

# **Syllabus of Courses offered to B.Tech. (Mechatronics) IV year**



# UTTARAKHAND TECHNICAL UNIVERSITY

## Program: B. Tech- Mechatronics

Year: 4, Semester: VII, Scheme and Evaluation Pattern

S.No	Course No.	Subject	Periods			Evaluation			External Exam	Total Marks
			L	T	P	Sessional				
						CT	TA	Total		
<b>Theory</b>										
1.	TMTE-701	Modelling & Simulation	3	1	0	30	20	50	100	150
2.	TME-701	CAD/CAM	3	1	0	30	20	50	100	150
3.	TMTE-702	Rapid Prototyping	3	1	0	30	20	50	100	150
4.		Elective-I	3	1	0	30	20	50	100	150
5.		Open Elective	3	1	0	30	20	50	100	150
<b>Practical/Design</b>										
1.	PME-751	CAD/CAM Lab	0	0	2	0	0	25	25	50
2.	PMTE-753	Indus. Training/Seminar	0	0	2	0	0	25	25	50
3.	PMTE-752	Project	0	0	2	0	0	100	0	100
4.	PMTE-754	Seminar	0	0	2	0	0	50	0	50
<b>Total</b>										<b>1000</b>
<b>Semester: VIII</b>										
<b>Theory</b>										
S.No	Course No.	Subject	Periods			Evaluation			External Exam	Total Marks
			L	T	P	Sessional				
						CT	TA	Total		
1.	TMTE-801	Design of Mechatronic Systems	3	1	0	30	20	50	100	150
2.	TEC-034	Embedded Systems	3	1	0	30	20	50	100	150
3.		Elective-II	3	1	0	30	20	50	100	150
4.		Elective-III	3	1	0	30	20	50	100	150
<b>Practical/Design</b>										
1.	PMTE-851	Mechatronics Lab	0	0	2	0	0	25	25	50
2.	PMTE-852	Project	0	0	6	0	100	100	200	300
4.		General Proficiency	0	0	0	0	0	50	0	50
<b>Total</b>										<b>1000</b>

**Electives-I:**

1. TMTE – 071: CIM & Flexible Manufacturing Systems
2. TMTE – 072: Industrial Safety Engineering
3. TMTE – 073: Composite Materials
4. TMTE - 074: Digital Image Processing

**Electives-II:**

1. TMTE-081: Soft Computing Techniques
2. TMTE-082: Refrigeration & Air Conditioning
3. TMTE-083: Operation Research
4. TMTE –084: Product Design & Costing

**Electives-III:**

1. TMTE – 085: Statistical Quality Control
2. TMTE – 086: Finite Element Methods
3. TMTE – 087: Design for Manufacturing
4. TMTE – 088: Intelligent Instruments

**UTTARAKHAND TECHNICAL UNIVERSITY**  
**SESSION 2009-10**

**LIST OF OPEN ELECTIVES-VII SEMESTER Effective from the session – 2009-10**

[ List of Open Elective of 7th Semester for B. Tech. Civil/Electrical/Electrical and Electronics/  
Mechanical & Allied Courses/ Electronics and Communications & Allied Courses/  
Instrumentation and Control & Allied Courses/Computer Science and Engineering & Allied  
Courses/ Information Technology & Allied Courses/ Biotechnology ]

<b>S.No.</b>	<b>P.Code</b>	<b>Subject</b>	<b>Deptt.</b>
1.	TOE 01	Non-conventional Energy Resources	Electrical
2.	TOE 02	Reliability Engineering	Electrical
3.	TOE 03	Environment & Ecology	Civil
4.	TOE 04	Geographic Inf. System (GIS) Technology & its Applications	Civil
5.	TOE 05	Entrepreneurship Development Programme	Humanities
6.	TOE 06	Ancient Indian Culture	Humanities
7.	TOE 07	Human Values	Humanities
8.	TOE 08	Quality System & Management	Mechanical
8.	TOE 09	Condition Monitoring & Diagnostics	Mechanical
10.	TOE 10	Value Engineering	Mechanical
11.	TOE 11	Nanotechnology	Mechanical
12.	TOE 12	Solar Energy	Mechanical
13.	TOE 13	Human Resource Management	Mechanical
14.	TOE 14	Advance Material Science	Mechanical
15.	TOE 15	Industrial Instrumentation	Instrumentation & Control
16.	TOE 16	Biomedical Engineering	Instrumentation & Control
17.	TOE 17	Fundamentals of Coding Theory	Electronics & Communication
18.	TOE 18	Consumer Electronics	Electronics & Communication
19.	TOE 19	Artificial Neural Networks & Fuzzy Logic	Electrical
20.	TOE 20	Human Computer Interaction	Computer Science
21.	TOE 21	IT in Business	Information Technology
22.	TOE 22	Artificial Intelligence in Manufacturing	Manufacturing Technology
23.	TOE 23	Health, Hospital and Equipment Management	Biomedical Engineering
24.	TOE 24	Introduction to Medical Physics	Biomedical Engineering
25.	TOE 25	Modern Control System	Electrical
26.	TOE 26	Mechatronics	Electrical
27.	TOE 27	SCADA & Energy Management System	Electrical

**Note: The students will choose any one subject of the course of other than their Engineering Branch**

# Uttarakhand Technical University

**Subject Code: TMTE- 701**

**Course Title: Modelling & Simulation**

**Contact Hours: L:3 T:1 P:0**

**Examination Duration: 3 Hours**

## **Course Content:**

### **Unit-I**

#### **Introduction;**

Systems , Models and Simulation, Continuous and Discrete Systems, system modeling, Types of models, Principles used in modeling ,Static and Dynamic physical models, Static and Dynamic Mathematical models, Introduction to Static and Dynamic System simulation , Advantages ,Disadvantages and pitfalls of Simulation.

### **Unit-II**

**System Simulation:** Types of System Simulation, Monte Carlo Method, Comparison of analytical and Simulation methods, Numerical Computation techniques for Continuous and Discrete Models, Distributed Lag Models, Cobweb Model, continuous system simulation using languages/package.

### **Unit –III**

**Continuous System Simulation:** Continuous System models, Differential Equations, Analog and Hybrid computers, Analog Methods, Digital-Analog Simulators, Continuous system simulation using languages/package, Hybrid simulation; Real Time simulations.

### **Unit –IV**

**System Dynamics & Probability concepts in Simulation:** Exponential growth and decay models, logistic curves ,Generalization of growth models , System dynamics diagrams, Multi segment models , Representation of Time Delays ,Generation of a Random numbers, Generating Discrete distributions, Rejection Method.

### **Unit-V**

**Discrete System Simulation:** Discrete events, Representation of Time , Generation of Arrival Patterns, stochastic simulation, Service times, Simulation of single and two server queue, simulation of inventory system, simulation of activity network, discrete simulation using languages/package.

## **Recommended Books:**

1. Geoffrey Gordon, 'System Simulation', Pearson Education.
2. Narsingh Deo, 'System Simulation with Digital Computer', Prentice Hall of India
3. Jerry Banks and John S. Carson II, 'Discrete Event System Simulation', PHI
4. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, 'Discrete – Event System Simulation', Pearson Education.
5. Gottfried B. S., 'Elements of Stochastic Process Simulation', Prentice Hall, London

# Uttarakhand Technical University

**Subject Code:** TME 701

**Contact Hours:** L: 3 T:1 P:0

**Course Title:** CAD/CAM

**Examination Duration:** 3 Hours

## **UNIT I :**

**CAD TOOLS:** Definition of CAD Tools, Types of system, CAD/CAM system evaluation criteria, input and output devices. Graphics standard, functional areas of CAD, Modeling and viewing, Review of C, C++, statements such as if else for while & switch, functions, pointer notations, structure & class, concept of OOP.

**GEOMETRICMODELLING:** Output primitives- Bresenham's line drawing and Mid-point circle algorithms. Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves her mite cubic splines Bezier curves B-splines rational curves

## **UNIT II:**

**SURFACE MODELING:** **Mathematical** representation surfaces, Surface model, Surface entities surface representation, Parametric representation of surfaces, plane surface, rule surface, surface of revolution, Tabulated Cylinder.

**PARAMETRIC REPRESENTATION OF SYNTHETIC SURFACES** – Hermite Bicubic surface, Bezier surface, B- Spline surface, COONs surface, Blending surface , Sculptured surface, Surface manipulation – Displaying, Segmentation, Trimming, Intersection, Transformations (both 2D and 3D).

**GEOMETRICMODELLING-3D** : Solid modeling, Solid Representation, Boundary Representation (B-rep), Constructive Solid Geometry (CSG).

## **UNIT III :**

CAD/CAM Exchange : Evaluation of data – exchange format, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF.

**Collaborative Engineering:** Collaborative Design, Principles, Approaches, Tools, Design Systems. Introduction to CAD/CAE, Element of CAD, Concepts of integrated CAD/CAM, CAD Engineering applications, its importance & necessity. Finite Element Methods: Introduction and Application of FEM, Stiffness Matrix/ Displacement Matrix, One/Two Dimensional bar & beam element (as spring system) analysis.

## **UNIT – IV**

**NC Part Programming-** Manual (word address format) programming. Examples Drilling and Milling.

## **UNIT – V**

System Devices- Introduction to DC motors, stepping motors, feed back devices such as encoder, counting devices, digital to analog converter and vice versa.

**Interpolators-** Principle, Digital Differential Analysers. Linear interpolator, circulator Interpolator and its software interpolator. Control of NC Systems- Open and closed loops. Automatic control of closed loops with encoder & tachometers. Speed variation of DC motor. Adaptive control

### **Recommended Books:**

1. CAD/CAM Theory and Practice – Ibrahim Zeid ,TMH
2. CAD/CAM – Groover & Zimmers Pearson
3. Computer Oriented Numerical Methods – Rajaraman PHI Learning

# Uttarakhand Technical University

**Subject Code: TMTE-702**

**Course Title: Rapid Prototyping**

**Contact Hours: L: 3 T: 1 P: 0**

**Examination Duration: 3 Hours**

## **Course Contents:**

### **UNIT I: INTRODUCTION**

8

Need - Development of RP systems – RP process chain - Impact of Rapid Prototyping on Product Development –Digital prototyping - Virtual prototyping- Rapid Tooling – Benefits - Applications

### **UNIT II: REVERSE ENGINEERING AND CAD MODELING**

8

Basic concept- Digitization techniques – Model Reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data Requirements – geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation

### **UNIT III LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS**

8

Stereolithography (SLA): Apparatus: Principle, per-build process, part-building, postbuild processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications; Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. laminated object manufacturing(LOM): Working Principles, details of processes, products, materials; advantages, limitations and applications - Case studies.

### **UNIT IV: POWDER BASED RAPID PROTOTYPING SYSTEMS**

8

Selective Laser Sintering(SLS): Principle, process, Indirect and direct SLS- powder structures, modeling of SLS, materials, post processing, post curing, surface deviation and accuracy, Applications.

Laser Engineered Net Shaping(LENS):Processes, materials, products, advantages, limitations and applications– Case Studies.

### **UNIT V: OTHER RAPID PROTOTYPING TECHNOLOGIES**

8

Three dimensional Printing (3DP):Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies.

Shape Deposition Manufacturing (SDM): Introduction, basic process, shape decomposition, mold SDM and applications. Selective Laser Melting, Electron Beam Melting – Rapid manufacturing.

### **Recommended books:**

1. Rapid prototyping: Principles and applications, second edition, Chua C.K., Leong K.F., and Lim C.S., World Scientific Publishers, 2003.
2. Rapid prototyping, Andreas Gebhardt, Hanser Gardener Publications, 2003.
3. Rapid Prototyping and Engineering applications : A tool box for prototype development, Liou W.Liou, Frank W.Liou, CRC Press, 2007.
4. Rapid Prototyping: Theory and practice, Ali K. Kamrani, Emad Abouel Nasr, Springer, 2006.
5. Rapid Tooling: Technologies and Industrial Applications, Peter D.Hilton, Hilton/Jacobs, Paul F.Jacobs, CRC press, 2000.

# Uttarakhand Technical University

**Subject Code: PME-751**

**Course Title: CAD/CAM Lab**

**Contact Hours: L: 2 T: 1 P: 0**

**10 experiments (6 from CAD experiments, 4 from CAM experiment)**

## **A. CAD Experiments-**

1. Line drawing or Circle drawing algorithm experiment : writing the program and running it on computer.
2. Transformations algorithm experiment for translation/rotation/scaling : writing program and running it on computer.
3. Design problem experiment : writing the program for design of machine element or other system and running it on computer.
4. Optimisation problem experiment : writing a program for optimising a function and running it on computer.
5. Auto CAD experiment : understanding and use of Auto CAD commands.
6. Writing a small program for FEM for 2 spring system and running it. Or using a FEM package.
7. Use of Graphic software standards packages e.g. GKs/PHICS/GL etc.
8. Use of pro Engineer/Ideas etc.

## **B. CAM experiments-**

1. Writing a part-programming (in word address format or in APT) for a job for drilling operation (point-to-point) and running on NC machine.
2. Writing a part programming (in word address format or in APT) for a job for milling operation (contouring) and running on NC machine
3. Experiment on Robots and its programs
4. Experiment on Transfer line/Material handling.
5. Experiment on difference between ordinary machine and NC machine, study or retrofitting.
6. Experiment on study of system devices such as motors and feedback devices.
7. Experiment on Mechatronics & controls



# Uttarakhand Technical University

**Subject Code: TMTE- 801**

**Course Title: Design of Mechatronic Systems**

**Contact Hours: L: 3 T: 1 P: 0**

**Examination Duration: 3 Hours**

**Course Content:**

## **Unit – 1: Introduction**

The design process; systems; measurement systems; control systems; programmable logic controller; examples of mechatronic systems.

## **Unit – 2: Mechatronics in Manufacturing**

Production unit; input/output and challenges in Mechatronic production units; knowledge required; main features; computer integrated manufacturing; just in time production systems.

## **Unit – 3: Case Studies on Data Acquisition**

Testing of transportation bridge surface materials; transducer calibration system for automotive applications; strain gauge weighing system; solenoid force – displacement system; rotary optical encoder.

## **Unit – 4: Case Studies on Data Acquisition and Control**

Thermal cycle fatigue of a ceramic plate; pH control system; de-icing temperature control system; skip control of a CD player;

## **Unit – 5: Case Studies on Mechatronic System Design**

Mechatronic design of a coin counter; robotic walking machine; timed switch; windscreen wiper motion; pick and place robot; car park barriers; bar code reader; car engine management.

## **Recommended Books:**

1. W Bolton, 'Mechatronics', Pearson Education
2. Devdas Shetty and Richard A. Kolk, 'Mechatronics System Design', Vikas Publishing House
3. Appuu Kuttan K. K., 'Introduction to Mechatronics', Oxford Press, London
4. David G. Alciatore and Michael B. Hestand, 'Introduction to Mechatronics and Measurement Systems', Tata McGraw Hill
5. Brain Morriess, 'Automated Manufacturing Systems – Actuators, Controls, Sensors and Robotics', McGraw Hill International Edition

## Uttarakhand Technical University

**Subject Code:** TEC 034

**Contact Hours:** L: 3 T: 1 P: 0

**Course Title:** Embedded Systems

**Examination Duration:** 3 Hours

### UNIT I

**Introduction:** Embedded systems and its applications, Embedded Operating system, Design parameters of an embedded system and its significance, design life cycle, tools introduction, hardware and software partitioning and co-design.

### UNIT II

**Hardware Fundamentals For The Embedded Developers :** Digital circuit parameters-Open collector outputs Tristate outputs I/O sinking and Sourcing, PLD's, Watchdog Timers, Hardware design and development.

**Custom Single Purpose Processors:** Optimizing program, FSMD, Data path & FSM.

**General Purpose Processors And Asip's** (Application Specific Instruction set Programming): Software and operation of general purpose processors-Programmers View Development Environment-ASIPs Microcontrollers-DSP Chips.

### UNIT III

**Introduction To Microcontrollers And Micoprocessors:** Embedded versus external memory devices, CISC and RISC processors, Harvard and Von Neumann Architectures.

**RTOS** -Tasks, states, Data, Semaphores and shared data, Operating system services, Message queues, Mailboxes.

### UNIT IV

**ADVANCED PROCESSOR**-(only architectures) 80386, 80486, ARM and DUAL CORE, Core to DUO, i3, i5, i7 (References)

**Communication Basics:** Microprocessor Interfacing I/O Addressing, Direct memory access, Arbitration, multilevel bus architecture, Serial protocols, Parallel protocols and wireless protocols.

### UNIT V

**Real World Interfacing:** LCD, Stepping Motor, ADC, DAC, LED, Push Buttons, Key board, Latch Interconnection, PPI.

#### **Recommended Books:**

1. Embedded System Design-Frank Vahid/Tony Givargis, John Willey@2005.
2. Microcontroller (Theory and Applications) Ajay V Deshmukh, Tata McGraw-Hill@2005.
3. An Embedded Software Primer-David E.Simon, Pearson Education @ 1999.
4. The 8051 Microcontroller and embedded systems-Muhammad Ali Mazidi and Janice Gillispie.
5. Microcontrollers (Architecture, Implementation & Programming) Kenneth Hintz, Daniel Tabak, Tata McGraw-Hill@2005.
6. 8051 Microcontrollers & Embedded Systems 2nd Edition-Sampath Kr, Katson Books2006.

# Uttarakhand Technical University

**Subject Code: PMTE - 851**

**Course Title: Mechatronics Laboratory**

**Contact Hours: L:0 T:0 P:2**

## **List of Experiments:**

1. Mechatronic design of a coin counter;
2. Mechatronic design of robotic walking machine;
3. Study of timed switch;
4. Study of windscreen wiper motion;
5. Study of pick and place robot;
6. Study of car park barriers;
7. Study of bar code bar reader;
8. Study of car engine management system
9. Study of digital camera
10. Study of hard disk drive
11. Design of a digital thermometer system
12. Design of a digital barometer for atmospheric pressure
13. Design a digital ohmmeter

The institute may add more of similar experiments. A minimum of seven experiments are to be performed.

**Syllabi of elective courses offered to  
B.Tech. (Mechatronics) students**

**Electives-I:**

5. TMTE – 071: CIM & Flexible Manufacturing Systems
6. TMTE – 072: Industrial Safety Engineering
7. TMTE – 073: Composite Materials
8. TMTE - 074: Digital Image Processing

**Electives-II:**

5. TMTE-081: Soft Computing Techniques
6. TMTE-082: Refrigeration & Air Conditioning
7. TMTE-083: Operation Research
8. TMTE –084: Product Design & Costing

**Electives-III:**

5. TMTE – 085: Statistical Quality Control
6. TMTE – 086: Finite Element Methods
7. TMTE – 087: Design for Manufacturing
8. TMTE – 088: Intelligent Instruments

# Uttarakhand Technical University

**Subject Code: TMTE-071    Course Title: CIM and Flexible Manufacturing Systems**

**Contact Hours:    L: 3    T: 1    P: 0**

**Examination Duration: 3 Hours**

## **Course Contents:**

### **UNIT I: COMPONENTS OF CIM**

9

CIM as a concept and a technology, CASA/Sme model of CIM, CIM II, benefits of CIM, Communication matrix in CIM, fundamentals of computer communication in CIM – CIM data transmission methods – serial, parallel, asynchronous, synchronous, modulation, Demodulation; simplex and duplex; Types of communication in CIM – point to point (PTP); star and multiplexing. Computer networking in CIM – the seven layer OSI model, LAN model, MAP model, network topologies – star, ring and bus, advantages of networks in CIM

### **UNIT II: GROUP TECHNOLOGY AND COMPUTER AIDED PROCESSPLANNING**

9

History Of Group Technology – role of G.T in CAD/CAM Integration – part milies classification and coding – DCLASS and MCLASS and OPTIZ coding systems – facility design using G.T – benefits of G.T–cellular manufacturing. Process planning - role of process planning in CAD/CAM Integration – approaches to computer aided process planning – variant approach and generative approaches – CAPP and CMPP systems

### **UNIT III: COMPUTER AIDED PLANNING AND CONTROL & COMPUTER MONITORING**

9

Production planning and control – cost planning and control – inventory management–material requirements planning (MRP) – shop floor control. Lean and Agile Manufacturing. Types of production monitoring systems – structure model of manufacturing – process control and strategies – direct digital control.

### **Unit IV: Flexible Manufacturing Systems:**

7

Components of an FMS, types of systems, where to apply FMS technology, FMS work stations. Material handling and storage system: Functions of the handling system, FMS layout configurations; Material handling equipments. Computer control system: Computer function, FMS applications and benefits.

### **Unit V: Automation**

6

Types of automation, reasons for automating; automating strategies, Detroit-type automation: Automated flow lines Automated assembly systems : Design for automated assembly, types of automated assembly systems, part feeding devices, quantitative analysis of the delivery system operation, analysis of a single-station assembly machine.

## **Recommended Books:**

1. Automation, Production Systems and Computer Integrated Manufacturing', Groover M.P., PHI
2. Approach to Computer Integrated Design and Manufacturing Naua Singh, John Wiley and Sons, 1998.
3. Production Management Systems, 'A CIM Perspective Browne J, Harhen J, Shivnan J, Addison Wesley, 1996.
4. James A. Regh and Henry W. Kreabber, "Computer Integrated Manufacturing", Pearson Education second edition, 2005.
5. Ranky, Paul G., "Computer Integrated Manufacturing", PHI, 2005.

# Uttarakhand Technical University

**Subject Code: TMTE-072**

**Contact Hours: L: 3 T:1 P:0**

**Course Title: Industrial Safety Engineering**

**Examination Duration: 3 Hours**

## UNIT I

**Safety in Metal Working Machinery and Wood Working Machines:** General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines, Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards.

**Principles of Machine Guarding:** Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard opening. authorized entry to hazardous installations-benefits of good guarding systems.

## UNIT II

**Safety in Welding and Gas Cutting:** Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases-colour coding – flashback arrestor – leak detection-pipe line safety-storage and handling of gas cylinders.

## UNIT III

**Safety In Cold Forming And Hot Working Of Metals:** Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls, power press set up and die removal, inspection and maintenance Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills –hot bending of pipes, hazards and control measures. Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries

## UNIT IV

**Safety In Finishing, Inspection And Testing:** Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation.

## UNIT V

**Industrial Fire Protection Systems:** Sprinkler-hydrants-stand pipes – special fire suppression systems like deluge and emulsifier, selection criteria of the above installations, reliability, maintenance, evaluation and standards – alarm and detection systems. Other suppression systems – CO system, foam system, dry chemical powder (DCP) system, halon system – need for halon replacement – smoke venting. Portable extinguishers – flammable liquids – tank farms – indices of in flammability-fire fighting systems.

### **Recommended Books:**

1. William E. Clark , "Firefighting Principles & Practices ", Fire Engineering Books and Videos, 2nd edition 1991.
2. Accident Prevention Manual, National Safety Council (NSC), Chicago, 1982.
3. Occupational safety Manual, BHEL, Trichy, 1988.
4. N.V. Krishnan, Safety in Industry, Jaico Publishery House, 1996.
5. Safety in the use of wood working machines, HMSO, UK 1992.

# Uttarakhand Technical University

**Subject Code: TMTE-073**

**Contact Hours: L: 3 T:1 P:0**

**Course Title: Composite Materials**

**Examination Duration: 3 Hours**

## **Unit-I**

**Introduction:** General introduction to composites; historical background; concept of matrix and reinforcement and particulates.

**Matrix and reinforcement:** Types of matrix and reinforcement, volume fraction and weight fraction Fiber architecture fiber packing arrangements, whiskers

## **Unit-II**

**Fabrication methods of polymer composites:** Liquid resin impregnated routes, pressurized consolidation of resin pre-pegs, consolidation of resin molding compounds, injection molding of thermoplastics, hot press molding of thermoplastics

**Fabrication of ceramic composites:** Powder based routes, reactive processing, layered ceramic composites, carbon/carbon composites

## **Unit-III**

**Fabrication routes of metal matrix composites:** Squeeze infiltration, stir casting, spray deposition, powder blending and consolidation, diffusion bonding of foils, PVD

**Testing and characterization:** Different tests like internal stress measurement by diffraction, metallographic preparation etc with special emphasis to metal matrix composites

## **Unit IV**

**Mechanics of Composite Materials:** Continuous Fibres & Discontinuous Fibres, Nature of Stress vs Strain Curve for Composites, Mechanical Properties- Creep of Composites, Fatigue of Composites, Fracture Toughness, Designing with Composites

## **UNIT V**

**Dispersion and Particulate Strengthened Composites:** Dispersion Strengthened Composites, Particulate Strengthened Composites, Cermets, Polymets Introduction to Self Healing (Repairing) Composites, Molecular Composites, Micro Composites, Nano Composites, Left Handed Composite Materials, Biocomposites

### **Recommended Books:**

1. Mechanics of Fibrous Composites, CT Herakovich.
2. Analysis and Performance of Fibre Composites, BD Agarwal and LJ Broutman.
3. Mechanics of Composite Materials, RM Christensen.
4. Composite materials-Science and Applications- D.L.Chung, Springer
5. Hull D. and Clyne T. W., 'An Introduction to Composite Materials', Cambridge University Press



# Uttarakhand Technical University

**Subject Code:** TMTE-074

**Contact Hours:** L: 3 T:1 P:0

**Course Title:** Digital Image Processing

**Examination Duration:** 3 Hours

## UNIT I

**Introduction and Fundamentals:** Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization.

**Image Enhancement in Spatial Domain:** Introduction; Basic Gray Level Functions – Piecewise- Linear Transformation Functions: Contrast Stretching; Histogram Specification; Histogram Equalization; Local Enhancement; Enhancement using Arithmetic/Logic Operations – Image Subtraction, Image Averaging; Basics of Spatial Filtering; Smoothing - Mean filter, Ordered Statistic Filter; Sharpening – The Laplacian.

## UNIT II

**Image Enhancement in Frequency Domain:** Fourier Transform and the Frequency Domain, Basis of Filtering in Frequency Domain, Filters – Low-pass, High-pass; Correspondence Between Filtering in Spatial and Frequency Domain; Smoothing Frequency Domain Filters – Gaussian Lowpass Filters; Sharpening Frequency Domain Filters – Gaussian Highpass Filters; Homomorphic Filtering.

**Image Restoration:** A Model of Restoration Process, Noise Models, Restoration in the presence of Noise only-Spatial Filtering – Mean Filters: Arithmetic Mean filter, Geometric Mean Filter, Order Statistic Filters – Median Filter, Max and Min filters; Periodic Noise Reduction by Frequency Domain Filtering – Bandpass Filters; Minimum Mean-square Error Restoration.

## UNIT III

**Color Image Processing:** Color Fundamentals, Color Models, Converting Colors to different models, Color Transformation, Smoothing and Sharpening, Color Segmentation.

**Morphological Image Processing:** Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing, Morphological Algorithms – Boundary Extraction, Region Filling, Extraction of Connected Components.

## UNIT IV

**Registration:** Introduction, Geometric Transformation – Plane to Plane transformation, Mapping, Stereo Imaging – Algorithms to Establish Correspondence, Algorithms to Recover Depth

**Segmentation:** Introduction, Region Extraction, Pixel-Based Approach, Multi-level Thresholding, Local Thresholding, Region-based Approach, Edge and Line Detection: Edge Detection, Edge Operators, Pattern Fitting Approach, Edge Linking and Edge Following.

## UNIT V

**Feature Extraction:** Representation, Topological Attributes, Geometric Attributes

**Description:** Boundary-based Description, Region-based Description, Relationship.

**Object Recognition:** Deterministic Methods, Clustering, Statistical Classification, Syntactic Recognition, Tree Search, Graph Matching

### **Recommended Books:**

1. Rafael C. Gonzalvez and Richard E. Woods, Digital Image Processing 2nd Edition,.; PHI.
2. B. Chanda, D.D. Majumder, "Digital Image Processing & Analysis", PHI
3. R.J. Schalkoff; Digital Image Processing and Computer Vision, John Wiley and Sons, NY
4. A.K. Jain; Fundamentals of Digital Image Processing, Prentice Hall, Upper Saddle River, NJ.

# Uttarakhand Technical University

**Subject Code:** TMTE-081

**Course Title:** Soft Computing Techniques

**Contact Hours:** L: 3 T:1 P:0

**Examination Duration:** 3 Hours

## Unit I

Introduction to soft computing. Applications of Artificial Neural Networks, fuzzy logic, genetic algorithms and other soft-computing techniques. Their strengths and weaknesses. Synergy of soft computing techniques. Artificial neural networks : over view of history, Mathematical Models of Neurons, ANN architecture.

## Unit II

**Introduction to artificial neural network:** Neural Networks: Learning rules, Learning Paradigms-Supervised, Unsupervised and reinforcement Learning, ANN training Algorithms-perceptions, Training rules, Delta, Back Propagation Algorithm, Multilayer Perceptron Model, Competitive learning networks, Kohonen self organizing networks, Hebbian learning; Hopfield Networks,

## Unit III

**Fuzzy Logic:** Introduction to Fuzzy Logic, Classical and Fuzzy Sets: Overview of Classical Sets, Membership Function, Fuzzy rule generation. Operations on Fuzzy Sets: Compliment, Intersections, Unions, Combinations of Operations, Aggregation Operations. Fuzzy Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations.

## Unit IV

Genetic algorithms(Gas), Evolution strategies(Ess), Evolutionary programming(EP), Genetic Programming(GP),Selecting, crossover, mutation, schema analysis, analysis of selection algorithms; convergence; Markov & other stochastic models.

## Unit V

Other Soft computing approaches Simulated Annealing, Tabu Search, Ant colony based optimization.

### **Recommended Books:**

1. "Neuro-Fuzzy and Soft computing", Jang, Sun, Mizutani, Pearson
2. "Neural networks: a comprehensive foundation", Haykin,
3. "Genetic Algorithms", Goldberg,
4. "Fuzzy Sets & Fuzzy Logic", G.J. Klir & B. Yuan, PHI.
5. Anderson J.A., "An Introduction to Neural Networks", PHI, 1999
6. Hertz J. Krogh, R.G. Palmer, "Introduction to the Theory of Neural Computation", Addison- Wesley, California,
7. Melanie Mitchell, "An Introduction to Genetic Algorithm", PHI, 1998.
8. "Neural Networks-A Comprehensive Foundations", Prentice-Hall International, New Jersey, 1999
9. Freeman J.A. & D.M. Skapura, "Neural Networks: Algorithms, Applications and Programming Techniques", Addison Wesley, Reading, Mass, (1992).
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# Uttarakhand Technical University

**Subject Code:** TMTE- 082

**Course Title:** Refrigeration & Air Conditioning

**Contact Hours:** L: 3 T:1 P:0

**Examination Duration:** 3 Hours

## Unit I

**Refrigeration:** Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect & C.O.P. Air Refrigeration cycle: Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART).

## Unit II

**Vapour Compression System:** Single stage system, Analysis of vapour compression cycle, use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle, Different configuration of multistage system, Cascade system.

## Unit III

**Vapour Absorption system:** Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Ammonia – Water vapour absorption system, Lithium- Bromide water vapour absorption system, Comparison.

**Refrigerants:** Classification, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants.

## Unit IV

**Air Conditioning:** Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart, Different Psychometric processes, Thermal analysis of human body Effective temperature and comfort chart, Cooling and heating load calculations, Infiltration & ventilation, Internal heat gain, Sensible heat factor ( SHF ), By pass factor, Grand Sensible heat factor ( GSHF), Apparatus dew point (ADP).

## Unit V

**Refrigeration Equipment & Application:** Elementary knowledge of refrigeration & air conditioning equipments e.g compressors, condensers, evaporators & expansion devices, Air washers, Cooling, towers & humidifying efficiency, Food preservation, cold storage, Refrigerates Freezers, Icc plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, Basic difference between comfort and industrial air conditioning.

## **Recommended Books:**

1. Refrigeration and Air conditioning by C.P Arora.TMH
2. Refrigeration and Air conditioning by Arora & Domkundwar.Dhanpat Rai
3. Refrigeration and Air conditioning by stoecker & Jones.
4. Refrigeration and Air conditioning by Roy J. Dossat.Pearson
5. Heating Ventilating and Air conditioning by Mcquiston
6. Thermal Environment Engg. by Kuhen, Ramsey & Thelked. Central Book Agency. ASHRAE Handbooks

# Uttarakhand Technical University

**Subject Code:** TMTE-083

**Course Title:** Operations Research

**Contact Hours:** L: 3 T:1 P:0

**Examination Duration:** 3 Hours

## Unit I

**Introduction:** Linear programming, Definition, scope of Operations Research (O.R) approach and limitations of OR Models, Characteristics and phases of OR Mathematical formulation of L.P. Problems. Graphical solution methods.

**Linear Programming Problems:** The simplex method - slack, surplus and artificial variables. Concept of duality, two phase method, dual simplex method, degeneracy, and procedure for resolving degenerate cases.

## Unit II

**Transportation Problem:** Formulation of transportation model, Basic feasible solution using different methods, Optimality Methods, Unbalanced transportation problem, Degeneracy in transportation problems, Applications of Transportation problems.

**Assignment Problem:** Formulation, unbalanced assignment problem, traveling problem.

## Unit III

**Game Theory:** Formulation of games, two person-Zero sum game, games with and without saddle point, Graphical solution ( $2 \times n$ ,  $m \times 2$  game), dominance property.

## Unit IV

**Queuing Theory:** Queuing system and their characteristics. The M/M/1 Queuing system, Steady state performance analyzing of M/M/1 and M/M/C queuing model.

## Unit V

**PERT-CPM Techniques:** Network construction, determining critical path, floats, scheduling by network, project duration, variance under probabilistic models, prediction of date of completion, crashing of simple networks.

## Reference :

1. Taha H. A. - Operations Research , Pearson
2. Operations Research: Principles and practice: Ravindran, Phillips & Solberg, Wiley India ltd
3. AM Natarajan, P.Balasubramani , ATamilaravari "Operation research" Pearson 2005
4. Introduction to operation research: Theory and Applications, Springer BSP, Hyderabad S D Sharma-Operations Research, Kedarnath Ramnath

# Uttarakhand Technical University

**Subject Code: TMTE-084**  
**Contact Hours: L: 3 T:1 P:0**

**Course Title: Product Design And Costing**  
**Examination Duration: 3 Hours**

## UNIT I

**Product Design and Development:** Principles of creativity in design- integrated product development and concurrent engineering , Product analysis – Criteria for product design ,Market research – Design for customer and design for manufacture – Product life cycle.

## UNIT II

**Economics of Design:** Breaks even point - Selection of optimal materials and processes – Material layout planning – Value analysis – Re-engineering and its impact on product development.

## UNIT III

**Product Modeling:** Product modeling – Definition of concept - fundamental issues – Role and basic requirement of process chains and product models –Types of product models – model standardization efforts –types of process chains – industrial demands.

## UNIT IV

**Product Costing:** Bill of materials – Outline Process charts – Concepts of operational standard time – Work measurement by analytical estimation and synthesis of time – Budgets times – Labor cost and material cost at every stage of manufacture – W.I.P. costing

## UNIT V

**Recent Advances and Concepts In Product Design:** Fundamentals of FEM and its significance to product design – Product life cycle management – Intelligent information system – Concept of Knowledge based product and process design.

### **Recommended Books:**

1. Product Design and Development, 4th Edition, [Anita Goyal](#), [Karl T Ulrich](#), [Steven D Eppinger](#), Tata McGraw-Hill Education, 2009
2. Mechanical Estimating & Costing By Banga & Sharma.
3. Production Planning, Control and Industrial Management By Jain & Agarwal
4. Sameul Eilon, 'Element of Product Planning and Control', McMillan & Company.
5. Jones S. W., 'Product Design and Process Selection', Butterworth Publication

# Uttarakhand Technical University

**Subject Code: TMTE-085**

**Course Title: Statistical Quality Control**

**Contact Hours: L: 3 T:1 P:0**

**Examination Duration: 3 Hours**

## **UNIT I**

**Quality Fundamentals:** Importance of quality, meaning of quality, quality dimensions, quality planning, quality control, SQC, Quality assurance, quality costs, economics of quality, quality and productivity, quality and reliability, quality loss function.

## **UNIT II**

**Control Charts for Variables:** Process variation,– Statistical basis, 3 – sigma control limits, Rational sub-grouping, X ,R and S charts, Interpretation of charts, warning and modified control limits, operating characteristic curve for X – chart, SPC -process capability analysis – Cp, CPK, Cpm, Machine capability, Gauge capability.

## **UNIT III**

**Control Charts for Attributes** P, np, C, U and ku charts, demerits control chart, Multi –variable chart, individual measurement charts – moving average and moving range charts, quality control in service sector.

## **UNIT IV**

**Acceptance Sampling:** Need for Acceptance sampling, economics of sampling, sample selection, single and Double sampling – O.C. curves, Average outgoing quality (AOQ), Average sample Number (ASN), Average total inspection (ATI), Multiple and sequential sampling, sampling plans – military standards, Dodge – Roming, IS 2500.

## **UNIT V**

**Metrology & Inspection:** Fundamental methods of measurement, precision & accuracy, measurement devices - Linear and Angular - Coordinate Measuring Machine, Destructive and Non- Destructive Testing methods.

### ***Recommended Books:***

1. Statistical Quality Control, Eugene L. Grant and Richard S. Leaven Worth, TMH, Seventh Edition, 2000.
2. Quality Control. Dale H. Besterfield, Pearson Education Asia, Seventh Edition,2004.
3. Douglas C. Montgomery, Introduction to Statistical Quality Control, John Wiley & Sons, 2004
4. Burr I. W., 'Statistical Quality Control Methods', MerceL Dekker Inc.
5. Trietsch D., 'Statistical Quality Control', World Scientific

# Uttarakhand Technical University

**Subject Code:** TMTE-086  
**Contact Hours:** L: 3 T: 1 P:0

**Course Title:** Finite Element Method  
**Examination Duration:** 3 Hours

## **UNIT I**

Introduction to Finite Difference Method and Finite Element Method, Advantages and disadvantages

## **UNIT II**

Mathematical formulation of FEM, Variation and Weighted residual approaches, Shape functions, Natural co-ordinate system, Element and global stiffness matrix, Boundary conditions, Errors, Convergence and patch test, Higher order elements.

## **UNIT III**

Application to plane stress and plane strain problems, Axi-symmetric and 3D bodies, Plate bending problems with isotropic and anisotropic materials, Structural stability, Other applications e.g., Heat conduction and fluid flow problems.

## **UNIT IV**

Idealisation of stiffness of beam elements in beam-slab problems, Applications of the method to materially non-linear problems, Organisation of the Finite Element programmes, Data preparation and mesh generation through computer graphics, Numerical techniques, 3D problems.

## **UNIT V**

FEM, an essential component of CAD, Use of commercial FEM packages, Finite element solution of existing complete designs, Comparison with conventional analysis.

### ***Recommended Books:***

1. The Finite Element Method O.C. Zienkiewicz and R.L. Taylor McGraw Hill
2. An Introduction to Finite Element Method J. N. Reddy McGraw Hill
3. Finite Element Procedure in Engineering Analysis K.J. Bathe McGraw Hill
4. Finite Element Analysis C.S. Krishnamoorthy Tata McGraw Hill

# Uttarakhand Technical University

**Subject Code: TMTE-087**

**Contact Hours: L: 3 T:1 P:0**

**Course Title: Design For Manufacturing**

**Examination Duration: 3 Hours**

## **UNIT I**

**Introduction:** Economics of Process selection – General design principles of manufacturability– Proper material selection – Strength and Mechanical factors- Application of form design.

## **Unit II**

**Casting Design and Weldment Design:** Factors affecting casting design- Strength aspects – Sand casting and die casting design-Factors affecting weldment design-Gas and arc welding design.

## **UNIT III**

**Formed Metal Components and Non Metallic Part Design:** Design considerations for the manufacture of extruded, cold headed metal parts – Tube and section bends – Powder metal parts-Thermo setting plastic parts-Reinforced – Plastic/Composite parts.

## **UNIT IV**

**Machined Components Design:** Design considerations for the manufacture of Turned parts-drilled parts-milled parts, planned, shaped and slotted parts-Ground parts-parts produced by EDM.

## **UNIT V**

**Design for Assembly:** Types of assembly – DFA –Index – evaluation of assembly – assembly cost reduction – case of assembly – impact on quality – related software usage – case studies.

## **Recommended Books:**

1. [G. K. Lal](#), [Vijay Gupta](#), [N. Venkata Reddy](#) – “Fundamentals of Design and Manufacturing”, 1<sup>st</sup> Edition, Narosa Book Distributors Pvt. Ltd (2010)
2. [A.K. Chitale](#), [R.C. Gupta](#) - Product Design and Manufacturing, 5<sup>th</sup> Edition, PHI Learning (2011)
3. Poli C., ‘ Design for Manufacturing’, Butterworth – Heiuemann
4. Corbett J., ‘Design for Manufacturing’, Addison Wesley
5. Rhyder R. F., ‘Manufacturing Process Design and Optimization’, Marcel Dekker Inc.



# Uttarakhand Technical University

**Subject Code: TMTE-088**

**Contact Hours: L: 3 T:1 P:0**

**Course Title: Intelligent Instruments**

**Examination Duration: 3 Hours**

## Unit I

**Introduction:** Intelligence, features characterizing intelligence, intelligent instrumentation system; features of intelligent instrumentation; components of intelligent instrumentation system. Block diagram of an intelligent instrumentation system.

## Unit II

**Signal Processing, Manipulation And Transmission:** Signal amplification & attenuation (OP-AMP based); Instrumentation Amplifier (circuit diagram, high CMRR& other features); Signal Linearization (different types such as Diode resistor combination, OP-AMP based, etc.); Bias Removal, Signal filtering (outputs from ideal filters, outputs from constant-k filters, matching of filter sections, active analog filters); OP-AMP based Voltage-to-current converter, Current-to-voltage conversions, Signal integration, Voltage follower (pre amplifier); voltage comparator, Phase –Locked loop, Signal addition, Signal multiplication, Signal Transmission (Signal amplification, Shielding , Current loop transmission, Voltage-to-frequency conversion, Fiber optic transmission); Description of Spike Filter (software based)

## Unit III

**Smart Sensors:** Primary sensors; Excitation; Compensation (Nonlinearity: look up table method, polygon interpolation, polynomial interpolation, cubic spline interpolation, Approximation & regression: Noise & interference; Response time: Drift; Cross-sensitivity); information coding/Processing; Data Communication; Standards for smart sensor interface...

## Unit IV

**Interfacing Instruments & Computers:** Address decoding; Data transfer control; A/D converter; D/A converter; Sample & hold circuit; others interface considerations.

## Unit V

**Recent Trends In Sensor Technologies:** Introduction; Film sensors (Thick film sensors, thin film sensor) Semiconductor IC Technology- Standard methods; Micro electro- mechanical systems (Micro-machining, some application examples); Nono-Sensors.

## **Recommended Books:**

1. Barney, G.C., Intelligent instruments. Hemel Hempstead: Prentice Hall, 1985.
2. ALAN S. Morris, Principles of Measurements Instrumentation. New. Delhi: PHI Pvt. Ltd. 1999.
3. D.Patranabis, Sensors & Transducers. New .Delhi: PHI, 2003.
4. Roman Kuc, Introduction to Digital Signal Processing. New York: McGraw-Hill Pub. Co.
5. Gayakwad, R.A., 'Op – Amps and Linear Integrated Circuits', Prentice Hall, 2000