wiley and Sons, UK, 2008
2. Alan S. Morris, R. Langari, Measurement and Instrumentation; Theory and Application, Academic Press, USA, 2012

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	4	**0**	**0**	**4**

(17D90102) QUALITY ENGINEERING
Elective-II

Course Objectives:
To impart knowledge about the significance of quality and the various tools/ concepts of building quality into products.
To learn the techniques used for quality control and quality improvement.

UNIT-I
Quality value and Engineering: An overall quality system, quality engineering in production design, quality engineering in design production processes.
Loss function and quality level: Derivation and use of quadratile loss function, economic consequences of tightening tolerances as a means to improve quality, evaluations and types tolerances (N-type-, S-type and L-type)

UNIT-II
Tolerance Design and Tolerancing: Functional limits, tolerance design for N-type, L-type and S-type characteristics, tolerance allocation for multiple components.
Parameter and tolerance design: Introduction to parameter design, signal to noise ratios, parameter design strategy, Introduction to tolerance design, tolerance design using the Taguchi loss function, identification of tolerance design factors.

UNIT- III
Design of Experiments: Introduction, Task aids and Responsibilities for DOE process steps, DOE process steps description.
Analysis of variance (ANOVA): One-way ANOVA, two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.

UNIT-IV
Orthogonal Arrays: Typical test strategies, better test strategies, efficient test strategies, conducting and analyzing an experiment.
Interpolation of experimental results: Interpretation methods, percent contribution, estimating the mean

UNIT-V
ISO-9000 Quality system, BDRE, Quality improvement Techniques, 6-sigma, bench marking, quality circles-brain storming-fishbone diagram-problem analysis.

Course Outcomes:
The student will be able to:
1. Apply the tools and techniques of quality to resolve industrial engineering issues.
2. Estimate the obvious and hidden quality costs for a given production system.
3. Apply a system based approach for quality management.

TEXT BOOKS:

1. Taguchi techniques for quality engineering/Philip J.Ross / McGraw Hill Intl. 2nd Edition, 1995.
2. Total Quality Management by Dale H. Besterfield, Glen Besterfield

REFERENCES:

1. Quality Engineering in Production systems/G.Taguchi, A.Elasayed et al/Mc.Graw Hill Intl. Edition, 1989.
2. Taguchi methods explained: Practical steps to Robust Design/Papan P.Bagchi/Prentice Hall Ind. Pvt. Ltd. New Delhi.

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M. Tech – I year I Sem. (PE&ED)	**L**	**T**	**P**	**C**
	0	**0**	**3**	**2**

(17D90103) DESIGN SIMULATION LABORATORY

I. Modeling

1. Surface modeling
2. Solid modeling
3. Drafting
4. Assembling

II. Structural Analysis using any FEA Package for different structures that can be discretised with 1-D,2-D & 3-D elements

1. Static Analysis
2. Modal Analysis
3. Harmonic Analysis
4. Spectrum Analysis
5. Buckling Analysis
6. Analysis of Composites
7. Fracture mechanics

References:

User manuals of ANSYS package Version 10.0
PRO/E, I-DEAS Package /UNIGRAPHICS, CATIA

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M. Tech – I year II Sem. (PE&ED)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17D87204) INDUSTRIAL ROBOTICS

COURSE OBJECTIVES:

- To be familiar with the automation and brief history of robot and applications.
- To give the student familiarities with the kinematics of robots.
- To give knowledge about robot end effectors and their design.
- To learn about Robot Programming methods & Languages of robot.
- To give knowledge about various Sensors and their applications in robots.

UNIT-I

Robot – Definition – Robot anatomy – Co-ordinate systems, work envelope, types and classification – Specifications – Pitch, yaw, roll, joint notations, speed of motion and pay load – Robot parts and their functions – Need for robots – Different applications.

UNIT-II

Pneumatic drives – Hydraulic drives – Mechanical drives – Electrical drives – D.C. servo motors, stepper motor and A.C. servo motors – Salient features, applications and comparison of all these drives-End effectors – Grippers: Mechanical grippers, pneumatic and hydraulic grippers, magnetic grippers, vacuum grippers, RCC grippers – Two fingered and three fingered grippers – Internal grippers and external grippers – Selection and design considerations.

UNIT-III

Requirements of a sensor, principles and applications of the following types of sensors – Position of sensors (Piezo electric sensor, LVDT, Resolvers, Optical encoders, Pneumatic position sensors) – Range sensors (Triangulation principle, Structured, Lighting approach, Time of flight range finders, Laser range meters) – Proximity sensors (Inductive, Hall effect, Capacitive, Ultrasonic and Optical proximity sensors) – Touch sensors (Binary sensors, Analog sensors) – Wrist Sensors – Compliance Sensors – Slip Sensors.

UNIT-IV

Camera, frame grabber, sensing and digitizing image data – Signal conversion – Image Storage – Lighting techniques – Image processing and analysis – Data reduction – Segmentation – Feature extraction – Object recognition – Other algorithms – Applications – Inspection, identification, visual serving and navigation.

UNIT-V

Forward kinematics – Inverse kinematics – Differences: Forward kinematics and Reverse kinematics of manipulators with two and three degrees of freedom (In 2 dimensional), four degrees of freedom (In 3 dimensional) – Deviations and problems-GV – AGV – Implementation of robots in industries – Various steps - Safety considerations for robot operations.

COURSE OUTCOMES:

- Students will be equipped with the automation and brief history of robot and applications.
- Students will be familiarized with the kinematic motions of robot.
- Students will have good knowledge about robot end effectors and their design concepts.

TEXT BOOKS:

Robotics& Control – R.K. Mittal & I.J. Nagrath – TMH Publications
Robotics for engineers - Yoram Korean- McGrew Hill Co.
Industrial Robotics Technology programming and Applications - M.P.Groover, M.Weiss, R.N.Nagel, N.G.Odrey.

REFERENCES:

Robotics Control Sensing, Vision and Intelligence - K.S.Fu, R.C.Gonzalex, C.S.G.Lee- McGrew hill Book co.

Kinematics and Synthesis of linkages - Hartenberg and Denavit - McGrew Hill Book Co

Kinematics and Linkage Design - A.S. Hall - Prentice Hall Kinematics and Dynamics of Machinary - J.Hirchhorn - McGrew HillBook Company

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M. Tech – I year II Sem. (PE&ED)	**L**	**T**	**P**	**C**
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(17D87101) AUTOMATION IN MANUFACTURING

Course Objectives:

1. To study the types and strategies and various components in Automated Systems.
2. To understand the automated flow lines, line balancing, material storage and retrieval and inspection
3. To learn the adaptive control systems.

UNIT-I

Introduction to Automation: Automation in Production Systems-Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Principles and Strategies. Basic Elements of an Automated Systems, Advanced Automation Functions, Levels of automation

UNIT-II

Introduction to Material Handling, Overview of Material Handling Equipment, Material Handling System Design considerations, Principles of Material Handling. Material Transport Systems, Automated Guided Vehicle Systems, Monorails and other Rail Guided Vehicles, Conveyor Systems, Analysis of Material Transport Systems.

UNIT-III

Storage Systems, Storage System Performance, Storage Location Strategies, Conventional Storage Methods and Equipment, Automated Storage Systems, Engineering Analysis of Storage Systems. Automatic data capture-overview of Automatic identification methods, bar code technology, other ADC technologies.

UNIT-IV

Line balancing problem, largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights Method, Mixed Model Assembly Lines, assembly line design considerations. Transfer lines, Fundamentals of Automated Production Lines, Storage Buffers, and Applications of Automated Production Lines. Analysis of Transfer Lines with and without Storage buffers.

UNIT-V

Manual Assembly Lines - Fundamentals of Manual Assembly Lines, Alternative Assembly Systems, Design for Assembly, Analysis of Single Model Assembly Lines, Automated Assembly Systems, Fundamentals of Automated Assembly Systems, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems - Parts Delivery System at Work Stations, Multi-Station Assembly Machines, Single Station Assembly Machines , Partial Automation.

Course Outcomes:

At the end of the course student will be able to learn the-

1. Solve the line balancing problems in the various flow line systems with and without use buffer storage
2. Understand the different automated material handling, storage and retrieval systems and automated inspection systems.
3. Use of Adaptive Control principles and implement the same online inspection and control

TEXT BOOKS:

1. Automation, Production systems and computer integrated manufacturing, Mikel P. Groover, Pearson Eduction.

REFERENCE BOOKS:

1. CAD CAM : Principles, Practice and Manufacturing Management, Chris Mc Mohan, Jimmie Browne , Pearson edu. (LPE)
2. Automation, Buckinghsm W, Haper & Row Publishers, New York, 1961
3. Automation for Productivity, Luke H.D, John Wiley & Sons, New York, 1972.

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M. Tech – I year II Sem. (PE&ED)

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(17D87201) SIMULATION AND MODELLING OF MANUFACTURING SYSTEMS

Course objectives:

1. To impart knowledge about the energy interaction of different components of a system.
2. To model systems residing in different energy domains and to control directly the theoretical and real systems. Provide students with the ability to apply modelling technique for analysis and synthesis of thermal, mechanical, biological systems etc.

UNIT-I

System – ways to analyze the system – Model - types of models – Simulation – Definition – Types of simulation models – steps involved in simulation – Advantages and Disadvantages.
Parameter estimation – estimator – properties – estimate – point estimate – confidence interval estimates – independent – dependent – hypothesis – types of hypothesis- steps – types 1 & 2 errors – Framing – Strang law of large numbers.

UNIT-II

Building of Simulation model – validation – verification – credibility – their timing – principles of valid simulation Modeling – Techniques for verification – statistical procedures for developing credible model.

UNIT-III

Modeling of stochastic input elements – importance – various procedures – theoretical distribution – continuous – discrete – their suitability in modeling.
Generation of random variants – factors for selection – methods – inverse transform – composition – convolution – acceptance – rejection – generation of random variables – exponential – uniform – Weibull – normal Bernoullie – Binomial – uniform – Poisson.

UNIT-IV

Simulation languages – comparison of simulation languages with general purpose languages – Simulation languages vs Simulators – software features – statistical capabilities – G P S S – SIMAN- SIMSCRIPT –Simulation of M/M/1 queue – comparison of simulation languages.QUEST, WITNESS, PROMODEL and AUTOMOD

UNIT-V

Output data analysis – Types of Simulation with respect to output data analysis – warm up period- Welch algorithm – Approaches for Steady – State Analysis – replication – Batch means methods – comparisons
Applications of Simulation – flow shop system – job shop system – M/M/1 queues with infinite and finite capacities – Simple fixed period inventory system – Newboy paper problem.

Course Outcomes:

1. Introducing simulation tool
2. Explaining the concept and types of models
3. Understanding discrete and continuous simulation
4. Introducing various simulation languages and software
5. Understanding the role of probability distributions in simulation
6. Explaining the verification and validation of simulation models.

TEXT BOOKS:

1. Simulation Modelling and Analysis, Law, A.M.& Kelton, McGraw Hill, 2nd Edition, New York, 1991.
2. Discrete Event System Simulation, Banks J. & Carson J.S., PH , Englewood Cliffs, NJ, 1984.
3. Simulation of Manufacturing Systems, Carrie A. , Wiley, NY, 1990.
4. A Course in Simulation, Ross, S.M., McMillan, NY, 1990.
5. Simulation Modelling and SIMNET , Taha H.A. , PH, Englewood Cliffs, NJ, 1987
6. Performance modeling and analysis of manufacturing systems, Viswanat Narahari, PHI

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M. Tech – I year II Sem. (PE&ED)	**L**	**T**	**P**	**C**
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(17D90201) MECHANICS & MANUFACTURING METHODS OF COMPOSITES

Course objectives: The objective for this course is to develop an understanding of the linear elastic analysis of composite materials. This understanding will include concepts such as anisotropic material behavior and the analysis of laminated plates. The students will undertake a design project involving application of fiber reinforced laminates.

UNIT-I

Introduction to Composite Materials: Introduction ,Classification: Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber-Reinforced Composites and nature-made composites, and applications .

Reinforcements: Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

Processing methods: Autoclave, contact moulding, compression moulding, filament winding, man layup, pultrusion, vaccum assisted RTM .

UNIT-II

Macromechanical Analysis of a Lamina :Introduction ,Definitions: Stress, Strain ,Elastic Moduli,Strain Energy. 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-III

Hooke's Law for a Two-Dimensional Angle Lamina, Engineering Constants of an Angle Lamina, Invariant Form of Stiffness and Compliance Matrices for an Angle Lamina Strength Failure Theories of an Angle Lamina : Maximum Stress Failure Theory Strength Ratio,Failure Envelopes,Maximum Strain Failure Theory ,Tsai–Hill Failure Theory, Tsai–Wu Failure Theory, Comparison of Experimental Results with Failure Theories. Hygrothermal Stresses and Strains in a Lamina: Hygrothermal Stress–Strain Relationships for a Unidirectional Lamina, Hygrothermal Stress–Strain Relationships for an Angle Lamina

UNIT-IV

Micromechanical Analysis of a Lamina :Introduction, Volume and Mass Fractions, Density, and Void Content, Evaluation of the Four Elastic Moduli, Strength of Materials Approach, Semi-Empirical Models ,Elasticity Approach, Elastic Moduli of Lamina with Transversely Isotropic Fibers, Ultimate Strengths of a Unidirectional Lamina, Coefficients of Thermal Expansion, Coefficients of Moisture Expansion.

UNIT-V

Macromechanical Analysis of Laminates: Introduction , Laminate Code , Stress–Strain Relations for a Laminate, In-Plane and Flexural Modulus of a Laminate , Hygrothermal Effects in a Laminate, Warpage of Laminates.

Failure, Analysis, and Design of Laminates : Introduction , Special Cases of Laminates, Failure Criterion for a Laminate, Design of a Laminated Composite, Other Mechanical Design Issues

Course Outcomes:

Students who successfully complete the course will demonstrate the following outcomes by tests, homework, and design project.

1. An ability to identify the properties of fiber and matrix materials used in commercial composites, as well as some common manufacturing techniques.
2. An ability to predict the elastic properties of both long and short fiber composites based on the constituent properties.
3. An ability to rotate stress, strain and stiffness tensors using ideas from matrix algebra.

Text Books:

1. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press, 1994.
2. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley- Interscience, New York, 1980.
3. Mechanics of Composite Materials, Second Edition (Mechanical Engineering), By Autar K. Kaw ,Publisher: CRC

REFERENCES:

1. 1. R. M. Jones, Mechanics of Composite Materials, Mc Graw Hill Company, New York, 1975.
2. L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold, New York, 1969.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M. Tech – I year II Sem. (PE&ED)	**L**	**T**	**P**	**C**
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(17D04205) COMPUTER GRAPHICS
Elective-III

Course Objective: The students can understand the Basics of computer Graphics like drawing line, arc etc., Drawing of spline curves ,Creation of surfaces, Algorithms for 3D viewing, Available drawing standards

UNIT -I

Introduction to computer graphics: Color CRT raster scan monitors, plasma display & liquid crystal display monitors, computer input devices, hard copy devices.

Raster scan graphics: Line drawing algorithms – DDA & Bresenham algorithms, circle generation, general function rasterization, displaying lines, characters and polygons

UNIT-II

Filling algorithms: polygon filling, edge fill algorithm, seed fill algorithm, fundamentals of antialiasing and half toning.

UNIT–III

Line CLIPPING: Simple visibility algorithm, Cohen-Sutherland subdivision line clipping algorithm, mid point sub division algorithm.

Polygon clipping: polygon clipping, reentrant polygon clipping – Sutherland – Hodgeman algorithm, character clipping, 3D- clipping.

UNIT-IV

Transformations: Cartesian and homogeneous coordinate systems two dimensional and three dimensional transformations – scaling, rotation, Shearing, Zooming, viewing transformation, reflection, rotation about an axis, concatenation.

Unit -V

Rendering: Hidden line removal algorithms, surface removal algorithms, painters, Warnock, Z-buffer algorithm.

Shading algorithms: Constant intensity algorithm, Phong's shading algorithm, gourand shading algorithm, Comparison of shading algorithms.

Course Outcomes:

The students can understand the following

1. Basics of computer Graphics like drawing line, arc etc.
2. Drawing of spline curves
3. Creation of surfaces
4. Algorithms for 3D viewing

TEXT BOOKS:

Procedural elements for computer graphics-D.F.Rogers, Tata McGraw-Hill.
Computer Graphics-Donald Hearn & M.P. Bakers.
Computer graphics-Harrington.

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(17D15104) MATERIALS TECHNOLOGY

Elective-III

Course Objectives:

1. Able to understand the concept of materials i.e., conventional materials such as metallic and nonmetallic materials with their structures and applications
2. Explain the differences in properties of different materials, including metals, alloys, ceramics, polymers and composites
3. Relate the properties of materials to microstructure (quantitative skills)
4. Describe the basics of processing techniques for altering the microstructure and properties of different materials.

UNIT–I:

Elasticity in metals and polymers, mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals, strengthening mechanism, work hardening, solid solution, grain boundary strengthening. precipitation, particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behavior, super plasticity, deformation of non crystalline material.

UNIT–II:

Griffth's Theory of brittle fracture stress intensity factor and fracture Toughness, Toughening Mechanisms, Ductile and Brittle transition in steel, High Temperature Fracture, Creep, Larson – Miller Parameter, Deformation and Fracture mechanism maps. Simple problems.

UNIT–III:

Fatigue, Low and High cycle fatigue test, Crack Initiation and Propagation mechanism and Paris Law, Effect of surface and metallurgical parameters on Fatigue, effect of creep on fatigue. Fracture of non-metallic materials, fatigue analysis, Sources of failure, procedure of failure analysis. Selection for Surface durability, Corrosion and Wear resistance, Relationship between Materials Selection and Processing

UNIT–IV:

Modern Metallic Materials: Dual Phase Steels, Micro alloyed, High Strength Low alloy (HSLA) Steel, Transformation induced plasticity (TRIP) Steel, Maraging Steel, Intermetallics, Ni and Ti Aluminides. Smart Materials, Shape Memory alloys, Metallic Glass, Quasi Crystal and Nano Crystalline Materials. Metal-Matrix composites

UNIT-V

Nonmetallic Materials: Polymeric materials and their molecular structures, Production Techniques for Fibers, Foams, Adhesives and Coatings, Structure, Properties and Applications of engineering Polymers. Advanced structure of ceramics –WC, TiC, Al_2O_3, SiC, CBN and diamond- properties and applications, Composite Materials.

Course Outcomes:

1. Students are capable to define the concept of materials i.e., conventional materials with their structure, such as electronic configuration, structure of atom, etc.
2. Students become aware of different conventional materials such as metallic and nonmetallic materials, structures and their applications.
3. Students will be able to demonstrate the need for newer materials by comparing the limitations of conventional materials.
4. They will be able to compare the types of newer materials along with their properties and applications.
5. They will be able to compile about the properties, structure of ceramic materials and their need for newer applications and processing techniques

TEXT BOOKS:

1. Mechanical Behaviour of Materials, Thomas H. Courtney, 2nd Edition, McGraw Hill,2000.
2. Mechanical Metallurgy, George E. Dieter, McGraw Hill,1998.

REFERENCE BOOK:

1. Selection and use of Engineering Materials,Charles J.A, Butterworth Heiremann

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(17D90202) NON-DESTRUCTIVE EVALUATION

Elective III

Course objective:

To introduce all types of NDT and their applications in Engineering.

UNIT I:

Introduction to various non-destructive methods, Comparison of Destructive and Non destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications.

Physical principles, procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods-water washable, Post – Emulsification methods, Applications

UNIT II:

Eddy current testing & acoustic emission, Principles, Instrumentation for ECT, Absolute, differential probes, Techniques – High sensitivity techniques, Multi frequency, Phased array ECT, Applications.

Principle of AET, Instrumentation, Applications - testing of metal pressure vessels, Fatigue crack detection in aerospace structures.

UNIT III :

Magnetic particle testing & thermography, Principle of MPT, procedure used for testing a component, Equipment used for MPT, Magnetizing techniques, Applications.

Principle of Thermography, Infrared Radiometry, Active thermography measurements, Applications – Imaging entrapped water under an epoxy coating, Detection of carbon fiber contaminants.

UNIT IV:

Ultrasonic testing, Principle, Ultrasonic transducers, Ultrasonic Flaw detection Equipment, Modes of display A- scan, BScan, C- Scan, Applications, Inspection Methods - Normal Incident Pulse-Echo Inspection, Normal Incident Through-transmission Testing, Angle Beam Pulse-Echo testing, TOFD Technique, Applications of Normal Beam Inspection in detecting fatigue cracks, Inclusions, Slag, Porosity and Intergranular cracks - Codes, standards, specification and procedures and case studies in ultrasonics test.

UNIT V:

Radiography- Principle of Radiography, x-ray and gamma ray sources- safety procedures and standards, Effect of radiation on Film, Radiographic imaging, Inspection Techniques – Single wall single image, Double wall Penetration, Multiwall Penetration technique, Real Time Radiography - Codes, standards, specification and procedures and case studies in Radiography test. Case studies on defects in cast, rolled, extruded, welded and heat treated components – Comparison and selection of various NDT techniques

Course Outcomes:

- Various magnetizing methods may be used for practical purposes.
- Magnetic particle method and ultrasonic methods can be used to locate defects.
- Various other NDT methods to be studied

REFERENCES:

1. Baldev Raj, Jeyakumar,T., Thavasimuthu,M., "Practical Non Destructive Testing" Narosa publishing house, New Delhi, 2002
2. Peter J. Shull "Non Destructive Evaluation: Theory, Techniques and Application" Marcel Dekker,
Inc., New York, 2002
3. Krautkramer. J., "Ultra Sonic Testing of Materials", 1st Edition, Springer – Verlag Publication, New
York, 1996.

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M. Tech – I year II Sem. (PE&ED)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17D15101) ADVANCED MECHANISMS
Elective IV

Course Objectives:
To develop student understanding of the theoretical background for basic and advanced kinematics and synthesis of mechanisms to achieve desired motion.
To introduce students to basic and advanced computer-based tools for analysis and synthesis of mechanisms.
To provide an opportunity for students to use theory and application tools through a major mechanism design project.
To improve student ability to communicate understanding of the subject through professional technical reports and oral presentations.

UNIT-I
Introduction: Elements of Mechanisms; Mobility Criterion for Planar mechanisms and manipulators; Mobility Criterion for spatial mechanisms and manipulators. Spherical mechanisms-spherical trigonometry.
Kinematics of plane motion- I: The Inflection circle ; Euler – Savary Equation; Analytical and graphical determination of d_i ; Bobillier's Construction ;Collineastion axis ; Hartmann's Construction ;Inflection circle for the relative motion of two moving planes; Application of the Inflection circle to kinematic analysis.

UNIT-II
Kinematics of plane motion - II: Polode curvature; Hall's Equation; Polode curvature in the four bar mechanism; coupler motion; relative motion of the output and input links; etermination of the output angular acceleration and its Rate of change; Freudenstein's collineation –axis theorem; Carter –Hall circle; The circling – point curve for the Coupler of of a four bar mechanism.

UNIT-III
Introduction to Synthesis-Graphical Methods: The Four bar linkage ;Guiding a body through Two distinct positions; Guiding a body through Three distinct positions; The Rotocenter triangle ; Guiding a body through Four distinct positions; Burmester's curve.
Function generation- General discussion; Function generation: Relative –rotocenter method, Overlay's method, Function generation- Velocity – pole method; Path generation: Hrones's and Nelson's motion Atlas, Roberts's theorem.

UNIT-IV
Introduction to Synthesis - Analytical Methods: Function Generation: Freudenstien's equation, Precision point approximation, Precision – derivative approximation; Path Generation: Synthesis of Four-bar Mechanisms for specified instantaneous condition; Method of components; Synthesis of Four-bar Mechanisms for prescribed extreme values of the angular velocity of driven link; Method of components.

UNIT-V

Manipulator kinematics: D-H notation, D-H convention of assignment of co-ordinate frames and link parameters table;D-H transformation matrix ; Direct and Inverse kinematic analysis of Serial manipulators: Articulated ,spherical & industrial robot manipulators- PUMA, SCARA,STANFORD ARM, MICROBOT.

Differential kinematics Formulation of Jacobian for planar serial manipulators and spherical manipulator; Singularity analysis.

Course Outcome:

Study of advanced topics in kinematics with a focus of mechanism synthesis techniques. The course will primarily focus on planar mechanism, but will also treat spherical and spatial mechanisms.

Text Books:

1. Jeremy Hirschhorn, Kinematics and Dynamics of plane mechanisms, McGraw-Hill,1962.
2. L.Sciavicco and B.Siciliano, Modelling and control of Robot manipulators, Second edition, Springer -Verlag,London,2000.
3. Amitabh Ghosh and Ashok Kumar Mallik, Theory of Mechanisms and Machines. E.W.P.Publishers.

REFERENCES:

1. Allen S.Hall Jr., Kinematics and Linkage Design, PHI,1964.
2. J.E Shigley and J.J . Uicker Jr., Theory of Machines and Mechanisms , McGraw-Hill, 1995.
3. Mohsen Shahinpoor, A Robot Engineering Text book,Harper & Row Publishers, New York,1987.
4. Joseph Duffy, Analysis of mechanisms and Robot manipulators, Edward Arnold,1980

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M. Tech – I year II Sem. (PE&ED)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17D90203) ADVANCED METAL FORMING

ELECTIVE-IV

Course Objective:
To study and observe through demonstration the metal forming processes (Rolling, Forging and Sheet metal forming)

UNIT-I
Fundamentals of Metal Forming: Classification of forming processes, mechanisms of metal forming: slab method, Upper and lower bound analysis, Deformation energy method and finite element method.
Rolling of metals: Rolling processes, forces and geometrical relationship in rolling, simplified analysis, rolling load, rolling variables, theories of cold and hot rolling, problems and defects in rolling, torque and power calculations, Problems.

UNIT-II
Forging: Classification of forging processes, forging of plate, forging of circular discs, open die and closed-die forging, forging defects, and powder metallurgy forging. problems on flow stress ,true strain and forging load.
Extrusion: Classification, Hot Extrusion, Analysis of Extrusion process, defects in extrusion, extrusion of tubes, production of seamless pipes. Problems on extrusion load.

UNIT–III
Press tool design: Design of various press tools and dies like piercing dies, blanking dies, compound dies and progressive blanking dies, design of bending, forming.
Sheet Metal forming: Forming methods, Bending, stretch forming, spinning and Advanced techniques of Sheet Metal Forming, Forming limit criteria, defect in formed parts.

UNIT-IV
Drawing: Drawing of tubes, rods, and wires: Wire drawing dies, tube drawing process, analysis of wire, deep drawing and tube drawing. Problems on draw force. Design of drawing dies.

UNIT-V
Advanced Metal forming processes: HERF, Electromagnetic forming, residual stresses, in-process heat treatment and computer applications in metal forming. Problems on Blanking force, Blank diagram in Cup Diagram, Maximum considering shear.

Course Outcomes:

1. To acquire a deeper knowledge about metal forming under different conditions and in various processes.
2. Metal forming fundamentals and applications.
3. Metal forming mechanics.
4. Workability of testing techniques.

TEXT BOOKS:

1. Mechanical Metallurgy, G.E. Dieter , Tata McGraw Hill, 1998. III Edition
2. Principles of Metal Working , Sunder Kumar

REFERENCES:

1. Principles of Metal Working processes , G.W. Rowe
2. ASM Metal Forming Hand book.

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M. Tech – I year II Sem. (PE&ED)	**L**	**T**	**P**	**C**
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(17D90204) FRICTION AND WEAR IN MACHINERY
Elective IV

Course Objectives:
1. To develop an understanding on the principles and engineering significance of tribology.
2. It highlights the tribological considerations for the design of various machine elements.

UNIT–I
Introduction to Tribology- History of Tribology, interdisciplinary approach- economic benefits

UNIT-II
Friction causes of friction- Adhesion Theory- abrasive theory- Junction growth theory- Laws of rolling friction – Friction instability

UNIT-III
Wear- Wear mechanisms- Adhesive wear- Corrosive wear- abrasive wear- Fretting wear- wear analysis

UNIT-IV
Lubricants and lubrication- Importance to lubrication- Boundary lubrication- mixed lubrication- Full Fluid Film Lubrication Hydrodynamic lubrication- Elasto Hydrodynamic lubrication- Types and properties of lubricants- lubricants additives.

UNIT-V
Fluid Film Lubrication –Fluid Mechanics Concepts- Equation of Continuity and motion, Generalised Reynolds Equation with Compressible and Incompressible lubricants.
Rolling contact bearings –Gears-Journal Bearings- Finite Bearing

Course Outcomes:
The students will be able to:
1. Identify the causes of wears and friction in different contact surfaces.
2. Perform design calculations of hydrostatic and hydrodynamic lubrication for basic problems.
3. Design and analyze the performance of bearings

REFERENCE BOOK:
Ludema K.C- Friction, Wear, Lubrication- A Text Book in Tribology – CRC Press 2010

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M. Tech – I year II Sem. (PE&ED)

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(17D11211) MANUFACTURING SIMULATION LABORATORY

1. Study of elements , entities , activities and basic models of a simulation package modeling and simulation

2. Throughput analysis of a individual production facility using simulation.

3. Modeling of a typical manufacturing facility and study its performances.

4. Breakdown analysis of a production facility with one machine

5. Breakdown analysis of a production system having multiple machines

6.Modeling and Simulation of layouts

7.Study of transport system in a shop floor

8.Buffer size design

9.Identification of bottleneck machine on a given shop floor

10.Study of conjunction, collision and dead locks through simulation

Lab Facilities

Adequate number of Computer Systems in Networked Environment

Packages:

1. QUEST
2. PROMODEL
3. FLEXSIM
4. AUTOMOD
5. WITNESS

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
M.Tech III semester (PE&ED)

L	T	P	C
4	0	0	4

(17D20301) RESEARCH METHODOLOGY
(Elective V-OPEN ELECTIVE)

UNIT I

Meaning of Research – Objectives of Research – Types of Research – Research Approaches – Guidelines for Selecting and Defining a Research Problem – research Design – Concepts related to Research Design – Basic Principles of Experimental Design.

UNIT II

Sampling Design – steps in Sampling Design –Characteristics of a Good Sample Design – Random Sampling Design.
Measurement and Scaling Techniques-Errors in Measurement – Tests of Sound Measurement – Scaling and Scale Construction Techniques – Time Series Analysis – Interpolation and Extrapolation.
Data Collection Methods – Primary Data – Secondary data – Questionnaire Survey and Interviews.

UNIT III

Correlation and Regression Analysis – Method of Least Squares – Regression vs Correlation – Correlation vs Determination – Types of Correlations and Their Applications

UNIT IV

Statistical Inference: Tests of Hypothesis – Parametric vs Non-parametric Tests – Hypothesis Testing Procedure – Sampling Theory – Sampling Distribution – Chi-square Test – Analysis of variance and Co-variance – Multi-variate Analysis.

UNIT V

Report Writing and Professional Ethics: Interpretation of Data – Report Writing – Layout of a Research Paper – Techniques of Interpretation- Making Scientific Presentations in Conferences and Seminars – Professional Ethics in Research.

Text Books:

1. Research Methodology:Methods And Techniques – C.R.Kothari, 2nd Edition,New Age International Publishers.
2. Research Methodology: A Step By Step Guide For Beginners- Ranjit Kumar, Sage Publications (Available As Pdf On Internet)

3. Research Methodology And Statistical Tools – P.Narayana Reddy And G.V.R.K.Acharyulu, 1st Edition,Excel Books,New Delhi.

REFERENCES:

1. Scientists Must Write - Robert Barrass (Available As Pdf On Internet)
2. Crafting Your Research Future –Charles X. Ling And Quiang Yang (Available As Pdf On Internet)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
M.Tech III semester (PE&ED)

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4	0	0	4

(17D20302) HUMAN VALUES AND PROFESSIONAL ETHICS
(Elective V-OPEN ELECTIVE)

Unit I:
HUMAN VALUES:Morals, Values and Ethics-Integrity-Work Ethic-Service learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty - Courage- Co Operation – Commitment – Empathy –Self Confidence Character – Spirituality.

Unit II:
ENGINEERING ETHICS: Senses of Engineering Ethics- Variety of moral issues – Types of inquiry – Moral dilemmas – Moral autonomy –Kohlberg‟s theory- Gilligan‟s theory- Consensus and controversy – Models of professional roles- Theories about right action- Self interest - Customs and religion –Uses of Ethical theories – Valuing time –Co operation – Commitment.

Unit III :
ENGINEERING AS SOCIAL EXPERIMENTATION: Engineering As Social Experimentation – Framing the problem – Determining the facts – Codes of Ethics – Clarifying Concepts – Application issues – Common Ground - General Principles – Utilitarian thinking respect for persons.

UNIT IV:
ENGINEERS RESPONSIBILITY FOR SAFETY AND RISK: Safety and risk – Assessment of safety and risk – Risk benefit analysis and reducing riskSafety and the Engineer- Designing for the safety- Intellectual Property rights(IPR).

UINIT V:
GLOBAL ISSUES: Globalization – Cross culture issues- Environmental Ethics – Computer Ethics – Computers as the instrument of Unethical behavior – Computers as the object of Unethical acts – Autonomous Computers- Computer codes of Ethics – Weapons Development - Ethics .

Text Books :
1. “Engineering Ethics includes Human Values” by M.Govindarajan, S.Natarajan and V.S.SenthilKumar-PHI Learning Pvt. Ltd-2009.
2. “Engineering Ethics” by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.
3. “Ethics in Engineering” by Mike W. Martin and Roland Schinzinger – Tata McGrawHill– 2003.

4. “Professional Ethics and Morals” by Prof.A.R.Aryasri, Dharanikota Suyodhana-Maruthi Publications.
5. “Professional Ethics and Human Values” by A.Alavudeen, R.Kalil Rahman and M.Jayakumaran , Laxmi Publications.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
M.Tech III semester (PE&ED)

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(17D20303) INTELLECTUAL PROPERTY RIGHTS
(Elective V-OPEN ELECTIVE)

UNIT – I

Introduction To Intellectual Property: Introduction, Types Of Intellectual Property, International Organizations, Agencies And Treaties, Importance Of Intellectual Property Rights.

UNIT – II

Trade Marks : Purpose And Function Of Trade Marks, Acquisition Of Trade Mark Rights, Protectable Matter, Selecting And Evaluating Trade Mark, Trade Mark Registration Processes.

UNIT – III

Law Of Copy Rights : Fundamental Of Copy Right Law, Originality Of Material, Rights Of Reproduction, Rights To Perform The Work Publicly, Copy Right Ownership Issues, Copy Right Registration, Notice Of Copy Right, International Copy Right Law.

Law Of Patents : Foundation Of Patent Law, Patent Searching Process, Ownership Rights And Transfer

UNIT – IV

Trade Secrets : Trade Secrete Law, Determination Of Trade Secrete Status, Liability For Misappropriations Of Trade Secrets, Protection For Submission, Trade Secrete Litigation.

Unfair Competition : Misappropriation Right Of Publicity, False Advertising.

UNIT – V

New Development Of Intellectual Property: New Developments In Trade Mark Law ; Copy Right Law, Patent Law, Intellectual Property Audits.

International Overview On Intellectual Property, International – Trade Mark Law, Copy Right Law, International Patent Law, International Development In Trade Secrets Law.

TEXT BOOKS & REFERENCES:

1. Intellectual Property Right, Deborah. E. Bouchoux, Cengage Learing.
2. Intellectual Property Right – Nleashmy The Knowledge Economy, Prabuddha Ganguli, Tate Mc Graw Hill Publishing Company Ltd.,