JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)
III YEAR COURSE STRUCTURE & SYLLABUS (R16)

Applicable From 2016-17 Admitted Batch

III YEAR I SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	MT501PC	Mechanical Measurements and Control Systems	4	0	0	4
2	MT502PC	Manufacturing Process & Machine Tools	4	0	0	4
3	MT503PC	Finite Element Techniques	4	0	0	4
4	SM504MS	Fundamentals of Management	3	0	0	3
5		Open Elective – I	3	0	0	3
6	MT505PC	Manufacturing Process Lab	0	0	3	2
7	ME506PC	Machine Tools Lab	0	0	3	2
8	MT507PC	Heat Transfer Lab	0	0	3	2
9	*MC500HS	Professional Ethics	3	0	0	0
		Total Credits	**21**	**0**	**9**	**24**

III YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	-	Open Elective - II	3	0	0	3
2		**Professional Elective - I**				
	MT611PE	Machine Drawing	2	0	4	4
	MT612PE	Total Quality Management	3	0	0	3
	MT613PE	Unconventional Machining Processes	3	0	0	3
	MT614PE	Nanotechnology	3	0	0	3
3	MT601PC	Dynamics of Machinery	4	1	0	4
4	MT602PC	Motion Control Design	4	0	0	4
5	MT603PC	CAD/CAM	4	0	0	4
6	MT604PC	Instrumentation and Control Systems Lab	0	0	3	2
7	MT605PC	CAD/CAM Lab	0	0	3	2
8	EN606HS	Advanced English Communication Skills Lab	0	0	3	2
		Total Credits	**17/18**	**1**	**9/13**	**24/25**

During Summer Vacation between III and IV Years: Industry Oriented Mini Project

***Open Elective** subjects' syllabus is provided in a separate document.

***Open Elective –** Students should take Open Electives from the List of Open Electives Offered by Other Departments/Branches Only.

Ex: - A Student of Mechanical Engineering can take Open Electives from all other departments/branches except Open Electives offered by Mechanical Engineering Dept.

MECHANICAL MEASUREMENTS AND CONTROL SYSTEMS

	L	T	P	C
B.Tech. III Year I Sem.				
Course Code: MT501PC	**4**	**0**	**0**	**4**

UNIT-I

Definition – Basic principles of measurement – Measurement systems, generalized configuration and functional descriptions of measuring instruments – examples. Dynamic performance characteristics – sources of error, Classification, and elimination of error.

Measurement of Displacement: Theory and construction of various transducers to measure displacement – Piezo electric, Inductive, capacitance, resistance, ionization, and Photo electric transducers, Calibration procedures.

Measurement of Temperature: Classification – Ranges – Various Principles of measurement – Expansion, Electrical Resistance – Thermistor – Thermocouple – Pyrometers – Temperature Indicators.

UNIT-II

Measurement Of Pressure: Units – classification – different principles used. Manometers, Piston, Bourdon pressure gauges, Bellows – Diaphragm gauges. Low pressure measurement – Thermal conductivity gauges – ionization pressure gauges, Mcleod pressure gauge.

Measurement Of Level: Direct method – Indirect methods – capacitative, ultrasonic, magnetic, cryogenic fuel level indicators – Bubler level indicators.

Flow Measurement: Rotameter, magnetic, Ultrasonic, Turbine flow meter, Hot – wire anemometer, Laser Doppler Anemometer (LDA).

UNIT-III

Measurement Of Speed: Mechanical Tachometers – Electrical tachometers – Stroboscope, Non- contact type of tachometer

Measurement of Acceleration and Vibration: Different simple instruments-Principles of Seismic instruments – Vibrometers and accelerometers.

Stress Strain Measurements: Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, Strain gauge Rosettes.

UNIT-IV

Measurement Of Humidity – Moisture content of gases, sling psychrometer, Absorption psychrometer, Dew point meter

Measurement of Force, Torque and Power- Elastic force meters, load cells, Torsion meters, Dynamometers.

UNIT-V

Elements Of Control Systems: Introduction, Importance – Classification – Open and closed systems Servomechanisms – Examples with block diagrams – Temperature, speed and position control systems.

TEXT BOOKS:

1. Measurement Systems: Applications &design by Ernest O. Doebelin, TMH.
2. Measurement systems: Applications & design by D.S Kumar

REFERENCE BOOKS:

1. Instrumentation, measurement & analysis by B. C. Nakra & K. K. Choudhary, TMH
2. Experimental Methods for Engineers / Holman
3. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.
4. Mechanical Measurements / Sirohi and Radhakrishna / New Age
5. Instrumentation & mechanical Measurements by A.K. Tayal , Galgotia Publications

MANUFACTURING PROCESS AND MACHINE TOOLS

B.Tech. III Year I Sem.	L	T	P	C
Course Code: MT502PC	4	0	0	4

UNIT – I

Casting: Steps involved in making a casting - Its applications - Patterns and Types of patterns – Pattern allowances and their construction. Types of casting processes – Solidification of casting.

Welding: Classification of Welding Processes - Arc welding, forge welding – Resistance welding, Thermit welding, Explosive Welding, Electron Beam Welding and Laser Beam Welding. Inert Gas Welding, TIG Welding, MIG welding, soldering and Brazing, Heat affected zone in welding. Welding defects – causes and remedies – destructive and non-destructive testing of welds.

UNIT – II

Forming: Hot working, cold working, strain hardening, recovery, recrystallisation, and grain growth, Comparison of properties of Cold and Hot worked parts, rolling fundamentals – theory of rolling, types of Rolling mills and products.

Blanking and piercing – Bending and forming – Drawing and its types – wire drawing and Tube drawing – coining –spinning – Types of presses and press tools.

UNIT – III

Extrusion of Metals: Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion – Extruding equipment – Tube extrusion and pipe making, Hydrostatic extrusion.

Forging Processes: Forging operations and principles – Forging methods

UNIT – IV

Machining: Mechanics of orthogonal cutting – Lathe: Merchant's Force diagram, cutting forces – cutting speeds, feed, depth of cut, tool life, coolants, Machinability – Tool materials. Principle of working, specification of lathe – types of lathe – works and tool holding devices, Taper turning, Thread turning. Turret and capstan lathe – Principal features of automatic lathes.

Shaping, slotting and planing machines – Principles of working – Principal parts – specification, classification, and operations performed. Drilling and Boring Machines – Principles of working, specifications, types, operations performed – tool holding devices – twist drill – Boring machines.

UNIT – V

Milling machine – Principles of working – specifications – classifications of milling machines – Principal features of horizontal, vertical and universal milling machines – Geometry of milling cutters – methods of indexing – Accessories to milling machines, kinematic scheme of milling machines. Lapping, honing, and broaching machines –

comparison of grinding, lapping and honing. **Finishing Processes:** Grinding – fundamentals – theory of grinding – classification of grinding machines – cylindrical and surface grinding machine-Tool and cutter grinding machine

TEXT BOOKS:

1. Manufacturing Technology (Vol. 1 & Vol. 2) / P.N. Rao/TMH/2nd Edition

REFERENCE BOOKS:

1. Principles of Metal Castings / Rosenthal/TMH
2. A Course in Workshop Technology/B.S. Raghuwamshi /Dhanpat rai & Sons
3. Manufacturing Engineering and Technology/Kalpakjin S/ Pearson Edu.
4. Principles of Machine Tools/ Bhattacharya A and Sen.G.C/ New Central Book Agency.
5. Elements of Work Shop Technology – Vol. II/Hajra Choudry/ Media Promoters.
6. Fundamentals of Metal Machining and Machine Tools/ Geofrey Boothroyd/ McGraw Hill

FINITE ELEMENT TECHNIQUES

B.Tech. III Year I Sem.	**L**	**T**	**P**	**C**
Course Code: MT503PC	**4**	**0**	**0**	**4**

UNIT - I

Basic Concepts, applications of FEM, Basic equations in FEM, Methods in FEM. One Dimensional problems- Stiffness equations for a axial bar element in local co-ordinates using potential energy approach and virtual energy principle – properties of stiffness matrix. Familiarization of ANSYS software for solving Finite element problems.

Finite element analysis of uniform, stepped and tapered bars subjected to mechanical and thermal loads-Assembly of global stiffness matrix and load vector-Quadratic shape functions-Problems.

UNIT – II

Stiffness equations for a truss bar element oriented in 2D plane-Finite element analysis of trusses-Plane truss and space truss elements-methods of assembly-problems

Analysis of beams: Hermite shape functions-Element stiffness matrix- Load vector-Problems.

UNIT – III

2-D Problems: CST element-Stiffness matrix and load vector – Isoparametric element representation – Shape functions – Convergence requirements-Solving of problems

UNIT - IV

Two dimensional four noded isoperimetric elements - numerical integration – finite element modeling of axisymmetric solids subjected to Axisymmetric loading with triangular elements. 3-D problems: Tetrahedron element. Shape functions.

UNIT - V

Heat Transfer:-1-D Heat conduction — Composite slabs – 1D fin problems -2D Heat conduction – Analysis of thin plates. **Dynamic Analysis**: Dynamic equations-Lumped and consistent mass matrices-Eigen values and Eigen vectors – mode shapes – modal analysis for stepped bar and beams.

TEXT BOOK:

1. The Finite Element Methods in Engineering - SS Rao – Elsevier – 4^{th} Edition
2. Introduction to Finite Elements in Engineering-Tirupathi K. Chandragupta and Ashok D. Belagundu.

REFERENCES:

1. An introduction to Finite Element Method - JN Reddy - Mc Graw Hill
2. The Finite Element Method in engineering science – O. C. Zienkowitz, Mc. Graw hill
3. Finite Element Methods/ Alavala/TMH
4. Concepts and applications of finite element analysis-Robert Cook -wiley

FUNDAMENTALS OF MANAGEMENT

	L	T	P	C
B.Tech. III Year I Sem.				
Course Code: SM504MS	**3**	**0**	**0**	**3**

Course Objective: To understand the Management Concepts, applications of Concepts in Practical aspects of business and development of Managerial Skills.

Course Outcome: The students understand the significance of Management in their Profession. The various Management Functions like Planning, Organizing, Staffing, Leading, Motivation and Control aspects are learnt in this course. The students can explore the Management Practices in their domain area.

UNIT-I

Introduction to Management: Definition, Nature and Scope, Functions, Managerial Roles, Levels of Management, Managerial Skills, Challenges of Management; Evolution of Management- Classical Approach- Scientific and Administrative Management; The Behavioral approach; The Quantitative approach; The Systems Approach; Contingency Approach, IT Approach.

UNIT-II

Planning and Decision Making: General Framework for Planning - Planning Process, Types of Plans, Management by Objectives; Development of Business Strategy. Decision making and Problem Solving - Programmed and Non Programmed Decisions, Steps in Problem Solving and Decision Making; Bounded Rationality and Influences on Decision Making; Group Problem Solving and Decision Making, Creativity and Innovation in Managerial Work.

UNIT-III

Organization and HRM: Principles of Organization: Organizational Design & Organizational Structures; Departmentalization, Delegation; Empowerment, Centralization, Decentralization, Recentralization; Organizational Culture; Organizational Climate and Organizational Change.

Human Resource Management & Business Strategy: Talent Management, Talent Management Models and Strategic Human Resource Planning; Recruitment and Selection; Training and Development; Performance Appraisal.

UNIT-IV

Leading and Motivation: Leadership, Power and Authority, Leadership Styles; Behavioral Leadership, Situational Leadership, Leadership Skills, Leader as Mentor and Coach, Leadership during adversity and Crisis; Handling Employee and Customer Complaints, Team Leadership.

Motivation - Types of Motivation; Relationship between Motivation, Performance and Engagement, Content Motivational Theories - Needs Hierarchy Theory, Two Factor Theory, Theory X and Theory Y.

UNIT-V

Controlling: Control, Types and Strategies for Control, Steps in Control Process, Budgetary and Non- Budgetary Controls. Characteristics of Effective Controls, Establishing control systems, Control frequency, and Methods.

TEXT BOOKS:

1. Management Fundamentals, Robert N Lussier, 5e, Cengage Learning, 2013.
2. Fundamentals of Management, Stephen P. Robbins, Pearson Education, 2009.

REFERENCES:

1. Essentials of Management, Koontz Kleihrich, Tata Mc - Graw Hill.
2. Management Essentials, Andrew DuBrin, 9e, Cengage Learning, 2012.

MANUFACTURING PROCESS LAB

B.Tech. III Year I Sem.	**L**	**T**	**P**	**C**
Course Code: MT505PC	**0**	**0**	**3**	**2**

Pre-requisites: Manufacturing Technology

Course Objectives:

- Know about the basic Physical, Chemical Properties of materials
- Explain why some material(s) are better to be used in a product for given design requirements
- Learn the basic operation of various manufacturing processes
- Learn how various products are made using traditional, non-traditional, or Electronics manufacturing processes
- Design simple process plans for parts and products
- Understand how process conditions are set for optimization of production
- Learn how CNC machines work
- Write and execute CNC machining programs to cut parts on a milling machine
- Measure a given manufactured part to evaluate its size, tolerances and surface finish
- Design and fabricate a simple product

Course Outcomes: Understanding the properties of moulding sands and pattern making. Fabricate joints using gas welding and arc welding. Evaluate the quality of welded joints. Basic idea of press working tools and performs moulding studies on plastics.

Minimum of 12 Exercises need to be performed

I. Metal Casting Lab:

1. Pattern Design and making - for one casting drawing.
2. Sand properties testing - Exercise -for strengths, and permeability – 1
3. Moulding Melting and Casting - 1 Exercise

II. Welding Lab:

1. ARC Welding Lap & Butt Joint - 2 Exercises
2. Spot Welding - 1 Exercise
3. TIG Welding - 1 Exercise
4. Plasma welding and Brazing - 2 Exercises
   (Water Plasma Device)

III. Mechanical Press Working:

1. Blanking & Piercing operation and study of simple, compound and progressive press tool.
2. Hydraulic Press: Deep drawing and extrusion operation.
3. Bending and other operations

IV. Processing Of Plastics

1. Injection Moulding
2. Blow Moulding

REFERENCE BOOK:

1. Dictionary of Mechanical Engineering – G.H.F. Nayler, Jaico Publishing House

MACHINE TOOLS LAB

	L	T	P	C
B.Tech. III Year I Sem.				
Course Code: ME506PC	**0**	**0**	**3**	**2**

Course Objectives:

- To import practical exposure to the Machine tools
- To conduct experiments and understand the working of the same.

List of Experiments:

1. Introduction of general purpose machines -Lathe, Drilling machine, Milling machine, Shaper
2. Planing machine, slotting machine, Cylindrical Grinder, surface grinder and tool and cutter grinder
3. Step turning and taper turning on lathe machine
4. Thread cutting and knurling on -lathe machine
5. Drilling and Tapping
6. Shaping and Planning
7. Slotting
8. Milling
9. Cylindrical Surface Grinding
10. Grinding of Tool angles

HEAT TRANSFER LAB

B.Tech. III Year I Sem.	**L**	**T**	**P**	**C**
Course Code: MT507PC	**0**	**0**	**3**	**2**

Pre-requisite: Thermodynamics

Course Objectives: To enable the student to apply conduction, convection and radiation heat transfer concepts to practical applications

Course Outcome: At the end of the lab sessions, the student will be able to

- Perform steady state conduction experiments to estimate thermal conductivity of different materials
- Perform transient heat conduction experiment
- Estimate heat transfer coefficients in forced convection, free convection , condensation and correlate with theoretical values
- Obtain variation of temperature along the length of the pin fin under forced and free convection
- Perform radiation experiments: Determine surface emissivity of a test plate and Stefan- Boltzmann's constant and compare with theoretical value

Minimum twelve experiments from the following:

1. Composite Slab Apparatus – Overall heat transfer co-efficient.
2. Heat transfer through lagged pipe.
3. Heat Transfer through a Concentric Sphere
4. Thermal Conductivity of given metal rod.
5. Heat transfer in pin-fin
6. Experiment on Transient Heat Conduction
7. Heat transfer in forced convection apparatus.
8. Heat transfer in natural convection
9. Parallel and counter flow heat exchanger.
10. Emissivity apparatus.
11. Stefan Boltzman Apparatus.
12. Critical Heat flux apparatus.
13. Study of heat pipe and its demonstration.
14. Film and Drop wise condensation apparatus

PROFESSIONAL ETHICS

B.Tech. III Year I Sem.	**L**	**T**	**P**	**C**
Course Code: MC500HS	**3**	**0**	**0**	**0**

Course Objective: To enable the students to imbibe and internalize the Values and Ethical Behaviour in the personal and Professional lives.

Course Outcome: The students will understand the importance of Values and Ethics in their personal lives and professional careers. The students will learn the rights and responsibilities as an employee, team member and a global citizen.

UNIT - I

Introduction to Professional Ethics: Basic Concepts, Governing Ethics, Personal & Professional Ethics, Ethical Dilemmas, Life Skills, Emotional Intelligence, Thoughts of Ethics, Value Education, Dimensions of Ethics, Profession and professionalism, Professional Associations, Professional Risks, Professional Accountabilities, Professional Success, Ethics and Profession.

UNIT - II

Basic Theories: Basic Ethical Principles, Moral Developments, Deontology, Utilitarianism, Virtue Theory, Rights Theory, Casuist Theory, Moral Absolution, Moral Rationalism, Moral Pluralism, Ethical Egoism, Feminist Consequentialism, Moral Issues, Moral Dilemmas, Moral Autonomy.

UNIT - III

Professional Practices in Engineering: Professions and Norms of Professional Conduct, Norms of Professional Conduct vs. Profession; Responsibilities, Obligations and Moral Values in Professional Ethics, Professional codes of ethics, the limits of predictability and responsibilities of the engineering profession.

Central Responsibilities of Engineers - The Centrality of Responsibilities of Professional Ethics; lessons from 1979 American Airlines DC-10 Crash and Kansas City Hyatt Regency Walk away Collapse.

UNIT - IV

Work Place Rights & Responsibilities, Ethics in changing domains of Research, Engineers and Managers; Organizational Complaint Procedure, difference of Professional Judgment within the Nuclear Regulatory Commission (NRC), the Hanford Nuclear Reservation.

Ethics in changing domains of research - The US government wide definition of research misconduct, research misconduct distinguished from mistakes and errors, recent history of attention to research misconduct, the emerging emphasis on understanding and fostering responsible conduct, responsible authorship, reviewing & editing.

UNIT - V

Global issues in Professional Ethics: Introduction – Current Scenario, Technology Globalization of MNCs, International Trade, World Summits, Issues, Business Ethics and Corporate Governance, Sustainable Development Ecosystem, Energy Concerns, Ozone Deflection, Pollution, Ethics in Manufacturing and Marketing, Media Ethics; War Ethics; Bio Ethics, Intellectual Property Rights.

TEXT BOOKS:

1. Professional Ethics: R. Subramanian, Oxford University Press, 2015.
2. Ethics in Engineering Practice & Research, Caroline Whitbeck, 2e, Cambridge University Press 2015.

REFERENCES

1. Engineering Ethics, Concepts Cases: Charles E Harris Jr., Michael S Pritchard, Michael J Rabins, 4e , Cengage learning, 2015.
2. Business Ethics concepts & Cases: Manuel G Velasquez, 6e, PHI, 2008.

MACHINE DRAWING
(Professional Elective - I)

	L	T	P	D	C
B.Tech. III Year II Sem.					
Course Code: MT611PE	**2**	**0**	**0**	**4**	**4**

Pre-requisites: Engineering graphics

Course objectives: To familiarize with the standard conventions for different materials and machine parts in working drawings. To make part drawings including sectional views for various machine elements. To prepare assembly drawings given the details of part drawings.

Course Outcomes:

- Preparation of engineering and working drawings with dimensions and bill of material during design and development. Developing assembly drawings using part drawings of machine components.
- Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs.
- Types of sections – selection of section planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned.
- Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and tapered features.
- Title boxes, their size, location and details - common abbreviations and their liberal usage
- Types of Drawings – working drawings for machine parts.

Drawing of Machine Elements and simple parts

Selection of Views, additional views for the following machine elements and parts with every drawing proportion.

1. Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws.
2. Keys, cottered joints and knuckle joint.
3. Rivetted joints for plates
4. Shaft coupling, spigot and socket pipe joint.
5. Journal, pivot and collar and foot step bearings.

Assembly Drawings:

Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions.

1. Steam engine parts – stuffing boxes, cross heads, Eccentrics.
2. Machine tool parts: Tail stock, Tool Post, Machine Vices.
3. Other machine parts - Screws jacks, Petrol engine connecting rod, Plummer block
4. Simple designs of steam stop valve, spring loaded safety valve, feed check valve and air cock.

NOTE: First angle projection to be adopted. The student should be able to provide working drawings of actual parts.

TEXT BOOKS:

1. Machine Drawing by / Bhattacharyya / Oxford
2. Machine Drawing with Auto CAD / Goutham Pohit, Goutam Ghosh / Pearson

REFERENCE BOOKS:

1. Machine Drawing / Ajeet Singh / Mc Graw Hill
2. Machine Drawing / N.D. Bhat / Charotar

TOTAL QUALITY MANAGEMENT
(Professional Elective - I)

B.Tech. III Year II Sem.	L	T	P	C
Course Code: MT612PE	3	0	0	3

UNIT - I

Introduction, The concept of TQM, Quality and Business performance, attitude, and involvement of top management, communication, culture and management systems.

Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs. Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

UNIT -II

Customer Focus and Satisfaction: Process vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships.

Bench Marking: Evolution of Bench Marking, meaning of bench marking, benefits of bench marketing, the bench marking procedure, pitfalls of bench marketing.

UNIT- III

Organizing for TQM: The systems approach, organizing for quality implementation, making the transition from a traditional to a TQM organization, Quality Circles, seven Tools of TQM: Stratification, check sheet, Scatter diagram, lshikawa diagram, paneto diagram, Kepner &Tregoe Methodology.

UNIT- IV

The Cost of Quality: Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost information, Accounting Systems and Quality Management.

UNIT -V

ISO9000: Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQC Q- 90. Series Standards, benefits of ISO9000 certification, the third party audit, Documentation ISO9000 and services, the cost of certification implementing the system.

TEXT BOOK:

1. Total Quality Management / Joel E. Ross/Taylor and Franscis Limited
2. Total Quality Management/P. N. Mukherjee/PHI

REFERENCE BOOKS:

1. Beyond TQM / Robert L.Flood
2. Statistical Quality Control / E.L. Grant.
3. Total Quality Management:A Practical Approach/H. Lal
4. Quality Management/Kanishka Bedi/Oxford University Press/2011
5. Total Engineering Quality Management/Sunil Sharma/Macmillan

UNCONVENTIONAL MACHINING PROCESSES
(Professional Elective - I)

	L	T	P	C
B.Tech. III Year II Sem.				
Course Code: MT613PE	**3**	**0**	**0**	**3**

Course Overview:

The objective of this course is to introduce the student to mole advanced topics in the machining processes. The concept of material removal by an edged tool, involving plastic deformation and formation of chips, has been known to man for several hundred years. In recent years on increasing demand for the machining of components of complex shape made hard, difficult - to - machine materials with exacting tolerances ad surface finish has resulted in the development of a number of new machining processes.

Course Objectives:

1. To teach the modeling technique for machining processes
2. To teach interpretation of data for process selection
3. To teach the mechanics and thermal issues associated with chip formation
4. To teach the effects of tool geometry on machining force components and surface finish
5. To teach the machining surface finish and material removal rate

Course Outcomes:

1. Understand the basic techniques of machining processes modeling
2. Understand the mechanical aspects of orthogonal cutting mechanics
3. Understand the thermal aspects of orthogonal cutting mechanics
4. Ability to extend, through modeling techniques, the single point, multiple point and abrasive machining processes
5. Estimate the material removal rate and cutting force, in an industrially useful manner, for practical machining processes.

UNIT – I

Introduction – Need for non-traditional machining methods-Classification of modern machining processes – considerations in process selection. Materials. Applications.

Ultrasonic machining – Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent development.

UNIT - II

Abrasive Jet Machining, Water Jet Machining And Abrasive Water Jet Machine: Basic principles, equipments, process variables, and mechanics of metal removal, MRR, application and limitations.

Electro – Chemical Processes: Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring process, metal removal rate in ECM, Tool design, Surface finish and accuracy economic aspects of ECM – Simple

problems for estimation of metal removal rate. Fundamentals of chemical, machining, advantages and applications.

UNIT - III

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

UNIT – IV

Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes –General Principle and application of laser beam machining – thermal features, cutting speed and accuracy of cut.

UNIT - V

Application of plasma for machining, metal removing mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries. Chemical machining – principle - maskants - applications.

Magnetic abrasive finishing, Abrasive flow finishing, Electro stream drilling, shaped tube electrolyte machining.

TEXT BOOKS:

1. Advanced Machining Processes / VK Jain / Allied publishers
2. Modern Machining Processes - P. C. Pandey, H. S. Shan

REFERENCE BOOKS:

1. Manufacturing Engineering And Technology By Serope Kalpakjain, Pearson Publications. 2001
2. Manufacturing Engineering & Technology, Kalpakjain
3. Unconventional Manufacturing Processes, Singh M.K

NANOTECHNOLOGY
(Professional Elective - I)

	L	T	P	C
B.Tech. III Year II Sem.				
Course Code: MT614PE	**3**	**0**	**0**	**3**

Course Objective: Nano Technology is one of the core subjects of multidisciplinary nature. This has extensive applications in the field of energy, electronics, Biomedical Engg. Etc. Built to specifications by manufacturing matter on the atomic scale, the Nano products would exhibit an order of magnitude improvement in strength, toughness, and efficiency. The objective here is imparting the basic knowledge in Nano Science and Technology.

Course Outcome: The present syllabus of "Introduction to Nano Technology" will give insight into many aspects of Nanoscience, technology and their applications in the prospective of materials science.

UNIT - I

Introduction: History and Scope, Can Small Things Make a Big Difference? Classification of Nanostructured Materials, Fascinating Nanostructures, Applications of Nanomaterials, Nature: The Best of Nanotechnologist, Challenges, and Future Prospects.

UNIT - II

Unique Properties of Nanomaterials: Microstructure and Defects in Nanocrystalline Materials: Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple, and disclinations,

Effect of Nano-dimensions on Materials Behavior: Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, enhanced solid solubility,

Magnetic Properties: Soft magnetic Nanocrystalline alloy, Permanent magnetic Nanocrystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties, and Mechanical Properties.

UNIT - III

Synthesis Routes: Bottom up approaches: Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol-gel method ,Self assembly, **Top down approaches:** Mechanical alloying, Nano-lithography, **Consolidation of Nanopowders**: Shock wave consolidation, Hot isostatic pressing and Cold isostatic pressing Spark plasma sintering.

UNIT - IV

Tools to Characterize Nanomaterials: X-Ray Diffraction (XRD), Small Angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP), Nanoindentation.

UNIT - V

Applications of Nanomaterials: Nano-electronics, Micro- and Nano-electromechanical systems (MEMS/NEMS), Nanosensors, Nanocatalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water-Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defence and Space Applications, Concerns and challenges of Nanotechnology.

TEXT BOOKS:

1. Text Book of Nano Science and Nano Technology – B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, University Press-IIM.
2. Introduction to Nanotechnology – Charles P. Poole, Jr., and Frank J. Owens, Wley India Edition, 2012.

REFERENCES BOOKS:

1. Nano: The Essentials by T. Pradeep, Mc Graw- Hill Education.
2. Nanomaterials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L. Schodek.
3. Transport in Nano structures- David Ferry, Cambridge University press 2000
4. Nanofabrication towards biomedical application: Techniques, tools, Application and impact – Ed. Challa S.,S. R. Kumar, J. H. Carola.
5. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell.
6. Electron Transport in Mesoscopic systems - S. Dutta, Cambridge University press.

DYNAMICS OF MACHINERY

	L	T	P	C
B.Tech. III Year II Sem.				
Course Code: MT601PC	**4**	**1**	**0**	**4**

Pre-requisite: Kinematics of Machinery

Course Objectives: The objective is to introduce some of the components mainly used in IC Engines and make analysis of various forces involved. Subjects deals with topics like inertia forces in slider crank mechanism; IC Engine components & the analysis like governors is introduced. It also deals with balancing of rotating & reciprocating parts. Studies are made about balancing of multi cylinder engines, Radial engines etc. study of primary & secondary forces are considered while balancing. Finally they are introduced to the topic of vibrations. The study deals with linear, longitudinal, & torsional vibrations. The idea is to introduce the concept of natural frequency and the importance of resonance and critical speeds.

Course Outcome: the study of KOM & DOM are necessary to have an idea while designing the various machine members like shafts, bearings, gears, belts & chains and various I.C. Engine Components & Machine tool parts.

UNIT – I

Precession: Gyroscopes – effect of precession – motion on the stability of moving vehicles such as motorcycle – motorcar – aeroplanes and ships.

Static and Dynamic Force Analysis: Static force analysis of planar mechanisms – Analytical Method – Dynamic Force Analysis – D'Alembert's principle, Dynamic Analysis of 4-link mechanism, Slider Crank Mechanism.

UNIT – II

Turning Moment Diagram And Flywheels: Engine Force Analysis – Piston Effort, Crank Effort, etc., Inertia Force in Reciprocating Engine – Graphical Method - Turning moment diagram –fluctuation of energy – flywheels and their design - Inertia of connecting rod-inertia force in reciprocating engines – crank effort and torque diagrams.-.

UNIT – III

Friction: pivots and collars – uniform pressure, uniform wear – friction circle and friction axis: lubricated surfaces – boundary friction – film lubrication. Clutches – Types – Single plate, multi-plate and cone clutches.

Brakes And Dynamometers: Types of brakes: Simple block brake, band and block brake-internal expanding shoe brake-effect of braking of a vehicle. Dynamometers – absorption and transmission types. General description and methods of operation.

UNIT – IV

Governors: Types of governors - Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung with auxiliary springs. Sensitiveness, isochronisms and hunting – stability – effort and power of the governors.

Balancing : Balancing of rotating masses- Primary, Secondary, and higher balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples.

Examination of "V" and multi cylinder in-line and radial engines for primary and secondary balancing- locomotive balancing – Hammer blow – Swaying couple – variation of tractive effort.

UNIT – V

Vibrations: Free Vibration of mass attached to vertical spring – Transverse loads – vibrations of beams with concentrated and distributed loads. Dunkerly's method – Raleigh's method. Whirling of shafts – critical speed – torsional vibrations – one, two and three rotor systems.

TEXT BOOKS:

1. Theory of Machines /S. S. Rattan / Mc Graw Hill.
2. Theory of Machines /Sadhu Singh/ Pearson

REFERENCE BOOKS:

1. Theory of Machines and Mechanisms/Joseph E. Shigley / Oxford
2. Theory of Machines / Rao,J.S / New Age

MOTION CONTROL DESIGN

B.Tech. III Year II Sem. **L T P C**
Course Code: MT602PC **4 0 0 4**

UNIT – I

Introduction to Mechatronics, Mechatronics key elements, Graphical representation, Mechatronics design process, approaches in Mechatronics, Objectives of Mechatronics, Examples of Mechatronic Systems.

UNIT – II

Transmission mechanics – linear power transmission, lead screw, timing belt, conveyors, Rotary transmission - spur gears and planetary transmission. Motors – DC servo motors with encoded feedback – Brushless DC servo motors with Hall- effect sensor, Stepper motors – full step, half step, and microstep. AC induction motors and their applications.

UNIT – III

Control system in Motion control: programmable motion control, closed loop PID control – feed forward control – velocity, acceleration – fundamental concept for adaptive control and fuzzy logic. Programmable Logic Controller: Basic PLC Structures, Input / Output Processing, Ladder Programming, Latching and Internal relays, Sequencing, Timers and counters, Shift registers, Master and Jump controls.

UNIT – IV

INDUSTRIAL HYDRAULICS: Introduction, Merits of Fluid power and its utility for increase in productivity, symbolic representation of hydraulic elements – Hydraulic control valves, Hydraulic cylinders, Hydraulic accessories, and various pumps used in hydraulic system, Hydraulic fluids, Hydraulic circuits using Hydraulic cylinders and other elements. Applications of Hydraulic systems.

UNIT – V

INDUSTRIAL PNEUMATICS: Introduction, Symbolic representations of Pneumatic elements, Compressors and air installation, Pneumatic control valves, Pneumatic actuators, Pneumatic circuits using Pneumatic cylinders and other elements. Fluidics and fluid logic systems. Applications of Pneumatic systems.

TEXT BOOKS:

1. Introduction to Mechatronics and measurement Systems, Alciatore, 2009, 3e, TMH
2. Pneumatic systems - Principles and maintenance, SR Majumdar, TMH
3. Hydraulic systems – Principles and Maintenance, SR MAjumdar, TMH

REFERENCE BOOKS:

1. Mechatronics system design – Devdas shetty & Richard A. Kolk, Thomson, 2007
2. Mechatronics – W. Bolten, Pearson, 2010

3. Principles of Machine Tools – Sen & Bhattacharya
4. Introduction to Mechatronics, Appu Kuttan KK, Oxford Universities Press
5. Mechatronic systems: Fundamentals, Isermann, Springer.

CAD/CAM

	L	T	P	C
B.Tech. III Year II Sem.				
Course Code: MT603PC	**4**	**0**	**0**	**4**

Pre-requisites: To learn the importance and use of computer in design and manufacture

Course objectives: To provide an overview of how computers are being used in design, development of manufacturing plans and manufacture. To understand the need for integration of CAD and CAM

Course Outcomes: Understand geometric transformation techniques in CAD. Develop mathematical models to represent curves and surfaces .Model engineering components using solid modeling techniques. Develop programs for CNC to manufacture industrial components. To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

UNIT – I

Fundamentals of CAD/CAM, Automation , design process, Application of computers for design, Benefits of CAD, Computer configuration for CAD applications, Computer peripherals for CAD, Design workstation, Graphic terminal, CAD software- definition of system software and application software ,CAD database and structure.

Geometric Modeling: 3-D wire frame modeling, wire frame entities and their definitions, Interpolation and approximation of curves, Concept of parametric and non-parametric representation of curves, Curve fitting techniques, and definitions of cubic spline, Bezier, and B-spline.

UNIT-II

Surface modeling: Algebraic and geometric form, Parametric space of surface, Blending functions, parameterization of surface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface. B-spline surface, Regenerative surface and pathological conditions.

Solid Modelling: Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representations.

UNIT – III

NC Control Production Systems: Numerical control, Elements of NC system, NC part programming: Methods of NC part programming, manual part programming, Computer assisted part programming, Post Processor, Computerized part program, SPPL (A Simple Programming Language). CNC, DNC and Adaptive Control Systems.

UNIT – IV

Group Technology: Part families, Parts classification, and coding. Production flow analysis, Machine cell design.

Computer aided process planning: Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type, Machinability data systems.
Computer aided manufacturing resource planning: Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise resource planning, Capacity requirements planning.

UNIT – V
Flexible manufacturing system: F.M.S equipment, FMS layouts, Analysis methods for FMS benefits of FMS.
Computer aided quality control: Automated inspection- Off-line, On-line, contact, Non-contact; Coordinate measuring machines, Machine vision.
Computer Integrated Manufacturing: CIM system, Benefits of CIM , Benefits of CIM
TEXT BOOKS:

1. CAD/CAM /Groover M.P./ Pearson education
2. CAD / CAM Theory and Practice/ Ibrahim Zeid/TMH

REFERENCE BOOKS:

1. CAD/CAM Principles and Applications/P.N.Rao/ TMH
2. CAD/CAM Concepts and Applications/ Alavala/ PHI
3. CAD / CAM / CIM/Radhakrishnan and Subramanian/ New Age
4. Principles of Computer Aided Design and Manufacturing/ Farid Amirouche/ Pearson
5. Computer Numerical Control Concepts and programming/Warren S Seames/ Thomson.

INSTRUMENTATION AND CONTROL SYSTEMS LAB

B.Tech. III Year II Sem.	**L**	**T**	**P**	**C**
Course Code: MT604PC	**0**	**0**	**3**	**2**

Pre-requisites: Basic principles of Instrumentation and control systems

Course Outcomes: At the end of the course, the student will be able to Characterize and calibrate measuring devices. Identify and analyze errors in measurement. Analyze measured data using regression analysis. Calibration of Pressure Gauges, temperature, LVDT, capacitive transducer, rotameter.

1. Calibration of Pressure Gauges.
2. Calibration of transducer for temperature measurement.
3. Study and calibration of LVDT transducer for displacement measurement.
4. Calibration of strain gauge for temperature measurement.
5. Calibration of thermocouple for temperature measurement.
6. Calibration of capacitive transducer for angular displacement.
7. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
8. Calibration of resistance temperature detector for temperature measurement.
9. Study and calibration of a rotameter for flow measurement.
10. Study and use of a Seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
11. Study and calibration of Mcleod gauge for low pressure.
12. Measurement and control of Pressure of a process using SCADA system.
13. Measurement and control of level in a tank using capacitive transducer with SCADA.
14. Measurement and control of temperature of a process using resistance temperature detector with SCADA.
15. Measurement and control of flow of a process using SCADA systems.

CAD / CAM LAB

	L	T	P	C
B.Tech. III Year II Sem.				
Course Code: MT605PC	**0**	**0**	**3**	**2**

Pre-requisites: To give the exposure to usage of software tools for design and manufacturing. To acquire the skills needed to analyze and simulate engineering systems.

Course Objectives: To be able to understand and handle design problems in a systematic manner. To be able to apply CAD in real life applications. To be understand the basic principles of different types of analysis.

Course Outcomes: To understand the analysis of various aspects in of manufacturing design

Note: conduct any TEN excercises from the list gien below:

1. Drafting: Development of part drawings for various components in the form of orthographic and isometric. Representation of dimensioning and tolerances.
2. Part Modeling: Generation of various 3D Models through Protrusion, revolve, sweep. Creation of various features. Study of parent child relation. Feature based and Boolean based modeling and Assembly Modeling. Study of various standard Translators. Design of simple components.
3. Determination of deflection and stresses in 2D and 3D trusses and beams.
4. Determination of deflections, principal and Von-mises stresses in plane stress, plane strain and Axi-symmetric components.
5. Determination of stresses in 3D and shell structures (at least one example in each case)
6. Estimation of natural frequencies and mode shapes, Harmonic response of 2D beam.
7. Study state heat transfer analysis of plane and axi-symmetric components.
8. Development of process sheets for various components based on Tooling and Machines.
9. Development of manufacturing defects and tool management systems.
10. Study of various post processors used in NC Machines.
11. Development of NC code for free form and sculptured surfaces using CAM software.
12. Machining of simple components on NC lathe and Mill by transferring NC Code / from CAM software.

ADVANCED ENGLISH COMMUNICATION SKILLS LAB

	L	T	P	C
B.Tech. III Year II Sem.				
Course Code: EN606HS	**0**	**0**	**3**	**2**

Introduction

A course on *Advanced English Communication Skills (AECS) Lab* is considered essential at the third year level of B.Tech and B.Pharmacy courses. At this stage, the students need to prepare themselves for their career which requires them to listen to, read, speak and write in English both for their professional and interpersonal communication. The main purpose of this course is to prepare the students of Engineering for their placements.

Course Objectives: This Lab focuses on using multi-media instruction for language development to meet the following targets:

- To improve students' fluency in spoken English
- To enable them to listen to English spoken at normal conversational speed
- To help students develop their vocabulary
- To read and comprehend texts in different contexts
- To communicate their ideas relevantly and coherently in writing
- To make students industry-ready
- To help students acquire behavioral skills for their personal and professional life
- To respond appropriately in different socio-cultural and professional contexts

Course Outcomes: Students will be able to:

- Acquire vocabulary and use it contextually
- Listen and speak effectively
- Develop proficiency in academic reading and writing
- Increase possibilities of job prospects
- Communicate confidently in formal and informal contexts

Syllabus

The following course activities will be conducted as part of the Advanced English Communication Skills (AECS) Lab:

1. **Inter-personal Communication and Building Vocabulary** - Starting a Conversation – Responding Appropriately and Relevantly – Using Appropriate Body Language – Role Play in Different Situations - Synonyms and Antonyms, One-word Substitutes, Prefixes and Suffixes, Idioms and Phrases and Collocations.
2. **Reading Comprehension** –General Vs Local Comprehension, Reading for Facts, Guessing Meanings from Context, , Skimming, Scanning, Inferring Meaning.
3. **Writing Skills** – Structure and Presentation of Different Types of Writing – Letter Writing/Resume Writing/ e-correspondence/ Technical Report Writing.
4. **Presentation Skills** – Oral Presentations (individual or group) through JAM Sessions/Seminars/PPTs and Written Presentations through Posters/Projects/Reports/ e-mails/Assignments… etc.,
5. **Group Discussion and Interview Skills** – Dynamics of Group Discussion, Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Organization of Ideas and Rubrics of Evaluation- Concept and Process,

Pre-interview Planning, Opening Strategies, Answering Strategies, Interview through Tele-conference & Video-conference and Mock Interviews.

Minimum Hardware Requirement: Advanced English Communication Skills (AECS) Laboratory shall have the following infrastructural facilities to accommodate at least 35 students in the lab:

- **Spacious room with appropriate acoustics**
- **Eight round tables with five movable chairs for each table.**
- **Audio-visual aids**
- **LCD Projector**
- **Public Address system**
- **Computer with suitable configuration**

Suggested Software: The software consisting of the prescribed topics elaborated above should be procured and used.

- **Oxford Advanced Learner's Compass**, 8th Edition
- **DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.**

REFERENCES:

1. Kumar, Sanjay and Pushp Lata. English for Effective Communication, Oxford University Press, 2015.
2. Konar, Nira. English Language Laboratories – A Comprehensive Manual, PHI Learning Pvt. Ltd., 2011.