Uttarakhand Technical University, Dehradun

Scheme of Examination as per AICTE Flexible Curricula

Evaluation Schemes for B. Tech 2nd to 4thYear

W.E.F. Academic Session 2020-21

III to VIII SEMESTER

Bachelor of Technology (B. Tech.)

in

[MechanicalEngineering]

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						
				End Sem	Mid Sem	Quiz / Assignment	End Sem	Term Work /Lab Work & Sessional		L	T	P	
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						
				End Sem	Mid Sem	Quiz / Assignment	End Sem	Term Work /Lab Work & Sessional		L	T	P	
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 Credi
				Theory			Practical						
				End Sem	Mid Sem	Quiz / Assignment	End Sem	Term Work /Lab Work & Sessional		L	T	P	
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	12	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						
				End Sem	Mid Sem	Quiz / Assignment	End Sem	Term Work /Lab Work & Sessional		L	T	P	
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						
				End Sem	Mid Sem	Quiz / Assignment	End Sem	Term Work /Lab Work & Sessional		L	T	P	
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 Credi
				Theory			Practical						
				End Sem	Mid Sem	Quiz / Assignment	End Sem	Term Work /Lab Work & Sessional		L	T	P	
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 3rd Year

W.E.F. Academic Session 2020-21

Vto VIII SEMESTER

Bachelor of Technology (B. Tech.)

in

[MechanicalEngineering]

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	**Industrial Engineering & Ergonomics**	**L**	**T**	**P**
BMEP- 501		**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, Tailor, 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. Barrnes RM; Motion and Time Study; Wiley pub
4. Megaw ED; Contenmprory ergonomics; Taylor &fracis
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 expending 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 Bookss:

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; Machnine Design;

Suggested Experiments:

1. Study of various engineering materials.
2. Study and nomenclature of cerntrifugal 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 analyzeradiative 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 though 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 Stefen's Law, on radiation detrmination 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 insultation 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 it's 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, SolexCarburetor, 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.

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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 Banglore

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, Chemiluminescentanalyzers, 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

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, l Paul and Gupta: Managerial Economics Concepts & Cases, TMH, New Delhi.
6.Stephan R Robbins Fundamental of Management, Pearson

Uttarakhand Technical University, Dehradun

New Scheme of Examination as per AICTE Flexible Curricula

Mechanical Engineering, V-Semester

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 IS0-9000 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, Ishikava, 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 Qality 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

Uttarakhand Technical University, Dehradun

New Scheme of Examination as per AICTE Flexible Curricula

Mechanical Engineering, V-Semester

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.

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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, " Entreprenuership – 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 "Faulty 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

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, Polytrophic 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 &SarvanMulto 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 comparision & performance of different types of pumps and turbines.

Uttarakhand Technical University, Dehradun

New Scheme of Examination as per AICTE Flexible Curricula

Mechanical Engineering, VI-Semester

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 helicalgears, herringbone gears, crossed helical gears, Design of helical gears.

Unit 3: Worm Gears Types of worms, Terminology, Gear tooth proportions, Efficiency of worm gears, Heatdissipation 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 ofBearing, 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)

Uttarakhand Technical University, Dehradun

New Scheme of Examination as per AICTE Flexible Curricula

Mechanical Engineering, V-Semester

BMET-603	**Refrigeration and Air Conditioning**	**L**	**T**	**P**
BMEP-603		**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, 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-5

Refrigeration Equipment & Application:

Elementary knowledge of refrigeration & air conditioning equipmentse.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.

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. byKuhen, 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 ring and calculation of various proformance 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 refrigreation system.
9. To study different types of evaporators used in refrigeration systems.
10. To study basic components of air-conditioning system

Uttarakhand Technical University, Dehradun

New Scheme of Examination as per AICTE Flexible Curricula

Mechanical Engineering, V-Semester

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

Objectives:

(i) Tounderstand 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 thehelp 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: Defination 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 member 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, Trasistors, 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 BiHistand – 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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New Scheme of Examination as per AICTE Flexible Curricula

Mechanical Engineering, V-Semester

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, Axisymmetirc 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 Choleksy 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. anBelegundu, 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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New Scheme of Examination as per AICTE Flexible Curricula

Mechanical Engineering, VI-Semester

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

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. GrooverM.P,Weiss M, Nagel,OdreyNG; 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. GhosalAshitava; 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

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

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 domestics 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 routs; 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 Bookss:

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

Uttarakhand Technical University, Dehradun

Scheme of Examination as per AICTE Flexible Curricula

Evaluation Schemes for B. Tech 4th Year

W.E.F. Academic Session 2021-22

VII to VIII SEMESTER

Bachelor of Technology (B. Tech.)

in

[MechanicalEngineering]

Uttarakhand Technical University, Dehradun

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						
				End Sem	Mid Sem	Quiz / Assignment	End Sem	Term Work /Lab Work & Sessional		L	T	P	
1.	BMET 701	DC	Nano Materials	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 (Ansys/MATLAB)	-	-	-	30	20	50	0	1	2	2
6.	BMEP-507	IN	Internship III	-	-	-	-	50	50	-	-	2	1
7.	BMEP-706	P	Project Stage 1	-	-	-	50	100	150	0	0	4	2
Total				400	120	80	110	190	900	12	1	10	18
NSS/NCC													

Departmental Electives		Open Electives	
BMET 703(A)	Maintenance and Safety	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						
				End Sem	Mid Sem	Quiz / Assignment	End Sem	Term Work /Lab Work & Sessional		L	T	P	
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	Seminar					100	100	0	0	2	1
6	BMEP-806	P	Project Stage 2				100	100	150	0	0	8	4
Total				400	120	80	50	200	900	12	2	12	20

Departmental Electives		Open Electives	
BMET-803 (A)	Power Plant Engineering	BMET-804 (A)	Concepts of programming and OOPS
BMET-803 (B)	Solar Energy	BMET-804 (B)	Environment and Ecology
BMET-803 (C)	Experimental Stress Analysis	BMET-804 (C)	Programming in python

7th

SEM

Uttarakhand Technical University, Dehradun

New Scheme of Examination as per AICTE Flexible Curricula

Mechanical Engineering, VII-Semester

BMET- 701Maintenance and Safety	**L**	**T**	**P**
	3	**0**	**0**

Objectives:

On completion of the course, learner will be able to–

- Understand the concept of reliability and failure curve.
- Explain the concepts of different maintenance strategies.
- Understand the role replacement planning.
- Recognize and understand the different different material handling techniques.
- Student should able to use different concepts of maintenance management.

Course Outcome:

- Analyze failure data, maintainability, availability and reliability.
- Evaluate different Maintenance Strategies
- Interpret different Replacement techniques and planning
- Compare various handling techniques in engineering industries.
- Use different concepts of Maintenance Management and spare parts planning and control.

Detailed Content:

Unit-I INTRODUCTION: Introduction, operating life cycle, reliability, Failure data analysis, failure rate curve, hazardmodels. Maintainability, availability, reliability.

Unit-IIMAINTENANCE STRATEGIES: Break down maintenance, planned maintenance, strategies, preventivemaintenance, design out maintenance, planned lubrication, total productive maintenance, zerobreak down, preventive inspection of equipment used in emergency.

Unit-III REPLACEMENT ANALYSIS: Replacement planning &maintain or replace decision, replacement of items that deteriorate withtime identical equipment, replacement of items that fail without deterioration individual, groupreplacement, replacement in anticipation of failure. Break down maintenance planning.

Unit-IVSAFETY IN ENGINEERING INDUSTRY: Introduction - definitions - classification of engineering industry - different process inengineering industry. Safety in welding, cutting, finishing, Safety in heat treatments - safety inhandling and storage,.disposal of effluents - health precautions, elimination and prevention oflong time exposure to the hazardous fumes, source of fumes, ventilation and fume protection.Care and maintenance of common elements used in material handling *equipment* like ropechains slings, hooks , clamps .general safety consideration in material handling - manual andmechanical handling . Handling assessments - handling techniques – lifting, carrying, pulling,pushing, palletizing and stocking.Occupational diseases due to physical and chemical agents.

Unit-V Maintenance Management, production maintenance system, objectives and functions, forms, policy, planning, organization, economics of maintenance, manpower planning, materialsplanning, spare parts planning and control, evaluation of maintenance management.

Suggested Books:

1) Industrial Safety Handbook : William Handley
2) Introduction to Safety Engineering : David S Gloss & Miriam GayleWardle
3) Industrial Safety : Roland P Blake
4) Health and Safety in Welding and allied process :N C Balchin,Jaico publishers
5.Management of systems – R.N. Nauhria& R. Prakash.

Uttarakhand Technical University, Dehradun

New Scheme of Examination as per AICTE Flexible Curricula

Mechanical Engineering, VII-Semester

BMET- 702 Computer Integrated Manufacturing	**L**	**T**	**P**
BMEP- 702	**3**	**0**	**2**

Detailed Content:

Unit 1: **INTRODUCTION:**Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system –Types of production – Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production.

Unit 2: PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING: Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning –Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) – Simple Problems.

NC PART PROGRAMMING-

Manual (word address format) programming.Examples Drilling and Milling.

Unit 3: COLLABORATIVE ENGINEERING: Collaborative Design, Principles, Approaches, Tools, DesignSystems. Introduction to CAD/CAE, Element of CAD, Concepts of integrated CAD/CAM, CADEngineering applications, its importance & necessity. Finite Element Methods: Introduction andApplication of FEM, Stiffness Matrix/ Displacement Matrix, One/Two Dimensional bar & beamelement (as spring system) analysis.

Unit 4 :CELLULAR, FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS): Group Technology(GT), Part Families,Types of Flexibility – FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.

Unit 5: INDUSTRIAL ROBOTICS: Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability – Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

Suggested Books:

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

Suggested 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. Design problem experiment: writing the program for design of machine element or other system and running it on computer.
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.
9. Experiment on Transfer line/Material handling.
10. Experiment on difference between ordinary machine and NC machine, study or retrofitting.
11. Experiment on study of system devices such as motors and feedback devices.
12. Experiment on Mechatronics & controls.

Uttarakhand Technical University, Dehradun

New Scheme of Examination as per AICTE Flexible Curricula

Mechanical Engineering, VII-Semester

BMET- 703(A)Nanomaterials	**L**	**T**	**P**
	3	**0**	**0**

Detailed Content:

Unit I: Introduction to nanomaterials, Properties of materials &nanomaterials, role of size in nanomaterials, nanoparticles, semiconducting nanoparticles, nanowires, nanoclusters, quantum wells, conductivity and enhanced catalytic activity compared to the same materials in the macroscopic state

Unit II: Chemical Routes for Synthesis of Nanomaterials: Chemical precipitation and coprecipitation; Metal nanocrystals by reduction, Sol-gel synthesis; Microemulsions or reverse micelles, myle formation; Solvothermal synthesis; Thermolysis routes, Microwave heating synthesis; Sonochemical synthesis; Electrochemical synthesis; , Photochemical synthesis, Synthesis in supercritical fluids

Unit III: Fabrication of Nanomaterials by Physical Methods: -Inert gas condensation, Arc discharge, Plasma arc technique, RF plasma, MW plasma, Ion sputtering, Laser ablation, Laser pyrolysis, Ball Milling, Molecular beam epitaxy, Chemical vapour deposition method and Electro deposition

Unit IV: Nanocomposites: An Introduction: Types of Nanocomposite (i.e. metal oxide, ceramic, glass and polymer based); Core-Shell structured nanocomposites Superhard Nanocomposite: Synthesis, applications and milestones.

Unit–V: Nano ceramics: Dielectrics, ferroelectrics and magnetoceramics, Magnetism; Dia-, Para-, Ferro-, Antiferro-, Ferri-magnetism, Magnetic properties; Gaintmagnetoresistance, Tunnelingmagnetoresistance, Colossal magnetoresistance, Superparamagnetism High Tc materials: YBCO and Bi-systems (Brief idea), Superconducting nano-materials & their properties and applications.

Suggested Books:

1. Nanochemistry: A chemical approach to nanomaterials by G. A. Ozin, A. C. Aresnault, L. Cadematriri, RSC Publishing
2. Microfabrication and Nanomanufacturing- Mark James Jackson
3. Chemistry of nanomaterials : Synthesis, properties and applications by CNR Rao et.al.
4. Nanoparticles: From theory to applications – G. Schmidt, Wiley Weinheim 2004.
5. Fabrication of fine pitch gratings by holography, electron beam lithography and nano-imprint lithography (Proceedings Paper) Author(s): Darren Goodchild; Alexei Bogdanov; Simon Wingar; Bill Benyon; Nak Kim; Frank Shepherd

Uttarakhand Technical University, Dehradun

New Scheme of Examination as per AICTE Flexible Curricula

Mechanical Engineering, VII-Semester

BMET- 703(B)	Computational Fluid dynamics	L	T	P
		3	0	0

Objectives:

1. To teach fundamentals of computational method for solving non-linear partial differential equations (PDE) primarily in complex geometry.
2. To teach CFD techniques for solving incompressible and compressible N-S equation in primitive variables, grid generation in complex geometry.
3. To teach CFD techniques for solving transformation of N-S equation in curvilinear coordinate system and introduction to turbulence modelling.

Course Outcome:

1. To understand mathematical characteristics of partial differential equations.
2. To understand basic properties of computational methods – accuracy, stability, consistency
3. To learn computational solution techniques for time integration of ordinary differential equations & various types of partial differential equations
4. To learn how to computationally solve Euler and Navier-Stokes equations
5. To acquire basic programming and graphic skills to conduct the flow field calculations and data analysis.

Detailed Content:

Unit 1: Introduction: Brief introduction of boundary layer flow, incompressible and compressible flows, finite difference and finite volume method, example of parabolic and hyperbolic systems and time discretization technique, explicit and implicit methods, upwind and central difference schemes, stability, dissipation and dispersion errors. Solution of Simultaneous Equations: point iterative/block iterative methods, Gauss-Seidel iteration (concept of central coefficient and residue, SOR), CGS, Bi-CGSTAB and GMRES (m) matrix solvers, different acceleration techniques

Unit 2: Incompressible Flow: Higher order upwind schemes: second order convective schemes, QUICK. Solution of NS equations: Solution of incompressible N-S equation (Explicit time stepping, Semi–explicit time stepping). SMAC method for staggered grid: Predictor - Corrector step, discretization of N-S and continuity equations, Pressure correction Poisson's equation, boundary conditions (no-slip, moving wall, slip boundary and inflow conditions), outflow (zero gradient/Orlanski) boundary conditions for unsteady flows, algorithm for the SMAC method, stability considerations for SMAC method. Semi–implicit method (SIMPLE): Comparison with the SMAC and fully – implicit methods, algorithm for semi–implicit method, discussion on SIMPLE/SIMPLER and SIMPLEC. Discretization of governing equations and boundary conditions in FVM framework. SMAC method for collocated grid: Pressure–velocity coupling, N- S equations on a collocated grid, concept of momentum interpolation to avoid pressure velocity decoupling, discretization of governing equations using the concept of momentum interpolation.

Unit 3: Transformation of governing equation in ξ $\eta-$ plane, transformation of Laplace equation, introduction to geometrical parameters and the accuracy of the solution, basic facts about transformation, grid transformation on complex geometries. N-S equations in transformed plane, matrices and Jacobians.

Unit 4: Compressible Flow: N-S and energy equations, properties of Euler equation, linearization. Solution of Euler equation: Explicit and implicit treatment such as Lax-Wendroff, MacCormark, Beam and Warming schemes, Upwind schemes for Euler equation: Steger and Warming, Van Leer's flux splitting, Roe's approximate Riemann solver, TVD schemes. Solution of N-S equations: MacCormack, Jameson algorithm in finite volume formulation and transformed coordinate system. Grid system: Historical aspects of the various grids, Body fitted grids in complex geometries, orthogonal grids, mapping functions, staggered/collocated and structured/unstructured, various methods of grid generations (Algebraic, Transfinite, Poisson equation methods).

Unit 5: Uncertainty of numerical results: Sources of uncertainties, studies on grid independence, time-step independence, domain independence, initial condition dependence. Turbulence modelling: Introduction to turbulence, scales of turbulence, Reynolds Averaged Navier Stokes (RANS) equation, closure problem, eddy viscosity model, k-ε and k-ω model, introduction to large eddy simulation (LES) and direct numerical simulation.

Suggested Books:

1. Computational Fluid Flow and Heat Transfer, Second Edition by K. Muralidhar, T. Sundararajan (Narosa), 2011.
2. Computational Fluid Dynamics by Chung T. J., Cambridge University Press, 2003.
3. Computational Fluid Dynamics by Tapan K. Sengupta, University Press, 2005.
4. Numerical Computation of Internal and External Flows by Hirch C., Elesvier 2007.
5. Numerical Heat Transfer and Fluid Flow by S. V. Patankar (Hemisphere Series on Computational Methods in Mechanics and Thermal Science)
6. Essential Computational Fluid Dynamics by Zikanov. O., Wiley 2010.
7. Computer Simulation of Flow and Heat Transfer by P. S. Ghoshdastidar (4th Edition, Tata McGraw-Hill), 1998.

Uttarakhand Technical University, Dehradun

New Scheme of Examination as per AICTE Flexible Curricula

Mechanical Engineering, VII-Semester

BMET- 703(C)	Mechanical Vibration	L	T	P
		3	0	0

Objectives:

- Formulate mathematical models of problems in vibrations using Newton's second law or energy principles,
- Determine acomplete solution to the modeled mechanical vibration problems.
- Correlate results from the mathematical model to physical characteristics of the actual system.
- Design of a mechanical system using fundamental principles developed in the class.

Course Outcome:

- Constructing the governing differential equation and its solution for a vibrating mass subjected to an arbitrary force.
- Solve the motion and the natural frequency for forced vibration of a single degree of freedom damped or undamped system.
- Solve vibration problems that contain two degrees of freedom.
- Solve vibration problems that contain multiple degrees of freedom.
- Estimate numerical solutions to vibration problems by simple algorithms, and display the findings in graphical form.

Detailed Content:

UNIT- I

INTRODUCTION:

Periodic motion, harmonic motion, superposition of simple harmonic motions, beats, fourieranalysis.Single Degree Freedom System: Free vibration, Natural frequency, Equivalent Systems, Energy method fordetermining natural frequency, Response to an initial disturbance, Torsional vibrations, Damped vibrations. Damping models – Structural, Coulomb and Viscous damping,Vibrations of system with viscous damping, Logarithmic decrement, Viscous dampers.

UNIT- II

Single Degree Freedom: Forced vibration, Harmonic Excitation with viscous damping, Steady statevibrations, Forced vibrations with rotating and reciprocating unbalance, Support excitation, Vibration isolation, Transmissibility, Vibration measuring instruments- Displacement, Velocity,Acceleration and Frequency measuring instrument.

UNIT- III

Two Degree Freedom System: Introduction, Principal modes, Double pendulum, Torsional system withdamping,Coupled System, Undamped dynamic, vibration absorbers, Centrifugal pendulum absorber, Dry frictiondamper, Untuned viscous damper.

UNIT- IV

Multidegree Freedom System: Exact Analysis Undamped free and forced vibrations of multidegreesystem, Influence numbers, Reciprocal Theorem, Torsional vibration of multi rotor system, Vibration of gearedsystem, Principal coordinates, Continuous systems- Longitudinal vibration of bars, Torsional vibrations of Circularshafts, Lateral vibration of beams.

UNIT- V

Multidegree Freedom System: Numerical Analysis Rayleigh's, Dunkerley's, Holzer's and Stodola'smethods, Rayleigh – Ritz method. Critical Speed of Shafts: Shafts with one disc with and without damping, Multi-disc shafts, Secondarycritical speed.

Suggested books:

1. Mechanical Vibration –Magreb, Cengage India, New Delhi
2. Mechanical Vibration Practice with Basic Theory – V. Rama Murthy – Narosa Publishers
3. Machanical Vibrations – S.S. Rao, Pearson
4. Mechanical Vibration- Palm, Wiley India, New Delhi

Uttarakhand Technical University, Dehradun

New Scheme of Examination as per AICTE Flexible Curricula

Mechanical Engineering, VII-Semester

BMET-704 (A)	Energy Conservation	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 -I

Energy Audit: Definition, Need and Objectives.

Types of Energy Audit: Internal Audit, External Audit, Walk through Energy Audit, Preliminary EnergyAudit, Detailed Energy Audit, Industrial Energy Audit, Utility (Services) Energy Audit, Commercial EnergyAudit, Residential Energy Audit.

Basic Components of Energy Audit: Preparing for Audit Visit, Instrumentation, Data Collection TechnoeconomicAnalysis, Safety Considerations

Unit -II

Fuel Analysis

Proximate Analysis, Ultimate Analysis, Calorific Value. Combustion: Theoretical AirRequirement.

Insulation and Refractories

Insulation Type and Application, Economic Thickness of Insulation, Heat Savings and ApplicationCriteria, Refractory-Types, Selection and Application of Refractories.

Boilers:

Types, FBC Boilers,Mechanism of Fluidized Bed Combustion, Saving Potential.Analysis ofLosses, Performance Evaluation, Blow Down, Energy Conservation Opportunities.

Unit -III

Steam System:

Properties of Steam, Assessment of Steam Distribution Losses, Steam Leakages, SteamTrapping, Condensate and Flash Steam Recovery System, Identifying Opportunities for EnergySaving.

Cogeneration and Trigeneration

Need, Applications, Advantages, Combined Cycles, Saving Potential

Unit -IV

Waste Heat Recovery:

Availability and Reversibility, First and Second Law Efficiencies, Classification, Advantages andApplications, Commercially Viable Heat Recovery Devices, HVAC and Refrigeration

System,FactorsAffecting Refrigeration and Air Conditioning System Performance and Savings Opportunities.,Distribution systems for conditioned air**.**

Compressed Air Systems

Types of air compressors, compressor efficiency, efficient compressor operation, compressed airsystems components, capacity assessment, leakage test, factors affecting the performance andenergy savings opportunities.

Unit IV

Pumps and Pumping System

Performance evaluation, efficient system operation, flow control strategies and energyconservation opportunities.

Unit V

Electrical Systems: Active power, reactive power and apparent power, star, delta connection,electrical load management and electrical billing.

Power Factor: Power factor, Power factor improvement and its benefit, selection and location ofcapacitors, and energy conservation opportunities.

Electric Motors: Types, losses in induction motors, motor efficiency, factor affecting motorperformance, rewinding and motor replacement issues, energy saving opportunities in motors, energyefficient motors, soft starter with energy savers.

Suggested Books:

1. G. L. Witte, Phillips S.Scbmidt and Daid R. Brown, Industrial Energy Management andUtilization, Hemisphere Publishing Corporation, Washington
2. Carig,B. Saith, Energy Management Principles, Applications, Bnefit and Saving, Per nPress, New York.
3. F. W. Pyne, P gmEnergy Conservation Manual, Fairmont Proem, INC.P.O. Box 14227Atlanta,GA 30224
4. D. Patrick and S.W. Fardo, Energy U-sent and Conservation, Prentice Hall, INC EngleweekCliffs (NJ) 7632.
5. W R Murphy & G McKay, Energy Management, Elsiver/BSP hyderabad

Uttarakhand Technical University, Dehradun

New Scheme of Examination as per AICTE Flexible Curricula

Mechanical Engineering, VII-Semester

BMET- 704(B) Introduction to AI	**L**	**T**	**P**
	3	**0**	**0**

Course Objectives:

• The adoption of Artificial Intelligence (AI) technologies is widely expanding in our society. Applications of AI include: self-driving cars, personal assistants, surveillance systems, robotic manufacturing, machine translation, financial services, cyber security, web search, video games, and code analysis and product recommendations. Such applications use AI techniques to interpret information from a wide variety of sources and use it to enable intelligent, goal-directed behaviour.

Course Learning Outcomes:

1. Acquire advanced Data Analysis skills.
2. Stay Industry relevant and grow in your career.
3. Create AI/ML solutions for various business problems. Ÿ Build and deploy production grade AI/ML applications.
4. Apply AI/ML methods, techniques and tools immediately

Course Content:

Unit-1 (Introduction to AI): Definitions, Goals of AI, AI Approaches, AI Techniques, Branches of AI, Applications of AI. Introduction of Intelligent Systems: Agents and Environments, Good Behavior: the concept of Rationality, The Nature of Environments, The structure of Agents, How the components of agent programs work.

Unit-2 (Problems Solving, Search and Control Strategies)
Solving Problems by Searching, Study and analysis of various searching algorithms. Implementation of Depth-first search, Problem-Solving Agents, Searching for Solutions, Uninformed Search Strategies: Breadth-first search, Uniform-cost search, Depth-first search, Depth-limited search, Iterative deepening depth-first search, Bi-directional search Informed (Heuristic) Search Strategies: Greedy best-first search A* search: Minimizing the total estimated solution cost, Conditions for optimality: Admissibility and consistency, Optimality of A*, Memory-bounded heuristic search, Heuristic Functions, Generating admissible heuristics from sub problems: Pattern databases, Learning heuristics from experience.
Beyond Classical Search: Local Search Algorithms and Optimization Problems: Hill-climbing search Simulated annealing, Local beam search, Genetic algorithms, Local Search in Continuous Spaces, Searching with Non-deterministic Actions: AND-OR search trees, Searching with Partial Observations.

Unit- 3 (Knowledge Representations Issues, Predicate Logic, Rules)
Knowledge representation, KR using predicate logic, KR using rules.
Reasoning System - Symbolic, Statistical: Reasoning, Symbolic reasoning, Statistical reasoning.

Unit-4 (Quantifying Uncertainty, Learning Systems)
Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Bayes' Rule and Its Use, Representing Knowledge in an Uncertain Domain, Other Approaches to Uncertain Reasoning, Rule-based methods for uncertain reasoning, Representing vagueness: Fuzzy sets and fuzzy logic, Study of fuzzy logic and Decision trees, Implementation aspects of Decision

trees.
Learning from Examples: Forms of Learning, Supervised Learning, Learning Decision Trees, The decision tree representation, Expressiveness of decision trees, inducing decision trees from examples.

Unit-5 (Expert Systems)
Introduction, Knowledge acquisition, Knowledge base, Working memory, Inference engine, Expert system shells, Explanation, Application of expert systems.
Fundamentals of Neural Networks: Introduction and research history, Model of artificial neuron, Characteristics of neural networks, learning methods in neural networks, Single-layer neural network system, Applications of neural networks.
Fundamentals of Genetic Algorithms: Introduction, Encoding, Operators of genetic algorithm, Basic genetic algorithm.

Text/Reference Books:

1. Rich, Elaine Knight, Kevin, Artificial Intelligence, Tata McGraw Hill.
2. Luger, George F, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education.
3. Nilsson, Nils J, Artificial Intelligence, Morgan Kaufmann
4. Russell, Stuart J. Norvig, Peter, AI: A Modern Approach, Pearson Education

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New Scheme of Examination as per AICTE Flexible Curricula

Mechanical Engineering, VII-Semester

BMET 704(C) MEMS & Microsystems Technology	L	T	P
	3	0	0

Objectives:

On completion of the course, learner will be able to-

- Understand the concept of design MEMS systems.
- Explain the mems fabrications technologies.
- Understand the role of sensor and actuator in mems
- Recognize and understand the different applications of Mems
- Student should be able to use different concepts micro systems.

Course Outcome:

- Able to acquire the knowledge about the operations of micro devices, micro systems and their applications
- Able to design the micro devices, micro systems using the MEMS fabrication process
- Select one or more suitable MEMS/NEMS integration and packaging approaches for a given application.
- Exploring the fundamental working principle of bio-molecule sensing/sensors, and applying this knowledge to design solutions to probe biomedical and biology systems.
- Able to distinguish between classical and quantum mechanics

Detailed Content:

Unit- I OVERVIEW AND INTRODUCTION: New trends in Engineering and Science, Micro and Nanoscale systems, Overview of Nano and Microelectromechanical Systems, Introduction to Design of MEMS and NEMS, Applications of Micro and Nanoelectromechanical systems, Microelectromechanical systems, devices and structures Definitions, Materials for MEMS: Silicon, Silicon Compounds, Polymers, Metals.

Unit- II MEMS FABRICATION TECHNOLOGIES: Microsystem fabrication processes, Photolithography, Ion Implantation, Diffusion, Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect-Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials

Unit- III MICRO SENSORS AND ACTUATORS MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors. Case study: Piezo-resistive pressure sensor. MicroActuators - Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps. Case study: Comb drive actuators.

Unit- IV RF AND BIO MEMS: Introduction to RF MEMS technologies, Need for RF MEMS components in communications, space and defense applications, Materials and fabrication technologies, Special considerations in RF MEMS design. Case studies: Micro-switches BioMEMS- Drug delivery, Electronic nose, Bio chip.

Unit- V NANOSYSTEMS AND QUANTUM MECHANICS: Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Schrodinger Equation and Wave function Theory, Density Functional Theory, Nanostructures and Molecular Dynamic.

Texts/References Books:

1. S. D. Senturia, Microsystem Design (2005 edition)
2. Tai-Ran Hsu MEMS & Microsystems: Design, Manufacture, and Nanoscale Engineering, 2nd Edition
3. Marc Madau, Fundamentals of Microfabrication Science of Miniaturization, CRC Press
4. G. K. Ananthasuresh , K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat , V. K. Aatre Micro and Smart Systems Technology and Modeling (January 2012)
5. Minhang Bao "Analysis and Design Principles of MEMS Devicess", Peer reviewed international journals such as IEEE/ASME Journal of MEMS

8th SEM

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Mechanical Engineering, VIII-Semester

BMET- 801 Operation research	**L**	**T**	**P**
	3	**0**	**0**

Detailed Content:

Unit 1: Introduction:

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

Linear Programming Problems:

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

Unit 2: 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 3: 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 4: Queuing Theory:

Queuing system and their characteristics. The M/M/1 Queuing system, Steady state performance analyzingof M/M/ 1 and M/M/C queuing model.

Unit 5: PERT-CPM Techniques:

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

Reference :

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

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Mechanical Engineering, VIII-Semester

BMET 802 Automobile	**L**	**T**	**P**
BMEP-802	**3**	**0**	**0**

Objectives:

- Predict sources of energy and types of power plants.
- Analyse different types of steam cycles and estimate efficiencies in a steam power plant.
- Discriminate basic working principles of gas turbine and diesel engine power plants.
- Explain principal components and types of nuclear reactors.
- Evaluate cycle efficiency and performance of a gas cooled reactor power plant.

Course Outcome:

- Upon completion of this course, students will be able to analyze the automobile and its parts and about SI & CI engine
- They will be able to analyse the cooling and lubrication system
- Upon completion of this course, students will be able to analyze the suspension and chassis system
- Design steering and gear system.
- Design ignition and lighting system

Detailed Content:

Unit-I

INTRODUCTION: Classification of automobile, Parts of an automobile, Description of an automobile, performance of automobile, engine cycle-energy balance, terms connected with I.C. Engines, Detonation, performance number, tractive efforts.

FUEL-SUPPLY SYSTEM:

S.I. ENGINE: Carburetion & carburetors, Induction system, factor influencing carburetion, Mixture requirement, Distribution, Complete carburetor, theory of simple carburetor.

C.I. ENGINE: Functional requirements of an injection system, Fuel pump and fuel injector (Atomizer), Types of nozzles and fuel spray patterns, troubleshooting of a fuel system & carburetor, Turbo Charger (Function and benefits).

Unit II

ENGINE FRICTION, LUBRICATION & COOLING SYSTEM:

Determination of engine friction, Lubrication, lubrication system, Crankcase ventilation, Necessity of engine cooling, Areas of heat flow in engines, gas temperature variation, heat transfer, temperature distribution & temp. profiles, cooling air and water requirements, cooling systems, troubleshooting of cooling system, gear box (Problems).

Unit III

CHASSIS: Introduction. Classification of chassis, Frame.

SUSPENSION: Introduction, requirements of suspension system, springs, damper.

WHEELS: Introduction, Requirement, types of wheels.

TYRES: Introduction, requirements, types of tyre, tyre construction-cross ply, radial ply, belted bias, tyre materials tyre shape, tread patterns, tyre markings, tyre inflation pressure, causes of wear, factors affecting tyre life, wheel balancing, wheel alignments.

Unit IV

STEERING AND GEARS: Purpose, function, requirements, general arrangements of steering systems, steering gears, steering ratio, reversibility, steering geometry, under steering, over steering, steering arms, Drag link, power steering, adjusting of steering geometry, steering troubleshooting. Requirements. Clutches. Torque converters. Over drive and free wheel, Universal joint. Differential Gear Mechanism of Rear Axle. Automatic transmission, Steering
and Front Axle. Castor Angle,

FRONT AXLE: Introduction, construction, types of front axles, stub axles.

BRAKING SYSTEM: Necessity, functions, requirements, classification of brakes, Mechanical brakes, hydraulics brakes, power brakes, brake effectiveness, brake shoe holding down arrangements, brake tester, brake service, troubleshooting chart of hydraulic brakes system, air brakes & Brake shoes & drums.

UNIT V

AUTOMOTIVE ELECTRICAL SYSTEM: Introduction, main parts of vehicles.

STARTING SYSTEM: Introduction, battery, starting motor.

IGNITION SYSTEM: Introduction, purpose, requirements, coil ignition system, firing order, ignition timing, spark plugs, troubleshooting.

CHARCHING SYSTEM: Introduction. Dynamo, alternators.

LIGHTING: introduction, main circuits, lighting system.

Maintenance system: Preventive maintenance, break down maintenance, and over hauling system.

References :

1. Automotive Engineering- Hietner
2. Automobile Engineering - Kripal Singh.
3. Automobile Engineering - Narang.
4. Automotive Mechanics- Crouse

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Mechanical Engineering, VIII-Semester

BMET- 803(A) Power Plant Engineering	**L**	**T**	**P**
	3	**0**	**0**

Objectives:

The course discusses exclusively the various aspects of the convective heat and mass transfer.

Course Outcome:

- Estimate the different sources of energy and future planning of policies in India.
- Analyse the different components of thermal power plant.
- Explain different components of Nuclear power plant with safety features.
- Compare and analyze different economic aspects associated with different power generation systems.
- Analyze different environmental aspects of power generation systems.

Detailed Content:

Unit-I

Introduction

Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion, calculations.

Variable Load problem

Industrial production and power generation compared, ideal and realised load curves, terms and factors. Effect of variable load on power plan operation, methods of meeting the variable load problem.

Power plant economics and selection

Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection.

Unit-II

Steam power plant

Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories. General layout of steam power plant. Different systems such as fuel handling system, pulverizes and coal burners, combustion system, draft, ash handling system, feed water treatment and condenser and cooling system, turbine auxiliary systems such as governing, feed heating, reheating , flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency.

Unit-III

Diesel power plant

General layout, performance of diesel engine, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance.

Gas turbine power plant

Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants.

Unit-IV

Nuclear power plant

Principles of nuclear energy, basic components of nuclear reactions, nuclear power station.

Hydro electric station

Principles of working, applications, site selection, classification and arrangements, hydroelectric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems.

Unit-V

Nuclear fuels in fission and fusion reactors, Types of nuclear reactors, Fissile and fertile materials, Neutron chain reaction in fission reactors, Neutron flux, Concept of criticality for bare homogeneous reactors, Coolants, moderators, Control and structural materials. Heat generations and steady state temperature distribution in fuel elements, Heat removal.

Books:

1. Nuclear Reactor Engineering By S. Glastone and A . Sesonske.
2. Basic Nuclear Engineering, by K.S. Ram.
3. Introduction to Nuclear Engineering, by J.R lamarsh.
4. “Power Plant Engineering” F.T. Morse, Affiliated East-West Press Pvt. Ltd, New Delhi/Madras.
5. “Power Plant Engineering” Mahesh Verma, Metropolitan Book Company Pvt. Ltd. New Delhi.
6. “Power Plant Technology” El-Vakil, McGraw Hill.
7. Power Plant Engineering by P.K. Nag, Tata McGraw Hill.
8. Steam & Gas Turbines & Power Plant Engineering by R.Yadav, Central Pub.House.

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Mechanical Engineering, VII-Semester

BMET-803 (B) Solar Energy	**L**	**T**	**P**
	3	**0**	**0**

Objectives:

On completion of the course, learner will be able to-

- Understand the concept of solar radiation & sun-Earth geometry.
- Explain different types of solar collectors.
- Explain different types of solar water & air heating systems.
- Recognize and understand the different applications of solar distillation systems.
- Understand the concept of solar Photovoltaic systems.

Course Outcome:

After learning the course, the students should be able to

- Understand basics of solar radiation.
- Understand the concept of flat plate and evacuated solar collector
- Comprehend the concept of solar water heating, solar air heating.
- Understand the principles of solar concentrator and solar distillation.
- Understand the types and features of solar photovoltaic systems,

Detailed Content:

Unit- I Overview & Introduction :

Sun as a source of energy, Solar radiation, Solar radiation at the Earth's surface,Sun-Earth geometry, Measurement of Solar radiation-Pyroheliometer, Pyranometer, Sunshine recorder, Importance of Solar energy.

UNIT-II Solar Thermal Systems:

Principle of conversion of solar radiation into heat, Collectors used for solar thermal conversion, Flat plate collectors and Concentrating collectors, Solar Thermal Power Plant, Solar cookers, Solar hot water systems, Solar dryers, Solar greenhouses.

UNIT-III Solar water & air heating Systems:

Introduction to Solar water & solar air heating systems, Classification of Solar water & air heating system, choice of fluid , conventional heater, double exposure heaters, air heater with flow above and both sides of the absorber, heater with finned absorber.

UNIT-IV Solar distillation Systems & Energy storage

Solar distillation:

Introduction, working principle, thermal efficiency, heat transfer,passive solar still, designs of solar still, modified internal heat transfer.

Energy Storage: sensible heat storage, liquid media storage, solid media storage, dual media storage, basics of latent heat storage, chemical storage.

UNIT-V Solar Photovoltaic Systems:

Conversion of Solar energy into Electricity - Photovoltaic Effect, Solar photovoltaic cell and its working principle, Different types of Solar cells, Series and parallel connections, Photovoltaic applications: Battery chargers, domestic lighting, street lighting and water pumping

Texts/References Books:

1. Solar Energy- Fundamentals, design, modeling & applications, G.N. Tiwari, Narosa Pub., 2005.

2. Solar Energy-Principles of thermal energy collection & storage, S.P. Sukhatme, Tata Mc Graw Hill Publishers, 1999.

3. Solar Photovoltaics- Fundamentals, technologies and applications, Chetan Singh Solanki, PHI Learning Pvt. Ltd

4. Solar Energy Utilization, G. D. Rai, Khanna Publishers

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Mechanical Engineering, VIII-Semester

BMET- 803(C) Experimental Stress Analysis	**L**	**T**	**P**
	3	**0**	**0**

UNIT I

Elementary Elasticity:

Stress: Introduction, Stress Equations of Equilibrium, Laws of Stress Transformations, principal Stresses, Two-Dimensional State of Stress, Stresses Relative to Principal Co-ordinate System, Special States of Stress. Strain: Introduction, Displacement and Strain, Strain Transformation Equation, Principal Strains, Compatibility, Volume Dilation, Stress Strain Relations, Strain Transformation Equations and Stress Strain Relations for Two-Dimensional State of Stress.

UNIT II

Strain Measurements: Introduction, Properties of Strain Gage Systems, Types of Strain Gages, GridMethod of Strain Analysis. Brittle Coating Method: Coating Stresses, Failure Theories, Brittle Coating Crack Patterns, Resin and Ceramic Based Brittle Coating, Test Procedure, Analysis of Brittle Coating Data.

UNIT III

Electrical Resistance Strain Gages: Introduction, Strain Sensitivity in Alloys, Strain Gage Adhesives, Gage Sensitivity and Gage Factor. Strain Gage Circuit: Potentiometer and its Application, Wheat-Stone Bridge, Bridge Sensitivity, Null Balance Bridges. Analysis of Strain Gage Data: Three Element Rectangular Rosette, Delta Rosette, Stress Gage, Plane Shear-Gage.

UNIT IV

Theory of Photoelasticity: Introduction, Temporary Double Refraction, Stress Optic Law, Relative Retardation, Stressed Model in Plane Polariscope, Effect of Principal Directions, Effect of Principal Stress Difference, Stressed Model in Circular Polariscope, Light and Dark Field arrangements, Tardy Compensation, Fringe Sharpening and Multiplication by Partial Mirrors.

UNIT V

Two Dimensional Photoelasticity : Introduction, Isochromatic Fringe Patterns, Isoclinic Fringe Patterns, Compensation Techniques, Calibration Methods, Separation Methods, Shear Difference Method, Electrical Analogy Method, Oblique Incidence Method, Materials for TwoDimensional Photoelasticity.

References:

1. Experiment Stress Analysis by James W. Dally and William F. Riley, International Student Edition, McGraw-Hill Book Company.
2. Experiment Stress Analysis by Dr. Sadhu Singh, Khanna Publishers.TME-043

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Mechanical Engineering, VIII-Semester

BMET- 804(A) Concepts of programming and OOPS	**L**	**T**	**P**
	3	**0**	**0**

UNIT 1

UTILIZATION: Developer fundamentals such as editor, integrated programming environment, **UNIX** shell, modules, libraries.

PROGRAMMING FEATURES: Machine representation, primitive types, arrays and records, objects, expressions, control statements, iteration, procedures, functions, and basic I/O.

APPLICATIONS: Sample problems in engineering, science, text processing, and numerical methods.

UNIT 2

PROBLEM SOLVING WITH ALGORITHMS- Programming styles – Coding Standards and Best practices - Introduction to C Programming, Testing and Debugging. Code reviews, System Development Methodologies – Software development Models, User interface Design – introduction – The process – Elements of UI design & reports. 5

UNIT 3

OBJECTED ORIENTED CONCEPTS – object oriented programming, UML Class Diagrams– relationship – Inheritance – Abstract classes – polymorphism, Object Oriented Design methodology - Common Base class, Alice Tool – Application of OOC using Alice tool. 4

UNIT 4

RDBMS- DATA PROCESSING – the database technology – data models, ER modeling concept – notations – Extended ER features, Logical database design – normalization, SQL – DDL statements – DML statements – DCL statements, Writing Simple queries – SQL Tuning techniques – Embedded SQL – OLTP 8

REFERENCES:

1.Computer Concepts and C Programming by Vikas Gupta, Wiley India
2.Introduction to Computers by Peter Norton, TMH
3. G. Dromey, How to Solve It by Computer, Pearson
4.Programming in ANSI C by Balaguruswamy, TMH

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Mechanical Engineering, VIII-Semester

BMET- 804(B) Environment and Ecology	**L**	**T**	**P**
	3	**0**	**0**

Objectives:

1. .

Course Outcome:

1. .

Detailed Content:

UNIT-1 NATURAL RESOURCES :

Renewable and Non-renewable Resources :

Natural resources and associated problems.

a) Forest resources : Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources : World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.

f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

• Role of an individual in conservation of natural resources.

• Equitable use of resources for sustainable lifestyles.

UNIT- 2 ECOSYSTEMS

• Concept of an ecosystem.

• Structure and function of an ecosystem.

• Producers, consumers and decomposers.

• Energy flow in the ecosystem.

• Ecological succession.

• Food chains, food webs and ecological pyramids.

• Introduction, types, characteristic features, structure and function of the following ecosystems :-

a. Forest ecosystem

b. Grassland ecosystem

c. Desert ecosystem

d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT- 3 BIODIVERSITY AND ITS CONSERVATION

• Introduction – Definition : genetic, species and ecosystem diversity.

• Biogeographical classification of India

• Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic

and option values
• Biodiversity at global, National and local levels.
• Inida as a mega-diversity nation
• Hot-sports of biodiversity.
• Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts.
• Endangered and endemic species of India
• Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.

UNIT- 4 ENVIRONMENTAL POLLUTION & SOCIAL ISSUES
• Definition
• Cause, effects and control measures of :-
a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards
• Disaster management : floods, earthquake, cyclone and landslides.
• From Unsustainable to Sustainable development
• Urban problems related to energy
• Water conservation, rain water harvesting, watershed management
• Environmental ethics : Issues and possible solutions.
• Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.
• Wasteland reclamation.
• Consumerism and waste products.

REFERENCE BOOK
· Environmental Studies by Erach Bharucha, University Press.
· Environmental studies by R. Rajagoplan, Oxford University Press.
· Environment Science & Ethics Singhal, Singhal & Aggarwal, Pragati Prakshan, Meerut.
· Environmental Studies by Anubha Kaushik & C.P. Kaushik, New age International Publisher.
· Environmental Science by Santra, N.C.B.A, Calcutta.
· Environment and Ecology by Deeksha Dave and S.S. Katewa, Cengage Learning, New Delhi.
· Environmental Studies by Daniel's, Wiley India.
· Fundamental of Ecology, E.P.Odum, Cengage Learning.
· Environmental Science and Engineering by Wright, Pearson Publication.
· Environmental Engineering by Vasilind, Cengage Learning, New Delhi.
· First Ecology by Beeby and Brennan, Oxford University Press.
· Environment Science by Miller, Cengage Learning, New Delhi.
· Introduction to Environmental Engineering and Science by G.M. Masters, Prentice Hall India Pvt. Ltd.
o Hand book of Environmental laws, Rules, Guidelines, Compliances and Standards Vol. 1 & Vol. 2, Bharat Publication, New Delhi.

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Mechanical Engineering, VIII-Semester

BMET- 804(C) Programming in python	**L**	**T**	**P**
	3	**0**	**0**

Course Objective

- Learn the syntax and semantics of Python Programming Language.
- Write Python functions to facilitate code reuse and manipulate strings.
- Illustrate the process of structuring the data using lists, tuples and dictionaries.
- Demonstrate the use of built-in functions to navigate the file system.
- Appraise the need for working on web scraping.

Course Outcomes :

- Demonstrate the concepts of control structures in Python.
- Implement Python programs using functions and strings.
- Implement methods to create and manipulate lists, tuples and dictionaries.
- Apply the concepts of file handling and regExusing packages.
- Illustrate the working of scraping websites with CSV.

Detailed Content:

Unit 1

Introduction, Python Basics: Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program.

Flow control: Boolean Values, Comparison Operators, Boolean Operators,

Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules, Ending a Program Early with sys.exit.

Unit 2

Functions: def Statements with Parameters, Return Values and return Statements, The None Value, Keyword Arguments and print(), Local and Global Scope, The global Statement, Exception Handling.

Lists: The List Data Type, Working with Lists, Augmented Assignment Operators, Methods.

Unit 3

Dictionaries and Structuring Data: The Dictionary Data Type, Pretty Printing, Using Data Structures to Model Real-World Things.

Manipulating Strings - Working with Strings, Useful String Methods.

Unit 4

Pattern Matching with Regular Expressions: Finding Patterns of Text without Regular Expressions, Finding Patterns of Text with Regular Expressions, More Pattern Matching with Regular Expressions, Greedy and
Nongreedy Matching, The findall() Method, Character Classes, Making Your
Own Character Classes, The Caret and Dollar Sign Characters, The Wildcard Character, Review of Regex Symbols, Case-Insensitive Matching, Substituting Strings with the sub() Method, Managing Complex Regexes, Combining re.IGNORECASE, re .DOTALL, and re .VERBOSE.
Reading and Writing Files: Files and File Paths, The os.path Module, The File Reading/Writing Process, Saving Variables with the shelve Module, Saving Variables with the pprint.pformat() Function.
Organizing Files: The shutil Module, Walking a Directory Tree, Compressing Files with the zipfile Module.

Unit 5

Web Scraping: Project: MAPIT.PY with the web browser Module, Downloading Files from the Web with the requests Module, Saving Downloaded Files to the Hard Drive, HTML.
Working with Excel Spreadsheets: Excel Documents, Installing the openpyxl Module, Reading Excel Documents, Project: Reading Data from a Spreadsheet, Writing Excel Documents, Project: Updating a Spreadsheet, Setting the Font Style of Cells, Font Objects, Formulas, Adjusting Rows and Columns, Charts.
Text Books:

1. Al Sweigart, “Automate the Boring Stuff with Python”, William Pollock, 2015, ISBN: 978-1593275990.

Reference Books:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist”, 2nd Edition, Green Tea Press, 2015, ISBN: 978-9352134755.
2. Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition, Wiley India Pvt Ltd. ISBN-13: 978-8126556014.
3. Wesley J Chun, “Core Python Applications Programming”, 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365.
4. Roberto Tamassia, Michael H Goldwasser, Michael T Goodrich, “Data Structures and Algorithms in Python”, 1st Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126562176.
5. ReemaThareja, “Python Programming using problem solving approach”, Oxford University press, 2017. ISBN-13: 978-0199480173
6. Charles R. Severance, “Python for Everybody: Exploring Data Using Python 3”, 1st Edition, Shroff Publishers, 2017. ISBN: 978-9352136278.