TADIPATRI ENGINEERING COLLEGE

(Autonomous)

Veerapuram, (V), Tadipatri, Ananthapuramu (Dist.)-515411.

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M.Tech (Regular-Full time)
CAD/CAM

(Effective for the students admitted into I year from the Academic Year **2025-26** onwards)

MECHANICAL ENGINEERING

I YEAR COURSE STRUCTURE AND SYLLABUS

M.TECH. –MECHANICAL EGINEERING - COURSE STRUCTURE & SYLLABUS – R25

(Applicable from the academic year 2025-26 onwards)

I M.TECH I SEMESTER

S. No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	TEC25MCC0001T	Geometric Dimensioning and Tolerancing	PC	3	0	0	3
2.	TEC25MCC0002T	Advanced Finite Element Methods	PC	3	0	0	3
3.	TEC25MCCPE001a TEC25MCCPE001b TEC25MCCPE001c	**Program Elective – I** a. Computer Integrated Manufacturing b. Geometric Modelling **c.** Design of Hydraulic & Pneumatic Systems	PE	3	0	0	3
4.	TEC25MCCPE002a TEC25MCCPE002b TEC25MCCPE002c	**Program Elective – II** a. Advances in Manufacturing Technology b. Total Quality Management **c.** Computer Aided Process Planning	PE	3	0	0	3
5.	TEC25MCC0010P	Geometric Modelling Laboratory	PC	0	0	4	2
6.	TEC25MCCPE10P	Finite Element Analysis Laboratory	PC	0	0	4	2
7.	TEC25MRM101	Research Methodology and IPR	MC	2	0	0	2
8.	TEC25MCCSO01	**Skill Enhancement Course** Artificial Intelligence and Machine Learning	SE	0	1	2	2
9.	TEC25MAC01a TEC25MAC01b TEC25MAC01c	**Audit Course – I** a. English for Research Paper Writing b. Disaster Management **c.** Essence of Indian Traditional Knowledge	AC	2	0	0	0
Total							**20**

I M.TECH II SEMESTER

S.No.	Course codes	Course Name	Category	Hours per			Credits
				L	T	P	
1.	TEC25MCC0003T	Advanced Optimization Techniques	PC	3	0	0	3
2.	TEC25MCC0004T	Manufacturing Systems: Simulation	PC	3	0	0	3
3.	TEC25MCCPE003a TEC25MCCPE003b TEC25MCCPE003c	**Program Elective – III** 1. Intelligent Manufacturing Systems 2. Smart Manufacturing 3. Industrial Robotics and Expert Systems	PE	3	0	0	3
4.	TEC25MCCPE004a TEC25MCCPE004b TEC25MCCPE004c	**Program Elective – IV** 1. Mechatronics 2.MEMS:Design and Manufacturing 3. Fuzzy Logic and Neural Networks	PE	3	0	0	3
5.	TEC25MCC0020P	Process Automation Laboratory	PC	0	0	4	2
6.	TEC25MCCPE20P	CAM Laboratory	PC	0	0	4	2
7.	TEC25MRMC02	Quantum Technologies and Applications	MC	2	0	0	2
8.	TEC25MCVO01	Comprehensive Viva Voce	PC	0	0	0	2
9.	TEC25MAC02a TEC25MAC02b TEC25MAC02c	**Audit Course – II** a. Pedagogy Studies b. Personality Development through Life Enlightenment Skills c. Yoga for Stress Management	AC	2	0	0	0
Total							**20**

Course Code	TECMCC0001T	GEOMETRIC DIMENSIONING AND TOLERANCING	L	T	P	C
Semester	I		3	0	0	3

Course Objectives:

- Teach the basics of the geometric dimensioning and tolerances.
- Familiar with five groups of GD&T tolerances, form, orientation, location, runout and profile tolerances.
- Introduce tolerances of profiles of lines and surfaces with or without datums.
- Expose the students to various surface roughness parameters and their measurements in two dimensions.
- Understand the concepts of dimensional chains and inspection techniques.

Course Outcomes (CO): Student will be able to

- This course systematically introduces the essentials of the language of geometric dimensioning and tolerancing (GD&T) based on ASME standards, as well as the essentials of surface roughness measurements in both 2D and 3D including filtering techniques.
- This course also introduces the related concepts of Vectorial dimensioning and tolerancing, dimensional chains, measurement uncertainty, etc.
- The knowledge gained by the students by learning the above topics will help them to perform very well in their profession as metrologists as well as product designers.

UNIT – I **Basic Concepts**

General terms and definitions of geometrical features - General principle of sizes - System of limits and fits - Inspection of dimensional and geometrical deviations - Datums, datum systems, and selection of datums. Restraining degrees of freedom, DOF, Simulators. Rule #1(Boundary principle) and Rule #2.

UNIT – II **Form and Orientation Tolerances**

Principles of dimensioning - Introduction to geometric dimensioning and tolerancing (GD&T); Form tolerances: types, specifications and interpretations - measurement and evaluation of straightness, flatness and roundness - Orientation tolerances: types, specifications and interpretations, and verification of orientation tolerances. Exercises on each group. RFS, MMC and LMC concepts.

UNIT – III **Location, Runout and Profile Tolerances**

Tolerances of location: types, specifications and interpretations - verification techniques - Tolerances of profiles of lines and surfaces with or without datums - Tolerances of runout - Tolerancing of angles and cones. Exercises on each group. RFS, MMC and LMC concepts.

UNIT – IV **Surface Roughness**

Various parameters and their measurements in two dimensions - filtering and filtering techniques - areal parameters. Symbology

UNIT – V **Inspection of GD&T call-outs**

Vectorial dimensioning and tolerancing - Statistical tolerancing of mechanical assemblies - Dimensional chains - Measurement uncertainty - Computer-aided tolerancing and verification. Inspection techniques- conventional and CMM.

Textbooks:

1. Drake, P. J., Dimensioning and Tolerance Handbook, McGraw-Hill, Inc., New York. 1999.
2. Meadows, J. D., Geometric Dimensioning and Tolerancing: Applications and Techniques for use in Design, Manufacturing and Inspection, Marcel Dekker, Inc., New York. 1995.
3. Gill, P. S., Geometric Dimensioning and Tolerancing, S. K. Kataria & Sons, New Delhi.
4. ASME 14.5 - 2009 standards
5. Alex Krulikowski, Fundamentals of geometric dimensionining and tolerancing.
6. James D Meadows, ―Measurement of Geometric Tolerances in Manufacturing.

Reference Books:

1. Gupta, I. C., A Textbook of Engineering Metrology, Dhanpat Rai Publications, New Delhi.
2. Galyer, J. F. W. and C. R. Shotbolt, Metrology for Engineers, Cassell Publishers, London.
3. Henzold, G., Handbook of Geometrical Tolerancing: Design, Manufacturing and Inspection, John Wiley & Sons, Chichester.
4. Muralikrishnan, B. and J. Raja, Computational Surface and Roundness Metrology, Springer, USA.
5. Relevant Indian and International Standards.
6. Whitehouse, D. J., Surfaces and their Measurement, Hermes Penton Science, London.

Online Learning Resources:

- https://nptel.ac.in/courses/112/106/112106179/
- https://www.youtube.com/watch?v=X_VepJhq_vk
- https://www.youtube.com/watch?v=cjzSXPDBA_Q&t=1s
- https://www.youtube.com/watch?v=-tLq1wXio0U
- https://digitaldefynd.com/best-gdt-courses/

Course Code			L	T	P	C
TECMCC0002T	ADVANCED FINITE ELEMENT METHODS					
Semester	I		3	0	0	3

Course Objectives:

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

Course Outcomes (CO):

Students can able to solve below following problems.

- Students will learn the mathematical formulation of the finite elementmethod and how to apply it to basic (linear) ordinary and partial differential equations.
- Solve 1- D problems. & 2- D Structural & Heat Transfer Problems using FEA
- Solve Trusses & Beams Problems using FEA.
- Formulate & solve structural & dynamics problems.

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, Beams and frames - 1D**

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.

Fracture Mechanics: Formulation of J Integral.

Textbooks:

1. T.R.Chandraputla&A.D.Belegundu, Introduction to Finite Elements in Engineering, Pearson Education India; 4th edition - 1st January 2015.
2. J. N. Reddy, D.K. Gartling,The Finite Element Method in Heat Transfer and Fluid Dynamics, Taylor & Francis, 6 April 2010.

Reference Books:

1. Zienckiwicz O.C. & R. L. Taylor, Finite Element Method, McGraw-Hill,1983.
2. J. N. Oden, Finite Element of Nonlinear continua, McGraw-Hill, New York, 1971.
3. K. J. Bathe, Finite element procedures, . Prentice-Hall, 1996.
4. Prashant Kumar, Elements of Fracture Mechanics, McGraw Hill Education (India) Private Limited, 2009.
5. Meinhard Kuna, Finite Elements in Fracture Mechanics: Theory - Numerics - Applications, Springer Publications, 2013.

Online Learning Resources:

- https://nptel.ac.in/courses/112/104/112104193/

- https://nptel.ac.in/courses/112/104/112104205/
- https://nptel.ac.in/courses/105/105/105105041/
- https://nptel.ac.in/courses/112/106/112106130/
- https://nptel.ac.in/courses/112/103/112103295/

CourseCodeTECMCCPE001a		**COMPUTER INTEGRATED MANUFACTURING**	**L**	**T**	**P**	**C**
Semester	**I**		**3**	**0**	**0**	**3**

Professional Elective Course - I

Course Objectives:

- This course will enable the student
- To gain knowledge about the basic fundamental of CAD.
- To gain knowledge on how computers are integrated at various levels of planning and manufacturing understand computer aided planning and control and computer monitoring.

Course Outcomes (CO): Student will be able to

- Understand the importance of product development through CIM. Get knowledge of shop floor control, Computer Integrated Manufacturing and Automation.
- Adopt appropriate material handling and storage in an automated manufacturing environment.
- Incorporate methods of utilization of appropriate features in CAD application enhancing productivity in design

UNIT – I **Introduction and NC Machines**

Fundamental concepts in Manufacturing and Automation, Automation Strategies, Economic analysis in production, fundamentals of CAD / CAM, product cycle and CAD/CAM, Automation and CAD/CAM, Scope of CIM, Automated flow lines, Transfer mechanisms, methods of Line balancing.

Numerical control machines: Introduction- basic components of an NC system-the NC procedure- NC coordinate system, NC motion control system- application of numerical control- Economics of Numerical control.

UNIT – II **NC part programming:**

Introduction - The Bunch tape in NC - Tape code format - manual part programming. NC programming with manual data input.

UNIT – III **Computer controls in NC and Group Technology**

Computer controls in NC: NC controllers' technology - Computer Numerical Control (CNC), Direct Numerical control (DNC).

Adaptive control machining systems. adaptive control optimization system, adaptive control constraint system, applications to machining processes, computer process monitoring, hierarchical structure of computers in manufacturing, and computer process control.

Group Technology: Part families, parts classification and coding, production flow analysis, Composite part concept, Machine cell design, benefits of GT.

UNIT – IV **CAPP &FMS**

Computer aided planning systems: Approaches to Computer aided Process Planning (CAPP) - Generative and Retrieval CAPP systems, benefits of CAPP, Material Requirement Planning (MRP), mechanism of MRP, benefits, and Capacity Planning.

Flexible Manufacturing Systems: Components of FMS, FMS Work stations, Material Handling Systems, and Computer Control system, FMS layout configurations and benefits of FMS.

UNIT – V **CAQC**

Computer Aided Quality Control: A Introduction, Total Quality Management (TQM), QC and CIM, Inspection and Testing, Statistical Process Control (SPC), Objectives of CAQC, Role of Computer in QC, Coordinate Measuring Machine, Non-Contact Inspection Methods, Post Process Metrology, Computer Aided Inspection Using Robots, Integrated Computer Aided Inspection Systems, Flexible Inspection System (FIS).

Textbooks:

1. Mikel P.Groover, Automation, Production systems and Computer Integrated Manufacturing Systems –Pearson Education; Fourth edition 2016.
2. Radhakrishnan and Subramanian, CAD/CAM/CIM, New Age Publishers, 2007.

Reference Books:

1. Mikell P.Groover, and Emory W.Zimmers.Jr., CAD/CAM - PHI Publishers, 1984.
2. K.Lalit Narayan, K.Mallikarjuna Rao, MMM Sarcar, Computer Aided Design and Manufacturing, PHI Publishers, 2008.

Online Learning Resources:

- https://en.wikipedia.org/wiki/Computer-integrated_manufacturing
- https://www.techopedia.com/definition/30965/computer-integrated-manufacturing-cim
- https://www.youtube.com/watch?v=_OaBMsUgqgQ
- https://www.youtube.com/watch?v=edplvB_Xvso
- https://nptel.ac.in/courses/112/104/112104289/
- https://www.youtube.com/watch?v=9fqygvj-O2s.

Course Code TECMCCPE001b	GEOMETRIC MODELING Professional Elective Course - I	L	T	P	C
Semester I		3	0	0	3

Course Objectives:

- To Learn advanced concepts of feature based modeling and parametric modeling
- To understand the mathematical basis for geometric modeling of curves and surfaces and their relationship with computer graphics.
- To understand the methods of representation of wireframe, surface, and solid modeling systems.
- To Consider data associativity concepts of CAD/CAE integration; Be familiar with interoperability and data transfer techniques between design and analysis software systems.

Course Outcomes (CO): Student will be able to

Upon completing this course, the students will be able to:

- Represent curves and surfaces using parametric equations
- Define and relate the basic concepts, tools, and algorithms in geometric modeling and digital surface processing
- Critically analyze and assess current research on surface representations and geometric modeling with the intent to apply the proposed methods in your own work
- Define the methods of representation of wireframe, surface, and solid modeling systems.

UNIT – I **Introduction:**

Introduction: Definition, Explicit and implicit equations, parametric equations.

UNIT – II **Cubic Splines:**

Cubic Splines: Algebraic and geometric form of cubic spline, tangent vectors, parametric space of a curve, blending functions, four point form, reparametrization, truncating and subdividing of curves, Graphic construction and interpretation, composite pc curves.

UNIT – III **Bezier & B-Spline Curves**

Bezier Curves: Bernstein basis, equations of Bezier curves, properties, derivatives and related problems.

B-Spline Curves: B-Spline basis, equations, knot vectors, properties, derivatives and related problems.

UNIT – IV **Surfaces:**

Surfaces: Bicubic surfaces, Coon's surfaces, Bezier surfaces, B-Spline surfaces, surfaces of revolutions, Sweep surfaces, ruled surfaces, tabulated cylinder, bilinear surfaces, triangular patches, sculptured surface and rational parametric surface.

UNIT – V **Solids and Solid modeling concepts:**

Solids: Tricubic solid, Algebraic and geometric form.

Solid modeling concepts: Wire frames, Boundary representation, Half space modeling, spatial cell, Constructive Solid Geometry (CSG), Analytical Solid Modelling (ASM).

Textbooks:

1. Micheal E. Mortenson, Geometric Modeling, McGraw Hill Publishers, 2013.
2. Ibrahim Zeid, CAD/CAM: Theory and Practice, Tata McGraw Hill, 2010.
3. P. N. Rao, CAD/CAM principles and applications, 3-e, McGraw Hill Publishers, 2017.

Reference Books:

1. Rogoer's Adams, Elements of Computer Graphics, Tata McGraw Hill, 1990.
2. K.Lalit Narayan, K.Mallikarjuna Rao, MMM Sarcar, Computer Aided Design and Manufacturing, PHI Publishers, 2008.

Online Learning Resources:

- https://www.coursera.org/lecture/interactive-computer-graphics/3-4-flower-modeling-MrexG
- https://www.youtube.com/watch?v=0IgOapAtauM
- https://www.youtube.com/watch?v=tgbXCwjlcaE
- https://www.youtube.com/watch?v=CeOV_tVo970
- https://www.youtube.com/watch?v=hBJ4CLE8k1k
- https://nptel.ac.in/courses/112/102/112102101/

Course Code	TECMCCPE001c	DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS	L	T	P	C
Semester	I	Professional Elective Course – I	3	0	0	3

Course Objectives:

- To impart students on the science, use and application of hydraulics and pneumatics as fluid power in Industry.
- Also to impart knowledge on the methodology of basic and advanced design of pneumatics and hydraulics systems.

Course Outcomes (CO):

- It helps students to get knowledge on the need, use and application of fluid power and make them familiar to industrial design that lead to automation.

UNIT – I **HYDRAULIC POWER GENERATORS &ACTUATORS**

Hydraulic Power Generators – Types, Selection and specification of pumps, pump characteristics. Actuators - Types, selection and specifications of actuators, characteristics of actuators.

UNIT – II **CONTROL AND REGULATION ELEMENTS**

Pressure - direction and flow control valves - relief valves, non-return and safety valves - valve actuation systems.

UNIT – III **HYDRAULIC CIRCUITS**

Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits - industrial circuits - press circuits - hydraulic milling machine - grinding, planning, copying, - forklift, earth mover circuits- design and selection of components - safety and emergency mandrels.

UNIT – IV **PNEUMATIC SYSTEMS AND CIRCUITS**

Pneumatic fundamentals - control elements, position and pressure sensing - logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - Design Methods: cascade method - mapping method - step counter method.

UNIT – V **INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS**

Pneumatic equipments- selection of components - application -fault finding in fluid power systems - hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

Text Books:

1. Antony Espossito, “Fluid Power with Applications”, Prentice Hall, 1980.
2. Andrew Parr, “Hydraulic and Pneumatics” (HB), Jaico Publishing House, 1999.

Reference Books:

1. Dudleyt, A. Pease and John J. Pippenger, “Basic fluid power”, Prentice Hall, 1987.
2. Bolton. W., “Pneumatic and Hydraulic Systems “, Butterworth –Heinemann, 1997.
3. K.Shanmuga Sundaram, “Hydraulic and Pneumatic Controls: Understanding made Easy" S.Chand& Co Book publishers, New Delhi, 2006 (Reprint 2009).

Online Learning Resources:

- Chrome-extension://efaidnbmnnibpcaglefindmkaj/viewer.htms?pdfhrl https%3A%2%2Fwww.iare.ac.in%2Fsites%2Fdefault%2Ffiles%2FDHPS%2520LECTURER%2520NOTES%2520FINAL.pdf&chunk=true.
- chromeextension://efaidnbmnnnibpcajpcglclefindmkaj/viewer.html?pdfurl=https%3A%2F%2Fwww.iare.ac.in%2Fsites%2Fdefault%2Ffiles%2FDHPS%2520PPT%2520%2520FINAL.pdf&chunk=true.
- https://nptel.ac.in/courses/112/105/112105047/

Course Code	TECMCCPE002a	ADVANCES IN MANUFACTURING TECHNOLOGY	L	T	P	C
Semester	I		3	0	0	3

Professional Elective Course - II

Course Objectives:

- Provide an integrated, effective and practical platform for create facilities for teaching, training and research & development work for post-graduate studies in various fields of manufacturing technology.
- Link up with national and international colleges/ universities of excellence to impart the education, maintain quality & content of curriculum and award degree certificates in post-Graduation / Doctorates.
- Provide facilities for international and national subject experts to stay, teach and conduct research projects / programmes on mutual exchange and recognition basis.

Course Outcomes (CO):

- Analyze technical problems, propose solutions and document with written and oral reports.
- Employ technology for communications, data collection, analysis, simulation and control.
- Use Basic Project management skills, project team work and ethical behavior.
- Machine variety materials using a conversational and CNC lathe, milling machine and grinder.
- Use the basic manufacturing methods, measurements, automation and quality control.

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 **Mechanical Energy Based NTM Process**

Elements of the process, mechanics of metal removal, process parameters, effect of process parameters on surface finish and metal removal rate, economic considerations, applications and limitations, recent developments in Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining and Ultrasonic Machining.

UNIT – III **Electro – Chemical Energy Based NTM Process**

Electro - Chemical Machining: Fundamentals of electro chemical machining, metal removal rate in ECM, Tool design, Surface finish and accuracy economics aspects of ECM.

Electro Discharge Machining: General Principle and applications of EDM, Mechanics of metal removal, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, Wire EDM.

UNIT – IV **Thermo Electric Based NTM**

Electron Beam Machining: Generation and control of electron beam for machining, theory of electron beam machining, principle, advantages, and 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.

Laser Beam Machining: Principle, effect of machining parameters on surface finish, applications and limitations.

UNIT – V **Additive Manufacturing**

Additive Manufacturing: Definition, Classification of AM Processes, Steps in AM Process,Fused Deposition Method, Steriolithography, Selective Laser sintering, Laminated Object Manufacturing, and 3D Printing – Working principle, applications and limitations.

Text Books:

1. V.K.Jain, Advanced Machining Processes - Allied Publishers Private Limited.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing- John Wiley & Sons Publishers.

3. SeropeKalpakjian and Steven R.Schmid, Manufacturing Engineering and Technology – Pearson.
4. P.C Pandey and H.S Shan, Modern Machining Process- Tata McGraw - Hill Education, 1980.
5. T.Jagadeesha, Unconventional Machining Processes - I.K Publishers, 2016.
6. Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.

Reference Books:

1. P.N.Rao, Manufacturing Technology - McGraw Hill Education Private Limited.
2. Amitabha Ghosh, Asok Kumar Mallik,Manufacturing Science - East West press.

Online Learning Resources:

- https://nptel.ac.in/courses/112/107/112107078/
- https://youtu.be/t3y_Ys3LgGM
- https://www.youtube.com/watch?v=E4VZ_rFqpG4&t=1s
- https://youtu.be/-tcaR7oSx_w
- https://youtu.be/Uybg6VDLoRQ
- https://youtu.be/Uybg6VDLoRQ
- https://youtu.be/aWQsEX1TrSI

CourseCode TECMCCPE002b	TOTAL QUALITY MANAGEMENT Professional Elective Course - II	L	T	P	C
Semester I		3	0	0	3

Course Objectives:

- Introduce the students, the basic concepts of Total Quality Management.
- Expose with various quality issues in Inspection.
- Gain Knowledge on quality control and its applications to real time.
- Know the extent of customer satisfaction by the application of various quality concepts.
- Understand the importance of Quality standards in Production.

Course Outcomes (CO):

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

- Develop an understanding on quality Management philosophies and frameworks
- Adopt TQM methodologies for continuous improvement of quality
- Measure the cost of poor quality, process effectiveness and efficiency to identify areas for improvement
- Apply benchmarking and business process reengineering to improve management processes.
- Determine the set of indications to evaluate performance excellence of an organization.

UNIT – I **Introduction**

Introduction: Definition of Quality, Dimensions of Quality, Definition of Total quality management, Quality Planning, Quality costs – Analysis, Techniques for Quality costs, Basic concepts of Total Quality Management.

UNIT – II **Historical Review:**

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

UNIT – III **TQM Principles:**

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

UNIT – IV **TQM Tools:**

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

UNIT – V **Quality Systems:**

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

Text Books:

1. Dale H Besterfield, Total Quality Management, Fourth Edition, Pearson Education, 2015.
2. Subburaj Ramaswamy, Total Quality Management, Tata Mcgraw Hill Publishing Company Ltd., 2005.
3. Joel E.Ross , Total Quality Management, Third Eition, CRC Press, 2017.

Reference Books:

1. Narayana V and Sreenivasan N.S, Quality Management – Concepts and Tasks, NewAge International, 1996.
2. Robert L.Flood, Beyond TQM, First Edition, John Wiley & Sons Ltd, 1993.
3. Richard S. Leavenworth & Eugene Lodewick Grant, Statistical Quality Control, Seventh Edition, Tata

Mcgraw Hill, 2015
4. Samuel Ho , TQM – An Integrated Approach, Kogan Page Ltd, USA, 1995.

Online Learning Resources:

- https://www.youtube.com/watch?v=VD6tXadibk0
- https://www.investopedia.com/terms/t/total-quality-management-tqm.asp
- https://blog.capterra.com/what-is-total-quality-management/
- https://nptel.ac.in/courses/110/104/110104080/
- https://onlinecourses.nptel.ac.in/noc21_mg03/preview
- https://nptel.ac.in/courses/110/104/110104085/
- https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-mg39/

CourseCodeTECMCCPE002c			L	T	P	C
Semester	I	**COMPUTER AIDED PROCESS PLANNING**	3	0	0	3

Professional Elective Course - II

Course Objectives:

After studying this unit, you should be able to understand what is process planning and CAPP,

- To know the various steps involved in CAPP.
- To classify the various methods of CAPP.
- To understand the feature recognition in CAP.
- Notable requirements for process planning systems are consistency, accuracy, and ease of application and completeness.

Course Outcomes (CO):

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

- Generate the structure of automated process planning system and uses the principle of generative and retrieval CAPP systems for automation.
- Select the manufacturing sequence and explains the reduction of total set up cost for a particular sequence.
- Predict the effect of machining parameters on production rate, cost and surface quality anddetermines the manufacturing tolerances.
- Explain the generation of tool path and solve optimization models of machining processes.

UNIT – I **Introduction to CAPP**

Information requirement for process planning system, Role of process planning, advantages of conventional process planning over CAPP, Structure of Automated process planning system, feature recognition, methods.

Generative CAPP system: Importance, principle of Generative CAPP system, automation of logical decisions, Knowledge based systems, Inference Engine, implementation, benefits.

UNIT – II **Retrieval CAPP system**

Significance, group technology, structure, relative advantages, implementation, and applications

Selection of manufacturing sequence: Significance, alternative manufacturing processes, reduction of total set-up cost for a particular sequence, quantitative methods for optimal selection, examples.

UNIT – III **Determination of machining parameters**

reasons for optimal selection of machining parameters, effect of parameters on production rate, cost and surface quality, different approaches, advantages of mathematical approach over conventional approach, solving optimization models of machining processes.

Determination of manufacturing tolerances: design tolerances, manufacturing tolerances, methods of tolerance allocation, sequential approach**,** integration of design and manufacturing tolerances, advantages of integrated approach over sequential approach.

UNIT – IV **Generation of tool path**

Simulation of machining processes, NC tool path generation, graphical implementation, determination of optimal index positions for executing fixed sequence, quantitative methods.

UNIT – V **Implementation techniques for CAPP**

MIPLAN system, Computer programming languages for CAPP, criteria for selecting a CAPP system and benefits of CAPP. Computer integrated planning systems, and Capacity planning system.

Text Books:

1. Mikel P.Groover, Automation, Production systems and Computer Integrated Manufacturing Systems – Pearson Education; Fourth edition 2016.
2. Dr.Sadhu Singh, Computer Aided Design and Manufacturing – Khanna Publishers, 1998.

Reference Books:

1. David Bedworth, "Computer integrated design and manufacturing" TMH.
2. K.Lalit Narayan, K.Mallikarjuna Rao, MMM Sarcar, Computer Aided Design and Manufacturing, PHI Publishers, 2008.
3. Radhakrishnan and Subramanian, CAD/CAM/CIM, New Age Publishers, 2007.

Online Learning Resources:

- https://nptel.ac.in/courses/112/104/112104188/
- https://www.youtube.com/watch?v=20_K7c65Swg
- https://www.youtube.com/watch?v=y24meNZbUoU
- https://youtu.be/PRjExZxWsNc
- https://nptel.ac.in/courses/103/103/103103164/

Course Code	TECMCC0010P	**GEOMETRIC MODELING LABORATORY**	**L**	**T**	**P**	**C**
Semester	I		**0**	**0**	**4**	**2**

Course Objectives:

- To train the students with CAD packages.
- To impart the 2D and 3D modeling skills to the students.
- To import and export different IGES files from one software to another

Course Outcomes (CO):

- Students will be able to design different parts of mechanical equipments
- Students will be able to apply their skills in various designing and Manufacturing Industries.

List of Experiments:

1. Generation of the following curves using "C" language
   a) Cubic Splines
   b) Bezier curves
   c) B-Splines.
2. Generation of the following surfaces using "C" language
   a) Bezier surfaces
   b) B-Spline surfaces
3. Typical tasks of Modeling using PRO/E, IDEAS, CATIA solid modeling packages
   a) Sketcher Module
   b) Part Module
   c) Assembly Module
   d) Drafting Module
   e) Surface Modelling.

CourseCodeTEC25MCCPE10P	**FINITE ELEMENT**	**L**	**T**	**P**	**C**
Semester I	**ANALYSIS LABORATORY**	**0**	**0**	**4**	**2**

Course Objectives:

- To use the commercial Finite Element packages to build Finite Element models and solve a selected range of engineering problems.
- To validate a Finite Element model using a range of techniques.
- To communicate effectively in writing to report (both textually and graphically) the method used, the implementation and the numerical results obtained.
- To discuss the accuracy of the Finite Element solutions.

Course Outcomes (CO):

- Ability to solve engineering problems using the commercial software's like

ANSYS, SIMUFACT, ABAQUS, SIMULIA, MAT LAB.

List of Experiments:

Finite Element Analysis using ANSYS 14.5 Package for different structures the discretization can be done with 1-D, 2-D & 3-D elements to perform the following analysis:

1. Static Analysis
   - **a.** Stress analysis of 2D truss.
   - **b.** Stress analysis of a plate with a circular hole and L-Bracket – 2D and 3D
   - **c.** Stress analysis of beams (cantilever, simply supported & fixed ends)
   - **d.** Stress analysis of an axi-symmetric component
2. Thermal and Fluid flow Analysis
   - **a.** Conductive heat transfer analysis of a 2D and 3D components
   - **b.** Convective heat transfer analysis of a 2D component
   - **c.** Coupled field analysis of a component
   - **d.** Determination of velocity of a fluid and volumetric flow rates for 1-D Fluid flow
   - **e.** Determination of velocity of a fluid and volumetric flow rates for 2-D Fluid flow
3. Modal Analysis
   - **a.** mode frequency analysis of a 2D component
   - **b.** mode frequency analysis of beams (cantilever, simply supported, fixed ends)
4. Transient analysis
   - a. Transient analysis of a cantilever beam
5. FEM through MAT LAB
   - **a.** Introduction to MAT LAB
   - **b.** Analysis of 1-dimesional & 2D dimensional truss.
   - **c.** Analysis of 1-dimesional & 2D dimensional beam.
   - **d.** Analysis of 1-dimesional & 2D dimensional heat conduction.

Course Code	TEC25MRM101	RESEARCH METHODOLOGY AND IPR (Mandatory Course)	L	T	P	C
Semester I			2	0	0	2

Course Objectives:

- To give an overview of the research methodology and explain the technique of defining a research problem
- To explain the functions of the literature review in research.
- To explain carrying out a literature search, its review, developing theoretical and conceptual frameworks and writing a review.
- To explain the art of interpretation and the art of writing research reports.
- To explain various forms of the intellectual property, its relevance and business impact in the changing global business environment.

Course Outcomes (CO):

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

- Understand the meaning of research and various methods of research.
- Select the area of research by studying the literature.
- Understand the concepts of Testing of Hypotheses and Interpretation and Report Writing.

UNIT – I **RESEARCH FORMULATION AND DESIGN**

Motivation and objectives – Research methods vs. Methodology. Types of research – Descriptive Vs Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical,concept of applied and basic research process, criteria of good research.Defining and formulating the research problem, selecting the problem, necessity of defining theproblem, importance of literature review in defining a problem, literature review-primary andsecondary sources, reviews, monograph, patents, research databases, web as a source, searchingthe web, critical literature review, identifying gap areas from literature and research database,development of working hypothesis.

UNIT – II **DATA COLLECTION AND ANALYSIS**

Accepts of method validation, observation and collection of data, methods of data collection,sampling methods, data processing and analysis strategies and tools,data analysis with staticallyPackage (Sigma STAT,SPSS for student t-test, ANOVA, etc.), hypothesis testing.

UNIT – III **INTERPRETATION AND REPORT WRITING**

Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significanceof Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types ofReports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for WritingResearch Reports, Conclusions.

UNIT – IV **RESEARCH ETHICS, IPR AND SCHOLARYPUBLISHING**

Ethics-ethical issues, ethical committees (human & animal); IPR- intellectual property rightsand patent law, commercialization, copy right, royalty, trade related aspects of intellectualproperty rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper,Citation and acknowledgement, plagiarism, reproducibility and accountability.

UNIT – V **PATENTS RIGHTS & NEW DEVELOPMENTS IN IPR**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent informationand databases. Geographical Indications. New Developments in IPR: Administration of Patent System.New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledgeCase Studies, IPR and IITs.

Text Books:

1. C.R. Kothari, Gaurav Garg, Research Methodology: Methods and Techniques New Age International 4th Edition, 2018.
2. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering student.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology Publications. 2 volumes.

Reference Books:

1. Research Methods: the concise knowledge base Trochim Atomic Dog Publishing 2005.
2. Conducting Research Literature Reviews: From the Internet to Paper Fink A Sage Publications 2009.

Online Learning Resources:

- https://nptel.ac.in/courses/121/106/121106007/
- https://www.youtube.com/watch?v=sI3pUyDUQVg
- https://www.youtube.com/watch?v=GSeeyJVD0JU
- https://www.youtube.com/watch?v=EVcPmmfK1Do

Course Code **ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**

TECMCCSO01	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

Semester I

Course Objectives: Student will be able

- Knowledge of Artificial Intelligence, focusing on intelligent agents, problem-solving techniques, and state-space search approaches.
- Understand and apply various problem-solving and search techniques, including uniform and heuristic search strategies in artificial intelligence.
- Explore and apply local search techniques for solving Constraint Satisfaction Problems (CSPs) and adversarial search strategies to make optimal decisions.
- Apply various statistical reasoning techniques for knowledge representation and reasoning in AI, as well as logic programming and reasoning methods.
- Familiar in fundamental concepts of Machine Learning techniques, as well as classification, regression, clustering problems, and an introduction to neural networks and deep learning.

Course Outcomes (CO): Student will be able to

- Design intelligent agents, define problems using state-space models, and apply AI techniques.
- Implement and compare different search algorithms (both uniform and heuristic), apply and analyze appropriate strategies for solving AI problems.
- Solve CSPs using local search methods and implement adversarial search algorithms to make optimal decisions in competitive game scenarios.
- Utilize statistical and logical reasoning methods, to represent knowledge and perform forward and backward reasoning in AI applications.
- Understanding and apply various machine learning techniques, along with an introduction to neural networks and deep learning.

UNIT – I

Introduction to Artificial Intelligence and Problem-Solving Agent: Problems of AI, AI technique, Tic – Tac – Toe problem. Intelligent Agents, Agents & environment, nature of environment, structure of agents, goal-based agents, utility-based agents, learning agents. Defining the problem as state space search, production system, problem characteristics, and issues in the design of search programs.

UNIT – II

Search Techniques: Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies Greedy best -first search, A* search, AO* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search.

UNIT – III

Constraint Satisfaction Problems and Game Theory: Local search for constraint satisfaction problems. Adversarial search, Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.

UNIT – IV

Knowledge & Reasoning: Statistical Reasoning: Probability and Bays' Theorem, Certainty Factors and Rule-Base Systems, Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic. AI for knowledge representation, rule-based knowledge representation, procedural and declarative

knowledge, Logic programming, Forward and backward reasoning.

UNIT - V

Introduction to Machine Learning: Exploring sub-discipline of AI: Machine Learning, Supervised learning, Unsupervised learning, Reinforcement learning, Classification problems, Regression problems, Clustering problems, Introduction to neural networks and deep learning.

Textbooks:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Third Edition, 2015.
2. Nils J. Nilsson, "Artificial Intelligence: A New Synthesis", 1st Edition, Morgan-Kaufmann, 1998.

Reference Books:

1 Elaine Rich, Kevin Knight, & Shivashankar B Nair, "Artificial Intelligence", McGraw Hill, 3rd ed.,2017.
2. Patterson, "Introduction to Artificial Intelligence & Expert Systems", Pearson, 1st ed. 2015.
3. Saroj Kaushik, "Logic & Prolog Programming", New Age International, Ist edition, 2002.
4. Joseph C. Giarratano,Gary D. Riley, "Expert Systems: Principles and Programming", 4th Edition, 2007.

Course Code **ENGLISH FOR RESEARCH PAPER WRITING**

	L	T	P	C
TEC25MAC01a	**2**	**0**	**0**	**0**

Semester I

Course Objectives: This course will enable students:

- Understand the essentials of writing skills and their level of readability
- Learn about what to write in each section
- Ensure qualitative presentation with linguistic accuracy

Course Outcomes(CO):Student will be able to

- Understand the significance of writing skills and the level of readability
- Analyze and write title, abstract, different sections in research paper
- Develop the skills needed while writing a research paper

UNIT -I Lecture Hrs:10

1Overview of a Research Paper- Planning and Preparation- Word Order- Useful Phrases - Breaking upLongSentences-StructuringParagraphsandSentences-BeingConciseandRemovingRedundancy -Avoiding Ambiguity

UNIT – II Lecture Hrs:10

Essential Components of a Research Paper-Abstracts-Building Hypothesis-Research Problem-Highlight Findings- Hedging and Criticizing, Paraphrasing and Plagiarism, Cauterization

UNIT – III Lecture Hrs:10

Introducing Review of the Literature–Methodology-Analysis of the Data-Findings- Discussion-Conclusions-Recommendations.

UNIT – IV Lecture Hrs:9

Key skills needed for writing a Title, Abstract, and Introduction

UNIT - V Lecture Hrs:9

Appropriate language to formulate Methodology, in corporate Results, put forth Arguments and draw Conclusions

Suggested Reading

1. Gold bort R (2006)Writing for Science,Yale University Press(available on Google Books) Model Curriculum of Engineering & Technology PG Courses [Volume-I]
2. DayR (2006)How toWrite and Publish a Scientific Paper,Cambridge University Press
3. High man N(1998),Hand book of Writing for the Mathematical Sciences, SIAM. Highman's book
4. A drianWallwork,English for Writing Research Papers, Springer New York Dord recht Heidel berg London, 2011

Course Code	TEC25MAC01b	DISASTER MANAGEMENT	L	T	P	C
Semester I		(Audit Course 1 and 2)	2	0	0	0

Course Objectives:

- learn to demonstrate a critical understanding of key concepts in disaster risk reduction and
- humanitarian response.
- critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple
- perspectives.
- develop an understanding of standards of humanitarian response and practical relevance in
- specific types of disasters and conflict situations.
- critically understand the strengths and weaknesses of disaster management approaches,
- planning and programming in different countries, particularly their home country or the countries they work in

Course Outcomes (CO):

After completion of this course the student can be able to

- explain various reasons for disasters in India (L2)
- demonstrate Disaster Prone Areas In India (L2)
- understand risk assessment and disaster mitigation. (L2)

UNIT – I **Introduction**

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT – II **Repercussions Of Disasters And Hazards**:

Repercussions Of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Disaster Prone Areas In India

UNIT – III

Disaster Prone Areas InIndia: StudyOf Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

Disaster Preparedness And Management

UNIT – IV

Disaster Preparedness And Management: Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard;Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Risk Assessment & Disaster Mitigation

UNIT – V

Risk Assessment: Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And NationalDisaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation InRisk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

Disaster Mitigation: Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

Text Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.

Reference Books:

1. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep&Deep Publication Pvt. Ltd., New Delhi.

Online Learning Resources:

Course CodeTEC25MAC01c	SANSKRIT FOR TECHNICAL	L	T	P	C
Semester I	KNOWLEDGE	2	0	0	0
	(Audit Course 1 and 2)				

Course Objectives:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjectsenhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore thehuge knowledge from ancient literature

Course Outcomes (CO):

After completion of this course the student can be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood
- Being a logical language will help to develop logic in students

UNIT – I

- Alphabets in Sanskrit,
- Past/Present/Future Tense,
- Simple Sentences

UNIT – II

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

UNIT – III

- Technical concepts of Engineering-Electrical, Mechanical,
- Architecture, Mathematics

Text Books:

1. “Abhyaspustakam” – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi.
2. “Teach Yourself Sanskrit” Prathama Deeksha-VempatiKutumbshastri, Rashtriya SanskritSansthanam, New Delhi Publication.

Reference Books:

1. “India’s Glorious Scientific Tradition” Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Code	TEC25MCC0003T	ADVANCED OPTIMIZATION TECHNIQUES	L	T	P	C
Semester	II		3	0	0	3

Course Objectives:

- To understand the theory of optimization methods and algorithms developed for solving various types of optimization problems
- To develop and promote research interest in applying optimization techniques in problems of Engineering and Technology
- To apply the mathematical results and numerical techniques of optimization theory to concrete engineering problems..

Course Outcomes (CO): Student will be able to

- Understand importance of optimization of industrial process management
- Apply basic concepts of mathematics to formulate an optimization problem
- Analyse and appreciate variety of performance measures for various optimization problems

UNIT – I

Linear programming: Two-phase simplex method, Big-M method, duality, interpretation, applications. Assignment problem: Hungarian's algorithm, Degeneracy, applications, unbalanced problems, traveling salesman problem.

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.

UNIT – III

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

UNIT – IV

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, random population generation, solving differential equations using GP

UNIT – V

Dominated sorted GA, convergence criterion, applications of multi-objective problems .

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

Textbooks:

7. Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers
8. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers
9. Engineering Optimization – S.S.Rao, New Age Publishers

Reference Books:

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

Course Code			L	T	P	C
TECMCC0004T		MANUFACTURING SYSTEMS: SIMULATION MODELLING AND ANALYSIS				
Semester	**II**		**3**	**0**	**0**	**3**

Course Objectives:

- Learn ways of analyzing the systems.
- Classification of systems-based nature of dynamics and knowledge of elements.
- To develop simulation model for dynamic discrete – event stochastic system.
- To run the model and collect the data.
- To analyze the output data of simulation for specified for performance measures based on type of simulation and method of output data analysis.

Course Outcomes (CO):

Students can able to solve below following problems.

- Define the state of system W.R.T specified performance measures.
- Develop simulation model for the said system
- Generate random variations and learn various simulation languages.
- Analyze through simulation the model and present the results to specified confidence level.
- Apply simulation for flow shop systems and job shop systems.

UNIT – I **System Modeling and Statistical Analysis**

System Analysis, 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 and 2 Errors, Framing, Strong Law of Large Numbers.

UNIT – II **Model Validation and Stochastic Inputs**

Building of Simulation Model, Validation, Verification, Credibility their Timing, Principles of Valid Simulation Modeling, Techniques for Verification, Statistical Procedures for Developing Credible Model. Modeling of Stochastic Input Elements, Importance, Various Procedures, Theoretical Distribution, Continuous, Discrete their Suitability in Modeling.

UNIT – III **Random Variate Generation and Simulation Languages**

Generation Of Random Variates, Factors for Selection, Methods, Inverse Transform, Composition, Convolution, Acceptance, Rejection, Generation of Random Variable, Exponential, Uniform Weibull, Normal Bernoullie, Binomial Uniform Poison. Simulation Languages, Comparison of Simulation Languages with General Purpose Languages, Simulation Languages vs Simulators, Software Features, Statistical Capabilities, GPSS, SIMAN, SIMSCRIPT, Simulation of M-M-1 Queue, Comparison of Simulation Languages.

UNIT – IV **Output Data Analysis and Steady-State Simulation**

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.

UNIT – V **Simulation Applications in Manufacturing**

Applications of Simulation, Flow Shop System, Job Shop System M/M/1 Queues with Infinite and Finite Capacities, Simple Fixed Period Inventory System, New Boy Paper Problem.

Textbooks:

1. Simulation Modelling and Analysis by Law, A.M. and Kelton, McGraw Hill, 2nd Edition, 1991.
2. Discrete-Event System Simulation, Jerry Banks and John S. Carson II, PrenticeHall, 1 st Edition, 1984.

Reference Books:

6. Simulation of Manufacturing Systems, Allan Carrie, John Wiley and Sons, Chichester and New York, 1st Edition, 1988.
7. A Course in Simulation, Sheldon M. Ross, Macmillan Publishing Company, 1st Edition, 1990.
8. Simulation Modeling and SIMNET, H. A. Taha, Prentice Hall, 1st Edition, 1988.
9. Modeling and Simulation of Discrete Event Systems, Byoung Kyu Choi and DongHun Kang, Wiley, 2nd Edition, 2023.
10. Introduction to Simulation Using Simulink, Michael A. Dwyer, Springer, 1st Edition, 2023. 6. Simulation with AnyLogic, Andrei Borshchev, Springer, 2nd Edition, 2021. 7. Manufacturing Systems Modeling and Analysis, Guy L. Curry and Richard M. Feldman, Pearson Education, 2nd Edition, 2023.

CourseCode		INTELLIGENT MANUFACTURING SYSTEMS	L	T	P	C
TEC25MCCPE003a		Professional Elective Course - III				
Semester	II		3	0	0	3

Course Objectives:

- To understand the computer integrated manufacturing systems
- To provide an in-depth understanding of components of knowledge based systems
- To provide an understanding of artificial intelligence
- To design and develop automated process planning
- To develop group technology for intelligent manufacturing systems..

Course Outcomes (CO): Student will be able to

- Select the necessary tools for computer integrated manufacturing systems
- Use appropriate knowledge of components of knowledge based systems
- Use machine learning techniques for intelligent manufacturing systems
- Apply the concepts of automated process planning
- Apply the group technology for intelligent manufacturing systems.

UNIT – I **Computer Integrated Manufacturing System**

Computer Integrated Manufacturing Systems Structure and Functional Areas of CIM System, CAD, CAPP, CAM, CAQC, ASRS. Advantages of CIM, Manufacturing Communication Systems, MAP / TOP, OSI Model, Data Redundancy, Top- Down and Bottom-Up Approach, Volume of Information, Intelligent Manufacturing System Components, System Architecture and Data Flow, System Operation

UNIT – II **Knowledge Based System Components and Representation**

Components of Knowledge Based Systems, Basic Components of Knowledge Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Interference Engine, Knowledge Acquisition.

UNIT – III **Artificial Intelligence and Neural Networks in Manufacturing**

Machine Learning, Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks, Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing

UNIT – IV **Automated Process Planning and Equipment Selection**

Automated Process Planning, Variant Approach, Generative Approach, Expert Systems f or Process Planning, Feature Recognition, Phases of Process Planning, Knowledge Based System for Equipment Selection (KBSES), Manufacturing System Design, Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem, Problem Solving Approach in KBSES, Structure of the KRSES.

UNIT – V **Group Technology and Knowledge Based Clustering**

Models and Algorithms Visual Method, Coding Method, Cluster Analysis Method, Matrix Formation, Similarity Coefficient Method, Sorting-Based Algorithms, Bond Energy Algorithm, Cost Based Method, Cluster Identification Method, Extended CI Method, Knowledge Based Group Technology, Group Technology in Automated Manufacturing System, Structure of Knowledge Based System for Group Technology (KBSCIT) Data Base, Knowledge Base, Clustering Algorithm.

Textbooks:

3. Intelligent Manufacturing Systems, Andrew Kusiak, Prentice Hall, 1st Edition, 1990.
4. Artificial Neural Networks, Yagna Narayana, PHI, 1st Edition, 2006

Reference Books:

3. Automation, Production Systems and CIM, Mikell P. Groover, PHI, 2nd Indian Reprint, 2007.
4. Neural networks: A comprehensive foundation, Simon Haykin, PHI, 2nd Edition, 2005.
5. Artificial neural networks, B. Vegnanarayana, PHI Learning Pvt. Ltd., 1st Edition, 2006.
6. Neural networks in Computer intelligence, Li Min Fu, TMH, 1st Edition, 2003.
7. Neural Networks: A Comprehensive Foundation, James A. Freeman and David M. Skapura, Pearson education, 2nd Edition, 2004.
8. Introduction to Artificial Neural Systems, Jacek M. Zurada, JAICO Publishing House, Indian Edition, 2006.

Course Code TEC25MCCPE003b

SMART MANUFACTURING
Professional Elective Course - III

		L	T	P	C
Semester	**II**	**3**	**0**	**0**	**3**

Course Objectives:

- To understand the basics of Industry 4.0
- To understand the Business model and impact of IIoT
- To understand the concepts of virtual reality, lean manufacturing
- To gain knowledge of various sensors and actuators.
- To understand various data transmission technologies.

Course Outcomes (CO): Student will be able to
Upon completing this course, the students will be able to:

- Explain Smart Business Perspective, Cyber security, Impacts of Industry 4.0.
- Understand the basics of the Industrial Internet of Things.
- Understand various key technologies.
- Implement various sensors and actuators.
- Understand different industrial transmission technologies and IOT applications in real life

UNIT – I **Industry 4.0 Basics**

Industrial Revolution: Phases, Evolution of Industry 4.0, Environmental Impacts of Industrial Revolution, Applications, Design Requirements, Drivers of Industry 4.0, Sustainability Assessment of Industries, Smart Business Perspective, Cyber Security, Impacts of Industry 4.0.

UNIT – II **Industrial Internet of Things and Digital Enterprise Architecture**

Industrial Internet of Things, Basics: IIoT and Industry 4.0, IIC, Industrial Internet Systems, Design of Industrial Internet Systems, Impact of Industrial Internet, Benefits of Industrial Internet, Industrial Sensing, Industrial Processes, Features of IIoT for Industrial Processes, Industrial Plant, The Future Architecture, Digital Enterprise.
Business Models and Reference Architecture of IIoT: Definition of a Business Model, Business Models of IIoT, Industrial Internet Reference Architecture.

UNIT – III **Enabling Technologies for Smart Manufacturing and IIoT**

Key Technologies: Off-site Technologies, Cloud Computing, Fog Computing. On-site Technologies, Augmented Reality, Virtual Reality, Smart Factories, Lean Manufacturing System, Big Data and Advanced Analytics.

UNIT – IV **Sensors and Actuators for Intelligent Systems**

Sensors: Various Sensor Types and Their Underlying Working Principles, Characteristics of Sensors, Resolution, Calibration, Accuracy and Others, Sensor Categories, Thermal, Mechanical, Electrical, Optical and Acoustic Sensors.
Actuators: Thermal, Hydraulic, Pneumatic, Electromechanical Actuator

UNIT – V **Industrial Communication Systems and IIoT Applications**

Industrial Data Transmission and Acquisition: Architecture of Various Data Transmission Technologies Like Foundation Fieldbus, Profibus, Highway Addressable Remote Transducer (HART), Interbus, Bitbus, Digital STROM, Controller Area Network, and Other Recent and Upcoming Technologies. Distributed Control System, SCADA and PLC System.
IIoT Applications: IoT Applications on Industrial Automation, Factories and Assembly Line, Plant Security and Safety, Transportation, Agriculture, Healthcare, Home Automation, Oil, Chemical and Pharmaceutical Industry and Others.

Textbooks:

2. Introduction to Industrial Internet of Things and Industry 4.0, Sudip Misra, Chandana Roy, Anandarup Mukherjee, CRC Press, 1st Edition, 2021.
3. 2. Internet of Things: A Hands-on Approach, Vijay Madisetti and Arshdeep Bahga, University Press, 1st Edition, 2015.
4. 3. Introduction to Internet of Things: A Practical Approach, S.R.N. Reddy, Rachit Thukral, Manasi Mishra, ETI Labs, 1st Edition, 2016.

Reference Books:

3. Industry 4.0: The Industrial Internet of Things, Alasdair Gilchrist, Apress, 1st Edition, 2016.
4. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Florian Michahelles, Springer, 1st Edition, 2011.
5. Smart Manufacturing: Concepts and Methods, Anthony Tarantino, CRC Press, 1st Edition, 2022.
6. Enabling the Internet of Things: From Integrated Circuits to Integrated Systems, Massimo Alioto, Springer, 1st Edition, 2017.
7. Industrial Internet of Things: Cybermanufacturing Systems, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, Springer, 1st Edition, 2017.
8. Cyber-Physical Systems: Foundations, Principles and Applications, Houbing Song, Danda B. Rawat, Sabina Jeschke, Christian Brecher, Morgan Kaufmann, 1st Edition, 2016.

Course Code	TEC25MCCPE003c	Industrial Robotics and Expert Systems Professional Elective Course – III	L	T	P	C
Semester	II		3	0	0	3

Course Objectives:

- To teach students the basics of robotics, construction features, sensor applications, robot cell design, robot programming and application of artificial intelligence and expert systems in robotics.

Course Outcomes (CO):

Students are to the basics kinematics of robotics, and are able to understand the robot programming and also artificial intelligence and expert systems in robotics

UNIT – I **INTRODUCTION AND ROBOT KINEMATICS**

Hydraulic Power Generators – Types, Selection and specification of pumps, pump characteristics. Actuators - Types, selection and specifications of actuators, characteristics of actuators.

UNIT – II **ROBOT DRIVES AND CONTROL**

Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

UNIT – III **ROBOT SENSORS**

Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.

UNIT – IV **ROBOT CELL DESIGN AND APPLICATION**

Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis. Industrial application of robots.

UNIT – V **ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS**

Methods of Robot Programming – Characteristics of task level languages lead through programming methods – Motion interpolation. Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques - Application of AI and KBES in Robots.

Text Books:

3. K.S. Fu, R.C. Gonzalez and C.S.G. Lee, “Robotics Control, Sensing, Vision and Intelligence”, Mc Graw Hill, 1987
4. Yoram Koren,” Robotics for Engineers’ Mc Graw-Hill, 1987

Reference Books:

4. Kozyrey, Yu. “Industrial Robots”, MIR Publishers Moscow, 1985.
5. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, “Robotics Engineering – An Integrated Approach”, Prentice-Hall of India Pvt. Ltd., 1984.
6. Deb, S.R.” Robotics Technology and Flexible Automation”, Tata Mc Graw-Hill, 1994.
7. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey,” Industrial

Robotics Technology, Programming and Applications", Mc Graw-Hill, Int. 1986.
8. Timothy Jordanides et al ,"Expert Systems and Robotics ", Springer –Verlag, New York, May 1991.

Course Code	TEC25MCCPE004a	Mechatronics	L	T	P	C
Semester	II	Professional Elective Course - IV	3	0	0	3

Course Objectives:

- To understand the mechatronics systems.
- To provide an in-depth understanding of components of knowledge based systems.
- To provide an understanding of artificial intelligence.
- To design and develop automated process planning.
- To develop group technology for intelligent manufacturing systems.

Course Outcomes (CO):

- Understand and describe different mechatronics systems.
- Explain the principle of operation of various solid state devices.
- Describe the working of hydraulic and pneumatic actuating systems and use them appropriately.
- Use program logic controls effectively.
- Design mechatronic systems.

UNIT – I **Mechatronic Systems and Design Process**

Mechatronics Systems, Elements, Levels of Mechatronics System, Mechatronics Design Process, System, Measurement Systems, Control Systems, Microprocessor Based Controllers, Advantages and Disadvantages of Mechatronics Systems. Sensors and Transducers, Types, Displacement, Position, Proximity, Velocity, Motion, Force, Acceleration, Torque, Fluid Pressure, Liquid Flow, Liquid Level, Temperature and Light Sensors

UNIT – II **Sensors, Transducers and Signal Conditioning**

Solid state electronic devices, PN junction diode, BJT, FET, DIA and TRIAC. Analog signal conditioning, amplifiers, filtering. Introduction to MEMS and typical applications

UNIT – III **Actuators and Drive Systems**

Design Consideration, Hydraulic and Pneumatic Actuating Systems, Fluid Systems, Hydraulic and Pneumatic Systems, Components, Control Valves, Electro Pneumatic, Hydro Pneumatic, Electro Hydraulic Servo Systems: Mechanical Actuating Systems and Electrical Actuating Systems.

UNIT – IV **Microprocessors, Microcontrollers and Interfacing**

Digital Electronics and Systems, Digital Logic Control, Micro Processors and Micro Controllers, Programming, Process Controllers, Programmable Logic Controllers, PLCs Versus Computers, Application Of PLCs for Control.

UNIT – V **System Modeling and Simulation**

System and interfacing and data acquisition, DAQS, SCADA, A to D and D to a conversions; Dynamic models and analogies, System response. Design of mechatronics systems and future trends.

Text Books:

7. Mechatronics Integrated Mechanical Electronics Systems, K P Ramachandran and GK Vijaya Raghavan, Wiley India Edition, 2008.
8. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering, W Bolton, Pearson Education Press, 3rd Edition, 2005.

Reference Books:

3. Mechatronics Source Book, Newton C. Braga, Thomson Publications, Chennai, 1st Edition, 2002.
4. Mechatronics System Design, Devdas Shetty, Richard A. Kolk, Thomson Learning, 2nd Edition, 2005.
5. Mechatronics, M.D. Singh, J.G. Joshi, Prentice-Hall of India (PHI), 1st Edition, 2006.
6. Mechatronics – Electronic Control Systems in Mechanical and Electrical Engineering,

W. Bolton, Pearson Education, 4th Edition, 2012.
7. Mechatronics – Principles and Applications, Godfrey C. Onwubolu, Elsevier, Indian Print, 1st Edition, 2006.
8. Introduction to Mechatronics and Measurement Systems, David G. Alciatore and Michael B. Histand, McGraw-Hill Education, 6th Edition, 2023.

CourseCode		MEMS:Design and Manufacturing	L	T	P	C
TEC25MCCPE004b		Professional Elective Course – IV				
Semester	**II**		**3**	**0**	**0**	**3**

Course Objectives:

- To introduce the fundamentals, design principles, and applications of MEMS devices.
- To study microfabrication and micromachining processes used in MEMS manufacturing.
- To understand the operation of micro sensors, micro actuators, and microstructures.
- To explore materials, modeling, and simulation techniques for MEMS design.
- To examine packaging, testing, and reliability aspects of MEMS products.

Course Outcomes (CO):

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

- Explain the structure, working principles, and applications of MEMS devices.
- Select suitable materials and fabrication techniques for MEMS manufacturing.
- Analyze the design and performance of micro sensors and micro actuators.
- Use modeling and simulation tools for MEMS product development.
- Evaluate packaging, reliability, and industrial applications of MEMS.

UNIT – I **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.

UNIT – II **Engineering Science for Microsystems Design**

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 – III **Engineering Mechanics for Microsystems Design**

Static Bending of Thin plates, Mechanical Vibration, Thermomechanics, Fracture Mechanics, Thin Film Mechanics and Overview of Finite Element Stress Analysis.

UNIT – IV **Thermo Fluid Engineering and Microsystems Design**

Overview of Basics of Fluid Mechanics in Macro and Micro scales, 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, Overview of Heat conduction in Solids, Heat Conduction in Multilayered Thin films and solids in Sub Micrometer Scale, Design Considerations, Process Design Mechanical Design, Mechanical design using FEM, Design of a Silicon Die for a Micro pressure sensor.

UNIT – V **Materials for MEMS and Microsystems**

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.

Text Books:

4. 1. MEMS and Microsystems: Design and Manufacturing, Tia-Ran Hsu, Tata McGraw-Hill, 1st Edition, 2002.
5. Foundations of MEMS, Chang Liu, Pearson Education, 2nd Edition, 2012.

Reference Books:

5. An Introduction to Microelectromechanical Systems Engineering, Nadim Maluf, Artech House, 1st Edition, 2000.
6. Micro Robots and Micromechanical Systems, W.S.N. Trimmer, Sensors and

Actuators, Volume 19, 1989.
7. Applied Partial Differential Equations, D.W. Trim, PWS-Kent Publishing, Boston, 1st Edition, 1990.
8. MEMS: Introduction and Fundamentals, Mohamed Gad-el-Hak, CRC Press, 3rd Edition, 2022.
9. Micro electromechanical Systems: Design and Analysis, Tai-Ran Hsu, John Wiley and Sons, 2nd Edition, 2023.
10. Design and Development Methodologies for MEMS and Microfluidic Devices, Paul Kirby and Philip LeDuc, Elsevier, 1st Edition, 2022.

CourseCode		Fuzzy Logic and Neural Networks	L	T	P	C
TEC25MCCPE004c		Professional Elective Course - IV				
Semester	II		3	0	0	3

Course Objectives:

After studying this unit, you should be able to understand what is process planning and CAPP,

- To introduce the fundamentals of fuzzy logic and fuzzy set theory.
- To study the design and application of fuzzy inference systems.
- To understand the structure, learning algorithms, and applications of neural networks.
- To explore hybrid systems integrating fuzzy logic and neural networks.
- To apply fuzzy and neural computing techniques to real-world engineering problems.

Course Outcomes (CO):

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

- Explain fuzzy set theory, membership functions, and fuzzy rules.
- Design fuzzy inference systems for decision-making and control applications.
- Apply perceptron, backpropagation, and other learning algorithms in neural networks.
- Develop hybrid neuro-fuzzy systems for complex problem solving.
- Implement fuzzy logic and neural network models in engineering applications.

UNIT – I **Fuzzy Set Theory and Logic Control**

Basic Concepts of Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relation Equations, Fuzzy Logic Control, Fuzzification, Defuzzification, Knowledge Base, Decision Making Logic, Membership Functions, Rule Base.

UNIT – II **Adaptive Fuzzy Systems**

Performance Index, Modification of Rule Base, Modification of Membership Functions, Simultaneous Modification of Rule Base and Membership Functions, Genetic Algorithms, Adaptive Fuzzy System, Neuro Fuzzy Systems.

UNIT – III **Artificial Neural Networks**

Introduction, History of Neural Networks, Multilayer Perceptions, Back Propagation Algorithm and its Variants, Different Types of Learning, Examples.

UNIT – IV **Mapping and Recurrent Networks**

Counter Propagation, Self Organization Map, Congnitron and Neocognitron, Hopfield Net, Kohonnen Nets, Grossberg Nets, Art-I, Art-II Reinforcement Learning.

UNIT – V **Case Studies**

Application of Fuzzy Logic and Neural Networks to Measurement, Control Adaptive Neural Controllers, Signal Processing and Image Processing.

Text Books:

3. C++, Neural Networks and Fuzzy Logic, Vallum B.R. and Hayagriva V.R., BPB Publications, New Delhi, 1st Edition, 1996.
2. Fuzzy Logic with Engineering Applications, Timothy J. Ross, Wiley, 5th Edition, 2023

Reference Books:

4. 1. Fuzzy Logic and Neural Networks, Chennakesava R. Alavala, New Age International, 1st Edition, 2008.
5. Neural Networks for Control, W. Thomas Millon, Richard S. Sutton, Paul J. Werbos, MIT Press, 1st Edition, 1992.
6. Fuzzy Sets, Fuzzy Logic: Theory and Applications, George J. Klir and Bo Yuan, Prentice-Hall of India Pvt. Ltd., New Delhi, 1st Edition, 1995.
7. Neural Networks and Fuzzy Systems, Bart Kosko, Prentice-Hall of India Pvt. Ltd., New Delhi, 1st Edition, 1994.
8. Introduction to Fuzzy Control, Dimiter Driankov, Hans Hellendoorn, Michael

Reinfrank, Narosa Publishing House, New Delhi, 1st Edition, 1996.
9. Introduction to Artificial Neural Systems, Jacek M. Zurada, Jaico Publishing House, New Delhi, Indian Edition, 1994

Course Code	TEC25MCC0020P	Process Automation Laboratory	L	T	P	C
Semester	II		0	0	4	2

Course Objectives:

- To review and train in CAD modeling.
- To train on various areas of finite element analysis of mechanical components. CAM lab
- To train on part programming and program generation from a CAD model.
- To train on machining in various CNC machines.
- To train on various modern measuring instruments.

Course Outcomes (CO):

- Students will be able to review and train in CAD modeling.
- Students will be get trained on various areas of finite element analysis of mechanical components.
- Students would get trained on part programming and program generation from a CAD model•
- Students would get trained on machining in various CNC machines, Students would get trained on various
- modern measuring instruments..

List of Experiments:

1. Aristo XT Six axis Robot
   a. Introduction to Robot programming
   b. Robot programming exercises (Point-to-Point and continuous path task)
2. Either Online / Offline mode.
   a. Simulation of a manufacturing system for increasing production rate.
   b. Simulation of a simple automation system.
3. Either Online / Offline mode.
   I. Hydraulic Circuits
      a. Introduction to Automation studio & its control
      b. Draw & Simulate the Hydraulic circuit for series & parallel cylinders connection
      c. Draw & Simulate Meter-in, Meter-out and hydraulic press and clamping.
      d. Sequencing circuits in hydraulics.
      e. Synchronizing circuits in hydraulics.
   II. Pneumatic circuits
      a. Sequencing circuits in Pneumatics.
      b. Synchronizing circuits in Pneumatics.
      c. Design and Simulation of simple pneumatic circuit by using Cascade Method.
      d. Design and Simulation of simple pneumatic circuit by using step counter method
4. Additive manufacturing machine
   a. Introduction to Additive manufacturing Machine.
   b. Design and fabrication of simple symmetrical and unsymmetrical components

CourseCode	CAM LABORATORY	L	T	P	C
TEC25MCCPE20P					
Semester II		**0**	**0**	**4**	**2**

Course Objectives:

- To get practical knowledge on manual part programming of CNC lathe machine by using G codes and M codes.
- To get practical knowledge on manual part programming of CNC milling and drilling machine by using G codes and M codes.
- To get the practical knowledge on APT language.

Course Outcomes (CO):

- Upon successful completion students should be able to:
- Use an understanding of General and Machine (G& M) code to generate or edit a program which
- will operate a CNC Lathe.
- Apply mathematical methods to calculate Cartesian coordinates

List of Experiments:

Finite Element Analysis using ANSYS 14.5 Package for different structures the discretization can be done with 1-D, 2-D & 3-D elements to perform the following analysis:

6. ramming (using G and M codes) in CNC Lathe Machine
   (a) Part programming for linear interpolation, circular interpolation, chamfering and grooving.
   (b) Part programming by using standard canned cycles for facing, turning, taper turning and thread cutting.
7. Manual part programming (using G and M codes) in CNC Milling Machine
   (a) Part programming for linear interpolation, circular interpolation and contour motions.
   (b) Part programming involving canned cycles for drilling peak drilling and boring.
8. APT (Automatically Programmed Tools) language in CNC Milling and Lathe machine.

4. Cutting tool path generation using any one simulation package for different machining operation

Course Code **Quantum Technologies and Applications**

	L	T	P	C
TEC25MRMC02	**3**	**0**	**0**	**3**

Semester II

Course Objectives: Student will be able
Present core quantum principles such as superposition and
entanglement without mathematical formalism.
2. Develop conceptual clarity on qubits, quantum states, and information frameworks.
3. Examine the theoretical challenges in realizing scalable quantum systems.
4. Introduce foundational ideas in quantum communication and computing.
5. Highlight applications, industrial adoption, and future research directions
in quantum technologies.

Course Outcomes (CO): Student will be able to

- Explain fundamental quantum concepts conceptually.

Distinguish classical information systems from quantum information frameworks.
Identify the principal theoretical limitations in building quantum computers.
 Describe the conceptual basis of quantum communication and computation.
 Discuss current applications, technological trajectories, and career opportunities in the quantum domain.

UNIT – I Foundations of Quantum Theory and Technologies

Transition from classical to quantum physics. Key conceptual principles: Superposition, Entanglement, Uncertainty, Wave-particle duality. Quantum states and measurement; the role of the observer. Representative quantum systems: electrons, photons, atoms. Concept of quantization and discrete energy levels. Strategic relevance of quantum technologies. Overview of major domains: Computing, Communication, Sensing. Global quantum initiatives: India's National Quantum Mission, EU Quantum Flagship, USA, China

UNIT – II Conceptual Structure of Quantum Information

Qubits: qualitative understanding using spin and polarization. Classical bits vs quantum bits: distinctions and implications. Quantum systems (non-engineering perspective): trapped ions, superconducting qubits, photonics. Coherence and decoherence mechanisms. Abstract notions: quantum states, measurement operators, Hilbert space—interpretation without mathematics. Entanglement and nonlocality as foundational resources. Quantum vs classical information principles; philosophical considerations.

UNIT – III Building a Quantum Computer – Challenges and Requirements

Conceptual prerequisites for functional quantum hardware. Fragility of quantum states: decoherence, noise, stability issues. Requirements: isolation, error resilience, scalability, control. Why maintaining entanglement is difficult; theoretical necessity of quantum error correction. Comparative overview of hardware platforms (superconducting circuits, trapped ions, photonics).Current progress vs scientific constraints; conceptual view of quantum software's role..

UNIT – IV Quantum Communication and Computing

(Redundant explanations removed, retaining only unique themes.)Quantum vs classical communication paradigms. Essentials of Quantum Key Distribution (QKD) and its security rationale. Entanglement-enabled communication protocols. Concept of the Quantum Internet and secure global networking. Introduction to quantum computing and quantum parallelism.Conceptual comparison of classical and quantum gate operations. Challenges: decoherence, noise, and the necessity of error correction frameworks.

UNIT - V Applications, Industry, and Future Directions

Application domains: Healthcare and drug discovery, Material science and chemistry, Optimization and logistics, Quantum sensing and precision timing. Case studies: IBM, Google, Microsoft, PsiQuantum. Ethical, societal, and policy considerations. Barriers to adoption: cost, skilled workforce, standards. Emerging research and career landscapes; India's strategic opportunity in the global quantum ecosystem..

Textbooks:

1. Nielsen & Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 2010.
2.Rieffel & Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.
3.Chris Bernhardt, Quantum Computing for Everyone, MIT Press, 2019.

Reference Books:

1. David McMahon, Quantum Computing Explained, Wiley, 2008.
2. Kaye, Laflamme, Mosca, An Introduction to Quantum Computing, OUP, 2007. Scott Aaronson, Quantum Computing Since Democritus, CUP, 2013.
3. Susskind & Friedman, Quantum Mechanics: The Theoretical Minimum, Basic Books, 2014. Rosenblum & Kuttner, Quantum Enigma, OUP, 2011.
4. Benenti et al., Principles of Quantum Computation and Information, World Scientific, 2004. DST India and MeitY: Official Quantum Mission Reports, 2020 onwards.
5. Quantum Flagship EU: Roadmaps and Strategy Documents.

Online Learning Resources

- IBM Quantum Experience & Qiskit Textbook Coursera – Quantum Mechanics and Quantum
- Computation (UC Berkeley) edX – Quantum Internet & Quantum Computers
  YouTube – Quantum Computing for the Determined (Michael Nielsen)

Course Code	**PEDAGOGY STUDIES (Audit Course 1 and 2)**	**L**	**T**	**P**	**C**
TEC25MAC02a		**2**	**0**	**0**	**0**

Semester II

Course Objectives: This course will enable students:
• Review existing evidence on the review topic to inform programme design and policy making undertaken
by the DfID, other agencies and researchers.
• Identify critical evidence gaps to guide the development.

Course Outcomes(CO):Student will be able to
• What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
• What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
• How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT -I

Introduction and Methodology: Aims and rationale, Policy back ground, Conceptual frame work and terminology Theories of learning, Curriculum,Teacher education. Conceptual frame work,Research questions. Overview of methodology and Searching.

UNIT – II

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT – III

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the scho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of th body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT – IV

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers tolearning: limited resources and large class sizes

UNIT - V

Research gaps and future directions: Research design, Contexts,Pedagogy,Teacher education, Curriculum and assessment, Dissemination and research impact.

Suggested Reading

1. AckersJ,HardmanF(2001)ClassroominteractioninKenyanprimaryschools,Compare, 31 (2): 245-261.
2. AgrawalM(2004)Curricularreforminschools:Theimportanceofevaluation,Journalof Curriculum Studies, 36 (3): 361-379.
3. AkyeampongK(2003) Teacher training in Ghana - does it count? Multi-site teachereducation research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, LussierK, PryorJ, Westbrook J (2013)Improving teaching and learning of basic maths and reading in Africa: Does teacherpreparation count?International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
Chavan M (2003)ReadIndia: A mass scale, rapid, 'learning to read'campaign.
6. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Code TEC25MAC02b	**Personality Development through**	**L**	**T**	**P**	**C**
Semester II	**Life Enlightenment Skills**	**2**	**0**	**0**	**0**
	(Audit Course 1 and 2)				

Course Objectives:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Outcomes (CO):

After completion of this course the student can be able to

- StudyofShrimad-Bhagwad-Geetawillhelpthestudentindevelopinghispersonalityand achieve the
- highest goal in life
- • The person who has studied Geetawilllead the nation and mankind to peace and prosperity
- • Study of Neetishatakam will help in developing versatile personality of students

UNIT – I

Neetisatakam- Holistic development of personality
Verses-19,20,21,22(wisdom)
Verses-29,31,32(pride &heroism)
Verses-26,28,63,65(virtue)

UNIT – II

Neetisatakam- Holistic development of personality
Verses-52,53,59(dont's)
Verses-71,73,75,78(do's)

UNIT – III

Approach to day to day work and duties.
ShrimadBhagwadGeeta:Chapter2-Verses41,47,48,
Chapter3-Verses13,21,27,35,Chapter6-Verses5,13,17,23,35,
Chapter18-Verses45,46,48.

UNIT - IV

Statements of basic knowledge.
ShrimadBhagwadGeeta:Chapter2-Verses 56,62,68
Chapter12 -Verses13,14,15,16,17,18
Personality of Rolemodel. Shrimad Bhagwad Geeta:

UNIT – V

Chapter2-Verses 17,Chapter3-Verses36,37,42,
Chapter4-Verses18,38,39
Chapter18– Verses37,38,63

Text Books:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi.
3. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya SanskritSansthanam, New Delhi Publication.

Suggested Reading:

1. "SrimadBhaga vadGita"bySwamiSwarupanandaAdvaitaAshram(PublicationDepartment), Kolkata
2. Bhartrihari'sThree Satakam (Niti-sringar-vairagya) by P.Gopinath, RashtriyaSanskrit Sansthanam, New Delhi.

Course Code	TEC25MAC02c	STRESSMANAGEMENT BY YOGA	L	T	P	C
Semester II		(Audit Course 1 and 2)	2	0	0	0

Course Objectives:

- To achieve overall health of body and mind
- • To overcome stress

Course Outcomes (CO):

After completion of this course the student can be able to

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT – I

Definitions of Eight parts of yog.(Ashtanga)

UNIT – II

Yam and Niyam.

UNIT – III

Do`sand Don't'sin life. i) Ahinsa,satya,astheya,bramhacharyaand aparigrahaii) Shaucha,santosh,tapa,swadhyay,ishwarpranidhan

UNIT – IV

Asan and Pranayam

UNIT – V

i)Various yogposes and their benefits for mind &body ii)Regularization of breathing techniques and its effects-Types of pranayam

Suggested Reading:

1. 'Yogic Asanas forGroupTarining-Part-I": Janardan SwamiYogabhyasiMandal, Nagpur
2. "Rajayogaor conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata