

Uttarakhand Technical University, Dehradun
Scheme of Examination as per AICTE Flexible Curricula

Evaluation Schemes for B. Tech 2nd to 4th Year

W.E.F. Academic Session 2020-21

III to VIII SEMESTER



Bachelor of Technology (B. Tech.)

in

[Mechanical Engineering]

Uttarakhand Technical University, Dehradun

New Scheme of Examination as per AICTE Flexible Curricula
Bachelor of Technology (B.Tech.)II Year
[Mechanical Engineering]
W.E.F. Academic Session 2020-21

III Semester

| S. No. | Subject Code | Category | Subject Name | Maximum Marks Allotted | | | | | Total Marks | Contact Hours per Week | | | Total Credit |
|---------|----------------------|----------|---|------------------------|---------|-------------------|-----------|---------------------------------|-------------|------------------------|---|----|--------------|
| | | | | Theory | | | Practical | | | L | T | P | |
| | | | | End Sem | Mid Sem | Quiz / Assignment | End Sem | Term Work /Lab Work & Sessional | | | | | |
| 1. | BAST 301 | BSC-5 | Mathematics-III | 100 | 30 | 20 | - | - | 150 | 3 | 1 | - | 4 |
| 2. | BMET 302 | DC-1 | Basic Thermodynamics | 100 | 30 | 20 | - | - | 150 | 3 | 1 | - | 4 |
| 3. | BMET 303 BMEP 303 | DC-2 | Materials Science & Technology | 100 | 30 | 20 | 30 | 20 | 200 | 3 | - | 2 | 4 |
| 4. | BMET 304 BMEP 304 | DC-3 | Strength of Material | 100 | 30 | 20 | 30 | 20 | 200 | 3 | 1 | 2 | 5 |
| 5. | BMET 305 BMEP 305 | DC-4 | Manufacturing Science & Technology-I | 100 | 30 | 20 | 30 | 20 | 200 | 3 | 0 | 2 | 4 |
| 6. | BCSP 307 | DC | Programming Practices (Introduction to MATLAB) | - | - | - | - | 50 | 50 | - | - | 4 | 2 |
| 7. | BAST 107 | DLC -1 | Evaluation of Internship-I Completed at I Year Level //Seminar for Lateral Entry students | - | - | - | - | 50 | 50 | - | - | 2 | 1 |
| Total | | | | 500 | 150 | 100 | 90 | 160 | 1000 | 15 | 3 | 14 | 24 |
| 8 | BCST 308 | MC * | Cyber Security | Non Credit Course | | | | | | | | | |
| NSS/NCC | | | | | | | | | | | | | |

New Scheme of Examination as per AICTE Flexible Curricula
Bachelor of Technology (B.Tech.)II Year
[Mechanical Engineering]
W.E.F. Academic Session 2020-21

IV Semester

| S. No. | Subject Code | Category | Subject Name | Maximum Marks Allotted | | | | | Total Marks | Contact Hours per Week | | | Total Credit |
|---------|----------------------|----------|--|---|---------|-------------------|-----------|---------------------------------|-------------|------------------------|---|---|--------------|
| | | | | Theory | | | Practical | | | L | T | P | |
| | | | | End Sem | Mid Sem | Quiz / Assignment | End Sem | Term Work /Lab Work & Sessional | | | | | |
| 1. | BMET 401 BMEP 401 | DC | Applied Thermodynamics Engineering | 100 | 30 | 20 | 30 | 20 | 200 | 3 | 1 | 2 | 5 |
| 2. | BECT 402 | ESC | Energy & Environmental Engineering | 100 | 30 | 20 | - | - | 150 | 3 | 1 | - | 4 |
| 3. | BMET 403 BMEP 403 | DC | Theory Of Machine | 100 | 30 | 20 | 30 | 20 | 200 | 3 | 1 | 2 | 5 |
| 4. | BMET 404 BMEP 404 | DC | Fluid Mechanics | 100 | 30 | 20 | 30 | 20 | 200 | 3 | 1 | 2 | 5 |
| 5. | BMET 405 BMEP 405 | DC | Manufacturing Science & Technology-II | 100 | 30 | 20 | | | 150 | 3 | 0 | 0 | 3 |
| 6. | BECT 406 | HV | Universal Human Values-2 | 50 | 30 | 20 | - | - | 100 | 2 | 1 | 0 | 3 |
| 7. | BECP 407 | DLC | 90 hrs Internship based on using various software's – Internship -II | To be completed anytime during Third/ fourth semester. Its evaluation/credit to be added in fifth semester. | | | | | | | | | |
| Total | | | | 550 | 180 | 120 | 90 | 60 | 1000 | 17 | 5 | 6 | 25 |
| NSS/NCC | | | | | | | | | | | | | |

**New Scheme of Examination as per AICTE Flexible Curricula
Bachelor of Technology (B.Tech.)III Year
[Mechanical Engineering]**

V Semester

| S. No | Subject Code | Category | Subject Name | Maximum Marks Allotted | | | | | Total marks | Contact Hours per Week | | | Total Credit |
|---------|------------------------|----------|--|--|---------|-------------------|-----------|---------------------------------|-------------|------------------------|---|-----|--------------|
| | | | | Theory | | | Practical | | | L | T | P | |
| | | | | End Sem | Mid Sem | Quiz / Assignment | End Sem | Term Work /Lab Work & Sessional | | | | | |
| 1. | BMET 501 BMEP 501 | DC | Industrial Engineering & Ergonomics | 100 | 30 | 20 | 30 | 20 | 200 | 3 | 0 | 2 | 4 |
| 2. | BMET -502 BMEP 502 | DC | Machine Component Design –I | 100 | 30 | 20 | 30 | 20 | 200 | 2 | 1 | 2 | 4 |
| 3. | BMET -503 BMEP -503 | DC | Heat & Mass Transfer | 100 | 30 | 20 | 30 | 20 | 200 | 2 | 1 | 2 | 4 |
| 4. | BMET -504 | DE | Departmental Elective | 100 | 30 | 20 | - | - | 150 | 3 | 0 | 0 | 3 |
| 5. | BOME -505 | OE | Open Elective | 100 | 30 | 20 | - | - | 150 | 3 | 0 | 0 | 3 |
| 6. | BMEP -506 | D Lab | Machine Drawing Lab With Autocad | - | - | - | 30 | 20 | 50 | 0 | 0 | 2 | 1 |
| 7 | BMET -507 | DLC | Evaluation of Internship-II completed at II year level | - | - | - | - | 50 | 50 | - | - | 4 | 2 |
| 8 | | IN | Internship –III | To be completed any time during Fifth/ Sixth semester. Its evaluation/credit to be added in Seventh semester | | | | | | | | | |
| Total | | | | 500 | 150 | 100 | 90 | 110 | 1000 | 13 | 2 | 1/2 | 21 |
| NSS/NCC | | | | | | | | | | | | | |

| Departmental Electives | | Open Electives | |
|------------------------|--|----------------|---------------------------------|
| BMET 504(A) | IC Engine | BOME 505(A) | Principle of Management |
| BMET 504(B) | Machine Tool Design | BOME 505(B) | TQM and SQC |
| BMET 504(C) | Alternate Automotive Fuels & Emissions | BOET 504(D) | Innovation and Entrepreneurship |

New Scheme of Examination as per AICTE Flexible Curricula
Bachelor of Technology (B.Tech.)III Year
[Mechanical Engineering]
W.E.F. Academic Session 2020-21

VI Semester

| S. No | Subject Code | Category | Subject Name | Maximum Marks Allotted | | | | | Total marks | Contact Hours per Week | | | Total Credit |
|-------|-----------------------|----------|---------------------------------|--|---------|-------------------|-----------|---------------------------------|-------------|------------------------|---|----|--------------|
| | | | | Theory | | | Practical | | | L | T | P | |
| | | | | End Sem | Mid Sem | Quiz / Assignment | End Sem | Term Work /Lab Work & Sessional | | | | | |
| 1. | BMET 601 BMEP 601 | DC | Turbo machinery | 100 | 30 | 20 | 30 | 20 | 200 | 3 | 1 | 2 | 5 |
| 2. | BMET 602 BMEP 602 | DC | Machine Component Design -II | 100 | 30 | 20 | 30 | 20 | 200 | 3 | 0 | 4 | 5 |
| 3. | BMET -603 BMEP 603 | DC | Refrigeration and Air-condition | 100 | 30 | 20 | 30 | 20 | 200 | 3 | 1 | 2 | 5 |
| 4. | BMET -604(A/B/C) | DE | Departmental Elective | 100 | 30 | 20 | | | 150 | 3 | 0 | 0 | 3 |
| 5. | BOME -605 | OE | Open Elective | 100 | 30 | 20 | | | 150 | 3 | 0 | 0 | 3 |
| 6 | BMEP -607 | P | Minor Project -I | | | | | 50 | 50 | 0 | 0 | 4 | 2 |
| 7 | BMEP -608 | P | Open Source Lab | - | - | - | 30 | 20 | 50 | 0 | 0 | 2 | 1 |
| | | IN | Internship -III | To be completed any time during Fifth/ Sixth semester. Its evaluation/credit to be added in Seventh semester | | | | | | | | | |
| Total | | | | 500 | 150 | 100 | 120 | 130 | 1000 | 15 | 2 | 12 | 24 |

| Departmental Electives | | Open Electives | |
|------------------------|-----------------------|----------------|-----------------------------|
| BMET 604(A) | Mechatronics | BOME 605(A) | Robotics |
| BMET 604 (B) | Finite Element Method | BOME 605 (B) | Optimization Techniques |
| BMET 604 (C) | Product Design | BOME 605 (C) | Renewable Energy Technology |

***Students may also earn credits of open elective through NPTEL/Swayam.**

New Scheme /-of Examination as per AICTE Flexible Curricula
Bachelor of Technology (B.Tech.)IV Year
[Mechanical Engineering]
W.E.F. Academic Session 2020-21

VII Semester

| S. No | Subject Code | Category | Subject Name | Maximum Marks Allotted | | | | | Total marks | Contact Hours per Week | | | Total Credit |
|---------|----------------------|----------|---|------------------------|---------|-------------------|-----------|---------------------------------|-------------|------------------------|---|----|--------------|
| | | | | Theory | | | Practical | | | L | T | P | |
| | | | | End Sem | Mid Sem | Quiz / Assignment | End Sem | Term Work /Lab Work & Sessional | | | | | |
| 1. | BMET 701 | DC | Maintenance and Safety | 100 | 30 | 20 | | | 150 | 3 | 0 | 0 | 3 |
| 2. | BMET-702 BMEP-702 | DC | Computer Integrated Manufacturing | 100 | 30 | 20 | 30 | 20 | 200 | 3 | 0 | 2 | 4 |
| 3. | BMET-703 | DE | Departmental Elective | 100 | 30 | 20 | - | - | 150 | 3 | 0 | 0 | 3 |
| 4. | BMET-704 | OE | Open Elective | 100 | 30 | 20 | - | - | 150 | 3 | 0 | 0 | 3 |
| 5. | BMEP-705 | D Lab | Simulation lab/Virtual Lab (Ansys/MATLAB) | - | - | - | 30 | 20 | 50 | 0 | 1 | 2 | 2 |
| 6. | BMEP-507 | IN | Internship III | - | - | - | - | 50 | 50 | - | - | 2 | 1 |
| 7. | BMEP-706 | P | Minor Project-2 | - | - | - | 50 | 50 | 100 | 0 | 0 | 4 | 2 |
| Total | | | | 400 | 120 | 80 | 110 | 190 | 900 | 12 | 1 | 10 | 18 |
| NSS/NCC | | | | | | | | | | | | | |

| Departmental Electives | | Open Electives | |
|------------------------|------------------------------|----------------|--------------------------------|
| BMET 703(A) | Nano Materials | BMET 704(A) | Energy Conservation |
| BMET 703(B) | Computational Fluid Dynamics | BMET 704(B) | Introduction to AI |
| BMET 703(C) | Mechanical Vibration | BMET 704(C) | MEMS & Microsystems Technology |

***Students may also earn credits of open elective through NPTEL/Swayam.**

New Scheme of Examination as per AICTE Flexible Curricula
Bachelor of Technology (B.Tech.)IV Year
[Mechanical Engineering]
W.E.F. Academic Session 2020-21

VIII Semester

| S. No. | Subject Code | Category | Subject Name | Maximum Marks Allotted | | | | | Total marks | Contact Hours per Week | | | Total Credit |
|--------|----------------------|----------|-----------------------|------------------------|---------|-------------------|-----------|---------------------------------|-------------|------------------------|---|----|--------------|
| | | | | Theory | | | Practical | | | L | T | P | |
| | | | | End Sem | Mid Sem | Quiz / Assignment | End Sem | Term Work /Lab Work & Sessional | | | | | |
| 1. | BMET 801 | DC | Operation research | 100 | 30 | 20 | | | 150 | 3 | 1 | 0 | 4 |
| 2 | BMET 802 BMEP-802 | DC | Automobile | 100 | 30 | 20 | 30 | 20 | 200 | 3 | 1 | 2 | 5 |
| 3 | BMET-803 | DE | Departmental Elective | 100 | 30 | 20 | | | 150 | 3 | 0 | 0 | 3 |
| 4. | BMET-804 | OE | Open Elective | 100 | 30 | 20 | | | 150 | 3 | 0 | 0 | 3 |
| 5 | BMEP-805 | S | Open source Lab | | | | | 50 | 50 | 0 | 0 | 2 | 1 |
| 6 | BMEP-806 | P | Major Project | | | | 100 | 100 | 200 | 0 | 0 | 8 | 4 |
| Total | | | | 400 | 120 | 80 | 50 | 200 | 900 | 12 | 2 | 12 | 20 |

| Departmental Electives | | Open Electives | |
|------------------------|------------------------------|----------------|----------------------------------|
| BMET-802 (A) | Power Plant Engineering | BMET-803 (A) | Concepts of programming and OOPS |
| BMET-802 (B) | Solar Energy | BMET-803 (B) | Environment and Ecology |
| BMET-802 (C) | Experimental Stress Analysis | BMET-803 (C) | Programming in python |

Uttarakhand Technical University, Dehradun
Scheme of Examination as per AICTE Flexible Curricula

Evaluation Schemes for B. Tech 3rdYear

W.E.F. Academic Session 2020-21

Vto VIII SEMESTER



Bachelor of Technology (B. Tech.)

in

[Mechanical Engineering]

Uttarakhand Technical University, Dehradun

5th

SEM

Uttarakhand Technical University, Dehradun
New Scheme of Examination as per AICTE Flexible Curricula
Mechanical Engineering, V-Semester

| | | | | |
|--------------------------------------|--|----------|----------|----------|
| BMET- 501 BMEP- 501 | Industrial Engineering & Ergonomics | L | T | P |
| | | 3 | 0 | 2 |

Objectives:

1. Understand the concept of productivity and work study.
2. Understand the importance of plant layout and production planning and control.
3. Understand the role of maintenance management.
4. Understand the concept of inventory and quality control.
5. Differentiate among different job evaluation methods.

Course Outcome:

1. Ability to understand productivity and work study.
2. Ability to apply plant layouts and understanding the application of material handling equipments
3. An understanding of managerial economics
4. Ability to apply the concept of Inventory and supply chain management.
5. An understanding of job evaluation and merit rating.

Detailed Content:

Unit 1 Method study: purpose of work study, its objectives, procedure and applications; method study definition and basic procedure, selection of job, various recording techniques like outline process charts, flow process charts, man machine charts, two handed process charts, string diagram, flow diagram, multiple activity chart, simo, cyclographs and chrono-cyclographs; critical examination, development, installation and maintenance of improved method; principles of motion economy and their application in work design; micro motion study, memo motion study and their use in methods study.

Unit 2 Work measurement: Introduction & definition, objectives and basic procedure of work measurement; application of work measurement in industries; time study: basic procedure, equipments needed, methods of measuring time, selection of jobs, breaking a job into elements; numbers of cycles to be timed; rating and methods of rating, allowances, calculation of standard time.

Work sampling: Basic procedure, design of work sampling study conducting work sampling study and establishment of standard-time.

Unit 3 Job evaluation and incentive schemes: Starlight line, Taylor, Merrick and Gantt incentive plans
Standard data system; elemental and non-elemental predetermined motion systems, work factors system; Methods Time Measurement (MTM), MOST

Unit 4 Human factor engineering: Definition and history of development of human factors engineering, types & characteristics of man-machine-system, relative capabilities of human being and machines; development and use of human factor data; information input and processing; Introduction to information theory; factors effecting information reception and processing; coding and selecting of sensory inputs.

Unit 5 Display systems and anthropometric data: Display- types of visual display, visual indicators and warning signals; factorial and graphic display; general principles of auditory and tactral display, characteristics and selection.

Suggested Books:

1. ILO; work-study; International Labour Organization
2. Khan MI; Industrial Ergonomics; PHI Learning
3. Barnes RM; Motion and Time Study; Wiley pub
4. Megaw ED; Contemporary ergonomics; Taylor & Francis
5. Sandera M and McCormick E; Human Factors in Engg and design; MGHill
6. Currie RM; Work study; BIM publications
7. Mynard; Hand book of Industrial Engg

Suggested Experiments:

1. design of an office chair based on multiple section data;
2. Evaluation of an automobile driver's work station based on class data and population data using a quarter inch scale grid and jointed anthropometric templates.
3. measurement of impulsive and 3-second sustained strength as a function of handle grip length;
4. Measurement of reaction time (total time and initiation time) as a function of stimulus mode (light or tone), distance, and accuracy of movement.
5. Measurement of production rate and estimation of fatigue sensation (on a five level descriptive scale) using regular, ball handled, and Yankee screwdrivers;
6. Measurements of hand torque using pliers in the frontal and sagittal planes.
7. Measurement of visual acuity, lumens versus wattage for incandescent and fluorescent lighting
8. Determination of required and preferred illumination levels for reading various sizes of print.
9. Measurement of wall and floor reflectances (ceiling reflectances are given for reasons of safety).
10. Study of material handling equipments.

Uttarakhand Technical University, Dehradun
New Scheme of Examination as per AICTE Flexible Curricula
Mechanical Engineering, VI-Semester

| | | | | |
|------------------|-----------------------------------|----------|----------|----------|
| BMET- 502 | Machine Component Design-I | L | T | P |
| BMEP- 502 | | 2 | 1 | 2 |

Objectives:

1. Develop an ability to apply knowledge of mathematics, science, and engineering Outcomes.
2. To develop an ability to design a system, component, or process to meet desired needs.
3. To analyze identify, formulate, and solve engineering problems

Course Outcome:

1. Illustrate the fundamentals of stress analysis, theories of failure and material science in the design of machine components.
2. Analyze the principle of solid mechanics to design machine member, under variable loading.
3. Analyze the shaft design based on strength, rigidity and design various types of coupling based on application
4. Compare and analyze design parameters of Springs & joints on various loading application.
5. Illustrate the different types of Product design & development.

Detailed Content:

Unit 1: Introduction to stress in machine component: Stress concentration and fatigue: causes of stress concentration; stress concentration in tension, bending and torsion; reduction of stress concentration, theoretical stress concentration factor, notch sensitivity, fatigue stress concentration factor, cyclic loading, endurance limit, S-N Curve, loading factor, size factor, surface factor. Design consideration for fatigue, Goodman and modified Goodman's diagram, Soderberg equation, Gerber parabola, design for finite life, cumulative fatigue damage factor.

Unit 2: Shafts: Design of shaft under combined bending, twisting and axial loading; shock and fatigue factors, design for rigidity; Design of shaft subjected to dynamic load; Design of keys and shaft couplings.

Unit 3: Springs: Design of helical compression and tension springs, consideration of dimensional and functional constraints, leaf springs and torsion springs; fatigue loading of springs, surge in spring; special springs, Power Screws: design of power screw and power nut, differential and compound screw, design of simple screw jack.

Unit 4 : Brakes & Clutches: Materials for friction surface, uniform pressure and uniform wear theories, Design of friction clutches: Disk, plate clutches, cone & centrifugal clutches. Design of brakes: Rope, band & block brake, Internal expanding brakes, Disk brakes.

Unit 5: Journal Bearing: Types of lubrication, viscosity, hydrodynamic theory, design factors, temperature and viscosity considerations, Reynold's equation, stable and unstable operation, heat dissipation and thermal equilibrium, boundary lubrication, dimensionless numbers, Design of journal bearings, Rolling-element Bearings: Types of rolling contact bearing, bearing friction and power loss, bearing life; Radial, thrust & axial loads; Static & dynamic load capacities; Selection of ball and roller bearings; lubrication and sealing.

Suggested Books:

1. Shingley J.E; Machine Design; TMH

2. Sharma and Purohit; Design of Machine elements; PHI
3. Wentzell Timothy H; Machine Design; Cengage learning
4. Mubeen; Machine Design; Khanna Publisher
5. Ganesh Babu K and Srithar k; Design of Machine Elements; TMH
6. Sharma & Agrawal; Machine Design; Kataria & sons
7. Maleev; Machine Design;

Suggested Experiments:

1. Study of various engineering materials.
2. Study and nomenclature of centrifugal clutch.
3. Design of shaft- (specific design conditions provided by instructor)
4. Design of Spring-(specific design conditions provided by instructor)
5. Design of Rope break-(specific design conditions provided by instructor)
6. Design of band break-(specific design conditions provided by instructor)
7. Design of disc break-(specific design conditions provided by instructor)
8. Design of clutch-(specific design conditions provided by instructor)
9. Design of Journal bearing-(specific design conditions provided by instructor)
10. Design of rolling element bearing-(specific design conditions provided by instructor)

Uttarakhand Technical University, Dehradun
New Scheme of Examination as per AICTE Flexible Curricula
Mechanical Engineering, VI-Semester

| | | | |
|---------------------------------------|----------|----------|----------|
| ME- 503 Heat and Mass Transfer | L | T | P |
| | 2 | 1 | 2 |

Objectives:

- (1) The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
- (2) Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.
- (3) The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.

Course Outcome:

1. Students will be able to mathematically formulate and analyze heat transfer system by conduction mode
2. Students will be able to apply the conduction heat transfer knowledge on fins which are used in various applications
3. Students will be able to apply the knowledge of fluid flow and convection heat transfer to analyze the thermal system
4. Students will be able to analyze radiative heat transfer system
5. Students will be able to perform thermal design of various heat exchangers

Detailed Content:

UNIT-1 Introduction to Heat Transfer: Concepts of heat flows: conduction, convection and radiation; effect of temperature on thermal conductivity of materials; introduction to combined heat transfer mechanism.

Conduction :One-dimensional general differential heat conduction equation in the rectangular, initial and boundary conditions.

Steady State one-dimensional Heat conduction : Composite Systems in rectangular, cylindrical and spherical coordinates with and without Energy generation; thermal resistance concept; Analogy between heat and electricity flow; thermal contact resistance; Overall Heat Transfer Coefficient, critical thickness of insulation.

UNIT-2 Types of fins, Fins of uniform cross-sectional area; errors of measurement of temperature in thermometer wells.

Transient Conduction: Transient heat conduction Lumped capacitance method, unsteady state heat conduction in one dimension only, Heisler charts.

UNIT-3

Forced Convection: Basic concepts; hydrodynamic boundary layer; thermal boundary layer, flow over a flat plate; flow across a single cylinder and a sphere; flow inside ducts; empirical heat transfer relations; relation between fluid friction and heat transfer; liquid metal heat transfer.

Natural Convection :Physical mechanism of natural convection; buoyant force; empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and Cylinders, and sphere.

UNIT-4

Thermal Radiation : Basic radiation concepts; radiation properties of surfaces; black body radiation laws; shape factor; black-body radiation exchange; Radiation exchange between non-blackbodies in an enclosure; Infinite parallel Planes, radiation shields;

UNIT-5

Heat Exchanger :Types of heat exchangers; fouling factors; overall heat transfer coefficient; logarithmic Mean temperature difference (LMTD) method; effectiveness-NTU method; compact heat Exchangers, Steam distribution systems.

Condensation And Boiling : Introduction to condensation phenomena; heat transfer relations for laminar film condensation on vertical surfaces and on a horizontal tube; Boiling modes pool boiling, curve, forced convective boiling.

Introduction To Mass Transfer :Introduction; Flick's law of diffusion; steady state equimolar counter diffusion; steady state diffusion through a stagnant gas film.

Suggested Books:

1. Elements of Heat transfer by Cengel, TMH
2. Heat and mass transfer, M.Thirumaleswar, Pearson
3. Fundamentals of Heat & Mass Transfer by Incropera Wiley India
- 4.Heat& Mass Transfer by Khurmi, Schand,New Delhi 18

Suggested Experiments:

1. Conduction - Composite wall experiment
2. Conduction - Composite cylinder experiment
3. Convection - Pool Boiling experiment
4. Convection - Experiment on heat transfer from tube-natural convection.
5. Convection - Heat Pipe experiment.
6. Convection - Heat transfer through fin-natural convection .
7. Convection - Heat transfer through tube/fin-forced convection.
8. Any experiment - Such as on Stefan's Law, on radiation determination of emissivity, etc.
9. Any experiment - Such as on solar collector, etc. on radiation
10. Heat exchanger - Parallel flow experiment
11. Heat exchanger - Counter flow experiment
12. Any other suitable exp such as on critical insulation thickness.
13. Conduction - Determination of thermal conductivity of fluids.
14. Conduction - Thermal Contact Resistance Effect.

1. Uttarakhand Technical University, Dehradun
New Scheme of Examination as per AICTE Flexible Curricula
Mechanical Engineering, V-Semester

| | | | |
|---|----------|----------|----------|
| BMET 504-(A) Internal Combustion Engines | L | T | P |
| | 3 | 0 | 0 |

Objectives:

1. To familiarize with the terminology associated with IC engines.
2. To understand the basics of IC engines.
3. To understand combustion, and various parameters and variables affecting it in various types of IC engines.
4. To learn about various systems used in IC engines and the type of IC engine required for various applications

Course Outcome:

1. Analyse engine classification Cycle analysis
2. Estimate Combustion in SI engine, abnormal combustion and its control, combustion.
3. Categorize different Fuel injection in CI engines and Fuel injectors.
4. Analyse cooling systems, Cooling Towers & Radiators.
5. To Analyse Performance parameters and Testing of SI and CI engines.

Detailed Content:

Unit 1: Introduction of IC Engine:

Internal Combustion Engine: S.I. and C.I. engines of two and four stroke cycles, real cycle analysis of SI and CI engines, determination of engine dimensions, speed, fuel consumption, output, mean effective pressure, efficiency, factors effecting volumetric efficiency, heat balance, performance characteristics of SI and CI engines, cylinder arrangement, firing order, power balance for multi-cylinder engines .

Unit 2: Combustion in SI engines:

Flame development and propagation, Pressure-Crank Angle diagram, Stages of Combustion ignition lag, effect of air density, temperature, engine speed, turbulence and ignition timings, physical and chemical aspects, abnormal Combustion, effect of engine and fuel variables on abnormal combustion, pre-ignition, its causes and remedy, salient features of various type combustion chambers.

Unit 3: Combustion in CI Engines:

Various stages of combustion in CI Engines, delay period, diesel knock, knock inhibitors, salient features of various types of combustion chambers. Fuel injection in CI engine, Working Principle of fuel pump & fuel injectors, types of nozzles. Fuel injection in SI engine (MPFI, TBI, CRDI), Theory of carburetion, Solex Carburetor, simple problems on carburetion. Fuel metering in CI engines

Unit 4: Fuel:

Classification of IC Engine fuels, Desirable characteristics of SI & CI engine fuels, Rating of SI & CI engine fuels, Alternative fuels for SI and CI engine (liquid, gaseous, hydrogen, LPG, CNG, Biogas etc.), Air requirement, Analysis of combustion products, HHV and LHV of fuels.

Unit 5: Supercharging & Turbo charging:

Methods of supercharging, & turbo charging Effects of super charging and turbo charging. Engine Modifications for supercharging, supercharging of two stroke engines. Microprocessor controlled supercharging. Cooling & lubrication of SI & CI Engines.

Suggested books:

1. J.B. Heywood. Internal combustion Engines, Wiley
2. Ganeshan V; Internal Combustion engines; TMH
3. Mathur M L & Sharma RP; A. Course in IC engines; DhanpatRai
4. R Yadav, Internal Combustion Engines
- 5 Halderman JD and Mitchell CD; Automotive Engines theory and servicing; Pearson
6. DomKundwar; Internal Combustion Engines;DhanpatRai Publications
7. Taylor GF; Internal Combustion Engines Theory & Practice; MIT Press
8. Richard Stone; Introduction to IC Engines; Society of Automotive Engr (Palgrave McMillan)

Uttarakhand Technical University, Dehradun
New Scheme of Examination as per AICTE Flexible Curricula
Mechanical Engineering, V-Semester

| | | | |
|--|----------|----------|----------|
| BMET 504-(B)Machine Tool Design | L | T | P |
| | 3 | 0 | 0 |

Objectives:

1. Study of various machine internal parts
2. Dynamics of machining by varying parameters
3. Automation of machine parts

Course Outcome:

1. Students are able to apply the transmission concept.
2. Identify various parts of machine tools
3. Apply various design aspects of spindles and bearings
4. Reduce vibration and chatter developing on machine tools

Detailed Content:

Unit 1: Machine Tool Drive: working and auxiliary motion in machine, Machine tool drives, Hydraulic transmission, Mechanical transmission, General requirements of machine tool design, Layout of machine tools

Unit 2: Regulation of Speed and Feed Rates: Aim of speed feed regulation, stepped regulation of speed, design of speed box, Design of feed box, Special cases of gear box design, Set stopped regulation of speed and feed rates.

Unit 3: Design of Machine Tool Structure: Fundamentals of machine tool structures and their requirements, Design criteria of machine tool structure, Static and dynamic stiffness, Design of beds and columns, Design of housing models, Techniques in design of machine tool structure.

Unit 4: Design of Guide-ways and power Screws: Function and type of guide-ways, design of slide-ways, protecting devices for slide-ways, Design of power screws. Design of Spindles and Spindle Supports: Materials for spindles, Design of spindles, Antifriction bearings, Sliding bearings.

Unit 5: Dynamics of Machines Tools: General procedure of assessing dynamic stability of EES, Cutting processing, closed loop system, Dynamic characteristics of cutting process, Stability analysis.

Suggested books:

1. Machine Tool Design by N.K. Mehta, Tata McGraw Hill
2. Machine Tool design Handbook - CMTI Bangalore

Uttarakhand Technical University, Dehradun
New Scheme of Examination as per AICTE Flexible Curricula
Mechanical Engineering, V-Semester

| | | | |
|--|----------|----------|----------|
| BMET-504 (C) Alternate Automotive Fuels & Emissions | L | T | P |
| | 3 | 0 | 0 |

Objectives:

1. To present a problem oriented in depth knowledge of Alternate fuel and energy system.
2. To address the underlying concepts and methods behind alternate fuel and energy system.

Course Outcome:

1. Categorize, interpret and understand the essential properties of fuels for IC engines
2. Identify the need for alternate fuels and characterize prospective alternate fuels
3. Evaluate the vehicle fuel storage and dispensing facility requirements.
4. Analyze the implement limitations with regard to performance, emission and materials compatibility.
5. Develop strategies for control of emissions as per the legislation standards.

Detailed Content:

Unit 1: Introduction Automobile Fuels:

Classification of Automobile alternative fuels (liquid, gaseous, hydrogen, LPG, CNG, Biogas etc.), Desirable characteristics of SI & CI engine alternative fuels, Rating of SI & CI engine fuels, Introduction to alternate energy sources. Like EV, hybrid, fuel cell and solar cars. Merits and demerits of various alternate fuels.

Unit 2: Liquid alternative fuels:

Vegetable Oils: Various vegetable oils for automobile engines, esterification, performance in engines, performance and emission characteristics, bio diesel and its characteristics. Alcohols: Properties as engine fuel, alcohols and gasoline blends, performance in automobile engine, methanol and gasoline blends.

Unit 3: Gaseous Fuels:

Biogas: Introduction to Biogas system, Process during gas formation, Factors affecting biogas formation. Usage of Biogas in SI engine & CI engine., Properties of Natural gas, Hydrogen gas, LPG & CNG as engine fuels, storage and handling, performance and safety aspects to all gaseous fuel, fuel metering systems.

Unit 4: Automobile emissions:

Types of automobile emissions, emission characteristics, formation of automobile emissions, mechanism of HC , CO and NO in SI engine, exhaust emission and factors affecting the emission, evaporative emission, crankcase emission, lead emission CI engine emissions: formation of smoke, factors affecting the smoke formation, unburned hydrocarbons, carbon monoxide, oxides of nitrogen, smog and comparison of diesel and petrol emissions.

Unit 5: Emissions Norms & Measurement:

Emission norms as per Bharat Standard up to BS – IV and procedures for confirmation on production. Demerits of automobile emission to environment. Types Of Catalytic Conversion, Measurement Techniques Emission Standards and Test Procedure NDIR, FID, Chemiluminescent analyzers, Gas Chromatograph, smoke meters, emission standards.

Suggested Books:

1. J.B. Heywood. Internal combustion Engines, Wiley
2. Ganeshan V; Internal Combustion engines; TMH
3. Mathur M L & Sharma RP; A. Course in IC engines; DhanpatRai
4. R Yadav, Internal Combustion Engines
- 5 Halderman JD and Mitchell CD; Automotive Engines theory and servicing; Pearson
6. DomKundwar; Internal Combustion Engines; DhanpatRai Publications
7. Taylor GF; Internal Combustion Engines Theory & Practice; MIT Press
8. Richard Stone; Introduction to IC Engines; Society of Automotive Engr (Palgrave McMillan)

Uttarakhand Technical University, Dehradun
New Scheme of Examination as per AICTE Flexible Curricula
Mechanical Engineering, V-Semester

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|--|----------|----------|----------|
| BMET- 505 (A) Principle of Management | L | T | P |
| | 3 | 0 | 0 |

Objectives:

1. To enable the students to study the evolution of Management.
2. To study the functions and principles of management.
3. To learn the application of the principles in an organization.
4. To enable the effective and barriers communication in the organization
5. To study the system and process of effective controlling in the organization

Course Outcome:

1. Students will be able to have clear understanding of managerial functions like planning, and have same basic knowledge on international aspect of management.
2. To understand the planning process in the organization
3. To understand the concept of organization
4. Demonstrate the ability to directing, leadership and communicate effectively
5. To analysis isolate issues and formulate best control methods

Detailed Content:

UNIT 1

INTRODUCTION TO MANAGEMENT: Theories of management: Traditional behavioral, contingency and systems approach. Organization as a system.

UNIT 2

MANAGEMENT INFORMATION: Interaction with external environment. Managerial decision making and MIS.

UNIT 3

PLANNING APPROACH TO ORGANIZATIONAL ANALYSIS: design of organization structure; job design and enrichment; job evaluation and merit rating. 3

UNIT 4

MOTIVATION AND PRODUCTIVITY: Theories of motivation, leadership styles and managerial grid. Co-ordination, monitoring and control in organizations. Techniques of control. Japanese management techniques. Case studies.

Suggested Books:

1. Schermerhorn,; Management and Organisational Behaviour essentials, Wiley India
2. Koontz: Essentials of Management, PHI Learning.
3. Hirschey: Managerial Economics, Cengage Learning.
4. A V Rau: Management Science, BSP, Hyderabad
5. Mote, I Paul and Gupta: Managerial Economics Concepts & Cases, TMH, New Delhi.
6. Stephan R Robbins Fundamental of Management, Pearson

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Mechanical Engineering, V-Semester

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|----------------------------------|----------|----------|----------|
| BMET- 505 (B) TQM and SQC | L | T | P |
| | 3 | 0 | 0 |

Objectives:

1. To facilitate the understanding of total quality management principles and processes
2. Evaluate the principles of quality management and to explain how these principles can be applied within quality management systems.
3. Identify the key aspects of the quality improvement cycle and to select and use appropriate tools and techniques for controlling, improving and measuring quality.
4. Critically appraise the organisational, communication and teamwork requirements for effective quality management.
5. Critically analyse the strategic issues in quality management, including current issues and developments, and to devise and evaluate quality implementation plans.

Course Outcome:

1. Analyze & Correlate the importance of quality control
2. Compare and analyze the concept of Quality Management
3. To analyze the concept of quality circle.
4. Categorize and apply Quality function, decentralization and Theory of control charts
5. Distinguish different types ISO-9000 series and its concept of Quality.

Detailed Content:

Unit 1 Evolution of total quality management, historical perspective, teamwork, TQM and ISO 9000; information technology and Business Process Re-engineering (BPR); TPM and quality awards; aids and barriers to quality mgt, creating vision and initiating transformation, establishing programs for education and self-coordination, policy setting and review, flowchart of policy mgt and relation with daily mgt. improvements, measurement of key indicators; quality mgt leader; cross functional teams and coordination, policy setting and review, flowchart of policy mgt and relation with daily mgt.

Unit 2 Process- definition, variation and feedback, funnel-marble experiment- rules of adjustment and its effects, quality- definition, goalpost and kaizen view, quality of design, conformance and performance; Taguchi loss function, cost of quality, chain action of improving quality to productivity to motivation and low cost; Deming's theory of mgt, fourteen points and variance reduction; attributes enumerative and variables analytic studies.

Unit 3 SQC-Control charts: basic discrete and continuous distributions, measures of central tendency, variability and shapes, sampling, size and central value theorem, control chart structure, process plotting and stability, study of out-of-control evidences, defect detection and prevention, use of control charts in evaluating past, present and future trends; attribute control charts, count and classification charts, construction and interpretation of p, np, c and u charts, PDSA cycle(plan, do, study, act), and R charts, and s charts, individual and moving range chart, trial control limits and out of control points.

Unit 4 Process diagnostics: Between and Within Group variations, periodic and persistent disturbances, control chart patterns-natural, level-shift, cycle, wild, multi-universe, relationship and other out of control patterns; diagnosing a process, brainstorming; cause-effect, Ishikawa, interrelationship, systematic and matrix diagrams; change concepts and waste elimination

Unit 5 Process improvement: Performance and technical specifications, attribute-process and variable-process capability studies; unstable and stable process capability studies and examples; attribute and variable improvement studies; Inspection: acceptance sampling(AS)- lot formation, single, double and multiple/sequential sampling plans, operating characteristic (OC) curve, producer and consumer risk, theoretical invalidation of AS, kp rule for stable and chaotic processes.

Suggested Books:

1. Gitlow HS, Oppenheim et al; Quality Management; TMH
2. Gryna FM; Juran's Quality Planning and Analysis; TMH
3. Crosby Philips; Quality is still free; New Amer Library
4. Kulkarni VA and Bewoor AK; Quality Control; Wiley
5. Jankiraman B and Gopal RK; Total Quality Management- Text and Cases; PHI Learning
6. Sugandhi L and Samual A; Total Quality Management; PHI Learning
7. Subburaj R; Total Quality Management; TMH
8. Naidu Babu and Rajendran; TQM; New age International pub;
9. Chase Richard B et al; Operations management; SIE-TMH
10. Chary SN; Production and Operations Management; TMH 12

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Mechanical Engineering, V-Semester

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|--|----------|----------|----------|
| BMET- 505 (C) Innovation and Entrepreneurship | L | T | P |
| | 3 | 0 | 0 |

Objectives:

1. Acquire necessary knowledge and skills required for organizing and carrying out entrepreneurial activities
2. To develop the ability of analyzing and understanding business situations in which entrepreneurs act and to master the knowledge necessary to plan entrepreneurial activities.
3. Develop the ability of analyzing various aspects of entrepreneurship – especially of taking over the risk, and the specificities as well as the pattern of entrepreneurship development and, finally, to contribute to their entrepreneurial and managerial potentials.

Course Outcome:

1. Key concepts underpinning entrepreneurship and its application in the recognition and exploitation of product/ service/ process opportunities
2. Key concepts underpinning innovation and the issues associated with developing and sustaining innovation within organizations
3. How to design creative strategies for pursuing, exploiting and further developing new opportunities
4. Issues associated with securing and managing financial resources in new and established organizations

Detailed Content:

UNIT 1: Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT 2: Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT 3: Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity,

UNIT 4: Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

Suggested Books:

1. Khanka. S.S., “Entrepreneurial Development” S.Chand& Co. Ltd.,Ram Nagar, New Delhi, 2013.
2. Donald F Kuratko, “ Entrepreneurship – Theory, Process and Practice”, 9th Edition, Cengage Learning 2014.
3. Hisrich R D, Peters M P, “Entrepreneurship” 8th Edition, Tata McGraw-Hill, 2013.
4. Mathew J Manimala, “Enterprenuership theory at cross roads: paradigms and praxis” 2nd Edition Dream tech, 2005.

5. Rajeev Roy, 'Entrepreneurship' 2nd Edition, Oxford University Press, 2011.
6. EDII "Faculty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.

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Uttarakhand Technical University, Dehradun
New Scheme of Examination as per AICTE Flexible Curricula
Mechanical Engineering, VI-Semester

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|------------------|-----------------------|----------|----------|----------|
| BMET- 601 | Turbomachinery | L | T | P |
| BMEP- 601 | | 3 | 1 | 2 |

Objectives:

1. Giving an overview of different types of turbomachinery used for energy transformation
2. It will focus on applications in power generation, transport, refrigeration and the built environment.

Course Outcome:

1. Determine the velocity triangles in turbomachinery stages operating at design and offdesign conditions
2. Apply the affinity laws to pumps such as to determine their off-design behavior.
3. Perform the preliminary design of turbomachines (pumps, compressors, turbines) on a 1- D basis
4. Recognize relations between choices made early in the turbomachinery design process and the final components and operability
5. Recognize and discuss today's and tomorrow's use of turbomachines for enabling a sustainable society

Detailed Content:

Unit 1: Energy transfer in turbo machines: Application of first and second laws of thermodynamics to turbo machines, moment of momentum equation and Euler turbine equation, principles of impulse and reaction machines, degree of reaction, energy equation for relative velocities, one dimensional analysis only.

Unit 2: Steam turbines: Impulse staging, velocity and pressure compounding, utilization factor, analysis for optimum U.F Curtis stage, and Rateau stage, include qualitative analysis, effect of blade and nozzle losses on vane efficiency, stage efficiency, analysis for optimum efficiency, mass flow and blade height. Reactions staging: Parson's stages, degree of reaction, nozzle efficiency, velocity coefficient, stator efficiency, carry over efficiency, stage efficiency, vane efficiency, conditions for optimum efficiency, speed ratio, axial thrust, reheat factor in turbines, problem of radial equilibrium, free and forced vortex types of flow, flow with constant reaction, governing and performance characteristics of steam turbines.

Unit 3: Water turbines: Classification, Pelton, Francis and Kaplan turbines, vector diagrams and work-done, draft tubes, governing of water turbines. Centrifugal Pumps: classification, advantage over reciprocating type, definition of mano-metric head, gross head, static head, vector diagram and work done. Performance and characteristics: Application of dimensional analysis and similarity to water turbines and centrifugal pumps, unit and specific quantities, selection of machines, Hydraulic, volumetric, mechanical and overall efficiencies, Main and operating characteristics of the machines, cavitations.

Unit 4 : Rotary Fans, Blowers and Compressors: Classification based on pressure rise, centrifugal and axial flow machines. Centrifugal Blowers Vane shape, velocity triangle, degree of reactions, slip coefficient, size and speed of machine, vane shape and stresses, efficiency, characteristics, fan laws and characteristics. Centrifugal Compressor – Vector diagrams, work done, temp and pressure ratio, slip factor, work input factor, pressure coefficient, Dimensions of inlet eye, impeller and diffuser. Axial flow Compressors- Vector diagrams, work done factor, temp and pressure ratio, degree of reaction, Dimensional Analysis, Characteristics, surging, Polytropic and isentropic efficiencies.

Unit 5: Power transmitting turbo machines: Application and general theory, their torque ratio, speed ratio, slip and efficiency, velocity diagrams, fluid coupling and Torque converter, characteristics, Positive displacement machines and turbo machines, their distinction. Positive displacement pumps with fixed and variable displacements, Hydrostatic systems hydraulic intensifier, accumulator, press and crane.

Suggested Books:

1. Venkanna BK; turbomachinery; PHI
2. Shepherd DG; Turbo machinery
3. Csanady; Turbo machines
4. Bansal R. K; Fluid Mechanics & Fluid Machines;
5. Rogers Cohen & Sarvan Multo Gas Turbine Theory
6. Kearton W. J; Steam Turbine: Theory & Practice

Suggested Experiments:

1. Turbine exp. on Pelton wheel. (turbine efficiency)
2. Turbine exp. on Francis turbine. (turbine efficiency)
4. Tubrine exp. on Kaplan turbine. (turbine efficiency)
5. Exp. on Reciprocating pump.
6. Exp. on centrifugal pump.
7. Exp. on Hydraulic Jack/Press
8. Exp. on Hydraulic Brake
9. Exp. on Hydraulic Ram
10. Any other suitable experiment/test rig such as comparison & performance of different types of pumps and turbines.

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|------------------|------------------------------------|----------|----------|----------|
| BMET- 602 | Machine Component Design-II | L | T | P |
| BMEP- 602 | | 3 | 0 | 4 |

Objectives:

1. Enable students to attain the basic knowledge required understanding, analyzing, designing and select machine elements required in transmission systems.
2. To develop the ability of the selection of gear types, sizing, analysis and material selection of gear systems.
3. To develop the ability of the selection of bearings, analysis and material selection of bearings.
4. To develop an ability to design I.C. Engine parts, component, or process to meet desired needs.
5. To analyze identify, formulate, and solve engineering problems.

Course Outcome:

1. Select appropriate gears for power transmission on the basis of given load and speed.
2. Understand the standard geometry, application, failures of Gear and Design and Developed effectively Gears for different loading conditions
3. Select bearings for a given applications from the manufacturers catalogue.
4. Design and Develop bearings under different loading conditions

Detailed Content:

Unit 1: Spur Gears Tooth forms, System of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Gear manufacturing methods, Design considerations, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear tooth, Design of spur gears, AGMA and Indian standards.

Unit 2: Helical Gears Terminology, Proportions for helical gears, Beam strength and wear strength of helical gears, herringbone gears, crossed helical gears, Design of helical gears.

Unit 3: Worm Gears Types of worms, Terminology, Gear tooth proportions, Efficiency of worm gears, Heat dissipation in worm gearing, Strength and wear tooth load for worm gears, Design of worm gearing

Unit 4 : Sliding Contact Bearing Types, Selection of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubricants and lubrication, Hydrodynamic journal bearing, Heat generation, Design of journal bearing, Thrust bearing-pivot and collar bearing, Hydrodynamic thrust bearing,

Unit 5: Rolling Contact Bearing Advantages and disadvantages, Types of ball bearing, Thrust ball bearing, Types of roller bearing, Selection of radial ball bearing, Bearing life, Selection of roller bearings, Dynamic equivalent load for roller contact bearing under constant and variable loading, Reliability of Bearing, Selection of rolling contact bearing, Lubrication of ball and roller bearing, Mounting of bearing.

Suggested Books:

1. Mechanical Design Theory and methodology by Waldron, Springer India
2. Machine Design by Juvinall, Wiley India , New Delhi
3. Handbook of Gear Design by Maitra ,TMH
4. Shigleys Mechanical Engineering Design ,TMH

Suggested Experiments:

1. Study of Design consideration and Gear manufacturing methods.
2. Design of spur Gear- (specific design conditions provided by instructor)
3. Calculation of Beam strength of gear tooth & Dynamic tooth load- (specific design conditions provided by instructor)
4. Design of helical Gear-(specific design conditions provided by instructor)
5. Design of Worm Gear-(specific design conditions provided by instructor)
6. Design of Sliding contact Bearing-(specific design conditions provided by instructor)
7. Design of Rolling contact bearing-(specific design conditions provided by instructor)
8. Design of Journal bearing-(specific design conditions provided by instructor)

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Mechanical Engineering, V-Semester

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|------------------------------------|---|----------|----------|----------|
| BMET-603 BMEP-603 | Refrigeration and Air Conditioning | L | T | P |
| | | 3 | 1 | 2 |

Objectives:

1. To understand the principles of refrigeration and air conditioning.
2. To calculate the cooling load for different applications.
3. To select the right equipment for a particular application.
4. To design and implement refrigeration and air conditioning systems using standards.
5. Energy Conservation and Management.

Course Outcome:

1. Interpret the working principles and applications of refrigeration systems.
2. Interpret the vapour compression refrigeration system and identify methods for Performance improvement.
3. Demonstrate the working principles of air, vapour absorption, thermoelectric and estimate the condition of steam and performance of vapour power cycle and vapour compression cycle.
4. Analyze air-conditioning processes using the principles of psychrometry and estimate various essential properties related to Psychrometry and processes.
5. Evaluate cooling and heating loads in an air-conditioning system.

Detailed Content:

Unit-1

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-2

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-3

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-4

Air Conditioning:

Introduction to air conditioning, Psychrometric properties and their definitions, Psychrometric chart, Different Psychrometric 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-5

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, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, Basic difference between comfort and industrial air conditioning.

Suggested Books:

1. Refrigeration and Air conditioning by C.P Arora.TMH
2. Refrigeration and Air conditioning by Arora&Domkundwar.DhanpatRai
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. byKuhlen, Ramsey &Thelked. Central Book Agency.
7. ASHRAE Handbooks

Suggested References:

1. Visit a chilling plant and determine the COP and tonnage capacity of the chilling plant.
2. Experiment on refrigeration test rig and calculation of various performance parameters.
3. To determine COP and tonnage capacity of a Air conditioning system.
4. To determine the COP and tonnage capacity of a Mechanical Heat Pump.
5. Experiment on air-conditioning test rig & calculation of various performance parameters.
6. To study air washers
7. Study & determination of volumetric efficiency of compressor.
8. To study different types of expansion devices used in refrigeration system.
9. To study different types of evaporators used in refrigeration systems.
10. To study basic components of air-conditioning system

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|-----------------------------------|----------|----------|----------|
| BMET- 604 (A) Mechatronics | L | T | P |
| | 3 | 0 | 0 |

Objectives:

- (i) To understand the structure of microprocessors and their applications in mechanical devices
- (ii) To understand the principle of automatic control and real time motion control systems, with the help of electrical drives and actuators
- (iii) To understand the use of micro-sensors and their applications in various fields.

Course Outcome:

1. Install, troubleshoot, maintain and repair mechatronic systems using industry-standard tools, practices, and procedures.
2. Assist in design and rebuilding projects.
3. Follow, develop, and troubleshoot manufacturing processes and procedures.
4. Organize, interpret, and use technical information and documentation.
5. mechatronics applications and the use of micro-sensors and microprocessors.

Detailed Content:

UNIT – 1 INTRODUCTION: Definition of Mechatronics, Multi-disciplinary scenario, origins. Evaluation of Mechatronics, An over view of mechatronics, Design of mechatronics system. Measurements system and function of main elements of measurement systems. Need for mechatronics in industries. Objectives, advantages and disadvantages of mechatronics. Microprocessor based controllers. Principle of working of engine management system, automatic washing machine.

UNIT – 2 REVIEW OF TRANSDUCERS AND SENSORS: Definition and classification of transducers. Definition and classification of sensors. Principle of working and applications of light sensors, proximity sensors and Hall effect sensors. **MICROPROCESSOR:** Introduction, Microprocessor based digital control. Digital number system, binary and hexadecimal number system, Logic functions, Data word representation basic Elements of control systems.

UNIT 3 : MICROPROCESSOR ARCHITECTURE: 8085A processor architecture Terminology-such as, CPU, memory and address, ALU, assembler, data, registers, Fetch cycle, write cycle, state, bus interrupts. Micro controllers – difference between microprocessor and micro controllers. Requirements for control and their implementation in micro controllers. Classification of micro controllers.

Unit 4 :ELECTRICAL ACTUATORS: Actuator and actuator system. Classifications of actuator system with examples. Mechanical switches. Concept of bouncing Methods of Preventing bouncing of mechanical switches. Solenoids, Relays. Solid state switches – Diodes, Thyristors, Triacs, Transistors, Darlington pair. Electrical actuator. Principle, construction and working of AC, DC motors, stepper motors, permanent motors, servomotors, Servo systems and control

HYDRAULIC ACTUATORS: Valves – Classifications, Pressure Control Valves – Pressure relief valves, Pressure regulating/reducing valves, Pressure sequence valve. Flow control valves – Principle, needle valve, globe valve. Direction control valve –sliding spool valve, solenoid operated.

Unit 5 :SINGLE CONDITIONING: Concept, necessity, op-amps, protection, filtering, wheat stone bridge – Digital Signals – Multiplexer. Data acquisition – Introduction to digital signal processing – Concepts and different methods.

Suggested Books:

1. **Mechatronics** – Principles, Concepts and applications – Nitaigour and Premchand, Mahilik – Tata McGraw Hill -2003
2. **Mechatronics** – W. Bolton, Pearson Education Asia -2nd Edition, 2001.
3. **Introduction to mechatronics and measurement systems** –David G. Alciatore& Michel BiHstand – Tata McGraw Hill –2000
4. **Mechatronics** – H.D. Ramachandra – Sudha Publication -2003 **Mechatronics** by HMT Ltd. – Tata McGrawHill -2000.
5. **Mechatronics System design** by DevadasShetty and Richard A. Kark – Thomas Learining -1997.
6. **Mechatronics an Introduction** by Robert H Bishop – CRC
- 7 **Mechatronics systems Fundamentals** by Rolf Isermann - Springer

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|--|----------|----------|----------|
| BMET- 604 (B) Finite Element Method | L | T | P |
| | 3 | 0 | 0 |

Objectives:

1. To illustrate the principle of mathematical modeling of engineering problems
2. To introduce the basics and application of Finite Element Method.
3. To provide the fundamental concepts of the theory of the finite element method
4. To develop proficiency in the application of the finite element method to realistic engineering problems through the use of a major commercial general-purpose finite element code.

Course Outcome:

1. to obtain an understanding of the fundamental theory of the FEA method;
2. to develop the ability to generate the governing FE equations for systems governed by partial differential equations;
3. to understand the use of the basic finite elements for structural applications using truss, beam, frame, and plane elements; and
4. to understand the application and use of the FE method for heat transfer problems.
5. to demonstrate the ability to create models for trusses, frames, plate structures, machine parts, and components using ANSYS general-purpose software

Detailed Content:

Unit-I :Introduction -Structural analysis, objectives, static, Dynamic and kinematics analyses, Skeletal and continuum structures, Modeling of infinite d.o.f. system into finite d.o.f. system, Basic steps in finite element problem formulation, General applicability of the method.

Unit-II :Element Types and Characteristics -Discretization of the domain, Basic element shapes, Aspect ratio, Shape functions, Generalized co-ordinates and nodal shape functions. ID spar and beam elements, 2D rectangular and triangular elements, Axisymmetric elements.

Unit-III :Assembly of Elements and Matrices -Concept of element assembly, Global and local co-ordinate systems, Band width and its effects, Banded and skyline assembly, Boundary conditions, Solution of simultaneous equations, Gaussian elimination and Cholesky decomposition methods, Numerical integration, One and 2D applications.

Unit-IV :Higher Order and Isoparametric Elements -One dimensional quadratic and cubic elements, Use of natural co-ordinate system, Area co-ordinate system continuity and convergence requirements, 2D rectangular and triangular requirement.

Unit-V :Static & Dynamic Analysis -Analysis of trusses and frames, Analysis of machine subassemblies, Use commercial software packages, Advantages and limitations Hamilton's principle, Derivation of equilibrium, Consistent and lumped mass matrices, Derivation of mass matrices for ID elements, Determination of natural frequencies and mode shapes, Use of commercial software packages.

Suggested Books:

1. Rao, S.S., The Finite Element Method in Engineering, 2nd ed., Peragamon Press, Oxford.
2. Robert, D. Cook., David, S. Malkins, and Michael E. Plesha, Concepts and Application of Finite Element Analysis 3rd ed., John Wiley
3. Chandrupatla, T.R. and Belegundu, A.D., Introduction to Finite Elements in Engineering, Prentice Hall of India Pvt. Ltd.
4. Zienkiewicz O C, The Finite Element Method, 3rd ed, Tata McGraw Hill.

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Mechanical Engineering, VI-Semester

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|-------------------------------------|----------|----------|----------|
| BMET- 604 (C) Product Design | L | T | P |
| | 3 | 0 | 0 |

Objectives:

1. The program trains multidisciplinary designers to use their creativity, design thinking, and design process to bring new ideas, products, and value to companies, communities, and people.
2. Applying diverse 2-D and 3-D design skills to create well-conceived and executed objects, products, and systems that service a human need.
3. The program emphasis is on creativity, exploration, design thinking, solution finding, personal expression, aesthetics, craftsmanship, and entrepreneurship in the creation of lifestyle products and packaging for the global consumer market. 4. The program assists each student in developing personal career pathways to success.

Course Outcome:

1. Use the Product Design and Development Process, as a means to manage the development of an idea from concept through to production.
2. Apply creative process techniques in synthesizing information, problem-solving and critical thinking.
3. Demonstrate and employ hand drawing and drafting principles to convey concepts.
4. Use basic fabrication methods to build prototype models for hard-goods and soft-goods and packaging.
5. Demonstrate, apply, explain, and recognize basic engineering, mechanical, and technical principles.

Detailed Content:

Unit 1: Introduction to product design

Product life-cycle, product policy of an organization. Selection of a profitable product, Product design process, Product analysis.

Unit 2: Value engineering in product design

Advantages, applications in product design, problem identification and selection, Analysis of functions, Anatomy of function. Primary versus secondary versus tertiary/unnecessary functions, functional analysis: Functional Analysis System Technique (FAST), Case studies.

Unit 3: Introduction to Product design tools

QFD, Computer Aided Design, Robust design, DFX, DFM. DFA, Ergonomics in product design.

Unit 4: DFMA guidelines

Product design for manual assembly, Design guidelines for metallic and non-metallic products to be manufactured by different processes such as casting, machining, injection molding etc.,

Unit-5: Rapid Prototyping

Needs of rapid prototyping, needs, advantages, working principles of SLA, LOM and SLS.

Suggested Books:

1. Value Engineering: Concepts, Techniques and Applications by A.K. Mukhopadhaya
2. Rapid Prototyping: Principles and Applications by C.K. Chua
3. Engineering Design by Linda D. Schmidt

Uttarakhand Technical University, Dehradun
New Scheme of Examination as per AICTE Flexible Curricula
Mechanical Engineering, VI-Semester

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|-------------------------------|----------|----------|----------|
| BMET- 605 (A) Robotics | L | T | P |
| | 3 | 0 | 0 |

Objectives:

1. To acquire the knowledge on advanced algebraic tools for the description of motion.
2. To develop the ability to analyze and design the motion for articulated systems.
3. To develop an ability to use software tools for analysis and design of robotic systems

Course Outcome:

1. Be able to use matrix algebra and Lie algebra for computing the kinematics of robots.
2. Be able to calculate the forward kinematics and inverse kinematics of serial and parallel robots.
3. Be able to calculate the Jacobian for serial and parallel robot.
4. Be able to do the path planning for a robotic system.
5. Be proficient in the use of Maple or Matlab for the simulation of robots.

Detailed Content:

Unit 1 Introduction:

Need and importance, basic concepts, structure and classification of industrial robots, terminology of robot motion, motion characteristics, resolution, accuracy, repeatability, robot applications.

Unit 2 End Effectors and Drive systems:

Drive systems for robots, salient features and comparison, different types of end effectors, design, applications.

Unit 3 Sensors:

Sensor evaluation and selection, Piezoelectric sensors , linear position and displacement sensing, revolvers, encoders, velocity measurement, proximity, tactile, compliance and range sensing. Image Processing and object recognition.

Unit IV Robot Programming:

Teaching of robots, manual, walk through, teach pendant, off line programming concepts and languages, applications.

Unit V Safety and Economy of Robots:

Work cycle time analysis, economics and effectiveness of robots, safety systems and devices, concepts of testing methods and acceptance rule for industrial robots.

Suggested Books:

1. Mittal RK, Nagrath IJ; Robotics and Control; TMH
2. Groover M.P, Weiss M, Nagel, Odrey NG; Industrial Robotics-The Appl; TMH
3. Groover M.P; CAM and Automation; PHI Learning
4. Spong Mark and Vidyasagar; Robot Modelling and control; Wiley India
5. Yoshikava ; Foundations of Robotics- analysis and Control; PHI Learning;
6. Murphy ; Introduction to AI Robotics; PHI Learning
7. FU KS, Gonzalez RC, Lee CSG; Robotics □Control, sensing□; TMH
8. Shimon, K; Handbook of Industrial Robots; John Wiley & Sons,.
9. Ghosal Ashitava; Robotics Fundamental concepts and analysis; Oxford
10. Saha S; Introduction to Robotics; TMH
11. Yu Kozyhev; Industrial Robots Handbook; MIR Pub.22

Uttarakhand Technical University, Dehradun
New Scheme of Examination as per AICTE Flexible Curricula
Mechanical Engineering, VI-Semester

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|--|----------|----------|----------|
| BMET- 605 (B) Optimization Techniques | L | T | P |
| | 3 | 0 | 0 |

Objectives:

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

Course Outcome:

1. Understand importance of optimization of industrial process management.
2. Apply basic concepts of mathematics to formulate an optimization problem.
3. analyze and appreciate variety of performance measures for various optimization problems

Detailed Content:

Unit 1 Introduction to Optimization:

Engineering application of Optimization – Statement of an Optimization problem - Optimal Problem formulation - Classification of Optimization problem. Optimum design concepts, Definition of Global and Local optima – Optimality criteria - Review of basic calculus concepts – Global optimality

Unit 2 Linear programming methods for optimum design:

Review of Linear programming methods for optimum design – Post optimality analysis - Application of LPP models in design and manufacturing.

Unit 3 Optimization algorithms for solving unconstrained optimization problems:

Gradient based method: Cauchy's steepest descent method, Newton's method, Conjugate gradient method.

Unit-4 Optimization algorithms for solving constrained optimization problems:

Direct methods – penalty function methods – steepest descent method - Engineering applications of constrained and unconstrained algorithms.

Unit 5 Modern methods of Optimization:

Genetic Algorithms - Simulated Annealing - Ant colony optimization - Tabu search – Neural-Network based Optimization – Fuzzy optimization techniques – Applications. Use of Matlab to solve optimization problems.

Suggested Books:

1. Rao S. S. - 'Engineering Optimization, Theory and Practice' - New Age International Publishers - 2012 - 4th Edition.
2. Deb K. - 'Optimization for Engineering Design Algorithms and Examples' – PHI - 2000
3. Arora J. - 'Introduction to Optimization Design' - Elsevier Academic Press, New Delhi - 2004
4. Saravanan R. - 'Manufacturing Optimization through Intelligent Techniques' - Taylor & Francis (CRC Press) - 2006
5. Hardley G. - 'Linear Programming' - Narosa Book Distributors Private Ltd. - 2002

Uttarakhand Technical University, Dehradun
New Scheme of Examination as per AICTE Flexible Curricula
Mechanical Engineering, VI-Semester

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|--|----------|----------|----------|
| BMET- 605 (C) Renewable Energy Technology | L | T | P |
| | 3 | 0 | 0 |

Objectives:

1. Understand the various forms of conventional energy resources.
2. Learn the present energy scenario and the need for energy conservation
3. Explain the concept of various forms of renewable energy
4. Outline division aspects and utilization of renewable energy sources for both domestic and industrial application
5. Analyse the environmental aspects of renewable energy resources.

Course Outcome:

1. Describe the environmental aspects of non-conventional energy resources.
2. Know the need of renewable energy resources, historical and latest developments.
3. Describe the use of solar energy and the various components used in the energy production with respect to applications like - heating, cooling, desalination, power generation, drying, cooking etc.
4. Appreciate the need of Wind Energy and the various components used in energy generation and know the classifications.
5. Understand the concept of Biomass energy resources and their classification, types of biogas Plants-applications

Detailed Content:

UNIT-I Solar Radiation:

Extra-terrestrial and terrestrial, radiation measuring instrument, radiation measurement and predictions. Solar thermal conversion: Basics, Flat plate collectors-liquid and air type. Theory of flat plate collectors, selective coating, advanced collectors, Concentrators: optical design of concentrators, solar water heater, solar dryers, solar stills, solar cooling and refrigeration. Solar photovoltaic: Principle of photovoltaic conversion of solar energy; Technology for fabrication of photovoltaic devices; Applications of solar cells in PV generation systems; Organic PV cells.

UNIT-II Wind Energy:

Characteristics and measurement: Metrology of wind speed distribution, wind speed statistics, Weibull, Rayleigh and Normal distribution, Measurement of wind data, Energy estimation of wind regimes;

Wind Energy Conversion: Wind energy conversion principles; General introduction; Types and classification of WECS; Power, torque and speed characteristics; power curve of wind turbine, capacity factor, matching wind turbine with wind regimes; Application of wind energy.

UNIT-III Production of biomass:

Photosynthesis-C3 & C4 plants on biomass production; Biomass resources assessment; Co₂ fixation potential of biomass; Classification of biomass; Physicochemical characteristics of biomass as fuel Biomass conversion routes: biochemical, chemical and thermo chemical Biochemical conversion of biomass to energy: anaerobic digestion, biogas production mechanism, technology, types of digesters, design of biogas plants, installation, operation and maintenance of biogas plants, biogas plant manure-utilization and manure values. Biomass Gasification: Different types, power generation from gasification, cost benefit analysis of power generation by gasification.

UNIT-IV Small Hydropower Systems:

Overview of micro, mini and small hydro system; hydrology; Elements of turbine; Assessment of hydro power; selection and design criteria of turbines; site selection and civil works; speed and voltage regulation; Investment issue load management and tariff collection; Distribution and marketing issues. Ocean Energy: Ocean energy resources, ocean

energy routes; Principle of ocean thermal energy conversion system, ocean thermal power plants. Principles of ocean wave energy and Tidal energy conversion.

UNIT-V Geothermal Energy:

Origin of geothermal resources, type of geothermal energy deposits, site selection geothermal power plants; Hydrogen Energy: Hydrogen as a source of energy, Hydrogen production and storage. Fuel Cells: Types of fuel cell, fuel cell system and sub-system, Principle of working, basic thermodynamics

Suggested Books:

1. Kothari, Singal&Rajan; Renewable Energy Sources and Emerging Technologies, PHI Learn
2. Khan, B H, Non Conventional Energy, TMH.
3. Sukhatme and Nayak, Solar Energy, Principles of Thermal Collection and Storage, TMH.
4. Tiwari and Ghosal, Renewable Energy Resources: basic principle & application, NarosaPubl
5. KoteswaraRao, Energy Resources, Conventional & Non-Conventional, BSP Publication.
6. Chetan Singh Solanki, Solar Photovoltaics: Fundamental, technologies and Application, PHI L
7. AbbasiTanseem and Abbasi SA; Renewable Energy Sources; PHI Learning
8. Ravindranath NH and Hall DO, Biomass, Energy and Environment, Oxford University Press.
9. Duffie and Beckman, Solar Engineering of Thermal Process, Wiley
10. Nikolai, Khartchenko; Green Power; Tech Book International
11. Tester, Sustainable Energy-Choosing Among Options, PHI Learning.
12. Godfrey Boyle, Renewable Energy: Power for a sustainable future, Oxford OUP. 24