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**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Course No.</th>
<th>Subject</th>
<th>Periods</th>
<th>Evaluation</th>
<th>Total Marks</th>
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<tr>
<td>1.</td>
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<td>Rapid Prototyping</td>
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**Semester: VIII**

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<tr>
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<th>Subject</th>
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<th>Evaluation</th>
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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 ]

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<tr>
<th>S.No.</th>
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<th>Subject</th>
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<tr>
<td>1.</td>
<td>TOE 01</td>
<td>Non-conventional Energy Resources</td>
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<td>Reliability Engineering</td>
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<td>TOE 03</td>
<td>Environment &amp; Ecology</td>
<td>Civil</td>
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<td>4.</td>
<td>TOE 04</td>
<td>Geographic Inf. System (GIS) Technology &amp; its Applications</td>
<td>Civil</td>
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<td>5.</td>
<td>TOE 05</td>
<td>Entrepreneurship Development Programme</td>
<td>Humanities</td>
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<td>Ancient Indian Culture</td>
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<td>Condition Monitoring &amp; Diagnostics</td>
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<td>11.</td>
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<td>Nanotechnology</td>
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<td>Advance Material Science</td>
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<td>16.</td>
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<td>Instrumentation &amp; Control</td>
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<td>Fundamentals of Coding Theory</td>
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<td>18.</td>
<td>TOE 18</td>
<td>Consumer Electronics</td>
<td>Electronics &amp; Communication</td>
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<td>19.</td>
<td>TOE 19</td>
<td>Artificial Neural Networks &amp; Fuzzy Logic</td>
<td>Electrical</td>
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<td>20.</td>
<td>TOE 20</td>
<td>Human Computer Interaction</td>
<td>Computer Science</td>
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<td>21.</td>
<td>TOE 21</td>
<td>IT in Business</td>
<td>Information Technology</td>
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<td>22.</td>
<td>TOE 22</td>
<td>Artificial Intelligence in Manufacturing</td>
<td>Manufacturing Technology</td>
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<td>23.</td>
<td>TOE 23</td>
<td>Health, Hospital and Equipment Management</td>
<td>Biomedical Engineering</td>
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<td>24.</td>
<td>TOE 24</td>
<td>Introduction to Medical Physics</td>
<td>Biomedical Engineering</td>
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<td>25.</td>
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<td>Modern Control System</td>
<td>Electrical</td>
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<td>27.</td>
<td>TOE 27</td>
<td>SCADA &amp; Energy Management System</td>
<td>Electrical</td>
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Note: The students will choose any one subject of the course of other than their Engineering Branch
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:**

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
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.
GEOMETRIC MODELLING: 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 hermite 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).
GEOMETRIC MODELLING-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.

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.

Recommended Books:
1. CAD/CAM Theory and Practice – Ibrahim Zeid ,TMH
2. CAD/CAM – Groover & Zimmers Pearson
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

UNIT II: REVERSE ENGINEERING AND CAD MODELING
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
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.

UNIT IV: POWDER BASED RAPID PROTOTYPING SYSTEMS

UNIT V: OTHER RAPID PROTOTYPING TECHNOLOGIES
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.

Recommended books:
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 it 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 feed back devices.
7. Experiment on Mechatronics & controls
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:

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 Micoprocesors: 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, Keyboard, Latch Interconnection, PPI.

Recommended Books:
1. Embedded System Design-Frank Vahid/Tony Givargis, John Willey@2005.
3. An Embedded Software Primer-David E.Simon, Pearson Education @ 1999.
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
UNIT I: COMPONENTS OF CIM
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

UNIT III: COMPUTER AIDED PLANNING AND CONTROL & COMPUTER MONITORING

Unit IV: Flexible Manufacturing Systems:
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
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:
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

Recommended Books:
Uttarakhand Technical University

Subject Code: TMTE-073
Course Title: Composite Materials
Contact Hours: L: 3 T:1 P:0
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-peggs, 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 , Cermet, 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.
Uttarakhand Technical University

Subject Code: TMTE-074  
Course Title: Digital Image Processing  
Contact Hours: L: 3 T:1 P:0  
Examination Duration: 3 Hours

UNIT I


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.


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

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:
3. R.J. Schalkoff; Digital Image Processing and Computer Vision, John Wiley and Sons, NY
Unit I

Unit II

Unit III

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,
6. Hertz J. Krogh, R.G. Palmer, “Introduction to the Theory of Neural Computation”, Addison- Wesley, California,
10.
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

Unit III
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 hear 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
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

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 (2x n, m x 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:
3. AM Natarajan, P.Balasubramani, ATamilaravari “Operation research” Pearson 2005
UNIT I

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

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

Recommended Books:
3. Production Planning, Control and Industrial Management By Jain & Agarwal
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

Recommended Books:
5. Trietsch D., 'Statistical Quality Control', World Scientific
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:
Uttarakhand Technical University

Subject Code: TMTE-087                  Course Title: Design For Manufacturing
Contact Hours:  L: 3 T:1 P:0                   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

Recommended Books:
Uttarakhand Technical University

Subject Code: TMTE-088  
Course Title: Intelligent Instruments

Contact Hours: L: 3 T:1 P:0  
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 form 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, this film sensor) Semiconductor IC Technology- Standard methods; Micro electro- mechanical systems (Micro-machining, some application examples); Nono-Sensors.

Recommended Books: