Basaveshwar Engineering College (Autonomous), Department of Mechanical Engineering

Scheme Autonomous Syllabus (175 credits) 2018 - 19

B.E. III SEMESTER

Sl. No	Subject Code	Subject	Credits	Hours/Week			Examination Marks		
				Lecturer	Tutorial	Practical	CIE	SEE	Total
01	UMA 333C	Mathematics – III(Computational Methods for Mechanical Sciences)	3	3	-	-	50	50	100
02	UME 311C	Material Science & Metallurgy	3	3	-	-	50	50	100
03	UME 303C	Basic Thermodynamics	4	3	2	-	50	50	100
04	UME 304C	Strength of Materials	4	3	2	-	50	50	100
05	UME 312C	Foundry and Welding Technology	3	3	-	-	50	50	100
06	UME 307L	Material Science & Material Testing Lab	1	0	0	2	50	50	100
07	UME 310L	Mechanical Drawing Lab	1	0	0	2	50	50	100
08	UME 308L	Foundry & Forging Lab	1	0	0	2	50	50	100
09	UMA 330M	*Advanced Mathematics-I	0	3	0	-	50	50	100
		Total Credits :	20	18	4	6	450	450	900

* Advanced Mathematics – I is a mandatory subject only for students having diploma and admitted to 3rd Semester through Lateral Entry scheme during 2019-20 onwards. Passing the subject is compulsory: however marks will not be considered for awarding grade/class. A PP/NP grade will be awarded for passing/not passing the subject.

Basaveshwar Engineering College (Autonomous), Department of Mechanical Engineering

Scheme Autonomous Syllabus (175 credits) 2018 - 19

B.E. IV SEMESTER 2019-20

Sl. No	Code	Subject	Credits	Hours/Week			Examination Marks		
				Lecturer	Tutorial	Practical	CIE	SEE	Total
01	UMA433C	Mathematics – IV(Mathematical Methods for Mechanical Sciences)	3	3	-	-	50	50	100
02	UME 416C	Metrology & Instrumentation	3	3	-	-	50	50	100
03	UME 417C	Machining and Machine Tools	3	3	-	-	50	50	100
04	UME 415C	Applied Thermodynamics	3	2	2	-	50	50	100
05	UME 405C	Theory of Machines	4	3	2	-	50	50	100
		OR							
	UME418C	Theory of Machines	3	2	2		50	50	100
		and							
	UHS001N	Fundamentals of Quantitative Aptitude and Soft Skills	1		2		50	50	100
06	UME407L	Metrology & Instrumentation Lab	1	-	-	2	50	50	100
07	UME 408L	Machine Shop Lab	2	-	-	4	50	50	100
08	UME 411L	CAMD Lab	3	1	-	4	50	50	100
09	UMA430M	*Advanced Mathematics-II	0	3	---	---	50	50	100*
	Total Credits		22	18	8	10	450	450	900

* Advanced Mathematics – II is a Mandatory Subject only for students having Diploma and admitted to 3rd Semester through Lateral Entry scheme during 2019-20 onwards. Passing the subject is compulsory: however marks will not be considered for awarding grade/class. A PP/NP grade will be awarded for passing/not passing the subject.

MATERIALS SCIENCE AND METALLURGY

2018-2019

Semester	:	03		Subject Code	:	UME311C
Total Credits	:	03 (3-0-0)		CIE Marks	:	50
No. of Lecture Hrs./ Week	:	03		SEE Exam Marks	:	100
Total No. of Lecture Hrs	:	39		Exam Hours	:	03

Course Objectives:

The objectives of this course are to:

1. To Know the relationships between the structures, properties and applications of various engineering materials.
2. To Explain various mechanical properties of materials and gain the knowledge of various modes of failure of materials.
3. To Review and interpret solid solution and Fe-Fe_3C equilibrium phase diagrams
4. To Explain various heat treatment processes and their applications.
5. To Analyze the composition and properties of various engineering alloys, and the process of corrosion, causes and preventive methods.

Unit –I

Structure of Crystalline Solids:

10 Hours

Fundaments concepts of unit cell, space lattice, Bravaias space lattices, unit cells for cubic structure and HCP, coordination numbers and atomic packing factor for different cubic structures. Crystal imperfections – point, line, surface and volume defects. Diffusion mechanism, Fick's laws of diffusion.
Concepts of stress and strain, tensile properties, Impact test of materials, Hardness – Rockwell, Vickers and Brinell hardness testing. Plastic deformation.

Unit -II

Fatigue, Creep and Fracture **10 Hours**

Fatigue: fracture tests, S-N curves, factors affecting fatigue life and protection methods. Creep: the creep curves, mechanism of creep, creep resistant materials. Types, stages in cup and cone fracture.

Solid solutions:
Types, rules of governing the formation of solid solutions. Phase diagrams: basic terms, Gibbs phase rules, cooling curves, construction of phase diagrams, interpretation of equilibrium diagrams (use of tie line and Lever rule), types of phase diagrams (Eutectic systems, peritectic, eutectoid, peritectoid reactions).

Unit -III

Equilibrium phase Diagrams: **10 Hours**

Iron – iron carbide equilibrium phase diagram, phases in Fe-Fe_3C system, invariant reactions, microstructure of slowly cooled steels, effect of alloying elements on Fe-Fe_3C diagram. The TTT diagrams, drawing of TTT diagrams, TTT diagrams for eutectoid steels, effect of alloying elements.

Heat Treatment:
Annealing, normalizing, hardening, Induction hardening, harden ability, Jominy end-quench test.

Unit –IV

Engineering Alloys: **09 Hours**

Properties, composition and uses of low carbon, mild medium and high carbon steels, cast Irons, gray CI, white CI, malleable CI, SG iron. The light alloys, Al and Mg and Titanium alloys. Copper and its alloys: brasses and bronzes.

Corrosion:
Corrosion and its prevention: Galvanic cell, the electrode potentials, polarization, passivation. General methods of corrosion prevention by alloying, stress corrosion cracking.

Course outcomes:

1. Gain the knowledge of the relationships between the structures, properties and applications of various engineering material and various mechanical properties of materials.
2. Gain the knowledge of various modes of failure of materials, and interpret solid solution and various phase diagrams.
3. Gain the knowledge of Fe-Fe_3C equilibrium phase diagrams and various heat treatment processes and their applications.
4. Use the knowledge of composition and properties of various engineering alloys. Understand the process of corrosion, its causes and preventive methods

Text Books:

1. "Materials Science & Engineering- An Introduction", William D.Callister Jr. Wiley India Pvt. Ltd. 6th Edition,2006, New Delhi.
2. "Essentials of Materials For Science And Engineering", Donald R. Askeland, Pradeep P.Phule ThomsonEngineering, 2006.

Reference Books:

1. "Introduction to Material Science for Engineering", 6th edition James F. Shackel ford. Pearson, Prentice Hall, New Jersy, 2006.
3. "Physical Metallurgy, Principles & Practices", V Raghavan.PHI 2nd Edition 2006, New Delhi. 2. "Foundation of Material Science and Engineering", Smith, 3rd Edition McGraw Hill, 1997.

Scheme of Examination:

1. Total of Eight question with Two from each unit to be set uniformly covering the entire Syllabus.
2. Each question should not have more than four sub division.
3. Any Five full questions are to answer choosing at least one from each unit.

B. E. MECHANICAL ENGINEERING SEMESTER –III			
BASIC THERMODYNAMICS			
Course Code	UME 303 C	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:2:0	SEE Marks	100
Credits	3-1-0	SEE Exam Hours	03

UNIT-I **09 Hours**

Work & Heat: Definition of work-according to mechanics, according to thermodynamics, examples, sign convention; Displacement work- PdV expressions for displacement work in various processes through p-v diagrams, Other types of work – shaft work, paddle wheel work, working straining a bar, free expansion work, electrical work; Heat- definition, units and sign convention; Comparison and differences between work and heat, Numerical Problems

First Law of Thermodynamics: Joule's experiments; Statement of the First law of thermodynamics- cyclic, non-cyclic processes; Energy- modes of energy, internal energy, internal energy as a property; Specific heat- at constant volume, at constant pressure; Enthalpy; Extension of the First law to control volume- steady state-steady flow energy equation, important applications with line diagram, Numerical Problems.

UNIT- II **09 Hours**

Second Law of Thermodynamics: Energy- High grade, low grade; Heat reservoirs-heat source and heat sink; Heat engines-definition, schematic representation, thermal efficiency; Reversed heat engines-refrigerator, heat pump, COP; Second Law of Thermodynamics- Kelvin -Planck statement, PMM II, Clasius's statement; Equivalence of the two statements; Reversible and irreversible process – definition, factor that make a process reversible and irreversible; Carnot cycle- processes involved in Carnot cycle, PV, TS and line diagram; Carnot principles; Thermodynamic temperature scale. Numerical Problem.

Entropy: Carnot theorem; Clausius theorem; Entropy – property of a system; Clausius inequality-statement, proof, application to a reversible cycle; Entropy change of an irreversible process of a closed system; Principle of increase of entropy; Calculation of entropy using TdS relations, simple problems based on processes.

UNIT-III **09 Hours**

Pure substances: Pure substances-definition, examples, PT and PV diagrams, triple point, critical points, sub-cooled liquid, saturated liquid, mixture of saturated liquid and vapor, saturated vapor and superheated vapour states of a pure substance with water as example; Enthalpy- sensible, latent, total, super heat; Dryness factor (quality); TS and HS diagrams and representation of various processes on these diagrams, Separating and throttling calorimeter- description, line diagram. Numerical Problems.

UNIT - IV

Real gases: Introduction; Van der Waal's Equation; Van der Waal's constants in terms of critical properties; Reduced properties; Van der Waal's equation in terms of reduced properties; Compressibility factor; Generalized compressibility chart; Principles of corresponding states,

Numerical Problems.

Ideal gases: Equation of state; Internal energy and enthalpy as functions of temperature only; Universal and particular gas constants; Evaluation of heat, work, change in internal energy, enthalpy and entropy in various quasi-static processes; Ideal gas mixture-mass fractions, mole fractions, molecular weight of the mixture of ideal gases, Dalton's law of additive pressures, Amagat's law of additive volumes, evaluation of properties, Numerical Problems.

Assignment: (Mention the contents of the Assignment to be submitted)

Course Outcomes: At the end of the course, the student will be able to:
CO1:Define the concepts of heat, work, and energy, develop/analyze energy application device Demonstrate a basic understanding of the First Law of Thermodynamics for energy conservation analysis of different thermodynamics processes of systems and control volumes and to estimate required balances of heat, work and energy flow (heaters, coolers, pumps, turbines, pistons, etc.).

CO2:: Demonstrate a basic knowledge of the Second Law of Thermodynamics and its corollaries to determine whether a cycle is possible, and to determine the maximum performance/efficiency of cycles and its application to systems and control volumes. Use second Law of Thermodynamics for entropy balance analysis of different Thermodynamics processes of systems and control volume to solve problems in thermodynamics.
CO3:Use steam tables, equations, and charts, in evaluation of thermodynamic properties, calculate energy/enthalpy required for a particular application (boilers, heat exchangers, etc).

CO4:Use real / ideal gas equations/ charts/tables to calculate change in properties of the systems in case of single fluid and mixture of fluids.

Question paper pattern:

Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
Each question carries 20 marks and should not have more than 4 sub divisions.
Any five full questions are to be answered choosing at least one from each unit.

Sl No	Title of the Book	Name of the Author/s	Name of the Publishers	Edition and Year
Textbook/s				
1	Basic Thermodynamics	B.K.Venkanna & Swati. B. Wadawadagi	PHI New Delhi	Any edition
2	Thermodynamics – AEngineering Approach	Yunus, A.Cenegal and Michael A.Boles	Tata McGraw Hill Pub. Co., 2002	
Reference Books				
1	Advanced Engineering Thermodynamics	Adrian Bejan	John wiely	3rd Edition
2	Engineering Thermodynamics	Nihal E.Wijeysundera	World Scientific	2nd Edition
3	Classical Thermodynamics	Van Wylen G J	WielyEstern Ltd.	2nd Edition

Data Hand Book:

(1)Thermodynamic data handbook by Nijaguna&Samaga

B. E. MECHANICAL ENGINEERING
SEMESTER – III

Foundry & Welding Technology			
Course Code	**UME312C**	CIE Marks	50
Teaching Hours/Week(L:T:P)	3:0:0	SEE Marks	100
Credits	3	SEE Exam Hours	03

UNIT - I

Introduction: 10 Hours

Concept of Manufacturing process, its importance. Classification of Manufacturing processes. Introduction to Casting process steps involved. Varieties of components produced by casting process. Advantages & Limitations of casting process.

Patterns: Definition, functions, Materials used for pattern, various pattern allowances and their importance. Classification of patterns.

Binder: Definition, Types of binder used in moulding sand.Additives: Need, Types of additives used.

Sand Moulding : Types of base sand, requirement of base sand. Types of sand moulds.Moulding sand mixture ingredients (base sand, binder & additives. Method used for sand moulding.

Cores: Definition, Need, Types. Method of making cores, Binders used. Concept of Gating & Risering. Casting defects causes, features and remedies.

UNIT - II

Special Moulding Processes 10 Hours

Study of important moulding processes:

Green sand, Core sand, Dry sand, Sweep mould, CO2 mould, Shell mould, Investment mould & Full mould.

Metal moulds: Gravity die-casting, Pressure die casting, centrifugal casting, Squeeze Casting, Slush casting and continuous casting processes

UNIT - III

WELDING 11 Hours

Welding process: Definition, Principles, Classification, Application, Advantages & limitations of welding.

Arc Welding: Principle, Metal Arc welding (MAW), Flux Shielded Metal Arc Welding (FSMAW), Inert Gas Welding (TIG & MIG) Submerged Arc Welding (SAW) and Atomic Hydrogen Welding processes. (AHW)

Gas Welding: Principle, Oxy – Acetylene welding, Reaction in Gas welding,Flame characteristics, Gas torch construction & working. Forward and backward welding.

Special type of welding: Resistance welding - principles, Seam welding, Butt welding, Spot welding and projection welding. Friction welding, Explosive welding, Thermit welding, Laser welding and Electron beam welding.

UNIT - IV

METALLURGICAL ASPECTS IN WELDING 08 Hours

Structure of welds, Formation of different zones during welding. Heat affected zone (HAZ). Concept of electrodes, Filler rod and fluxes. Welding defects – Detection causes & remedy.

Inspection Methods – Types of inspection .NDT inspection (Advnatges) Methods used for Inspection of casting and welding. Visual, Magneticparticle, Fluorescent particle, Ultrasonic, Radiography inspection

Assignment: A set of questions covering whole syllabus will be given to the students. The students will answer to all the questions in the assignment booklet and submit.

Course Outcomes: At the end of the course, the students will be able to:

CO1: Select suitable manufacturing processes to manufacture the products optimally

CO2: Explain the technology, variables and complexity involved in producing a casting.

CO3: Analyze and access the importance of welding processes in manufacturing and apply knowledge to select appropriate welding process based on the type of industrial application

CO4: Interpret metallurgical aspects in welding, inspection methods for the quality assurance of components made of casting and welding process

Question paper pattern:

Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
Each question carries 20 marks and should not have more than 4 sub divisions.
Any five full questions are to be answered choosing at least one from each unit.

Sl No	Title of the Book	Name of the Author/s	Name of the publisher	Edition and year
Textbook/s				
1	Manufacturing & Technology	P.N.Rao	Tata McGraw Hill	2nd Edition 2003
2	Manufacturing-I	Dr.K.Radhakrishna	Sapna Book House	5th Edition 2006
Reference Books				
1	Manufacturing Technology	Serope and Kalpakjain	Pearson Education Asia	5th Edition 2006
2	Process and Materials of Manufacturing	Roy A Lindberg	Pearson Education	4th Edition 2006.

Strength of Materials (UME304C)

Semester	**:**	**03**	**Credits**	**:**	**03**
Teaching Hours/Week	**:**	2-2-0	**Total Teaching Hours**	**:**	39
CIE Marks	**:**	50	**SEE Marks**	**:**	100

UNIT I

Simple stress and strain: **10 Hours**

Introduction, stress, strain, mechanical properties of materials, Linear elasticity, Hooke's Law and Poisson's ratio, Stress-Strain relation – behavior in Tension for Mild steel and non ferrous metals. Extension / Shortening of a bar, bars with cross sections varying in steps, bars with continuously varying cross sections (circular and rectangular), Elongation due to self weight, Principle of super position.

Stress in composite section: Volumetric strain, expression for volumetric strain, elastic constants, simple shear stress, shear strain, temperature stresses (including compound bars).

UNIT II

Compound stresses: **10 Hours**

Introduction, plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Mohr's circle (introduction).

Thick and thin cylinders: Stresses in thin cylinders, changes in dimensions of cylinder (diameter, length and volume), Thick cylinders subjected to internal and external pressures (Lame's equation), (compound cylinders not included).

UNIT III

Bending moment and Shear force in beams: **09 Hours**

Introduction, Types of beams, loads and reactions, shear forces and bending moments, sign conventions, relationship between shear force and bending moments, shear force and bending moment diagrams for different beams subjected to concentrated loads, uniform distributed load (udl) and couple for different types of beams.

Bending and shear stresses in beams: Introduction, theory of simple bending, assumptions in simple bending, relationship between bending stresses and radius of curvature, relationship between bending moment and radius of curvature, shear streses,symmetrical I and T sections.

UNIT IV

Deflection of beams: **10 Hours**

Introduction, differential equation for deflection, equations for deflections-Cantilever subjected to concentrated load at free end,udl,simply supported beam subjected to point load at mid-span.UDL.

Torsion of circular shafts and Elastic stability of columns: Introduction, pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts, power transmitted by solid and hollow circular shafts.

Introduction to columns, Euler's theory for axially loaded elastic long columns, derivation of Euler's load for various end conditions, limitations of Euler's theory, Rankine's formula.

Course outcomes

CO 1. To be able to understand the different types of physical loads, properties of the materials, such as stresses, strains, elasticity, deformation for varying cross section, compound bars, self-weight and thermal stresses.

CO 2. Analyze the compound stresses analytically ,and graphically. And cylinders exposed to internal and

external pressures from the view point of stresses developed and change in their dimensions.

CO 3. To be able to understand the shear force and bending moment and estimate bending of beams of subjected to different loads with different end conditions of beams. Analyse the bending and shear stresses for different cross sections.

CO 4. To be able to understand the concept torque, stresses developed and the rigidity of the mechanical elements transmitting power or subjected to twisting moment.columns with different end conditions subjected to axial loading and

Reference Books:

1. "Strength of Materials", S.S.Bhavikatti, Vikas publications House – Pvt. Ltd., 2nd Ed., 2006.
2. "Mechanics of materials" K.V. Rao, G.C. Raju, First Edition,2007
3. "Engineering Mechanics of Solids" Egor.P. Popov, Pearson Edu. India, 2nd, Edition,1998.
4. "Mechanics of Solids", Mubeen, Pearson Edu. India, 2002
5. "Strength of Materials", W.A. Nash, Sehaum's Outline Series, Fourth Edition-2007.
6. "Mechanics of Materials" by R. C. Hibbeler, Printice Hall, Pearson Edu., 2005
7. "Mechanics of materials" James M. Gere, Thomson, Fifth edition 2004
8. "Mechanics of materials" Ferdinand Beer & Russell Johnstan, TATA MaGrawHill-2003
9. "Mechanics of Materials" Ansel C. Ugural, Page Turners 2013

Course Outcomes:

At the end of the course, the students will be able to:

1. To be able to understand the different types of physical loads, properties of the materials, such as stresses, strains, elasticity, deformation for varying cross section, compound bars, self-weight and thermal stresses.
2. Analyze the compound stresses analytically ,and graphically and cylinders exposed to internal and external pressures from the view point of stresses developed and change in their dimensions.
3. To be able to understand the shear force and bending moment and estimate bending of beams of subjected to different loads with different end conditions of beams. Analyze the bending and shear stresses for different cross sections.
4. To be able to understand the concept torque, stresses developed and the rigidity of the mechanical elements transmitting power or subjected to twisting moment columns with different end conditions subjected to axial loading.

Question paper pattern for SEE:

Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
Each question should not have more than four subdivisions.
Any five full questions are to be answered choosing at least one from each unit.

B. E. MECHANICAL ENGINEERING			
SEMESTER - IV			
METROLOGY AND INSTRUMENTATION			
Course Code	**UME416C**	CIE Marks	50
Teaching Hours/ week	3:0:0	SEE Marks	100
Credits	3	SEE Exam Hours	03

UNIT- I

STANDARDS OF MEASUREMENT: 10 Hours

Definition and Objectives of metrology, Standards of length - International prototype meter, Imperial standard yard, subdivision of standards, line and end standard, comparison, transfer from line standard to end standard, calibration of end bars (Numerical), Slip gauges, Wringing phenomena, Indian Standards (M-87, M-112), Numerical problems on building of slip gauges.

SYSTEM OF LIMITS, FITS, TOLERANCES AND GAUGING:

Definition of tolerance, Specification in assembly, Principle of inter changeability and selective assembly limits of size, Indian standards, concept of limits of size and tolerances, compound tolerances accumulation of tolerances, definition of fits, types of fits and their designation (IS 919 -1963), geometrical tolerance, positional - tolerances, hole basis system, shaft basis of system, classification of gauges, brief concept of design of gauges (Taylor's principles), Types of gauges - plain plug gauge, ring gauge, gauge materials.

UNIT- II

COMPARATORS AND ANGULAR MEASUREMENT: 10 Hours

Introduction to Comparator, Characteristics, classification of comparators, mechanical comparators -Johnson Microcenter, Sigma Comparators, dial indicator, Optical Comparators - principles, Zeiss ultra optimeter, Electrical Comparators - principles, LVDT, Pneumatic Comparators, back pressure gauges, Solex Comparators. Angular measurements, Bevel Protractor, Sine Principle and. use of Sine bars, Sine center, angle gauges, Clinometers

INTERFEROMETER AND SCREW THREAD GEAR MEASUREMENT:

Interferometer Principle of interferometer. Optical flats. Terminology of screw threads, measurement of effective diameter of screw threads by 3-wire method, Best size wire. Toolmakers microscope, gear terminology, use of gear tooth Vernier caliper and gear tooth micrometer

UNIT- III

MEASUREMENTS AND MEASUREMENT SYSTEMS: 10 Hours

Definition, Significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hystersis, repeatability, linearity, loading effect. Errors in Measurements, Classification of Errors. Transducers, Transfer efficiency, Primary and Secondary transducers, electrical, Mechanical, advantages of each type transducers.

INTERMEDIATE MODIFYING AND TERMINATING DEVICES: Mechanical systems, inherent problems, Electrical intermediate modifying devices, input circuitry and telemetry. Terminating devices, Mechanical, Cathode Ray Oscilloscope, Oscillographs, X-Y Plotters.

UNIT-IV

MEASUREMENT OF FORCE AND TORQUE, PRESSURE: 10Hours

Principle, analytical balance, proving ring, Torque measurement, Prony brake, hydraulic dynamometer. Pressure Measurements, Principle, use of elastic members, Bridgeman gauge, Mcloed gage, Pirani Gauge.

TEMPERATURE AND STRAIN MEASUREMENT:

Resistance thermometers, thermocouple, law of thermocouple materials used for construction, pyrometer, Optical Pyrometer. Strain Measurements, Strain gauge, methods of strain measurement.

Assignment: A set of questions covering whole syllabus will be given to the students. The students will answer to all the questions in the assignment booklet and submit.

Course Outcomes:

Upon successful completion of this course, the students will be able to:

1. *To Know* the basics of metrology and instrumentation, *classify, compare and choose* various linear standards. Can *understand, choose and make use* of slip gauges to build the required linear dimensions. Can *apply* the knowledge of limits, fits and tolerances in solving assembly problems.
2. *Classify and understand* the working of various comparators, sine bar, sine centre and angular measurement instruments. *Apply the knowledge* of interferometer, tool maker's microscope, gear tooth micrometer and optical flats for fine measurements.
3. Easily *identify* the stages of measurement systems and *understand the importance* of each stage (transducers, intermediate modifying and terminating stages) in measurement. Also *make use of the knowledge* of basic concepts related to measurement systems, *identify and classify* errors in measurements.
4. *Apply the knowledge* of working principle and construction of instruments used for the measurement of force, torque, pressure, temperature and strain measurements.

Question paper pattern:

1. Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
2. Each question carries 20 marks and should not have more than 4 sub divisions.
3. Any five full questions are to be answered choosing at least one from each unit.

Sl. No.	Title of the Book	Name of the Author/s	Name of the publisher	Edition and year
Text Books				
1	Mechanical measurements	Beckwith Marangoni and Lienhard	Pearson Education	6th Ed., 2006
2	Engineering Metrology	R. K. Jain	Khanna Publishers	1994
Reference Books				
1	Engineering Metrology	I. C. Gupta	Dhanpat Rai Publications	
2	Industrial Instrumentation	Alsutko, Jerry. D. Faulk	Thompson Asia Pvt. Ltd	2002
3	Measurement Systems Applications and Design	Ernest O, Doeblin	McGRAW Hill Book Co	

B. E. MECHANICAL ENGINEERING SEMESTER -IV			
APPLIED THERMODYNAMICS			
Course Code	UME 415 C	CIE Marks	50
Teaching Hours/Week (L:T:P)	2:2:0	SEE Marks	100
Credits	2-1-0	SEE Exam Hours	03

UNIT – I

Gas Power Cycles: **(3+3) Hours**

Air standard cycles- Carnot, Otto, Diesel, Dual and Stirling cycles, PV and TS diagrams, description / process, efficiency derivation, mean effective pressure derivation, comparison of Otto, Diesel and dual cycles;Numerical Problems.

Gas Turbines Cycles: (3+3)Hours

Gas Turbines (Simple and Ideal) - classifications, closed cycle – PV, TS diagram, description, efficiency derivation, work ratio derivation; open cycle- description /process, efficiency derivation; Advantages and disadvantages of closed cycle; Numerical problems.

UNIT- II

Gas Turbines: (2+2) Hours

Methods to improve thermal efficiency- regeneration, inter cooling, reheating, their PV, TS diagram, description / process.

Vapour Power Cycles (simple/Ideal) (4+4) Hours

Carnot vapour power cycle; drawbacks as a reference cycle; Simple Rankine cycle- description / process, PV, TS & line diagram, efficiency derivation; Comparison of Carnot and Rankine cycles; Effects of pressure and temperature on Rankin cycle performance, Numerical problems on above topics, Methods to improve performance of Rankine cycle: Practical regenerative Rankine cycle- TS, line diagram and description / process of open feed water heaters; Reheat Rankine cycle- TS, line diagram, process/description;.

UNIT - III

Reciprocating Compressors: (3+3)Hours

Air Compressor terminology; Operation of a single stage reciprocating air compressor; Work input of single stage- without clearance, representation on PV diagram for different processes, work done derivation for different process; Work input of single stage- with clearance, PV diagram, effect of clearance volume and volumetric efficiency; Adiabatic, isothermal and mechanical efficiencies; Multi-stage compressor- saving in work, optimum intermediate pressure, inter-cooling, minimum work for compression; Numerical problems on single stage only.

Refrigeration:(simple/Ideal) (4+4) Hours

Vapour compression refrigeration system- dry compression, wet compression, superheated & sub cooling compression, their PH, TS diagram, description/process, analysis: refrigerating effect, mass flow rate of refrigerant, theoretical piston displacement, actual piston displacement, refrigerating capacity (TR), power required, COP, analysis based on per TR; Numerical Problems; Air cycle refrigeration: reversed Carnot cycle, analysis as flow system; Reversed Brayton cycle- analysis as flow system;

UNIT - IV

Psychometrics: **(7+7) Hours**

Atmospheric air and psychometric properties- Dry bulb temperature, wet bulb temperature, dew point temperature, partial pressures, specific humidity, relative humidity, degree of saturation, enthalpy of moist air; Use of psychometric chart;Numerical problems.

I.C. Engines:

Geometrical properties of reciprocating engines; Performance parameters - indicated work, BP, IP, MEP, SFC, SEC, A/F ratio, equivalence ratio, efficiencies (mechanical, thermal / fuel conversion, volumetric), engine specific weight, engine specific volume; Methods of FP calculation; Measurement of fuel consumption and air consumption; Heat balance sheet;Numerical problems.

Assignment: (Mention the contents of the Assignment to be submitted)
Course Outcomes: At the end of the course, the student will be able to:

CO1: Students will demonstrate the ability to perform analysis of thermodynamic systems and air standard cycles (Otto, Diesel, dual, Stirling) and to perform appropriate calculations including those applicable to internal combustion engines. Also compare and discuss performance between Otto, Diesel and Dual thermodynamic cycle. Students will demonstrate the ability to perform analysis of thermodynamic gas power cycles Brayton. Students will do appropriate calculations.

CO2:Students will demonstrate the ability to perform analysis of modified Brayton cycle. They discuss the performance analysis of simple and modified Brayton cycle.
Student will understand the components and basic assumptions for the Rankine cycle and analyze and design steam power plants including systems with reheat and regeneration. They calculate and discuss performance of simple and modified Rankine cycle.

CO3:Student will demonstrate the ability to do thermodynamic analysis (single and multi-stage, single acting and double acting) of reciprocating compressor and optimize the power in put calculation.
Students will compare and discuss single and double acting, single and multi-stage performance data.Students will understand the components and basic assumptions for the vapor-compression refrigeration system, demonstrate the ability to design thermodynamic cycle and to perform analysis of reversed Carnot cycle based, refrigeration and heat pump cycles various working fluids.

CO4:Students will demonstrate the ability to apply psychrometrics and thermodynamics to analysis of heating, cooling. Students will do appropriate calculate required for air conditioning equipment.
Student will analyze the performance (BP, IP, BSFC, ISFC, BSEC, BTE, ITE, Volumetric efficiency, Mechanical Efficiency,) /heat balance sheet of internal combustion engine. They also discuss the performance data analysis
Question paper pattern:

- Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
- Each question carries 20 marks and should not have more than 4 sub divisions.
- Any five full questions are to be answered choosing at least one from each unit.

Sl No	Title of the Book	NameoftheAuthor/s	Name of the Publishers	Edition and Year
Textbook/s				
1	Applied Thermodynamics	B.K.Venkanna&Swati.B. Wadawadagi	PHI New Delhi	Any edition
2	Internal Combustion Engines	V.Ganeshan	Tata Mcgrawhill	Any edition
Reference Books				
1	. Thermodynamics – AEngineering Approach	Yunus, A.Cenegal and Michael A.Boles	, Tata McGraw Hill Pub. Co., 2002	
2	Fundamental of Classical Thermodynamics	G.J. Van Wylen and R.E.Sonntag		Any edition
3	A Course in I.C.Enginesy M. L Mathur, R.P. Sharma	M. L Mathur, R.P. Sharma	DhanpatRai& Sons	Any edition
Data Hand Book: [1] Thermodynamic data handbook by Nijaguna&Samaga [2] Refrigeration and Air conditioning data hand book				

B.E. MECHANICAL ENGINEERING SEMESTER- IV			
MACHINING AND MACHINE TOOLS			
Course Code	UME 417C	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	100
Total Teaching hours	42	SEE Exam Hours	03

UNIT - I

Theory of Metal Cutting: 12 Hours

Single point cutting tool nomenclature, geometry, orthogonal and oblique cutting, mechanism of chip formation, types of chips, shear angle relationship, Merchants circle diagram and analysis (Relation of orthogonal cutting forces), Ernst Merchant's solution, stress and strain in the chip, power and energy relations in metal cutting, problems of Merchant's analysis, tool wear and tool failure, tool life, effects of cutting parameters on tool life, tool failure criteria, causes of wear, Taylor's tool life equation, problems on tool life evaluation.

UNIT - II

Turning, Shaping and Planing Machines: 10Hours

Classification, constructional features of turret and capstan lathe (Including tool layout, process chart), shaping and planing machines, specification of shaping and planing machines, drive mechanisms of lathe, shaping and planing machines, quick return mechanisms, hydraulic quick return mechanism, motor drive mechanism, table feed mechanism, operations on turret and capstan lathe, shaping and planing machines, problems of machining time for lathe, shaper and planner.

Drilling Machines:

Types of drilling machines, drill drive mechanism, drilling operations, drill bit nomenclature, types of drills, drill materials, estimation of machining time in drilling.

UNIT – III

Milling Machines: 10 Hours

Classification, up milling and down milling concepts, constructional features, nomenclature, milling cutters, milling operations, Indexing: simple, compound, differential and angular indexing calculations, problems on simple and compound indexing.

Cutting Tool Materials:

Desired properties, selection of tool materials, types of cutting tool materials. Cutting fluids, desired properties, types and selection. Heat generation in metal cutting, factors affecting heat generation, heat distribution in tool and work piece, measurement of tool tip temperature.

UNIT - IV

Grinding Machines: 10 Hours

Types of abrasives, bonding process, classification of grinding machines, constructional features, cylindrical, surface and centerless grinding machines, grinding wheel preparation, fixing of grinding wheel, specification of grinding wheel.

Broaching and Finishing Processes:

Broaching, Lapping, Honing, Buffing, Super finishing and Polishing: Principles of operation, types, construction and applications.

Non Traditional Machining: Introduction, need, classification, principle, metal removal and equipment in USM, ECM, EDM and PAM, advantages, disadvantages and applications.

Assigments: Quiz/presentation/set of questions covering entire syllabus.

Course Outcomes: Upon successful completion of this course, the students will be able to:
CO1: Compare and select the tool materials, geometries for different metals and analyze the cutting forces, tool life and summarize the effect of cutting parameters.
CO2: Demonstrate the knowledge of, constructional features of various types of machine tools, different mechanisms, cutting fluids and their uses.
CO3: Prepare process chart and work on basic machine tools to perform different operations and estimate machining time.
CO4: Analyze non traditional machining and conventional machining processes with respect to their mechanism of material removal, advantages, limitations and applications.

Question paper pattern:

- Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
- Each question carries 20 marks and should not have more than 4 sub divisions.
- Any five full questions are to be answered choosing at least one from each unit.

Sl No	Title of the Book	Name of the Author/s	Name of the Publishers	Edition and Year
Textbook/s				
1	Workshop Technology Vol-II	Hazara Choudhry	Media Promoters and Publishers Pvt. Ltd.	14, 2014
2	Production Technology	R.K.Jain	Khanna Publications	2003
3	Production technology	HMT	Tata MacGraw Hill	2001
Reference Books				
1	Manufacturing Science	Amitabha Ghosh and Mallik	Affiliated East West Press	2003
2	Production Technology	P. C. Sharma	S. Chand & Company Pvt. Ltd.	8, 2014
3.	Fundamentals of Machining and Machine Tools	G. Boothroyd, Winston A. Knight	MARCEL DEKKER, INC	2, 2005
4	Production Engineering	P. C. Pandey, C.	Standard Publishers Distributors	10, 2016

B. E. MECHANICAL ENGINEERING SEMESTER -IV			
THEORY OF MACHINE			
Course Code	UME 418 C	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:1:0	SEE Marks	100
Credits	3	SEE Exam Hours	03

UNIT – I

Introduction: **6 Hours**

DEFINITIONS: Link or element, kinematic pairs, degrees of freedom, Grubler's criterion (without derivation), Kinematic chain, Mechanism, structure, Mobility of Mechanism, Inversion, Machine. kinematic chains and inversions: Inversions of Four bar chain; Single slider crank chain and Double slider crank chain.

MECHANISMS:

7 Hours

Quick return motion mechanisms -Drag link mechanism, Whitworth mechanism and Crank and slotted lever Mechanism. Straight line motion mechanisms –Peaucellier's mechanism and Robert's mechanism. Intermittent Motion mechanisms – Geneva mechanism and Ratchet and Pawl mechanism. Toggle mechanism, Pantograph, Ackerman steering gear mechanism.

UNIT- II

STATIC FORCE ANALYSIS: **6Hours**

Introduction: Static Equilibrium. Equilibrium of Two and Three Force Members. Members with Two Forces and Torque, Free Body Diagrams, Principle of Virtual Work. Static Force Analysis of Four Bar Mechanism and Slider-Crank Mechanism with and without friction.

BALANCING OF ROTATING MASSES: **8 Hours**

Static and Dynamic Balancing, Balancing of Single Rotating Mass by Balancing Masses in Same plane and in Different planes. Balancing of Several Rotating Masses by Balancing Masses in Same plane and in Different planes.

UNIT - III

GOVERNORS: **6 Hours**

Types of Governors: Force Analysis of Porter and Hartnell Governors. Controlling Force, Stability, Sensitiveness, Isochronism, Effort and Power

GYROSCOPE: **6 Hours**

Vectorial Representation of Angular Motion, Gyroscopic Couple. Effect of Gyroscopic Couple on Ship, Plane Disc, Aeroplane, Stability of Two Wheelers and Four Wheelers.

UNIT - IV

GEAR TRAINS: **6 Hours**

Simple gear trains, Compound gear trains for large speed reduction, Epicyclic gear trains, Algebraic and tabular methods of finding velocity ratio of epicyclic gear trains. Tooth load and torque calculations in epicyclic gear trains.

CAMS: **7 Hours**

Types of cams, Types of followers, Displacement, Velocity and Acceleration time curves for cam profiles. Disc cam with reciprocating follower having knife -edge, roller and flat-faced follower, Disc cam with oscillating roller follower, Follower motions including SHM, Uniform velocity, uniform acceleration and retardation and Cycloidal motion.

Assignment: Quiz of 25 questions and MCQ Type

Course Outcomes: At the end of the course, the student will be able to:
CO1: Construct/Compose mechanisms to provide specific motion.
CO2: To analyze forces acting on the mechanisms.
CO3: To analyze the effect of a gyroscopic couple on Ship, Aeroplane and an Automobile.
To identify gears & gear trains and construct cam profile for the specific follower motion.

Question paper pattern:

Total of eight questions with two from each unit to be set uniformly covering the entire syllabus. Each question carries 20 marks and should not have more than 4 sub divisions.
Any five full questions are to be answered choosing at least one from each unit.

Sl No	Title of the Book	NameoftheAuthor/s	Name of the Publishers	Edition and Y
Textbook/s				
1	Theory of Machines	Rattan S.S	McGraw-Hill Education	2ndedition, 20
2	Theory of Machines	Sadhu Singh	Pearson Education (Singapore) Pvt. Ltd., Indian Branch, New Delhi	2ndedition, 20
Reference Books				
1	Theory of Machines & Mechanisms	Shigley. J. V. and Uickers, J.J	OXFORDUniversity press.	3rd edition 20
2	Theory of Machines	Robert L. Norton	McGraw-Hill Higher Education	3rd edition 20

B. E. MECHANICAL ENGINEERING SEMESTER -III			
Material Science and Material Testing Lab			
Course Code	**UMA307L**	CIE Marks	50
Teaching Hours/Week (L:T:P)	**0-0-2**	SEE Marks	100
Credits	**01**	SEE Exam Hours	03

PART – A

1. Impact Test (Charpy)
2. Impact Test (Izod)
3. Brinnell Hardness Test
4. Vickers Hardness Test
5. Rockwell Hardness Test

PART - B

1. Tensile test using UTM
2. Compression Test using UTM
3. Bending Test using UTM
4. Shear Test using UTM
5. Preparation of samples for micro structural analysis (Demonstration)

* All test as per ASTM standards

Laboratory Assessment:

1. Each laboratory subject is evaluated for 100 marks (50 CIE and 50 SEE).
2. The CIE in laboratory in classes is carried out for 50 marks (30 marks for the performance and term work)
3. For remaining 20 marks one practical test to be conducted

The SEE practical is conducted for 50 marks two question to be set from each Part A, and Part B. for 20 marks each and 10 marks Viva voce.

B. E. MECHANICAL ENGINEERING SEMESTER -III			
Mechanical Drawing Lab			
Course Code	**UMA310L**	CIE Marks	50
Teaching Hours/Week (L:T:P)	**0-0-2**	SEE Marks	100
Credits	**01**	SEE Exam Hours	03

Part – A

Drafting overview

Scales (Enlarging and Reducing BIS Code of engineering)
Dimensioning and tolerance
Surface finish
Conventions, abbreviations and symbols
Orthographic conversion (Miscellaneous Problems)
Component drawing reading 3 examples

PART – B

Assembly

Valves (Any two), using drafter
Free hand sketching of the following
Valve gear mechanism
Automobile parts- Carburetor, Fuel pump, differential, power transmission, steering system, braking system, Clutches, Gear Box

Laboratory Assessment:

1. Each laboratory subject is evaluated for 100 marks (50 CIE and 50 SEE).
2. The CIE in laboratory in classes is carried out for 50 marks (30 marks for the performance and term work)
3. For remaining 20 marks one practical test to be conducted

The SEE practical is conducted for 50 marks two question to be set from each Part A, and Part B. for 20 marks each and 10 marks Viva voce.

B. E. MECHANICAL ENGINEERING SEMESTER -III			
Foundry and Forging Lab			
Course Code	**UMA308L**	CIE Marks	50
Teaching Hours/Week (L:T:P)	**0-0-2**	SEE Marks	100
Credits	**01**	SEE Exam Hours	03

Part – A

1. Testing of Molding sand and Cores and Preparation of sand specimens and conduction of the following tests:
2.

1. Compression, Shear and Tensile tests on Universal Sand Testing Machine.
2. Permeability test
3. Core hardness &Mould hardness tests.
4. Grain fineness number test (Sieve Analysis test)
5. Clay content test.
6. Moisture content test.

Shatter index

PART B

2. Foundry Practice

Use of foundry tools and other equipments. Preparation of moulds using two moulding boxes using patterns or without patterns. (Split pattern, Match plate pattern and Core boxes). Preparation of one casting (Aluminum or cast iron-Demonstration only)

PART C

3. Forging Operations

Preparing minimum three forged models involving upsetting, drawing and bending operations. Estimation of length of the raw material. Out of these three models, at least one model is to be prepared by using Power Hammer.

Laboratory Assessment:

1. Each laboratory subject is evaluated for 100 marks (50 CIE and 50 SEE).
2. The CIE in laboratory in classes is carried out for 50 marks (30 marks for the performance and term work)
3. For remaining 20 marks one practical test to be conducted

The SEE practical is conducted for 50 marks two question to be set from each Part A, and Part B. for 20 marks each and 10 marks Viva voce.

B.E. MECHANICAL ENGINEERING SEMESTER- IV			
Metrology & Instrumentation Lab			
Course Code	UME 407 L	CIE Marks	50
Teaching Hours/Week (L:T:P)	0-0-2	SEE Marks	100
Credits	01	SEE Exam Hours	03

PART – A: INSTRUMENTATION

1. Calibration of Pressure Gauge
2. Calibration of Thermocouple
3. Calibration of LVDT
4. Calibration of Load cell.
5. Calibration of Micrometer Screw gauge

PART-B: METROLOGY

6. Measurements of angle using Sine Center / Sine bar / bevel protractor
7. Measurements of alignment using Autocollimator / roller set
8. Measurements of Screw thread Parameters using two wires or three-wire methods.
9. Measurements of gear tooth profile using gear tooth vernier /gear tooth micrometer
10. Calibration of micrometer using slip gauges

Laboratory Assessment:

1 Each laboratory subject is evaluated for 100 marks (50 CIE and 50 SEE).

2 The CIE in laboratory in classes is carried out for 50 marks (30 marks for the performance and term work)

3 For remaining 20 marks one practical test to be conducted

The SEE practical is conducted for 50 marks two question to be set from each Part A, and Part B. for 20 marks each and 10 marks Viva voce.

B.E. MECHANICAL ENGINEERING SEMESTER- IV			
Machine Shop Lab			
Course Code	UME 408 L	CIE Marks	50
Teaching Hours/Week (L:T:P)	0-0-2	SEE Marks	100
Credits	01	SEE Exam Hours	03

Part – A

Preparation of three models on lathe involving Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning. Determination of gear train for thread cutting. Preparation of the process chart for the component.

PART - B

Cutting of V Groove/ dovetail / Rectangular groove using Shaping and Cutting of Gear Teeth using Milling Machine. Planning machine. Estimation of stroke length, Number of strokes, Estimation of rpm, Preparation of process chart for the component.

Laboratory Assessment:

1. Each laboratory subject is evaluated for 100 marks (50 CIE and 50 SEE).
2. The CIE in laboratory in classes is carried out for 50 marks (30 marks for the performance and term work)
3. For remaining 20 marks one practical test to be conducted

The SEE practical is conducted for 50 marks two question to be set from each Part A (Process chart five marks + 15 marks for job) and Part B (Process chart and programming 15 marks + Virtual machining 5 marks). for 20 marks each and 10 marks Viva voce.

B.E. MECHANICAL ENGINEERING SEMESTER- IV			
Computer Aided Machine Drawing Lab			
Course Code	UME 411 L	CIE Marks	50
Teaching Hours/Week (L:T:P)	1-0-2	SEE Marks	100
Credits	02	SEE Exam Hours	03

Part A

Sections of Solids: Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on, axis inclinations, spheres and hollow solids). True shape of sections.

Orthographic views: Conversion of pictorial views into orthographic projections of simple machine parts with or without section. (Bureau of Indian Standards conventions are to be followed fo r the drawings) Hidden line conventions. Precedence of lines.

Thread forms: Thread terminology, sectional views of threads. ISO Metric (Internal & External) BSW (Internal & External) square and Acme. Sellers thread, American Standard thread.

Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly) simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw.

Part B

Keys & Joints:
Parallel key, Taper key, Feather key, Gibhead key and Woodruff key.

Riveted Joints: single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag, using snap head rivets). Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods.

Couplings:
Flanged coupling and universal coupling (Hooks' Joint)

Part C

Assembly Drawings (Part drawings should be given)

1. Plummer block (Pedestal Bearing)
2. I.C. Engine connecting rod
3. Screw jack (Bottle type)
4. Tailstock of lathe
5. Machine vice
6. Tool Head of shaper

CO1 To define basic sketching commands and navigational commands used in SOLID EDGE software

CO2 To define basic conversion of pictorial views into orthographic projections of simple machine parts with or without section

CO3 To analyze thread terminology, sectional views of threads, ISO Metric, BSW, square, Acme and Sellers thread, fasteners, joints and Couplings

CO4 To develop solid models (3D drawings) of various machine parts and develop assembly using solid edge software.To explain and draw 2D drawings in assembly or in single unit

Laboratory Assessment:

1. Each laboratory subject is evaluated for 100 marks (50 CIE and 50 SEE).
2. The CIE in laboratory in classes is carried out for 50 marks (30 marks for the performance and term work)
3. For remaining 20 marks one practical test to be conducted for sketching and printouts from SOLID EDGE.

The SEE practical is conducted for 50 marks of three hour duration two question to be set from each Part A, Part B and Part C. Student has to answer one question each from Part A and Part B for 10 marks each and one question from part C for 30 marks

Sl No	Title of the Book	Name of the Author/s	Name of the Publishers	Edition and Year
Textbook/s				
1	A Primer on Computer Aided Machine Drawing-2007		VTU, Belgaum	2007
2	Machine Drawing	N.D.Bhat& V. M. Panchal		
3	Machine Drawing	N. Siddeshwar, P. Kanniah, V.V.S. Sastri	Tata Mc GrawHill	2006
Reference Books				
1	A Text Book of Computer Aided Machine Drawing	S. Trymbaka Murthy	CBS Publishers, New Delhi	2007

5th Semester Syllabus

2018-19

Regular 19-20 Lateral Admitted Students

UME 509 C: Design of Machine Elements
Credits: 03 (2-2-0)

Semester: 05
Total Teaching Hours: 40

Course Description:

The primary objective of this course is to illustrate how engineering design uses the many principles learned in previous engineering science courses and to show how these principles are practically applied. The emphasis in this course is on machine design: the design of mechanical components used to modify force and/or motion. The type of design addressed in this course is that of detailed design, which is to define the shape, size and material of a particular machine element such that it will not fail under the expected load and operating conditions.
The course contains fundamentals of machine design, including analysis and design of mechanical components. Covering shafts, fasteners, joints, keys, couplings, riveted and welded joints and power screws. Includes predicting static and fatigue failures for various loadings and materials. The course will prepare students for careers in different sections of design engineering and able to cater the needs of the industries, institutes and R&D activities.

Course Outcomes:

1. **CO1:**Understand the terminologies and preliminary concepts related to Normal, shear, biaxial, tri axial and Principal stresses, stress-strain diagram, codes and standards.
2. **CO2:**Apply the concepts of stress analysis, theories of failure and material science to analyze, design and/or select commonly used machine components.
3. **CO3:**To apply different theories to the design of shafts subject to combined static and dynamic loads.
4. **CO4:** Analyze and design springs for various loadings and applications.
5. **CO5**: Analyze and design of spur gears for various loadings and applications.

UNIT – I

INTRODUCTION and DESIGN FOR STATIC & IMPACT STRENGTH:

12 Hours

Definitions: Normal, Shear, Biaxial and Triaxial Stresses, Stress Tensor, Principal Stresses
Engineering Materials and their Mechanical properties, Stress-Strain diagrams, Stress Analysis, Design considerations: Codes and Standards.

Design for Static & Impact Strength: Static Strength: Static loads and Factor of Safety,
Theories of failure. Maximum Normal Stress Theory, Maximum Shear Stress Theory, Distortion Energy Theory Failure of Brittle Materials, Failure of Ductile Materials
Stress Concentration, Determination of Stress Concentration Factor.

UNIT –II

DESIGN FOR FATIGUE STRENGTH

08 Hours

Design for Fatigue Strength: Introduction- S-N Diagram, Low Cycle Fatigue, High Cycle Fatigue, Endurance Limit, Endurance Limit Factors: Size effect, Surface effect, Stress Concentration effects. Fluctuating Stresses, Goodman and Soderberg relationship, Stresses due to Combined Loading,

Cumulative Fatigue Damage. Threaded Fasteners: Stresses in Threaded Fasteners, Effect of Initial Tension, Design of Threaded Fasteners under Static, Dynamic and Impact loads
Design of Eccentrically loaded Bolted Joints

UNIT –III

DESIGN OF SHAFTS **12 Hours**

Design of Shafts: Torsion of Shafts, Design for strength and Rigidity with Steady loading, ASME & BIS codes for Power Transmission shafting, Shafts under Fluctuating loads and Combined loads.

UNIT –IV:

SPRINGS, SPUR GEARS **10 Hours**

SPRINGS: Types of springs, Stresses in helical coil springs of circular and non-circular cross sections. Tension and compression springs, springs under fluctuating loads, Energy stored in springs, Torsion, Belleville and Rubber springs. Leaf Springs: Stresses in leaf springs. Equalized stresses,
SPUR GEARS: Spur Gears: Definitions, Stresses in gear tooth: Lewis equation and form factor, Design for strength, Dynamic load and wear load.

DESIGN DATA HAND BOOKS:

1. Design Data Hand Book – K. Lingaiah, McGraw Hill, 2nd Ed. 2003.
2. Design Data Hand Book – K. Mahadevan and Balaveera Reddy, CBS Publication
3. Machine Design Data Hand Book – H.G. Patil, Shri Shashi Prakashan, Belgaum.
4. PSG Design Data Handbook PSG College of Technology, Coimbatore.

TEXT BOOKS:

1. Design of Machine Elements: V.B. Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition 2007.
2. Design of Machine Element by S. C. Sharma

REFERENCE BOOKS:

1. Machine Design: Robert L. Norton, Pearson Education Asia, 2001.
2. Design of Machine Elements: M. F. Spotts, T. E. Shoup, L. E. Hornberger, S. R. Jayram and C. V. Venkatesh, Pearson Education, 2006.
3. Machine Design: Hall, Holowenko, Laughlin (Schaum‟s Outlines series) Adapted by S.K. Somani, Tata McGraw Hill Publishing Company Ltd., New Delhi, Special Indian Edition, 2008.
4. Fundamentals of Machine Component Design: Robert C. Juvinall and Kurt M Marshek, Wiley India Pvt. Ltd., New Delhi, 3rd Edition, 2007.
5. Mechanical Engineering Design: Joseph E Shigley and Charles R. Mischke. McGraw Hill International edition, 6th Edition 2003.

Question paper pattern for SEE

1. Total of eight questions uniformly covering the entire syllabus.
2. Each question should not have more than four subdivisions.
3. Any five full questions are to be answered

UME 512 C: Metal Forming
Credits: 03 (2-2-0)

Semester: 05
Total Teaching Hours: 40

The objectives of this course are to:

1. Introduce students to the concepts and principles of metal forming (shaping) by pressure;
2. Discuss the equipment and sequence of technological operations involved in the various methods of metal shaping by pressure
3. Discuss the various methods to calculate the load necessary for plastic deformation
4. Provide students with opportunities to practically appreciate the essence of the methods of pressure shaping of metals as industrial manufacturing processes.

Course Outcomes:

1. **CO1:** Classify, compare, choose various metal forming operations; apply, elaborate and analyse yield criteria for ductile metals and summarize the effect of parameters on these operations considering the effect of force.
2. **CO2:** Explain, analyze, identify and relate various forging and rolling operations with metal flow and determination with modification of the power necessary to operate the equipments.
3. **CO3:** Distinguish, classify and explain types of drawing and extrusion operations in terms of die angle, parts produced, variables; formulate the load required (for existing and maximize reduction) to cause plastic deformation of the metal to occur without non uniform plastic deformation with justification.
4. **CO4:** Explain with illustrations and outline the shape finishing operations using sheet metal working, high energy rate forming and powder metallurgy by predicting the behavioral change of the metals during plastic deformation and propose the method to shape the metal by evaluating conventional forming and/or HERF and/or P/M route.

UNIT-I

INTRODUCTION AND CONCEPTS **06 Hours**

Classification of metal working processes, characteristics of wrought products, advantages and limitations of metal working processes. Concepts of true stress, true strain, {Apply knowledge of engineering fundamentals and mathematics (PO1)}. Determination of flow stress. Tresca and Von-Mises yield criteria {Interpretation of data and valid conclusions (PO4)}, Numerical problems

EFFECTSOFPARAMETERS
04 Hours
Temperature, strain rate, friction and lubrication, Deformation zone geometry, workability of materials, Residual stresses in wrought products.

UNIT-II

FORGING **05 Hours**

Classification of forging processes {Communicate effectively to comprehend and write effective reports and design documentation and give and receive clear instructions (PO10)}. Forging machines and equipment. Expressions for forging pressures and load in open die forging by slab analysis {Demonstrating the need for sustainable development (PO7)}, concepts of friction hill and factors affecting it. Die-design parameters. Forging defects, Residual stresses in forging.

ROLLING **05 Hours**

Classification of Rolling processes. Types of rolling mills. Roll separating force. Effects of front and back tensions, friction, friction hill. Maximum possible reduction {Applying ethical principles (PO8)}, defects in rolled products, rolling variables. Numerical problems.

UNIT-III

DRAWING: **05 Hours**

Drawing equipment and dies, expression for drawing load by slab analysis {Applying the knowledge of first principles of engineering science and mathematics (PO2)}, power requirement. Redundant work and its estimation, optimal cone angle and dead zone formation, drawing variables, Tube drawing and classification, Numerical problems.

EXTRUSION: **05 Hours**

Types of extrusion processes, extrusion equipment and dies, lubrication and defects in extrusion. Extrusion dies, Extrusion of seamless tubes. Extrusion variables, Numerical problems.

UNIT-IV

SHEETMETALFORMING: **04 Hours**

Forming methods, dies and punches, progressive die, compound die, combination die. Rubber forming. Open back inclinable press (OBI press), piercing, blanking, bending, deep drawing, LDR in drawing, defects of drawn products, stretch forming. Roll bending and contouring {Applying norms of the engineering practice (PO8)} and {Function effectively as an individual, and in diverse teams with multidisciplinary disciplines (PO9)}.

HIGH ENERGY RATE FORMING METHODS: **02 Hours**

Principles {Application of law of physics (PO1)} and {Recognizing the need (PO12) of HERF}, advantages, limitations and applications of explosive forming {Apply reasoning informed by the contextual knowledge to assess particularly health, safety and legal issues (PO6) relating to handling of explosives}, electro hydraulic forming and Electromagnetic forming.

POWDER METALLURGY: **04 Hours**

Basic steps in Powder metallurgy brief description of methods of production of metal powders, conditioning and blending powders, compaction, sintering (PO12), secondary finishing and secondary manufacturing operations {Demonstrating the need for sustainable development (PO7)}, application of powder metallurgy components {Select and apply appropriate technique based on the shape/size and property of part being produced (PO5) taking into account conventional forming, HERF and P/M route}, advantages and limitations.

TEXT BOOKS:

1. George E. Dieter, “Mechanical metallurgy” (SI Metric Edition), Mc Graw-Hill Series in Materials Science and Engineering, 2001.
2. B. L. Juneja, “Fundamentals of Metal Forming Processes”, Second Edition, New Age International Publishers, 2010

REFERENCE BOOKS:

1. Surender Kumar, “Technology of Metal Forming Processes”, Eastern Economy Edition, Prentice-Hall of India Private Limited, 2008.
2. G.W.Rowe, “Principle of Industrial Metal Working Processes”, CBS Publishers and Distributors, 2005.
3. Dr. Sadhu Singh, “Theory of Plasticity and Metal forming Processes”, Third Edition, Khanna Publishers, 2013.
4. P.C. Angelo, R. Subramanian, “Powder Metallurgy: Science, Technology and Applications”, Eastern Economy Edition, Prentice-Hall of India Private Limited, 2008.

Question Paper Pattern for Semester End Examination (SEE):

1. Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
2. Each question carries 20 marks and should not have more than 4 sub divisions.
3. Any five full questions are to be answered choosing at least one from each unit.

UME 513 C: FLUID MECHANICS
3 Credits (3-0-0)

Semester: 05
Total Teaching Hours: 40

Course Outcomes:

- **CO1:** To be able to Understand and correctly use the fluid properties terminology, thermodynamic properties and analyze the hydrostatic forces on the submerged surfaces
- **CO2:**To be able to Understand the conservation of mass principles and develop fluid flow equation (Dimensional analysis)
- **CO3:** To be able to Define, develop and apply the conservation of momentum and energy principles.
- **CO4:**To be able to Define, understand and analyze the compressible fluid flow aspects

UNIT - I

Properties of Fluids: **11 Hours**

Introduction, properties of fluids, viscosity, thermodynamic properties, Surface tension and Capillarity, Vapour pressure and Cavitation.

Fluid Statics:
Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, Absolute, gauge, atmospheric and vacuum pressures, single manometers, differential manometers, total pressure and center of pressure, vertical plane surface submerged in liquid, horizontal plane surface submerged in liquid, inclined plane surface submerged in liquid, curved surface submerged in liquid. Buoyancy, center of buoyancy, metacenter and metacentric height, conditions of equilibrium of floating and submerged bodies.

UNIT - II

Fluid Kinematics: **10 Hours**

Types of fluid flow, Introduction, continuity equation, continuity equation in three dimensions (Cartesian co-ordinate system only), velocity and acceleration, velocity potential function and stream function.

Dimensional Analysis: Introduction, derived quantities, dimensions of physical quantities, dimensional homogeneity, Buckingham's $\prod$ theorem, Raleigh's method, dimensionless numbers, similitude, types of similitude.

UNIT - III

Fluid Dynamics: **11 Hours**

Introduction, equations of motion, Euler's equation of motion, Bernoulli's equation from Euler's equation, Bernoulli's equation for real fluids.

Fluid flow measurements:
Introduction, venturimeter, orifice meter, Pitot tube. Discharge over rectangular and triangular notches.

Flow through pipes: Frictional loss in pipe flow, Darcy- Equation for loss of head due to friction in pipes, Chezy's equation for loss of head due to friction in pipes, hydraulic gradient and total energy line. Minor loses in pipes - Sudden enlargement, sudden contraction, obstruction, bend, elbow. Numericals

UNIT - IV

Laminar flow and viscous effects: **10 Hours**

Reynold's number, critical Reynold's number, Laminar flow through circular pipe-Hagen Poiseulle's equation, Laminar flow between parallel stationery plates.

Flow past immersed bodies:

Drag, Lift, expression for lift and drag, pressure drag and friction drag, boundary layer concept, displacement thickness, momentum thickness and energy thickness.

Introduction to compressible flow:

Velocity of sound in a fluid: velocity of sound in terms of Bulk modules, velocity of sound for isothermal process, velocity of sound for adiabatic process.

Mach number: Subsonic, sonic and supersonic flows, propagation of disturbance for different Mach numbers, Mach cone.

Stagnation properties: stagnation Pressure, Stagnation temperature, Area velocity relationship for compressible flows.

Text Books:

1. Fluid Mechanics (SI Units), Yunus A. Cingel John M. Oimbala. Tata McGraw-Hill, 2006.
2. Fluid Mechanics by Dr. Bansal.R.K, Lakshmi Publications, 2004.
3. Fluid Mechanics and hydraulics, Dr. Jagadishlal: Metropolitan Book Co-Ltd., 1997.

Reference books:

1. Fluid Mechanics by Oijush K.Kundu, Iram Cochen, Elsevier 3rd Edition. 2005.
2. Fluid Mechanics by John F.Douglas, Janul and M.Gasiosek and john A. Swaffield, Pearson Education Asia, 5th edition., 2006
3. Fluid Mechanics and Fluid Power Engineering," Kumar.D.S Kataria and Sons.,2004.
4. Essential Computational Fluid Dynamics by Oleg Ziaanov Pub:Jhon Wiley

Question Pattern:

1. Total of Eight question with two from each unit to be set uniformly covering the entire Syllabus.
2. Each question should not have more than four sub division.
3. Any Five full questions are to answer choosing at least one from each unit.

UME 514 C: Turbo Machines
3 Credits (3 – 0 – 0)

Course objectives:

- To Understand and correctly use the turbomachinery terminology, develop governing equation for rotating machinery and classify the rotating machines.
- To Define, understand and analyze the power absorbing turbomachine (Centrifugal Pump)
- To Define, understand and analyze the impulse and reaction steam turbines
- To Define, understand and analyze the water turbines (Pelton, Francis and Kaplan water turbines)

Course Outcomes:

- **CO1:** To be able to Understand and correctly use the turbomachinery terminology, develop governing equation for rotating machinery and classify the rotating machines.
- **Co2:** To be able to Define, understand and analyse the power absorbing turbomachine (Centrifugal Pump)
- **CO3:** To be able to Define, understand and analyze the impulse and reaction steam turbines
- **CO4:**To be able to Define, understand and analyze the water turbines (Pelton, Francis and Kaplan water turbines)

UNIT I

Introduction: **10Hours**

Definition of turbomachine; Parts of a turbo machine; Comparison with positive displacement machine; Classification of turbomachines; Application of dimensional analysis to turbomachines and their physical significance; specific speed: definition, derivation for power absorbing and power developing machines; Related numerical problems on dimensional analysis and model studies.

Energy Transfer in Turbomachines:

Euler turbine equation; Alternate form of Euler turbine equation; components of energy transfer; Degree of reaction; General analysis of a turbo machine: effect of blade discharge angle on energy transfer and degree of reaction; General analysis of turbines (axial): utilization factor, relation between utilization factor and degree of reaction, condition for maximum efficiency, condition for maximum utilization factor, optimum blade speed ratio and maximum energy transfer; Simple illustrative examples on above topics

UNIT II

General analysis of power absorbing turbomachines: **10 Hours**

General analysis of centrifugal pumps and compressors: effect of blade discharge, analysis on performance, theoretical head capacity relationship, centrifugal machines stage parameters, work done, power, stage pressure rise, degree of reaction

Centrifugal Pumps:

Working principle; main parts of a centrifugal pump; classification; Head: static head, manometric head; Efficiencies: manometric, mechanical, hydraulic efficiency, volumetric efficiency, overall efficiency; Work done by the pump; Pressure rise in pump; Minimum starting speed; Multistage pumps; Cavitation; Related numerical problems on above topics.

UNIT III

Steam and Gas Turbines: **10 Hours**

Impulse staging and need for compounding; Compounding: velocity, pressure, velocity and pressure; Impulse turbine: performance parameters, effects of friction and blade angles on blade efficiency, condition for maximum efficiency; maximum efficiency and work done, Related numerical problems on above topics.

Multistage impulse turbine (two stage):
work done, blade efficiency, condition for maximum efficiency, maximum blade efficiency, maximum work done, maximum utilization factor with equiangular blades; Reaction turbine: degree of reaction, condition for maximum efficiency (without carry over efficiency), maximum efficiency, maximum work done, utilization for factor, condition for maximum utilization factor, maximum utilization factor; blade design parameters; Related numerical problems on above topics.

UNIT IV

Hydraulic Turbine: **10 Hours**

Unit quantities; Terminology; Pelton Wheel: velocity triangle, power, hydraulic efficiency, condition for maximum hydraulic efficiency, maximum hydraulic efficiency; Turbine efficiency: hydraulic, mechanical, volumetric, overall; important design parameters, Related numerical problems on above topics.

Francis and Kaplan turbines: **10 Hours**

Velocity triangle, runner shapes for different blade speeds (blade angles), design parameters; Draft tube: types; function, design; Kaplan and Propeller turbines: velocity triangles, design parameter; Related numerical problems on above topics.

Text Book:

1. Principles of Turbo machinery, by D.G.Shephered, The Macmillan Company, 1964.
2. Turbines, Compressors and Fans, by S.M.Yahya, Tata Mc Graw Hill Company, 2nd Edition, 2002

Reference Books:

1. An Introduction to energy Conversion, Volume III – Turbo Machinery, by A. Kadambi and Manohar Prasad,Wiley Eastern Ltd., 1977.
2. Text book of Turbomachines by Govinde Gowda and A.M.Nagaraj, M.M. Publishers Davangere, 2011
3. A Treatise on Turbo machines, by G.Gopalaksrihsna and D. Prithiviraj, Scitech Publications India) PVT.,
Limited, 2002.
4. Gas Turbine Theory, By H.Cohen, GFC Rogers and HIH Saravanamuttoo, Thomson Press (India) Ltd., 4th
Edition, 1998.
5. Gas Turbines, by V.Ganeshan, Tata Mc Graw Hill, 2nd edition, 2002.

Scheme of Examination:
1. Eight questions to be set selecting two questions from each Unit.
2. Each question carries 20 marks.
3. Five questions to be solved selecting at least one question from each Unit

UME506H: Management and Entrepreneurship
3 Credits (3 – 0 – 0)

Semester: 05
Total Teaching Hours: 40

Course Objectives:

- Be employed as a practicing engineer in fields such as design, research, development, testing, manufacturing, operations and service systems;
- Assume positions of leadership and responsibility within an organization and contribute to the success of companies through effective problem solving
- Design, develop, implement, and improve integrated systems that include people, materials, information, equipment, and environments
- Continue to develop holistically, including the personal and professional skills necessary to adapt to our changing societal, technological, and global environments
- Embrace innovation through intellectual diversity and creative problem solving.
- Effectively adapt to the changing demands in workplace and are able to perform increasingly complex tasks

Course Outcomes: Student should be able to

- An ability to utilize the methodologies, computational skills, and analysis techniques of Industrial Engineering practices.
- An understanding of professional and ethical responsibility
- Build systematic approach to the discovery, integration, application, and communication of industrial engineering knowledge so as to serve our customers.
- An ability to improve, and manage integrated systems of people, technologies, material, information, and equipment.
- Enable them to understand the impact of industrial engineering solutions in a global, social, and environmental context.
- Have a strong sense of professionalism, with respect for fellow workers and their profession.

UNIT - 1

MANAGEMENT: 05Hours

Introduction – Meaning – nature and characteristics of Management, Scope and Functional areas of management – Management as a science, art of profession, Roles of Manager, Levels of Management, Development of Management Thought– early management approaches

PLANNING: 05 Hours

Nature, importance and purpose of planning process –Objectives – Types of plans (Meaning only), Importance of planning – steps in planning & planning premises.

UNIT – 2

ORGANIZING AND STAFFING: 05 Hours

Nature and purpose of organization –Principles of organization – Types of organization – Departmentation –Committees, Nature and importance of staffing–Process of Selection & Recruitment (in brief).

MOTIVATION AND BEHAVIOR: **05 Hours**

Hawthorns studies and its findings Maslow's theory X and Y theory, Immaturity theory motivation hygiene theory, McClelland's theory of motivation.

UNIT - 3

DIRECTING & CONTROLLING:
05 Hours

Meaning and nature of directing –Leadership styles, Communication – Meaning and importance, Coordination- meaning and importance and Techniques of Co –Ordination. Controlling--Meaning and steps in controlling – Essentials of a sound control system – Methods of establishing control (in brief).

ENTREPRENEUR: **05 Hours**

Meaning of Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneur (only types), Role of entrepreneurs in Economic Development, Entrepreneurship in India, Entrepreneurship – its Barriers.

. **UNIT – 4**

SMALL SCALE INDUSTRIES: **05 Hours**

Definition, Characteristics, Need and rationale, Objectives, Scope, role of SSI in Economic Development. Advantages of SSI Steps to start and SSI – Government policy towards SSI, Different Policies of SSI, Government Support for SSI during 5 year plans. Supporting Agencies of Government for SSI, Meaning, Nature of support, Objectives, Functions (brief).

QUALITY PHILOSOPHY: **05 Hours**

The Meaning of Quality and Quality Improvement, Brief History of Quality Methodology, Statistical Methods for Quality Control and Improvement

TEXT BOOKS:

1. Principles of Management, Koontz O Donnel, Mc.Graw Hill Intl. Book Co.
2. Statistical Quality Control, E.L. Grant and R.S. Leavenworth, 7thEdition, McGraw- Hill publisher
3. Entrepreneurship Development – Poornima.M.Charantimath –Small Business Enterprises – Pearson Education – 2006 (2 & 4).

REFERENCE BOOKS:

1. Essentials of Management, Koontz Weirich, Tata McGraw Hill Intl. Book Co., 7th Edition.
2. Entrepreneurship Development – S.S.Khanka – S.Chand & Co.
3. Quality Control, Mahajan, Khanna publication
4. Principles of Management, P.C.Tripathi, P.N.Reddy – Tata McGraw Hill,
5. Management, Stephen Robbins – Pearson Education/PHI – 17thEdition- 2003.

Scheme of Examination:
1 Eight questions to be set selecting two questions from each Unit.
2 Each question carries 20 marks.
3 Five questions to be solved selecting at least one question from each Unit

UHS 002 N: Advanced Quantitative Aptitude and Soft Skill

3 Credits (3 – 0 – 0)

Semester: 05
Total Teaching Hours: 40

Course Objectives:

1. To develop and augment the written communication skills
2. To develop a deep sense of analysis towards solving a problem
3. To fine-tune the quantitative, data analysis and interpretation skills

UNIT-I

Mathematical Ability: Ratios, Averages, Percentages, Profit Loss, Interest, Time & Work

08 Hours.

UNIT-II

Analytical Ability: Analytical Puzzles, Data Analysis, Para-jumbles and miscellaneous questions

08 Hours .

UNIT-III

Group Discussions & Written Communication: Zero GD, Parameters of Evaluation, Introduction and Conclusion, Mock GDs, Introduction to Business Communication

07 Hours .

UNIT-IV

Written English:Synonyms and Antonyms, Error Detection & Correction, Letter/Email Writing

07 Hours .
Total Hrs.: 30

Course Outcomes:

Students will be able to:

- **CO1** learnt the role of verbal and non-verbal communication and enhanced his/her ability to speak in public or to an audience
- **CO2** learned the techniques to augment his/her verbal ability
- **CO3** enhanced his/her written communication and learnt techniques to augment them further
- **CO4** understood analysis of the given problem and learnt to develop a method for solving it
- **CO5** enhanced and augmented his/her ability to work with quantitative aptitude

REFERENCE BOOKS:

1. R. S. Aggarwal, “A Modern Approach to Verbal and Non – Verbal Reasoning”, Sultan Chand and Sons, New Delhi, 2018
2. R. S. Aggarwal, “Quantitative Aptitude”, Sultan Chand and Sons, New Delhi, 2018

3. Chopra, “Verbal and Non – Verbal Reasoning”, MacMillan India
4. M Tyra, “Magical Book on Quicker Maths”, BSC Publications, 2018
5. Edward De Bono, “Lateral Thinking”, Penguin Books, New Delhi, 2016

UME 514 L: FLUID MECHANICS AND MACHINERY LABORATORY
1 Credits (0 – 0 – 3)

Course Objectives:

- To provide students with the experimental ability to operate and to analyze flow measuring devices.
- To teach students the applications of Bernoulli' s theorem, flow measuring devices such as venturimeter, orificemeter.
- To provide the student with experimental ability to measure major losses and minor losses due to bend, elbow, sudden enlargement, sudden contraction.
- To understand operation and power developed by Francis turbine, Pelton wheel.
- To provide the student understand operating characteristics and to calculate efficiency of centrifugal pump and reciprocating pump.

Course Outcomes:

- **CO1:**Students will demonstrate the ability to conduct, to measure and to calculate coefficient of discharge of Venturimeter and Orificemeter.
- **CO2:** Students will demonstrate the ability to calculate the effect of operating parameters on the performance of centrifugal pump and Reciprocating pump.
- **CO3:** Students will demonstrate the ability to calculate the effect of operating parameters on the performance and power developed by pelton wheel, Francis turbine
- **CO4:** Students will demonstrate the ability to calculate major losses and minor losses in a pipe flow.
- Individual experiments

Part A

Calibration of flow measuring device: (any 3)

a. Orifice plate
b. Flow nozzle
c. Venturimeter
d. Rotameter
e. V- Notch
f. Determination of co efficient of friction of flow through pipe
g. Determination of minor losses (Sudden Expansion, Sudden Contraction, Bend and Elbow) in flow through pipes
h. Determination of force developed by impact of jets on vanes

Part B

Group experiments

a. Performance testing of turbines
b. Pelton wheel,
c. Francis turbine
d. Kaplan turbine
e. Performance testing of pumps

- Single stage and multi stage centrifugal pump
- Reciprocating pump
- Performance test on two/single stage reciprocating air compressor
- Performance test on air blower

Scheme for Examination:

One Question from Part A - 15 Marks (05 Writeup+10)
One Question from Part B - 25 Marks (05 Writeup+20)
Viva-Voce - 10 Marks

Total 50 Marks

UME 507 L: FUELS AND I.C. ENGINE LAB
1 Credits (0 – 0 – 3)

Semester: 05
Total Teaching Hours: 40

Course Objectives:

- To provide students with the experimental ability to operate and to analyze internal combustion engines.
- To teach students the fuel metering system, air metering system, exhaust measuring method, torque measuring method, speed measuring method, cooling water measuring method.
- To provide the student with experimental ability to measure and to analyze/calculate fuel properties such as viscosity, flash and fire point.

Course Outcomes:

- Students will demonstrate the ability to conduct, to measure and to calculate/analyze properties of oil/fuel
- Students will demonstrate the ability to calculate the effect of operating parameters on the performance of SI and CI engines

Part A

Individual Experiments

2. Determination of Flash point and Fire point of lubricating oil and liquid fuel using Abel / Clevland / Pensky Martins Apparatus.
3. Determination of Viscosity of a lubricating oil using Redwood viscometer
4. Determination of Viscosity of lubricating oil using Saybolts viscometer.

Part B
Group experiments

Performance tests on I. C. Engines, calculations of IP, BP, FP, thermal efficiencies, mechanical efficiency, volumetric efficiency, air fuel ratio, SFC, BSEC, heat balance sheet for

1. Four stroke single Cylinder Diesel Engine
2. Four stroke Twin Cylinder Diesel Engine
3. Four Stroke Single Cylinder Petrol Engine

Scheme for Examination:

One Question from Part A - 15 Marks (05 Writeup+10)
One Question from Part B - 25 Marks (05 Writeup+20)
Viva-Voce - 10 Marks

Total 50 Marks

UCS559 L: Advance C Programming Lab
2 Credits (0-0-4)

Semester: 05
Total Teaching Hours: 40

The objective of the course is to:

- Imbibe thorough knowledge in advanced C programming concepts.
- Have proficiency in applying advanced C programming concepts to solve any real world problem.

Course outcomes:

By the end of the course, the student will be able to:

- **CO1:** Define advanced C programming concepts like pointers, data structures.
- **CO2:** Apply the knowledge of advanced C programming concepts to implement given requirement specification or to solve real world problem.
- **CO3:** Analyze different data structures and use suitable data structure to implement requirement specification.
- **CO4:** Implement, interpret, debug and test any given advanced C program.
- **CO5:** Develop software product using advanced C programming concepts to solve real world problem.

Unit -I

(6 hours)

Multidimensional arrays. Self-referential structures and Unions. Pointers: Introduction, Pointers for inter function communication, Pointers to pointers, Compatibility, Lvalue and Rvalue, Examples. Pointer Applications: Arrays and pointers, pointer arithmetic and arrays, passing an array to a function, memory allocation functions, array of pointers, Examples.

Unit -II

(6 hours)

Data Structures, Classifications (Primitive & Non Primitive), Data structure Operations, Stacks: Definition, Stack Operations, Array Representation of Stacks, Stacks using Dynamic Arrays, Stack Applications: Queues: Definition, Array Representation, Queue Operations. Programming Examples.

Unit -III

(6 hours)

Linked Lists: Definition, Representation of linked lists in Memory, Linked list operations: Traversing, Searching, Insertion, and Deletion. Applications of Linked lists.

Unit -IV

(6 hours)

Trees: Terminology, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals;

Textbooks:

1. Data Structures: A Pseudo-code approach with C, Gilberg & Forouzan, Cengage Learning2nd Edition, 2014
2. Data Structures through C, Yashwant Kanetkar, BPB Publications, 2017

Reference Books:

1. Data Structures: A Pseudo-code approach with C, Gilberg & Forouzan, Cengage Learning2nd Edition, 2014
2. Data Structures using C, Reema Thareja, Oxford press, 3rd Edition 2012
3. An Introduction to Data Structures with Applications, Jean-Paul Tremblay & Paul G., McGraw-Hill, 2nd Edition,2013

Web links and Video Lectures:

1. https://nptel.ac.in/courses/106/106/106106130/
2. https://www.classcentral.com/course/edx-c-programming-pointers-and-memory-management-11533
3. https://academicearth.org/computer-science/
4. http://nptel.vtu.ac.in/econtent/courses/BS/15PCD23/index.php

Quality and Reliability Engineering (UME 511 E)
Credits (3 – 0 – 0)

Semester: 05
Total Teaching Hours: 40

COURSE OUTCOMES

- **CO1:** To understand the concept of quality and know the various aspects of quality and its improvement.
- **CO2:** To understand the causes for variation and perform the quality control process
- **CO3:** To identify and analyze the failures of the components and subcomponents of mechanical and electronic items.
- **CO4:** To know the system concepts of reliability and its improvement tradeoffs.

UNIT - I

INTRODUCTION

0**5 Hours**

Definition of quality, Quality dimensions, Quality aspects-quality of design, quality of conformance and quality of performance. Quality Control-offline quality control, statistical process control and acceptance sampling plans (Only introduction). Quality Assurance

GRAPHICAL METHODS OF DATA PRESENTATION & QUALITY IMPROVEMENT

0**5 Hours**

Histograms, Run Charts, Pareto Diagrams, Cause and Effect diagrams and Scatter diagrams.

UNIT - II

STATISTICAL PROCESS CONTROL:

0**5 Hours**

Causes of Variation in quality, Central limit theorem, Control charts for variables and attribute (simple problem only), Process capability studies (theory only)

ACCEPTANCESAMPLINGPLANS:

05 Hours

Introduction, Advantages and disadvantages of sampling, producer's risk, consumer's risk, operating characteristics curve (simple problems to draw OC curve), effect of sample size and acceptance number on OC curve.

UNIT – III

RELIABILITY

10 Hours

Definition of reliability, reliability function, MTTF, hazard rate function, bathtub curve, derivation of the reliability function – constant failure rate model, time dependent failure rate models: Discrete and Continuous Distributions, Normal, Poisson, Binomial, Weibull Distribution

UNIT – IV

SYSTEM RELIABILITY

05 Hours

System reliability (Series, Parallel, Mixed and Standby components). Reliability and life testing plans (failure terminated and time terminated tests).

RELIABILITY IMPROVEMENT AND ALLOCATION

05 Hours

Difficulty in achieving reliability, Methods for improving reliability during design, Different techniques available to improve reliability, Optimization, Reliability-Cost trade off, Prediction and Analysis, Problems

TEXT BOOKS:

1. Fundamental and Quality Control and Improvement (Second Edition)- Amitava Mitra Prentice Hall of India, 2007
2. Reliability Engineering, L. S. Srinath, East-West Press, 2008.

REFERENCES :

1. Statistical Quality Control- M.Mahajan Dhanpat Rai & Co. (P) Ltd.

Scheme of Examination:

1. Eight questions to be set selecting two questions from each Unit.
2. Each question carries 20 marks.
3. Five questions to be solved selecting at least one question from each Unit.

UME535E - NON TRADITIONAL MACHINING
Credits (3 – 0 – 0)

Semester: 05
Total Teaching Hours: 40

Course Objectives:

The objectives of this course are:

- To educate students about the basic concepts of non-traditional machining, its advantages and limitations.
- To understand the need to move to the unconventional machining processes, differences between the traditional and non traditional machining processes.
- To understand the principle and operation of various non traditional machining processes.
- To study various parameters affecting the nontraditional machining processes.
- To understand the applications of various non traditional machining processes.

Course Outcomes:

Upon successful completion of this course, the students will be able to:

1. Compare non traditional machining and conventional machining processes with respect to their advantages, limitations and applications.
2. Analyze various process parameters affecting the material removal rate for a particular machining process.
3. Decide a particular non-traditional machining process for a particular material.
4. Decide a particular non-traditional machining process based on the type of counter, quantity of material to be removed.

UNIT - I

Introduction:

10 Hours

Need for non-traditional machining processes. Processes selection

Mechanical Process: Ultrasonic Machining-Definition-Principle of material removal, process description, effect of process parameters, process capability, applications, advantages and limitations

Abrasive Jet Machining:

Principles - parameters of the process applications-advantages and disadvantages.

UNIT - II

Thermal Metal Removal Process:

07 Hours

Electric discharge machining Principle of operation – mechanism of metal removal- basic EDM circuitry-spark erosion – Analysis of relaxation type of circuit - material removal rate in relaxation circuits-critical resistance parameters in RC Circuit-Die electric fluids-Electrodes for spark- surface finish- applications.

Chemical Machining:

03 Hours

Introduction-fundamental principle types of chemical machining Maskants Etchants- Advantages and disadvantages-applications.

UNIT-III

Electro chemical processes:

06 Hours

Electro chemical machining (ECM) Classification ECM process-principle of ECM Chemistry of the ECM parameters of the processes-determination of the metal removal rate, tool design, tool shape correction, Electro Chemical Grinding, Electro Chemical honing, Electrochemical deburring.

Plasma arc Machining:

04 Hours

Introduction-Plasma-Generation of Plasma and equipment Mechanism of metals removal, PAN parameters-process characteristics - type of torches applications.

UNIT - IV

Electron Beam Machining:

04 Hours

Introduction-Equipment for production of Electron beam Theory of electron beam machining Thermal & Non thermal types characteristics - applications.

Laser Beam Machining:

04 Hours

Introduction-principle of generation of lasers Equipment and Machining procedure-Types of Lasers-Process characteristics-advantages and limitations-applications

Ion Beam Machining:

02 Hours

Introduction-Mechanism of metal removal and associated equipment-process characteristics applications

Reference Books:

1. Hassan Abdel, Advanced Machining Processes, Mc Graw Hill, Mechanical Engineering Series.
2. HMT, Production technology, Tata Mc Graw Hill.
3. P.C Pandy & H.S. Shan, Modem Machining Processes, Tata McGraw Hill.
4. ASME, Metals hand book, Vol-3.
5. F.M Wilson, High velocity forming of metals, ASTME Prentice Hall.

Scheme of Examination:

Student has to solve any five full questions choosing at least one question from each unit.

6th Semester Syllabus

2018-19

Regular 19-20 Lateral Admitted Students

UME 622 C: Mechanical Vibrations
3 Credits (3-0-0)

Semester: 06
Total Teaching Hours: 40

- **CO1:** Students will be able to understand the fundamentals, causes and the need of mechanical vibrations and mathematical models for undammed single degree of freedom systems.
- **CO2:** Ability to analyze the mechanical model of damped free and forced vibratory system and formulating mathematical models for different damping systems.
- **CO3:** Ability to analyze and discus on different vibration measuring instruments. Ability to understand and formulate mathematical models for two degree of freedom systems of theoretical and real life engineering systems.
- **CO4:** Ability to analyze and formulate mathematical models for several degree of freedom systems using different numerical techniques. Able to understand causes and effects of Noise, Vibration, Harshness (NVH) and control.

UNIT - 1

INTRODUCTION:

03 Hours

Types of vibrations, Simple Harmonic Motion (S.H.M), principle of super position applied to Simple Harmonic Motions.Beat's phenomena.

UNDAMPED FREE VIBRATIONS:

07 Hours

Single degree of freedom systems. Undamped free vibration-natural frequency of free vibration, stiffness of spring elements, effect of mass of spring, Compound Pendulum, Determination of natural frequency using Newton's law and energy method.

UNIT – 2

DAMPED FREE VIBRATIONS:

05 Hours

Single degree freedom systems, different types of damping, concept of critical damping and its importance, study of response of viscous damped systems for cases of under damping, critical and over damping, Logarithmic decrement.

FORCED VIBRATION:

06 Hours

Single degree freedom systems, steady state solution with viscous damping due to harmonic force. Reciprocating and rotating unbalance, vibration isolation transmissibility ratio due to harmonic excitation and support motion.

UNIT – 3

VIBRATION MEASURING INSTRUMENTS & WHIRLING OF SHAFTS:

05 Hours

Vibrometer meter and accelerometer. Whirling of shafts with and without air damping. Discussion of speeds above and below critical speeds.

SYSTEMS WITH TWO DEGREES OF FREEDOM:

05 Hours

Introduction, principle modes and Normal modes of vibration, co-ordinate coupling, generalized and principal co-ordinates,.
Applications: a) Vehicle suspension. b) Dynamic vibration absorber.

UNIT - 4

NUMERICAL METHODS FOR MULTI DEGREE FREEDOM SYSTEMS:

06 Hours

Introduction, Influence coefficients, Maxwell reciprocal theorem, Reyleigh's method, Dunkerley's equation. Stodola method, Method of matrix iteration - Method of determination of the fundamental natural frequency,. Holzer's method.

Introduction to Noise, Vibration, Harshness (NVH) and control:

02 Hours

Subjective response of sound: Frequency and sound dependent human response; the decibel scale; relationship between, sound pressure level (SPL), sound power level and sound intensity scale; auditory effects of noise; hazardous noise,

TEXT BOOKS:

1. Mechanical Vibrations: G. K. Grover
2. Mechanical Vibrations: V.P. Singh, Dhanpat Rai & Company Pvt. Ltd., 3rd edition, 2006.

REFERENCE BOOKS:

1. Mechanical Vibrations: S.S. Rao, Pearson Education Inc, 4th Edition, 2003.
2. Mechanical Vibrations: S. Graham Kelly, Schaum's Outline Series, Tata McGraw Hill, Special Indian edition, 2007.
3. Theory & Practice of Mechanical vibrations: J.S. Rao & K. Gupta, New Age International Publications, New Delhi, 2001.
4. Elements of Vibrations Analysis: Leonanrd Meirovitch, Tata McGraw Hill, Special Indian edition, 2007.
5. Vibrations of continuous structures by Dr. S.S.Rao Wiley Publications

Question Paper Pattern for Semester End Examination (SEE):

1. Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
2. Each question carries 20 marks and should not have more than 4 sub divisions.
3. Any five full questions are to be answered choosing at least one from each unit.

UME 623 C: Heat Transfer
3 Credits (3-0-0)

Semester: 06
Total Teaching Hours: 40

Course Outcomes: At the end of the course the students will be able to

- Define, apply and analyze conduction heat transfer principles
- Define, apply and analyze transient heat transfer principles
- Define, apply and analyze forced and free convection heat transfer principles
- Define, apply and analyze the heat radiation, phase change heat transfer and mass transfer principles

UNIT – 1

INTRODUCTION

02 Hours

Modes of heat transfer: Basic laws governing conduction, convection, and radiation heat transfer; combined heat transfer mechanism, Overall heat transfer coefficient, Boundary conditions of 1st, 2nd and 3rd Kind.

CONDUCTION:

02 Hours

Derivation of general three dimensional heat conduction equation in Cartesian coordinate system, special cases, 3-D conduction in cylindrical and spherical coordinate systems (No derivation).

ONE DIMENSIONAL CONDUCTION:

05 Hours

Derivation for heat flow and temperature distribution in plane wall, hollow cylinder and hollow sphere without heat generation. Thermal resistance concept & its importance. Composite wall, cylinder and sphere, contact resistance; Critical thickness of insulation without heat generation, Heat transfer in extended surfaces of uniform cross-section without heat generation, Long fin, tip insulated fin and with heat transfer from the tip. Fin efficiency and effectiveness. Numerical problems.

UNIT – 2

ONE-DIMENSIONAL TRANSIENT CONDUCTION:

02 Hours

Conduction in solids with negligible internal temperature gradient (Lumped system analysis), Use of Transient temperature charts (Heisler's charts) for slab, long cylinder and sphere, Numerical Problems.

CONCEPTS AND BASIC RELATIONS IN BOUNDARY LAYERS:

04 Hours

Flow over a body velocity boundary layer; critical Reynolds number; general expressions for drag coefficient and drag force; thermal boundary layer; general expression for local heat transfer coefficient; Average heat transfer coefficient; Nusselt number. Flow inside a duct- velocity boundary layer, hydrodynamic entrance length and hydro dynamically developed flow. Numericals based on empirical relation given in data handbook.

FREE OR NATURAL CONVECTION:

04 Hours

Application of dimensional analysis for free convection- physical significance of Grashoff number; use of correlations of free convection in vertical, horizontal and inclined flat plates, vertical and horizontal cylinders and spheres, Numerical problems.

UNIT - 3

FORCED CONVECTIONS:

05Hours

Applications of dimensional analysis for forced convection. Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Use of various correlations for hydro dynamically and thermally developed flows inside a duct, use of correlations for flow over a flat plate, over a cylinder and sphere. Numerical problems.

HEAT EXCHANGERS:

05 Hours

Classification of heat exchangers; overall heat transfer coefficient, fouling and fouling factor; LMTD, Effectiveness-NTU methods of analysis of heat exchangers. Numerical problems.

UNIT – 4

RADIATION HEAT TRANSFER:

06Hours

Thermal radiation; definitions of various terms used in radiation heat transfer; Stefan-Boltzmann law, Kirchhoff's law, Planck's law and Wien's displacement law. Radiation heat exchange between two parallel infinite black surfaces, configuration factor or view factor, intensity of radiation and solid angle; Lambert's law; radiation heat exchange between two parallel infinite gray surfaces; effect of radiation shield (only discussion on non black surfaces); Numerical problems.

CONDENSATION AND BOILING:

04Hours

Types of condensation (discussion only) Nusselt theory for laminar condensation on a vertical flat surface (no derivation); use of correlations for condensation on vertical flat surfaces, horizontal tube and horizontal tube banks; Reynolds number for condensate flow; regimes of pool boiling, pool boiling correlations. Numerical problems.

TEXT BOOKS

1. Heat Transfer – A Basic approach by M. Necati Ozisik Tata Mc Graw Hill International ed. 1998
2. Heat Transfer – A Practical approach by Yunus A. Cenegal Tata Mc Graw Hill 2002

REFERENCE BOOKS

1. Heat Transfer by Tirumaleshwar, Pearson education, 2006
2. Principles of Heat Transfer by Kreith Thomson learning 2001
3. Fundamentals of Heat and Mass transfer By Frank P. Incropera and David P. Dewitt Johm Wiley and Sons 4th ed. 1995
4. Heat transfer, P.K. Nag, Tata Mc Graw Hill 2002

Scheme of Examination:

1 Eight questions to be set selecting two questions from each Unit.
2 Each question carries 20 marks.
3 Five questions to be solved selecting at least one question from each Unit.

UME 640 C: Engineering Economics
03 Credits (3-0-0)

Semester: 06
Total Teaching Hours: 40

COURSE OBJECTIVES:
The objectives of this course are to:

1. **CO1:** Introduce various concepts and methods of economic analysis in engineering, including the time value of money and its effect on economic decisions making.
2. **CO2:** Economic equivalence, economic measures of worth, cash flow analysis, equipment depreciation, replacement decisions, and cost accounting.
3. **CO3:** Prepare engineering students to analyze profit/revenue data and carry out make economic analysis in the decision making process to justify or reject alternatives/projects.
4. **CO4:** Learn the basics of finance, finance functions and ratio analysis.

COURSE OUTCOME:
1. Describe the role of economics in the decision making process and develop the ability to account for time value of money using engineering economy factors and formulas.
2. Evaluate the economic worth of alternatives based on their present worth, annual equivalent-worth, rate-of return.
3. Exhibit knowledge about the basic components of depreciation, estimation and costing.
4. Accrue the knowledge of financial functions, accounting & financial statements
5. Analyze the different financial ratios and draw inference.

Unit-I

Introduction:

5 Hours

Engineering and Economics, Definition, Engineering Decision-Makers, Problem solving and Decision making, Law of demand and supply, Law of returns, Interest and Interest factors: Interest rate, Simple interest, Compound interest, Cash - flow diagrams, Personnel loans and EMI Payment, Exercises and Discussion.

Present Worth Comparisons:

5 Hours

Conditions for present worth comparisons, Basic Present worth comparisons, Present worth equivalence, Net Present worth, Assets with unequal lives, infinite lives, Future worth comparison, Pay-back comparison, Exercises and problems.

Unit-II

Equivalent Annual worth Comparisons:

5 Hours

Equivalent Annual Worth Comparison methods, Situations for Equivalent Annual Worth Comparisons, Consideration of asset life, Comparison of assets with equal and unequal lives, Use of shrinking fund method, Annuity contract for guaranteed income, Exercises, Problems.

Rate of Return Calculations:

5 Hours

Rate of return, Minimum acceptable rate of return, IRR, IRR misconceptions, Problems.

Unit-III

Depreciation:

5 Hours

Causes of Depreciation, Basic methods of computing depreciation charges, Tax concepts and types of tax.

Estimating and Costing:

5 Hours

Components of costs such as Direct Material Costs, Direct Labor Costs, Fixed Over-Heads, Factory cost, Administrative Over-Heads, First cost, Marginal cost, Selling price, Estimation for simple components.

Unit-IV

Introduction, Scope of Finance, Finance Functions:

5 Hours

Statements of Financial Information: Introduction, Source of financial information, financial statements, Balance sheet, Profit and Loss account, relation between Balance sheet and Profit and Loss account.

Financial Ratio Analysis:

5 Hours

Introduction, Nature of ratio analysis, Liquidity ratios, Leverage ratios, Activity ratios, Profitability ratios, Evaluation of a firm's earning power. Comparative statements analysis.

Text Books:

1. Engineering Economy, Riggs J.L., McGraw Hill, 2002
2. Engineering Economy, Thuesen H.G., PHI, 2002

Reference:

1. Financial Management, I M Panday, Vikas Publishing House 2002
2. Engineering Economy, Paul Deoarmo, Macmillan Publishers, Co., 2001

Scheme of Examination:

Eight questions to be set selecting two questions from each Unit.
Each question carries 20 marks.
Five questions to be solved selecting at least one question from each Unit.

UME 641 C: Project Management
03 Credits (3-0-0)

Semester: 06
Total Teaching Hours: 40

Unit – I

Projects in Contemporary Organisation:
5 Hours

Definition, Why Project Management, Project Life Cycle, Project Management and the Project manager, Selecting the Project manager, Impact of Institutional Environment, Demands/duties of a Project manager, Information needs and the reporting process.

Market and Technical Appraisal:

5 Hours

Introduction to Market Survey, Steps in Market survey, Demand Forecasting, Uncertainties in Demand forecasting, Choice of Technology for Production, Plant Capacity, Machinery and Equipment.

Unit – II

Project Initiation: Strategic Management and Project Selection

5 Hours

Project Proposals, Numeric and Non-Numeric models for project selection, Criteria for choice for project selection, Nature of project selection models, Risk analysis of project under uncertainty.

Project Initiation: Project Organisation and Planning

5 Hours

Functional Organisation, Project Organisation, Matrix Organisation, Mixed Organisation systems, Organising Risk Management, Steps in Project planning, Project plan elements.

Unit – III

Project Implementation: Scheduling and Control

5 Hours

Introduction to project scheduling, Network Techniques: PERT and CPM, Calculation of activity time, Critical path and time, Precedence Diagramming, Introduction to project control, Objectives/Purposes of project control, Types of project control process.

Project Implementation: Budgeting and Cost Estimating

5 Hours

Estimating project budgets: Top-Down budgeting, Bottom-Up budgeting, Work Element costing, An Iterative budgeting process.

Unit - IV

Project Auditing:

5 Hours

Purposes or Need of evaluation, the project audit, the project audit life cycle, Audit report: Preparation and Use.

Project Termination:

5 Hour s Varieties of project termination, Termination by Extinction, Termination by Addition, Termination by Integration, Termination by Starvation, When to terminate a project, Termination process, Final report of project history.

Reference Books:

1. "Project Management: A Managerial Approach", Jack R. Meredith, Samuel J. Mantel JR, Wiley India Edition. Fifth Edition.
2. "Projects: Preparation, Appraisal, Budgeting and Implementation", Prasanna Chandra, Tata McGraw Hill Publishing Company Limited, New Delhi, Third Edition.
3. "Project Management", Dennis Lock, Publisher: Taylor & Francis.9th Edition.

UME 604 H: Operation Research
03 Credits (3-0-0)

Semester: 06
Total Teaching Hours:40

COURSE OUTCOMES:

- **CO1:** To have the knowledge about role of operations research in formulating the problem and solution to by mathematical model for the areas of production, distribution of goods and economics etc.
- **CO2:** To understand variety of other problems of operations research like assignment, transportation, travelling salesman etc.
- **CO3:** To identify the resources required for a project and generate a plan and use CPM and PERT techniques, to plan, schedule, and control project activities.
- **CO4:** To solve the game theory problems for the conflicts situation management and know the replacement policies of varied items.

UNIT – 1

INTRODUCTION

2 Hours

Definition, scope of Operations Research (OR) approach and limitations of OR Models, Characteristics and phases of OR

LINEAR PROGRAMMING PROBLEMS

9 Hours

Linear programming, graphical method, simplex method, Two-phase method, duality theory, dual simplex method.

UNIT – 2

TRANSPORTATION PROBLEMS

6 Hours

Mathematical model for Transportation problem, balanced and unbalanced transportation problem. Methods to solve transportation problem, finding basic feasible solution, testing solution for optimality

ASSIGNMENT PROBLEMS

4 Hours

Formulation, unbalanced assignment problem, travelling salesman problem

UNIT - 3

SEQUENCING

4 Hours

Johnson's algorithm, n - jobs to 2 machines, n - jobs 3machines, n -jobs m machines without passing sequence. 2 jobs n machines with passing. Graphical solutions priority rules.

PERT-CPM TECHNIQUES:

5 Hours

Project network construction, Critical Path Method (CPM), determination of critical path, Project Evaluation and Review Technique (PERT), probability of completing a project in a scheduled date.

UNIT – 4

GAME THEORY

5 Hours

Laws of Probability, Formulation of games, two people-Zero sum game, games with and without saddle point, Graphical solution (2x n, m x 2 game), and dominance property.

REPLACEMENT MODELS

5 Hours

Introduction, replacement of items whose maintenance and repair costs increase with time, ignoring changes in the value of money during the period, replacement of items whose maintenance costs increase with time and value of money also changes with time, replacement of items that fail suddenly, group replacement policy.

TEXT BOOKS:

1. Operations Research, Prem Kumar Gupta, D S Hira, 3rd Edition, S Chand and Company Ltd., New Delhi, 2008.
2. Operations Research, Panneerselvam R, Prentice – Hall of India, New Delhi, 2002

REFERENCE BOOKS:

1. Operation Research AM Natarajan, P. Balasubramani, A Tamilaravari Pearson 2005
2. Operations Research, S. D. Sharma, Kedarnath Ramanath and Co, 2002

Scheme of Examination:

1. Eight questions to be set selecting two questions from each Unit.
2. Each question carries 20 marks.
3. Five questions to be solved selecting at least one question from each Unit.

UHS003N: CAREER PLANNING AND PROFESSIONAL SKILLS

1 Credits (2-0-0)

Course Objectives:

1. To enhance the ability to think and reason critically
2. To augment the student's attention to detail and problem-solving skills in basic computations
3. To successfully handle personal interviews and enhance public speaking skills

UNIT-I

Reasoning Ability: Boolean Logic, Cryptarithms, Critical Reasoning, Verbal and Non-Verbal Reasoning

07 Hours.

UNIT-II

Written & Spoken English: Reading Comprehension, Sentence Completion, Recap of sounds and stress, Pausing and Rhythm

08 Hours .

UNIT-III

Mathematical Thinking: Taking Time to Work with Distances, Permutations, Probability, Data Sufficiency

07 Hours .

UNIT-IV

Interview Skills: Mock GDs, Résumé Writing, FAQs in HR Interviews, Interview Etiquette, Team & Leadership Skills

08 Hours .

Total Hrs.: 30

Course Outcomes:

After active participation in this course, the student will have

CO1: learnt to handle personal interviews successfully

CO2: enhanced the usage and understanding of the various structures in the English Language

CO3: augmented his/her leadership and team workmanship skills

CO4: understood analysis of the given problem and learnt to develop a method for solving it

CO5: enhanced and augmented his/her ability to work with quantitative problems

REFERENCE BOOKS:

1.R. S. Aggarwal, "A Modern Approach to Verbal and Non – Verbal Reasoning", Sultan Chand and Sons, New Delhi, 2018

2.R. S. Aggarwal, "Quantitative Aptitude", Sultan Chand and Sons, New Delhi, 2018

3.Chopra, "Verbal and Non – Verbal Reasoning", MacMillan India

4.M Tyra, "Magical Book on Quicker Maths", BSC Publications, 2018

5.Edward De Bono, "Lateral Thinking", Penguin Books, New Delhi, 2016

Evaluation Methodology:

Continuous Internal Evaluation:
2CIEs with40 Objective Questions in 75 minutes(2 x 20 marks)
1 assignment of 10 marks (in class oral/written conduction in the form of GD/test)

Semester Ending Examination: 50 Objective Questions in 90 minutes covering entire syllabus

UME 637 L: HEAT & MASS TRANSFER LABORATORY

2 Credits (0 – 0 – 3)

Semester: 06

Total Teaching Hours:

Course objectives

CO1: To Define, Apply and Analyze unidirectional conduction heat transfer problems.

CO2: To Define, Apply and Analyze transient heat transfer problems and fluid flow fundamentals to natural and forced convection heat transfer problems.

CO3: To Define, Apply and Analyze forced convection and heat exchanger problems.

CO4: To Define, Apply and Analyze heat radiation and phase change heat transfer problems.

Course Outcomes:

- To be able to Define, apply and analyze conduction heat transfer principles
- To be able to Define, apply and analyze transient heat 40 transfer principles
- To be able to Define, apply and analyze forced and free convection heat transfer principles
- To be able to Define, apply and analyze the heat radiation, phase change heat transfer and mass transfer principles

PART – A

21 Hours

1. Determination of Thermal Conductivity of a Metal Rod.
2. Determination of Overall Heat Transfer Coefficient of a Composite wall.
3. Determination of Effectiveness on a Metallic fin.
4. Determination of Heat Transfer Coefficient in a free Convection on a vertical tube.
5. Determination of Heat Transfer Coefficient in a Forced Convention Flow through a Pipe.
6. Determination of Emissivity of a Surface.

PART – B

21 Hours

1. Determination of Stefan Boltzman Constant.
2. Determination of LMDT and Effectiveness in a Parallel Flow and Counter Flow Heat Exchangers
3. Experiments on Boiling of Liquid and Condensation of Vapour
4. Performance Test on a Vapour Compression Refrigeration.
5. Performance Test on a Vapour Compression Air – Conditioner
6. Experiment on Transient Conduction Heat Transfer

Scheme of Examination:

One Question from Part A – 20 Marks (05 Write up +15)

One Question from Part B – 20 Marks (05 Write up +15)

Viva-Voce – 10 Marks

Total 50 Marks

UME 608 L: DYNAMICS LABORATORY

1 Credits (0 – 0 – 2)

Semester: 06
Total Teaching Hours:

Course Objectives:

- To understand degree of freedom, Types of vibrations (longitudinal and Torsional)
- To understand the importance of Damping logarithmic decrement frequency by conducting experiments
- To analyse the gyroscopic principal and its various parameters experimentally
- To construct Mohr's circle by conducting experiment on strain rosette guage
- To study the fringe patterns on the photo elastic material with the help of polariscope
- To Know the various characteristics of the different governor by plotting the graphs
- To calculate critical speed for the shaft subjected to various speed and observe various mode shapes.
- To verify the balancing of rotating mars in different plane experimentally.

Course Outcomes:

- Students are able to understand Degree of freedom and distinguish longitudinal vibration and Torsional Vibration.
- Students realize the importance of damping
- Students will be observe the working of gyroscopic principal
- Students will observe the various fringe pattern from photo elastic material and calculate fringe constant.
- Student will study the effect of speed on sleeve displacement and of rotation in various governors.
- Students will observe the critical speed and relate with theoretical speed.
- Students will able to understand loading at different planes and verify the force and verify the force and couple polygon experimentally.

PART – A

1. Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in
    a. single degree of freedom vibrating systems (longitudinal and torsional)
2. Balancing of rotating masses.
3. Determination of critical speed of a rotating shaft.
4. Determination of Fringe constant of Photo elastic material using.
5. Circular disc subjected to diametric compression.
6. Pure bending specimen (four point bending)
7. Determination of stress fringe constant using Photo elasticity for simple components like plate with a hole under tension or bending, circular disk with circular hole under compression.

PART – B

1. Determination of equilibrium speed, sensitiveness, power and effort of Porter/Prowel /Hartnel Governor. (Only one or more)
2. Determination of Pressure distribution in Journal bearing.
3. Determination of Principal Stresses and strains in a member subjected to combined loading using Strain rosettes.
4. Determination of natural frequency of compound pendulum.
5. Experiments on Gyroscope

PART – C

Use of MAT Lab software for solving 06 typical problems in Vibration and Control Engineering

Scheme of Examination:

One question from Part A – 20 Marks (05 Write up +15)
One question from Part B or Part C – 20 Marks (05 Write up +15)
Viva – Voce – 10 Marks
Total: 50 Marks

UME 610 P: Mini Project
1 Credits (0 – 0 – 2)

Semester: 06
Total Teaching Hours:

Course Objective and outcomes:

To explore the problems in the society ,Industry, Agriculture etc and plan and design the solution

Project outcome

Literature Survey

Project problem definition

Submission of project proposal

Scheme of examination
CIE – 50 Marks
Project Report + Submission

SEE – 50 Marks
Presentation Viva-voce

7th Semester Syllabus

2018-19

Regular 19-20 Lateral Admitted Students

UME 701 C: Finite Element Methods
4 Credits (2 – 2 – 0)

Semester: 07
Total Teaching Hours: 40

Course Objectives:

- To equip the students with the Finite Element Method.
- To enable the students to formulate the design problems into FEA.
- To introduce basic aspects of finite element technology, including domain discretization, polynomial
- Interpolation, application of boundary conditions, assembly of global arrays, and solution of the
- Resulting algebraic systems.

COURSE OUTCOME:

- **CO1:**To obtain an understanding of the fundamental theory of the FEM method;
- **CO2:**To develop the ability to generate the governing FE equations for systems governed by partial
  differential equations;
- **CO3:**Formulate simple problems into finite elements
- **CO4:**Derive element stiffness matrix equations by different methods by applying basic laws of mechanics.
- **CO5:**To understand the use of the basic finite elements for structural applications using truss, beam, frame, and plane elements.
- **CO6:**To understand the use of of the basic finite elements for heat transfer applications
- **CO7:**To understand the application and use of the FE method for engineering problems.

Unit – 1

12 Hours

Introduction: Equilibrium equations in elasticity subjected to body force, traction forces, stress strain relations for plane stress and plane strain, Boundary conditions, Initial conditions, Euler's Lagrange's equations of bar, beams, Principle of a minimum potential energy, principle of virtual work, Rayleigh-Ritz method Galerkins method and Matrix techniques .

Basic Procedure: General description of Finite Element Method, , Discretization process; types of elements 1D, 2D and 3D elements, size of the elements, location of nodes, node numbering scheme, half Bandwidth, Stiffness matrix of bar element by direct method, Properties of stiffness matrix, Preprocessing, post processing. Engineering applications of finite element method. Advantages & Disadvantages of FEM.

Unit – 2

12 Hours

Interpolation Models: Polynomial form of interpolation functions- linear, quadratic and cubic, Simplex, Complex, Multiplex elements, Selection of the order of the interpolation polynomial, Convergence requirements, , static condensation. penalty approach and elimination method.

one dimensional bar element: Recall of 1D linear bar element. Lagrangian interpolation, Higher order one dimensional elements- quadratic, Cubic element and their shape functions, properties of shape functions, Effect of temperature on 1D elements and stress calculation.

Unit -3

12 Hours

TWO dimensional elements: Shape functions and stiffness matrix of 2D elements four-Node quadrilateral, Nine-Node quadrilateral Eight-Node quadrilateral, serendipity and lagrange comparison with 2D pascals triangle. CST and LST shape functions , jacobian matrix , stiffness matix, force terms, stress calculation and Numerical integration. Introduction to 3-D elements shape function of tetrahedron element.

Unit -4

12 Hours

TRUSSES AND BEAM ELEMENTS: Analysis of trusses and beam elements its shape functions, stiffnes matrix and stress calculation

Heat Transfer Problems: Steady state heat transfer, 1D heat conduction governing equation, boundary conditions, One dimensional element, Functional approach for heat conduction, Galerkin approach for heat conduction, heat flux boundary condition, 1D heat transfer in thin fins.

Text Books:

1. Finite Elements in engineering, Chandrupatla T.R., 3rd Pearson Edition.
2. Finite Element Analysis, C.S.Krishnamurthy,–Tata McGraw Hill Publishing Co. Ltd, New Delhi, 1995.
3. “Fundamental Finite Element Analysis and Application” by “Asghar Bhatti” by PageTurner 2013.
4. “Advanced Topics in Finite Element Analysis of Structures with Mathematica and MATLAB Computations” by
M. Asghar Bhatti by PageTurner 2013.

Reference Books:

1. The FEM its basics and fundamentals: O.C.Zienkiewicz, Elsevier, 6e.
2. Finite Element Method, J.N.Reddy, McGraw –Hill International Edition.
3. Finite Element Methods, by Daryl. L. Logon, Thomson Learning 3rd edition, 2001.
4. Finite Element Analysis, by H.V. Lalshminarayana, universities press, 2004.

Scheme of Examination:

1. Eight questions to be set selecting two questions from each Unit.
2. Each question carries 20 marks.
3. Five questions to be solved selecting at least one question from each Unit

UME 705L: C A E Laboratory
1 Credits (1 -0 -2)

Semester: 07
Total Teaching Hours:

Course Objectives:

- To equip the students with the Finite Element analysis fundamentals.
- To enable the students to formulate the design problems into FEA.
- To introduce basic aspects of finite element technology, including domain discretization, polynomial interpolation, application of boundary conditions, assembly of global arrays, and solution of the resulting algebraic systems.

Course Outcome:

- **CO1:** To demonstrate the ability to create models for trusses, frames, plate structures, machine parts, and components using ANSYS general-Purpose software;
- **CO2:** To model multi-dimensional heat transfer, flow analysis, model problems and harmonic problems using ANSYS;
- **CO3:** To demonstrate the ability to evaluate and interpret FEA analysis results for design and evaluation purpose;
- **CO4:** To develop a basic understanding of the limitations of the FE method and understand the possible error sources in its use.

UNIT – I

Study of a FEA package and stress analysis of

a. Trusses – (Minimum 2 exercises).

b. Beams – Simply supported, cantilever beams with UDL and with varying load.

UNIT – II

a. Stress analysis of a rectangular plate with a circular hole.

b. Thermal Analysis – 2D problem with conduction and convection boundary conditions.

c. Fluid flow Analysis – Potential distribution in the 2D bodies.

d. Dynamic Analysis

1) Fixed – fixed beam for natural frequency determination.
2) Bar subjected to forcing function.
3) Fixed – fixed beam subjected to forcing function.

REFERENCE BOOKS:

1. A first course in the Finite element method by Daryl L Logan, Thomason, Third Edition.
2. Fundaments of FEM by Hutton – McGraw Hill, 2004.
3. Finite Element Analysis by George R. Buchanan, Schaum Series.

Scheme for Examination:

One Question from Unit I	-	15Marks
One Question from Unit II	-	25Marks
Viva-Voce	-	10 Marks
Total	-	50 Marks

UME 826 L: CNC Laboratory
(1 Credits)

Course Objectives:

The objectives of this course are to:

- To introduce the concepts and capabilities of computer numerical control machine tools.
- To learn basic CNC programming using G codes and M codes
- To learn the working of CNC using different drives
- To develop simple products using CNC programming

Course Learning Outcomes/Competencies:

Upon successful completion of this course, the students will be able to:

- **CO1:** Understand the basic procedures and concepts of programming, set up and operation of a CNC Machining Center.
- **CO2:** Identify and understand the basic programming codes.
- **CO3:** Create geometry and tool paths from the specifications for simple parts
- **CO4:** Identify and define the functions of the CNC machine control.
- **CO5:** Set up the CNC machining center for manufacturing simple parts
- **CO6:** Manufacture simple parts on the CNC machining center.

List of Experiments
Part-A

1. Programming on lathe for facing
2. Programming on lathe for simple turning
3. Programming on lathe for step turning
4. Programming on lathe for groove cutting

Part-B

5. Programming on milling with drill tap attachment for facing
6. Programming on milling with drill tap attachment for drilling
7. Programming on milling with drill tap attachment for tool path movement

Laboratory Assessment:

1. Each laboratory subject is evaluated for 100 marks (50 CIE and 50 SEE).
2. The CIE in laboratory in classes is carried out for 50 marks (30 marks for the performance and term work)
3. For remaining 20 marks, practical test to be conducted for execution of two programs, each carrying 7.5
   marks and 05 marks for viva voce.
4. The SEE practical is conducted for 50 marks of three hour duration two question to be set from each
Part A, Part B. Student has to answer one question each from Part A and Part B for 20 marks each and 10 marks for viva voce.

UME 711 P: PROJECT PHASE – I
5 Credits (5 days, daily 2 Hours)

Course Objective and outcomes:

The explore the problems in the society ,Industry, Agriculture etc plan and design the solution

- Literature Survey
- Project problem definition
- Submission of project proposal

Scheme of examination

CIE – 50 Marks
SEE – 50 Marks Presentation Viva-voce

UME 713 E: NON DESTRUCTIVE TESTING
3 Credits (3-0-0)

Semester: 07
Total Teaching Hours: 40

- Course Outcome:
- To have a basic knowledge of surface N D E techniques which enable to carry out
- various inspection in accordance with the established procedures.
- Differentiate various defect types and select the appropriate N D T methods for
- better evaluation.
- Documentation of the testing and evaluation of the results for further analysis.
- Students will be able to understand significance and suitability of various non
- destructive testing methods in industrial application.

UNIT-I

Introduction to NDT Testing: 9 Hours

Information gathered from NDT, Defects in manufacturing Advantages and disadvantages of NDT, Comparison of destructive & Non-destructive tests, Methods of NDT, Common application of NDT, Flaw detection & evaluation, leak detection & evaluation, Non Destructive Evaluation, visual inspection. Replication microscopy technique for Non Destructive Evaluation: Specimen preparation, replication techniques, and micro structural analysis

UNIT-II

Liquid Penetrant Inspection: 9 Hours

Principles, penetrant methods, procedure, materials used, equipment, parameters and applications Magnetic Particle Inspection: Principle, general procedure, advantages & limitations,applications , magnetic field generation, types of magnetic particles and suspension liquids, Direction of the Magnetic Field ,Importance of Magnetic Field Direction

UNIT-III

Radiography Inspection: 9 Hours

principle, X-ray radiography, equipment, Gamma-ray radiography, real time radiography & film radiography , radiation safety ,advantages, disadvantages and applications of radiography Computed tomography: Principles, capabilities, comparison to other NDE methods, CT equipments, industrial computed tomography applications

UNIT-IV

Ultrasonic inspection: 12 Hours

Basic equipment, advantages & limitations, inspection methods pulseecho A, B, C scans transmission transducers & couplantsThermal Inspection: Principles, equipment, inspection methods applications Eddy Current
Inspection: Principles of operation, procedure, advantages & limitations, operating variables, inspection coils, eddy current instruments, application examples

UME 721 E: ADVANCED MANUFACTURING TECHNOLOGY
3 Credits (3-0-0)

Semester: 07
Total Teaching Hours: 40

COURSE OBJECTIVES :

The objective of the course is to provide the students with knowledge of various selected advanced manufacturing topics for state of the art manufacturing industry.

1. The topics are presented from a fundamental scientific perspective, and further developed to consider systems level and integration with other process within the manufacturing enterprise.
2. The knowledge of engineering materials and especially the use of advanced composites in design and manufacturing industry. The practice of product life cycle management from the concept to the proto typing and manufacturing. The PDM deals with the service of the products at the customer centric engineering.
3. The topics concerned to the plant layout design and the material handling equipments provide the insight to the development of newer approaches in the design of plant layout and material handling.
4. The basic knowledge pertaining to project management have been introduced to understand the concepts, types and applications of the project management.
5. Entrepreneurial in contributing to innovation and development within their business, workplace or community
6. Effective and ethical in work and community situations Adaptable and able to manage change, and Aware of local and international environments in which they will be contributing (e.g. socio-cultural, economic, natural)

COURSE OUTCOMES:

1. The learner is to develop capacity to integrate the knowledge and to analyse, evaluate and manage the different aspects of the recent developments in manufacturing.
2. The learner should demonstrate the application of modern materials by incorporating the properties and characteristics.
3. Capacity to obtain and analyse the possibilities of changing layout design based on the type of manufacturing.
4. Develop a knowledge to understand and analyse the types of layouts corresponding to the volume of production. Ability to make decision about the right type of material handling system and control.
5. Capacity to perform research analyses on human behavior in manufacturing environment related to professional and engineering ethics.

Ability to understand the requirements for the preparation of patent and patent filing.

Unit-1

10 Hours

Introduction: Introduction to CAD/CAM, product system facilities: Low, medium and high, Manufacturing support systems, Automation in production systems: Automated manufacturing

systems, Computerized manufacturing systems, Reasons for automating, Automation principles and strategies.

Advances in CAM: Tool path generation, CNC machine programming, Reverse engineering, Rapid prototyping, Rapid tooling, Virtual reality applications in product development

Unit-2

10 Hours

Modern materials and alloys: Advanced composites: Particulate and dispersion composites, Metal matrix and ceramic composites, Carbon-carbon composites, Smart and nano materials.

.

05 Hours

Product life cycle management: Introduction, Product information, PLM framework, Benefits, Implementation, Enabling technologies, Example of business problem. Product data management: Evolution of PDM systems, Scope, Benefits, Implementation, Software capabilities, software functions.

Unit-3

10 Hours

Plant Layout and Material Handling: Objectives, types, computerized layout. Types of material Handling equipments, Analysis of material handling systems, AGV system.

Project management: Concept, categories of projects, Phases of project life cycle, Roles and responsibilities of project leader, Tools and techniques of project management.

Unit-4

10 Hours

Professional ethics: Engineering ethics: Meaning, basic and scope of professional ethics. Generic concerns: Responsibility, reasonable care, good works, implements to responsibility. Honesty, Integrity and reliability, Ways of misusing truths, why is dishonesty is wrong? Integrity in engineering research and testing. Risk, safety and liability, liability towards client, society and environment.

Intellectual Property Rights: Meaning and different forms of IPR, Patents: Introduction, criteria for patentability, Patentable and non-patentable invention, Advantages of patent to inventor, Infringement of patent, Remedies for infringement, Patent filing.

Text Books:

1. Groover M. P., Automation, Production Systems and CIM, Prentice Hall of India, 2008.
2. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill, 2008.
3. P. Ramarao, Advanced Materials and Their Applications, Wiley Eastern
4. Harris Charles, Engineering Ethics, ThemasIndia, NewDelhi, 2005
5. R. Radhakrisnan, S. Balasubramanian, Intellectual Property Rights.

Reference:

1. P. N. Rao, CAD/CAM Principles and Applications, 2nd Edition
2. Apple, Plant layout and Material Handling

Scheme of Examination:

Two questions from each unit to be set.

CIE Marks: 50
SEE Marks: 10

UME 712 E COMPOSITE MATERIALS
3 Credits (3 – 0 – 0)

Semester: 07
Total Teaching Hours: 40

Course objectives:

- To Understand composites, matrix and reinforcement, and know the types, benefits and properties of composites.
- To understand polymer matix composites, their production methods, applications
- To understand metal matix composites, their production methods, applications
- To know the mechanics of composite materials, solve the numerical on modulus of rigidity, cutting and joining of composite materials.

Course Outcomes:

- To be able to define the composites, matrix and reinforcement, the types, benefits and properties of composites.
- To be able to explain polymer matix composites, their production methods, applications
- To be able to define and explain metal matix composites, their production methods, applications
- To be able to understand the mechanics of composite materials, solve the numerical on modulus of rigidity, cutting and joining of composite materials.

UNIT I

Introduction to composite materials

10 hours

Definition and classification of composites based on matrix and reinforcement, Characteristics of composite materials, Fibrous composites, Laminate composites and particulate composites. Factors which determine the properties of composites, Benefits of composites, properties and types of reinforcements and matrices, Reinforcement-matrix interface. -

UNIT II

Polymer matrix composites **10 hours**

Introduction, Polymer matrices, Processing methods like Lay up and curing, open and closed mold process- hand lay up techniques, laminate bag molding, production procedures for bag molding, filament winding, pultrusion, pulforming, thermo-forming, molding methods, properties of PMCs and applications, Some commercial PMCs. -

UNIT III

Metal matrix composites **10 hours**

Introduction, Metallic matrices, Classification of MMCs, Need for production of MMCs, Interface reactions, processing methods like Powder metallurgy, diffusion bonding, Melt stirring, Compo/Rheo casting, Squeeze casting, Liquid melt infiltration, Spray deposition and Insitu Processes, Properties of metal matrix composites, Applications, Some commercial MMCs.-

UNIT IV

Mechanics of composite materials **10 hours**

Continuous fibers, Iso-stress condition, Iso-strain condition, critical volume fraction of fiber and minimum volume fraction of fiber, Numericals on modulus of rigidity, and mechanics of discontinuous fibers, stress Vs strain curves for PMCs, MMCs, and CMCs.
Cutting and machining of composites: Reciprocating knife cutting, cutting of cured composite,
Joining of composites: Mechanical fastening, Adhesive bonding .-

Text Books

1) Composite Science and Engineering By K. K. Chawala Springer Verlag 1998.
2) Introduction to composite materials by Hull and Clyne, Cambridge University Press, 2nd edition, 1990.
3) Composite Materials: Engineering and Science – F. L. Mathew and R. D. Rawlings, Woodhead Publishing Limited

Reference Books

1) Meing Schwaitz, "Composite materials hand book", McGraw Hill Book Company. 1984
2) Composite Materials-Production Properties, Testing and Applications-Narosa Publishing House
3) Robert M. Jones, "Mechanics of Composite Materials", McGraw Hill Kogakusha Ltd. 1998.
4) Forming Metal Hand Book 9th edition, ASM Hand Book, and v15. 1998, P327-38.
5) Mechanics of composites by Artar Kaw, CEC Press, 2002
6) Composite materials By S.C. Sharma Publishing House, 200.

Principles of composite materials mechanics By Ronald F. Gibson, Mc Graw Hill International, 1994

Scheme of Examination:

Two questions from each unit to be set.

CIE Marks: 50

SEE Marks: 100

UME727E Control Engineering
3 Credits (3 – 0 – 0)

Semester: 07
Total Teaching Hours: 40

Course objectives:

- To study the fundamental concepts of Control systems and mathematical modeling of the system.
- To study the concepts of block diagrams & signal flow graph and the basic concepts of proportional, integral, and derivative (PID) control.
- To study the characteristics of closed-loop control systems, including steady-state and transient response, parametric sensitivity, disturbances, error, and stability.
- To learn the basic performance criteria for first and second order systems.
- To learn the basics of stability analysis of the system.

Course outcomes:

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

- Understand the basic concepts and application of control system and demonstrate the fundamentals of feedback control systems.
- Determine and use models of physical systems in forms suitable for use in the analysis and design of control systems.
- Determine the time and frequency-domain responses of first and second-order systems to step and sinusoidal (and to some extent, ramp) inputs.
- Analyze the absolute stability of a closed-loop control system like RH criteria, Polar, Nyquist and Bode.
- Apply root-locus technique to analyze and design control systems.
- Express and solve system equations in state-variable form (state variable models).

UNIT – 1

INTRODUCTION

5 Hours

Concept of automatic controls, open and closed loop systems, concepts of feedback, requirement of an ideal control system. Types of controllers – Proportional, Integral, Proportional Integral, Proportional Integral Differential controllers.

MATHEMATICAL MODELS:

5 Hours

Transfer function models, models of mechanical systems, hydraulic systems.

UNIT – 2

BLOCK DIAGRAMS AND SIGNAL FLOW GRAPHS:

5 Hours

Transfer Functions definition, function, blocks representation of system elements, reduction of block diagrams, signal flow graphs: Mason's gain formula.

TRANSIENT AND STEADY STATE RESPONSE ANALYSIS:

5 Hours

Introduction, first order and second order system response to step, ramp and impulse inputs, concepts of time constant and its importance in speed of response. System stability: Routh's – Hurwitz Criterion.

UNIT – 3

FREQUENCY RESPONSE ANALYSIS:

8 Hours

Polar plots: Stability Analysis, Relative stability concepts, phase and gain margin, Bode Plots: stability analysis using Bode plots, Simplified Bode Diagrams.

UNIT – 4

ROOT LOCUS PLOTS:

6 Hours

Definition of root loci, general rules for constructing root loci, Analysis using root locus plots.

STATE SPACE VARIABLES:

4 Hours

Introduction to multi input multi output systems, Observability and control ability criteria

CONTROL ACTION AND SYSTEM COMPENSATION:

2 Hours

Series and feedback compensation, Physical devices for system compensation.

UMEXXXE: TOOL DESIGN
3 Credits (3 – 0 – 0)

Semester: 07
Total Teaching Hours: 40

Course outcomes

After successful completion of course the students should understand,

1. The design procedure and design of cutting tools
2. Locating and clamping methods and design of jigs
3. Design of fixtures and their economy
4. Working of press tools and press tool operations
5. Design of sheet metal bending, forming and drawing dies
6. Able to analyze the commonly used polymer tooling materials and design aspects like pressure and forces etc.,

UNIT - I

Tool Design Methods:
5 Hours

Introduction, the design procedure, drafting and design techniques in tooling drawing.

Design of Cutting Tools: **6 Hours**

Introduction, the metal cutting process, revision of metal cutting tools-single point cutting tools, milling cutters, drills and drilling, reamers, taps, selection of carbide tools, determining the insert thickness for carbide tools.

UNIT - II

Locating and Clamping Methods: **5 Hours**

Introduction, basic principle of location, locating methods and devices, basic principle of clamping.

Design of Drill Jigs: **6 Hours**

Introduction, types of drill jigs, general considerations in the design of drill jigs, drill bushings, methods of construction.

UNIT - III

Design of Fixtures: **5 Hours**

Introduction, types of fixtures, fixtures and economic.

Design of Press-working Tools:

5 Hours

Power presses, cutting operations, types of die – cutting operations and their design, evolution of blanking and progressive blanking.

UNIT - IV

Design of Sheet Metal Bending, Forming and Drawing Dies:

6 Hours

Introduction, bending dies, forming dies, drawing dies, evolution of a draw die, progressive dies and selection of progressive dies. Strip development for progressive dies, evolution of progressive

dies, examples of progressive dies. Extrusion dies, drop forging dies and auxiliary tools, problems.

Plastics as Tooling Materials:

4 Hours

Introduction, plastics common ly used as tooling materials, application of epoxy plastic tools, construction methods, metal forming operations with Urethane dies, calculating forces for Urethane pressure pads, problems.

Reference Books:

1. Cyril Donaldson, G H Lecain and V C Gold. Tool Design, 3rd edition, TMH Publishing Co. Ltd. New Delhi, 2000
2. ASTME, Fundamentals of Tool Design, PHI (P) Ltd. New Delhi, 1983
3. Rodin Cutting tool Design., Mir Publications
4. Arshinov “Metal Cutting and Tool Design”.
5. HINMAN “Press working of Metals”

Scheme of Examination:

Student has to solve any five full questions, selecting at least ONE question selecting from each unit.

UME 720 E POWER PLANT ENGINEERING

3 Credits (3 – 0 – 0)

Semester: 07
Total Teaching Hours: 40

Course Objectives:

- To define and understand the types of fuels and burning methods to produce steam.
- To define and understand ash, dust handling and chimney draught of a steam power plant.
- To define and understand the boilers, boiler accessories and performance of boilers.
- To define and understand steam turbines, cooling ponds, cooling towers and co-generation power plants.

Course Outcomes:

- CO 1: To be able to define and understand the types of fuels and burning methods to produce steam.
- CO 2: To define and understand ash, dust handling and chimney draught of a steam power plant.
- CO 3: To define and understand the boilers, boiler accessories and performance of boilers.
- CO4: To define and understand steam turbines, cooling ponds, cooling towers and co-generation
  power plants.

UNIT – I

10 Hours

Introduction: Energy and power, sources of power, Need power generation, power plant cycles and classification of power plant cycles, Classification, layout of modern steam power plant, Essentials requirements of steam power station, Selection of site for steam power station, Capacity of steam power plant, Choice of steam conditions

Steam Power Plant: Different types of fuels used for steam generation, Coal handling; Requirements of good coal handling plant, coal handling systems, equipment for burning coal in lump form, strokers, different types. Advantages and disadvantages of using pulverized fuel, equipment for preparation and burning of pulverized coal, unit system and bin system, Coal burners; Fluidized bed combustion.

UNIT – II

10 Hours

Ash and dust handling: Ash handling equipment and ash handling systems; Dust collection, Removal of smoke and dust, Dust collectors, Efficiency of dust collectors, uses of ash and dust, general layout of ash and dust collection systems, fly ash; composition, disposal and application

Chimney draught: Classification, Natural, draught, Chimney height and diameter, Condition for maximum discharge through chimney, Efficiency of chimney, Draught losses, Artificial draught; forced, induced and balanced draught, Advantages of mechanical draught. Numerical problems.

UNIT – III

10 Hours

Boilers: Classification and comparison, Selection of a boiler, Essentials of good boiler, Generation of steam using forced circulation, high and supercritical pressures, a brief account of L Mont, Benson, Velox, Schmidt, Loeffer and Ramson steam generators.

Accessories: Accessories for the Steam Generator such as super-heaters, desuperheater, control of super heaters, Economisers, Air Pre-heaters and re-heaters, feed water heaters and evaporators.

Performance of boilers: Evaporative capacity, Equivalent evaporation, Factor of evaporation, Boiler efficiency, Heat losses in a boiler plant. Numerical problems.

UNIT – IV

10 Hours

Steam turbines: Steam nozzles, nozzle efficiency, Compounding of steam turbines, Difference between impulse and reaction steam turbines, Turbine efficiencies. Steam condensers; Classification, comparison between jet and surface condensers. Numerical problems.

Cooling ponds and Cooling towers: Introduction, Natural and artificial ponds, Cooling ponds, Spray ponds. Cooling towers; Introduction, Natural and forced draft cooling towers, Comparision between natural and forced draft cooling towers. Feed water treatment; Impurities in water and troubles caused by the impurities, Methods of feed water treatment, pH value of water.

Cogeneration power plants: Classification, Topping and bottoming cycles, Advantages and disadvantages of steam power plants. **10 Hours**

TEXT BOOKS:

1. Power Plant Technology, M.M. EL-Wakil, McGraw Hill, International. 1994

2. Power Plant Engineering, R.K.Rajput, 4 th Ed. Laxmi Publications, 2008,

REFERENCE BOOKS:

1. Power Plant Engineering, P.K Nag, 3rd Ed. Tata McGraw Hill2nd ed 2001,

2. Power Plant Engineering, Domakundawar, Dhanpath Rai sons.2003

Scheme of Examination:

1. Eight questions to be set selecting two questions from each Unit.
2. Each question carries 20 marks.
3. Five questions to be solved selecting at least one question from each Unit

UME XXX E: REFRIGERATION AND AIR CONDITIONING

3 Credits (3 – 0 – 0)

Semester: 07

Total Teaching Hours: 40

UNIT – 1

BRIEF REVIEW OF VARIOUS METHODS OF REFRIGERATION:

6 Hour

Vapour compression cycle: Analysis of Vapour Compression cycle using P-H and T-S diagrams-calculations, standard rating of operating conditions, Actual vapour compression cycle, Second law analysis of Vapour Compression Cycle.

REFRIGERANTS: **4 Hours**

Types of Refrigerants, Comparative study of Ethane and Methane derivatives, of Refrigerants, Requirements of Refrigerants, Effects of lubricants in Refrigerants, substitutes of CFC Refrigerants, Mixture Refrigerants-azeotropic mixtures.

UNIT – 2

MULTI PRESSURE VAPOUR COMPRESSION SYSTEMS:

4 Hours

Multi stage compression, Multi evaporator systems, Cascade systems, calculation, production of solid carbon dioxide, System practices for multistage system.

EQUIPMENTS USED IN VAPOUR COMPRESSION REFRIGERATION SYSTEM: Compressors:

4 Hours

Principle, types of compressors, capacity control. Condensers: Types and construction, Expansion devices: Types- Automatic expansion valve, Thermostatic expansion valves, capillary tube. Sizing Evaporator: Types & construction.

UNIT -3

VAPOUR ABSORPTION SYSTEM:

5 Hours

Common refrigerant absorbent combinations, Binary mixtures, Ammonia Water Absorption system, Actual vapour absorption cycle and its representation on enthalpy. Composition diagram, calculations. Triple fluid vapour absorption refrigeration system. Water-Lithium Bromide absorption chiller.

PSYCHOMETRY OF AIR CONDITIONING PROCESS-REVIEW:

5 Hours

Review of Psychometric processes, Summer Air conditioning, Apparatus Dew point, winter air conditioning.

DESIGN CONDITIONS: Outside design conditions, choice of inside conditions, comfort chart. Choice of supply design condition.

UNIT – 4

LOAD CALCULATIONS AND APPLIED PSYCHOMETRICS:

5Hours

Internal heat gains, system heat gains, break up of ventilation load and effective sensible heat factor, Bypass factor, cooling load estimate. Psychometric calculations for cooling. Selection of Air conditioning apparatus for cooling and dehumidification, evaporative cooling.

TRANSMISSION AND DISTRIBUTION OF AIR:

Room Air Distribution, Friction loss in ducts, dynamic losses in ducts, Air flow through simple Duct system, Duct design.

CONTROLS IN REFRIGERATION AND AIR CONDITIONING EQUIPMENTS:

6 Hours

High pressure and low pressure cut out, thermostats, pilot operated solenoid valve, motor controls, bypass control-Damper motor. VAV controls.

TEXT BOOKS:

1. Refrigeration and Air-Conditioning' by C. P. Arora, Tata McGraw Hill Publication, 2nd edition, 2001.
2. Refrigeration and Air-Conditioning' by W. F. Stoecker, Tata McGraw Hill Publication, 2nd edition, 1982.

REFERENCE BOOKS:

1. 'Principles of Refrigeration' Dossat, Pearson-2006.
2. 'Heating, Ventilation and Air Conditioning' by Mc Quistion, Wiley Students edition, 5th edition 2000.
3. 'Air conditioning' by PITA, 4th edition, pearson-2005
4. 'Refrigeration and Air-Conditioning' by Manohar Prasad

UME XXX E: Operation Management

3 Credits (3 – 0 – 0)

Semester: 07

Total Teaching Hours: 40

UNIT - 1

Introduction:

10 Hours

Functional subsystems of organization, System concept of production, Types of production system, Productivity, strategic management, World class manufacturing.

Product Design and Analysis: New product development concepts, Process planning and design, Value analysis/Value engineering, Make or buy decision, Ergonomic consideration in product design

UNIT - 2

Forecasting:

10 Hours

Nature and use of forecasting, Sources of data, Demand patterns, Factors affecting forecast, types of forecasting, Forecasting Models – Linear Regression, Simple moving average, weighted moving average, e, Single exponential smoothing, Double exponential smoothing, Adjusted exponential smoothing and Delphi method.

Facility Location: Introduction, factors influencing plant location, break even analysis, single facility location problem, Minimax location problem and gravity location problem.

UNIT – 3

Plant Layout and Materials Handling:

10 Hours

Introduction, Classification of layout, Layout design procedures – Computerized Relative Allocation of Facilities Technique (CRAFT), Automated Layout Design Program (ALDEP) and, Computerized Relationship Layout Planning (CORELAP).

Line Balancing: Concept of mass production system, objective of assembly line balancing, rank positional weight method and the COMSOL Algorithm.

UNIT – 4

Modern Production Management Tools:

10 Hours

Just-In-Time manufacturing – introduction and overvies of JIT, basic principles, push/pull production, kanban systems (pull systems). Total Quality Management – scope of TQM, benefits of TQM, quality control activities during product cycle, operating quality costs. Kaizen – Key elements of kaizen, classification of kaizen, steps of implementation of kaizen Blitz, guidelines of kaizen team, benefits of kaizen. Lean Manufacturing – steps of lean manufacturing, components of lean manufacturing. 10 Hours

TEXT BOOKS:

1. Production and Operations Management, R. Panneerselvam. Prentice Hall of India Pvt Ltd. 2005.
2. Analysis and Control of Production Systems, 2nd Edition, Elsayed A. Elsayed, Thomas O. Boucher, Pearson, 1994
3. Production and Operations Management, R. B. Khanna, PHI, 2010.

REFERENCE BOOKS:

1. Modern Production/Operations Management, Buffa, Wiley Eastern Ltd.2001
2. Operations Management, Joseph G MonksMc Graw Hill 1987.

Scheme of Examination:

Eight questions to be set selecting two questions from each Unit.
Each question carries 20 marks.
Five questions to be solved selecting at least one question from each Unit

Open Elective

UME XXX E: Product Design & Rapid Prototyping

3 Credits (3 – 0 – 0)

Semester: 08
Total Teaching Hours: 40

Course Objectives

- Understand the Product Development Process
- Identify steps of engineering design process for product design
- Understand the generic development process
- Define the significance of rapid prototyping in product deign
- Understand basics of prototyping
- Identify the basic methods of rapid prototyping

Course Outcomes

- CO1:Learning basics of product design as a means to manage the development of an idea from concept through to production
- CO2:Analyse ,evaluate and apply the generic method for product development
- CO3:Learning basics of prototyping
- CO4: Demonstrate Stereolithogrphy , selective laser sintering , fused deposition modeling , laminated object manufacturing & solid ground curing

Unit –I

10 Hours

Introduction: Definition, importance of PD, Objectives of PD, essential requirements of PD, who designs product, Project team, steps in new PD, Characteristics of successful product development, duration and cost of product development, challenges of product development, design for manufacture, remanufacturing, sequential and concurrent engineering.

Development processes and organizations: A generic development process, Usefulness of a well-defined Development Process, task & responsibilities for marketing, design and manufacturing , concept development: the front end process, adopting the generic product development process, process flow diagram for variant of products, product development organizations (functional, project & matrix)

Unit-II

8 Hours

Product Planning: The product planning process, types of product development projects , Identify opportunities, evaluate and prioritize projects , allocate resources and plan timing, complete pre project planning, reflects all the results and the process

Identifying customer needs : Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and process

Unit-III

9 Hours

Introduction: Prototype fundamentals, definition of Prototypes, types of prototypes, need for the compression in product development, RP fundamentals, RP wheel, history of RP systems, applications of RP, growth of RP industry, basic principle of rapid prototyping processes, classification of RP systems advantages and disadvantages of rapid prototyping

Stereolithography systems: principle, process details, advantages and disadvantages, applications

Unit-IV

12 Hours

Selective Laser sintering: principle, process details, advantages and disadvantages, applications
Fused deposition modeling: principle, , process details , advantages and disadvantages, applications **Laminated object manufacturing:** Principle, process details, LOM materials advantages and disadvantages, applications
Solid Ground curing: principle of operation, machine details, advantages and disadvantages, applications

TEXT BOOKS

- Product design & development by Karl T Ulrich and Steven D Eppinger
- Rapid Prototyping principles and applications by C K Chua, K F Leong and C S Lim

Reference Books

- The design of everyday things by Don Norman
- Product designs from concept to Manufacture by Jennifer Hudson
- Additive manufacturing by Brent Stucker, David W. Rosen, and lan Gibson
- Engineering design and rapid prototyping by Ali K. Kamrani and Emad Abouel Nasr

- **Scheme Of Examination**

- Eight questions to be set selecting two questions from each unit
- Each question carries 20 marks
- Five questions to be answered selecting at least one question from each unit

UME XXX E: Advance Metal Joining Process

3 Credits (3 – 0 – 0)

Semester: 08

Total Teaching Hours: 40

Unit –I

06 Hours

Distortion, methods to avoid distortion. Stresses in Joint Design, Welding and Cladding of dissimilar materials, concepts and metallurgical problems in dissimilar metal welding / joining.

07 Hours

Electro Slag, Welding Electron Beam Welding, Plasma arc Welding, Laser Beam Welding, Explosion Welding, Diffusion Welding, Ultrasonic Welding, Friction welding and Thermit welding,

Unit –II

06 Hours

Advanced brazing processes, different types: conventional brazing, active metal brazing, furnace brazing. Advantages, disadvantages. Welding of plastics: principle, common weld able plastics, heated tool welding, hot gas welding, high frequency welding, and ultrasonic welding.

Inspection of Welds**:**

07 Hours

Destructive techniques like Tensile, Bend, Nick break, Impact & Hardness. Non-Destructive techniques like 'X' rays, Ultrasonic, Magnetic particle, Dye Penetrant, Gamma ray inspection.

Unit –III

06 Hours

Welding Symbols-Need for, Representing the welds, Basic weld symbols, Location of Weld, Supplementary symbols, Dimensions of welds, Examples

Welding Design: **07 Hours**

Introduction, Principles of sound welding design, Welding joint design. Welding positions, Allowable strengths of welds, under steady loads.

Unit –IV

6 Hours

Quality Control in Welding - Introduction, Quality assurance v/s Quality control, Weld quality, Discontinuities in welds, their causes and remedies and Quality conflicts.

Computer-Aided Welding Design:

7 Hours

Introduction. Principles of sound welding design, Wilding joint design. Welding positions. Allowable strengths: of welds .under steady loads. Weld throat thickness.

Reference Books:

1. Welding Engineering Hadbook by A.W.S.
2. Welding Engineering by Rossi.
3. Advanced Welding processes - Nikodaco & Shansky MIR Publications. .
4. Welding Technology by O.P. Khanna.
5. Welding for engines by Udin, funk & Wulf
6. Welding and welding technology- R.L Little.

UME XXX E: Information Technology Approaches in Manufacturing
3 Credits (3 – 0 – 0)

Semester: 08
Total Teaching Hours: 40

Course Outcomes: (CO)
The students will be able to:

- Understand and identify the manufacturing sector with the application of Information Technology theory and tools. learn the IT system ingredients to understand concepts, specifications and applications.
- Understand the method of transforming the design and manufacturing information into data, identify the classification and application of different data management methods, gain knowledge of Query language and knowledge of handling manufacturing data using different types of file systems.
- Study the role of Information Technology in manufacturing sequences comprising of various production activities, apply the concepts of concurrent engineering, collaborative design in manufacturing network.
- Apply the concept of the ERP in manufacturing; understand the concept of IoT and its applications

UNIT-1

10 Hours.

Information Technology and the Increasing Complexity of Manufacturing:

Introduction, Information Technology for Manufacturing- Definition and Elements, Flexibility for the future, Recognizing Information Technology's Increasing Capability in a Changing World, New Manufacturing Styles.

IT Systems:

Computer Hardware- Fundamentals, Classification of Computers, Design Workstations, Principles of Networking, Private Computer Communication Networks, (VPN, PSDN, ISDN), Network Topologies, Transmission Media, Intranet, Internet

UNIT-2

10 Hours.

4. Introduction to CIM Database:

Database requirements of Manufacturing, Database, Features of Database Management System, Database Models-Hierarchical, Network and Relational, DBMS architecture, Query Language. SQL as a knowledge base query language.

Product Data Exchange: Introduction, Types of Translators, IGES, STEP, ACIS and DXF, Processors, Case Study on STEP.

UNIT-3

10 Hours.

Concurrent Engineering: Introduction, Implementation of Concurrent Engineering, Concurrent engineering and Information Technology, Soft and Hard prototyping, Characteristics of Concurrent Engineering, Key factors influencing the success of CE, Examples of CE.

Collaborative Design: Introduction, Distributed Computing, Intranets and Extranets, Instant Messaging, Virtual Reality Modeling Language, Traditional Design, Collaborative Design, Collaborative Principles, Collaborative approaches, Collaboration Tools, Collaborative Design Systems.

UNIT-4

10 Hours.

Planning of Resources for Manufacturing through Information Systems: Introduction, Role of MRP-II in a CIM system, Manufacturing Applications, Engineering Applications, Dynamic Enterprises, ERP, SCM, Selection of an ERP package, ERP in India, Dynamic Enterprise Modelling (DEM).

IoT: IoT Overview, IoT Hardware, Iot Software, IoT Technology and Protocols, IoT Common Uses, IoT Manufacturing Applications, Energy Applications.

Reference Books:

1. Radhakrishnan, Subramanyan, V. Raju, "CAD/CAM/CIM", NewAge International Publishers, Third Edition.
2. Mikell P. Groover, "Automation, Production Systems, and Computer-Integrated Manufacturing", Prentice-Hall of India Pvt. Ltd. Second Edition.
3. Ibrahim Zeid, "Mastering CAD/CAM", Tata McGraw-Hill Publishing Company Ltd.
4. www.tutorialpoint.com , "Internet of Things", Tutorials Point, Simply easy learning.

Question Paper Pattern for Semester End Examination (SEE):

1. Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
2. Each question carries 20 marks and should not have more than 4 sub divisions.
3. Any five full questions are to be answered choosing at least one from each unit.

828 E: HYDRAULICS AND PNEUMATICS
3 Credits (3-0-0)

Semester: 08
Total Teaching Hours: 40

UNIT – 1

INTRODUCTION TO HYDRAULIC POWER:
8 Hours

Pascal's law and problems on Pascal's Law, continuity equations, introduction to conversion of units. Structure of Hydraulic Control System. The Source of Hydraulic
Power: Pumps Pumping theory, pump classification, gear pumps, vane pumps, piston pumps, pump performance, pump selection. Variable displacement pumps.

HYDRAULIC ACTUATORS AND MOTORS:

6 Hours

Linear Hydraulic Actuators [cylinders], Mechanics of Hydraulic Cylinder loading, Hydraulic Rotary Actuators, Gear motors, vane motors, piston motors, Hydraulic motor theoretical torque, power and flow rate, hydraulic motor performance.

UNIT – 2

CONTROL COMPONENTS IN HYDRAULIC SYSTEMS:

5 Hours

Directional Control Valves – Symbolic representation, Constructional features, pressure control valves – direct and pilot operated types, flow control valves.

HYDRAULIC CIRCUIT DESIGN AND ANALYSIS:

7 Hours

Control of single and double – acting Hydraulic Cylinder, regenerative circuit, pump unloading circuit, Double pump Hydraulic system, Counter Balance Valve application, Hydraulic cylinder sequencing circuits. Locked cylinder using pilot check valve, cylinder synchronizing circuits, speed control of hydraulic cylinder, speed control of hydraulic motors, accumulators and accumulator circuits.

UNIT -3

MAINTENANCE OF HYDRAULIC SYSTEMS:

6 Hours

Hydraulic oils; Desirable properties, general type of fluids, sealing devices, reservoir system, filters and strainers, problem caused by gases in hydraulic fluids, wear of moving parts due to solid particle contamination, temperature control, trouble shooting.

INTRODUCTION TO PNEUMATIC CONTROL:

6 Hours

Choice of working medium, characteristics of compressed air. Structure of Pneumatic control system. Pneumatic Actuators: Linear cylinders – Types, conventional type of cylinder working, end position cushioning, seals, mounting arrangements applications. Rod–less cylinders, types, working advantages. Rotary cylinder types construction and application. Design parameters, selection.

UNIT – 4

DIRECTIONAL CONTROL VALVES:

7 Hours

Symbolic representation as per ISO 1219 and ISO 5599. Design and constructional aspects, poppet valves, slide valves spool valve, suspended seat type slide valve. Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, use of memory valve. Flow control valves and speed control of cylinders supply air throttling and exhaust air throttling use of quick exhaust valve. Signal processing elements: Use of Logic gates – OR and AND gates pneumatic applications. Practical examples involving the sue of logic gates. Pressure dependent controls types construction–practical applications. Time dependent controls –Principle, construction, practical applications.

MULTI-CYLINDER APPLICATIONS:

7 Hours

Coordinated and sequential motion control. Motion and control diagrams – Signal elimination methods. Cascading method – principle. Practical application examples (up to two cylinders) using cascading method (using reversing valves). Electro- Pneumatic control: Principles-signal input and out put pilot assisted solenoid control of directional control valves, use of relay and contactors. Control circuitry for simple single cylinder applications. Compressed air: Production of compressed air – compressors, preparation of compressed air- Driers, Filters, Regulators, Lubricators, Distribution of compressed air- Piping layout.

TEXT BOOKS:

1. Fluid Power with applications, Anthony Esposito, Fifth edition pearson education, Inc. 2000.
2. Pneumatics and Hydraulics, Andrew Parr. Jaico Publishing Co.2000.

REFERENCE BOOKS:

1. Oil Hydraulic Systems - Principles and Maintenance, S.R. Majumdar, Tata Mc Graw Hill publishing company Ltd. 2001.
2. Pneumatic Systems, S.R. Majumdar, Tata Mc Graw Hill publishing Co., 1995.
3. Industrial Hydraulics, Pippenger, Hicks, McGraw Hill, New York.

Questions pattern:

1. Total of eight question with two from each unit to be set uniformly covering the entire syllabus.
2. Each question should not have more than four sub division
3. Any five full questions are to be answered choosing at least one from each unit.

UME XXX E: THEORY OF ELASTICITY
3 Credits (3 – 0 – 0)

Semester: 08
Total Teaching Hours: 40

Course objectives:

- To be able to analyze some real problem and to formulate the conditions of theory of elasticity applications.
- To be proficient with basic concepts in continuum mechanics of solids, including of strain, internal force, stress and equilibrium in solids.
- To teach student s to apply the methods of theory of elasticity in technical calculations on the basis of illustrative examples

Course Outcome:

- CO1: To know the definition of stress and deformation and how to determine the components of the stress and strain tensors.
- CO2: To know how to apply the conditions of compatibility and equations of equilibrium.
- CO3: To understand how to express the mechanical characteristics of materials, constitutive equations and
  generalized Hook law.
- CO4: To use the equilibrium equations stated by the displacements and compatibility conditions stated by stresses .
- C05: To solve the basic problems of the theory of elasticity by using Airy function expressed as biharmonic function.
- CO6: To solve torsion problems in bars and thin walled members.
- CO7: To understand index notation of equations, tensor and matrix notation applied to thermal stresses.

UNIT – 1

DEFINITION AND NOTATION:

5 Hours

Stress, Stress at a Point, Equilibrium Equations, Principal Stresses, Mohr's Diagram, Maximum Shear Stress, Boundary Conditions.

STRAIN AT A POINT:

5 Hours

Compatibility Equations, Principal Strains, Generalized Hooke's law, Methods of Solution of Elasticity Problems – Plane Stress-Plane Strain Problems.

UNIT – 2

TWO DIMENSIONAL PROBLEMS:

5 Hours

Cartesian co-ordinates – Airy's stress functions – Investigation of Airy's Stress function for simple beam problems – Bending of a narrow cantilever beam of rectangular cross section under edge load – method of Fourier analysis – pin ended beam under uniform pressure.

GENERAL EQUATIONS IN CYLINDRICAL CO-ORDINATES:

5 Hours

Thick cylinder under uniform internal and / or external pressure, shrink and force fit, stress concentration.

UNIT – 3

STRESSES IN AN INFINITE PLATE

5 Hours

Stress in infinite plate with a circular hole subjected to uniaxial and biaxial loads, stress concentration, stresses in rotating discs and cylinders.

TORSION OF CIRCULAR, ELLIPTICAL AND TRIANGULAR BARS:

5 Hours

Torsion of circular, elliptical and triangular bars, membrane analogy, torsion of thin open sections and thin tubes.

UNIT – 4

THERMAL STRESSES:

5 Hours

Thermo elastic stress strain relationship, Equations of equilibrium Thermal stresses in thin circular discs.

UNIQUENESS THEOREM:

5 Hours

Principle of super position, reciprocal theorem, Saint Venant principle.

TEXT BOOKS:

1. Advanced Mechanics of solids, L. S. Srinath, Tata Mc. Graw Hill, 2003
2. Theory of Elasticity: S. P. Timoshenko and J. N Gordier, Mc. Graw Hill International, 3rd edition, 1972

REFERENCES BOOKS:

1. Theory of Elasticity: Dr. Sadhu Singh, Khanna Publications, 1988
2. Elasticity, Theory, Applications & Numericals: Martin H Sadd, Elsevier. 2005
3. Applied Elasticity, Seetharamu & Govindaraju, Interline Publishing 2005, 2006

Scheme of Examination:

1. Eight questions to be set selecting two questions from each Unit.
2. Each question carries 20 marks.
3. Five questions to be solved selecting at least one question from each Unit

UME XXX E: Design of Mechanism
3 Credits (3 – 0 – 0)

Semester: 08
Total Teaching Hours: 40

Course Outcomes:

- CO1: An ability to analyze and design mechanisms to create arbitrary motion.
- CO2: An ability to know the position synthesis of planar mechanism.
- CO3: An ability to design and construct a working mechanism in small teams, and to document the design in a detailed report.
- CO4: An ability to use modern software tools for linkage synthesis.

Unit - 1

Geometry of motion: 10 Hours

Introduction, analysis and synthesis, mechanism terminology, planar, spherical and spatial mechanisms, mechanical advantage, equivalent mechanisms, unique mechanisms.

Generalized principles of dynamics:

Fundamental laws of motion, generalized coordinates, configuration space, constraints, virtual work, principle of virtual work, energy and momentum, work and kinetic energy, equilibrium and stability, kinetic energy of a system, angular momentum

Unit - 2

Lagrange's Equation: 10 Hours

Larange's equation from D.Alembert's principles, examples, Hamiltons equations, Hamiltons principle, Lagrange's equation from Hamiltons principle, derivation of Hamiltons equations, examples.

Synthesis of linkages:

Type, number, and dimensional synthesis, function generation, path generation and body guidance, Precision positions, structural error, Chebychev spacing, two position synthesis of slider crank mechanisms, crank-rocker mechanisms with optimum transmission angle.

Unit - 3

Motion generation: 10 Hours

Poles and relative poles, relative poles of 4-bar mechanism, relative poles of slider crank mechanism.

Graphical methods of dimensional synthesis:

Two position synthesis of crank and rocker mechanisms, three position synthesis, four position synthesis (point precision reduction), overlay method, coupler curve synthesis, cognate linkages.

Unit – 4

Analytical methods of dimensional synthesis: 10 Hours

Freudenstein's equation for four bar mechanism and slider crank mechanism, examples, Bloch's method of synthesis.

Cams: Introduction, pressure angle, parameters affecting pressure angle, effect of offset follower motion, radius of curvature and undercutting, cams with specified contours.

TEXT BOOKS:

1. "Theory of Machines and Mechanism", E. Shigley, J. J. Uicker, McGraw Hill Company.
2. "Classical Dynamics", Greenwood, Prentice Hall of India, 2004

REFERENCE BOOKS:

1. 'Mechanism & machine Theory', A.G. Ambekar, PHI, 2007
2. 'Kinematics, Dynamics & Design of Machinery', K. J. Waldron, G. L. Kinzel, Wiley India, 2007.
3. 'Design of Machinery', R. C. Nortan , Tata McGraw Hill
4. Advanced Mechanism Design, Erdman sandoor, Vol-1 PHI, 2006

Question Paper Pattern for Semester End Examination (SEE):

1. Total of eight questions with two from each unit to be set uniformly covering the entire syllabus.
2. Each question carries 20 marks and should not have more than 4 sub divisions.
3. Any five full questions are to be answered choosing at least one from each unit.

UME829E: Reliability Engineering and Experimental Design
3 Credits (3 – 0 – 0)

Semester: 08
Total Teaching Hours: 40

UNIT-1

BASICS OF RELIABILITY: 10 Hours

Reliability: Definition and basic concepts of Reliability; Life-cycle curve and Probability distributions in modeling; Probability distributions to model failure rate; System Reliability: Systems with components in series; Systems with components in parallel; Systems with components in series and parallel; Systems with standby components.

UNIT-2

RELIABILITY AND LIFE TESTING PLANS:

10 Hours

Operating characteristics curves; Types of tests; Failure-terminated test; Time-terminated test; Sequential reliability testing; Life testing plans using the exponential distribution; Standard life testing plans using Handbook H 108.

UNIT-3

EXPERIMENTAL DESIGN:

10 Hours

Introduction; Experimental design fundamentals; Some experimental design; Completely randomized design; Randomized block design; Latin square design; Factorial experiments; Two-factor factorial experiment; Role of contrasts; The 2k factorial experiment.

UNIT-4

THE TAGUCHI METHOD:

10 Hours

The Taguchi philosophy; Loss function; Signal-to-Noise-Ratio and Performance measures; Critique to S/N Ratios; Experimental design in the Taguchi Method; Orthogonal arrays and linear graphs; Estimation of effects; Parameter design in Taguchi method; Critique to experimental design and the Taguchi Method

TEXT BOOKS:

1. Fundamentals of Quality Control and Improvement by Amitava Mitra, Prentice Hall of India New Delhi
2. Probability, Statistics and Random Processes by T Veerarajan, Tata McGraw-Hill New Delhi

REFERENCE BOOK:

1. Introduction to Reliability Engineering by Dhilan & Singh
2. Robust design by Sunil Phadike

Scheme of Examination:

1 Eight questions to be set selecting two questions from each Unit.
2 Each question carries 20 marks.
3 Five questions to be solved selecting at least one question form each Unit

UMEXXX E: Supply Chain Management
3 Credits (3 – 0 – 0)

Semester: 08
Total Teaching Hours: 40

Course Outcomes (CO): Upon completion of this course the student will be able to:

1. Demonstrate the supply chain objectives, importance, decision phases, process views, performance with strategic fit and their impact on success of a supply chain.
2. Develop a distribution network with different modes of transportation, understanding the effect of e-business on the design of distribution networks in different industries.
3. Express the role of forecasting and sourcing with their risk management.
4. Analyse technology and coordination in a supply chain, applications of IT for supply chain drivers and the processes that enable supply chain performance.

Unit- I

10 Hours

Framework of Supply Chains: Introduction to supply chain, The objective of a supply chain, The importance of supply chain decisions, Decision phases in a supply chain, Process views of a supply chain: Cycle view of supply chain processes, Push/Pull view of supply chain processes, Examples (minimum two) of Supply Chains.

Performance of Supply Chains: Competitive and supply chain strategies, Achieving strategic fit: Understanding the customer and supply chain uncertainty, Understanding the supply chain capabilities, Achieving strategic fit, Issues affecting strategic fit, Expanding strategic scope, Drivers of supply chain performance, Framework for structuring drivers, Facilities, Inventory, Transportation, Information, Sourcing, Pricing.

Unit- II

10 Hours

Designing the Supply Chain Network: The role of distribution in the supply chain, Factors influencing distribution network design, Design options for a distribution network: Manufacturer storage with direct shipping (MSWDS), MSWDS and in-transit merge, Distributor storage with package carrier delivery, Distributor storage with last-mile delivery, Manufacturer or Distributor storage with customer pick-up, Retail storage with customer pickup, Selecting a distributor network design.

Transportation in a Supply Chain: The role of transportation in a Supply Chain, Modes of transportation, Design options for a transportation network: Direct shipment network, Direct shipping with milk-runs, All shipments via central-DC, Shipping via DC using milk-runs, Tailored network, Tailored transportation: By customer density and distance, By size of customer, The Role of IT in transportation, Risk management in transportation, Making transportation decisions in practice.

Unit- III

10 Hours

Demand forecasting in a Supply Chain: The role of forecasting in a supply chain, Characteristics of forecasts, Components of a forecast and forecasting methods, Basic approach to demand forecasting, The role of IT in forecasting, Risk management in forecasting, Forecasting in practice.

Sourcing and Cross-Functional Drivers in a Supply Chain: The role of sourcing in a supply chain, In-house or Outsource, Risks of using a Third-party, Supplier scoring and assessment, The procurement process, Sourcing planning and analysis, The Role of IT in Sourcing, Risk Management in Sourcing, Making Sourcing Decisions in Practice.

Unit- IV

10 Hours

Information Technology in a Supply Chain: The Role of IT in a supply chain, The supply chain IT framework, Customer Relationship Management (CRM), Internal supply chain management, Supplier Relationship Management (SRM), The Transaction Management Foundation, The future of IT in the supply chain, Risk Management in IT, Supply Chain IT in Practice.

Coordination in a Supply Chain: Lack of Supply Chain Coordination and the Bullwhip Effect, The Effect on performance of lack of coordination, Obstacles to coordination in a supply chain, Managerial levers to achieve coordination, Building strategic partnerships and trust within a supply chain, The Role of IT in Coordination, Achieving Coordination in Practice

Text Books:

1. Supply Chain Management–Strategy, Planning & Operation. Sunil Chopra, Peter Meindl & D V Kalra, Third Edition, Pearson Prentice Hall (Education, South Asia), 2009, ISBN: 978-81-317-1130-9.

References Books:

1. Supply Chain Redesign–Transforming Supply Chains into Integrated Value Systems. Robert B Hand-field, Ernest L Nichols, Jr., Pearson Education Inc, 3rd Edition (3rdImpreesion), 2007, ISBN: 81-317-0401-7 2.
2. Modelling the Supply Chain -Jeremy F Shapiro, Duxbury, Thomson Learning, 2002, ISBN 0-534-37363
3. Designing & Managing the Supply Chain. David Simchi Levi, Philip Kaminsky & Edith Simchi Levi; McGraw Hill

Question Paper Pattern for Semester End Examination (SEE):

1. Total of eight question with two from each unit to be set uniformly covering the entire syllabus.
2. Each question should not have more than four sub divisions.
3. Any five full questions are to be answered choosing at least one from each unit.

UMEXXX E: Renewable Energy
3 Credits (3 – 0 – 0)

Semester: 08
Total Teaching Hours: 40

Unit-I

Introduction

Energy source, India's production and reserves of commercial energy sources, need for non-conventional energy sources. advantages and disadvantages

Solar Radiation Measurement of Solar Radiation Solar Radiation Geometry 10 Hours

Solar Radiation : Extra-Terrestrial radiation, spectral distribution of extra terrestrial radiation, solar constant, solar radiation at the earth's surface, beam, diffuse and global radiation, solar radiation data. Measurement of Solar Radiation : Pyrometer, shading ring pyrheliometer, sunshine recorder, schematic diagrams and principle of working. Solar Radiation Geometry : Flux on a plane surface, latitude, declination angle, surface azimuth angle, hour angle, zenith angle, solar altitude angle expression for the angle between the incident beam and the normal to a plane surface (No derivation) local apparent time. Apparent motion of sum, day length, numerical examples.

Unit-II

Radiation Flux on a Tilted Surface:

10 Hours

Beam, diffuse and reflected radiation, expression for flux on a tilted surface (no derivations) numerical examples. Solar Thermal Conversion : Collection and storage, thermal collection devices, liquid flat plate collectors, solar air heaters concentrating collectors (cylindrical, parabolic, paraboloid) (Quantitative analysis); sensible heat storage, latent heat storage, application of solar energy water heating. Space heating and cooling, active and passive systems, power generation, refrigeration. Distillation (Qualitative analysis) solar pond, principle of working, operational problems.

Unit-III

Photovoltaic Conversion :

10 Hours

Description, principle of working and characteristics, applications.

Wind Energy :

Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, wind machines; Types of wind machines and their characteristics, horizontal and vertical axis wind mills, elementary design principles; coefficient of performance of a wind mill rotor

Tidal Power :

Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, limitations.

Unit-IV

Energy from Bio Mass:

10 Hours

Photosynthesis, photosynthetic oxygen production, energy plantation, bio gas production from organic wastes by anaerobic fermentation, description of bio-gas plants, transportation of bio-gas, problems involved with bio-gas production, application of bio-gas, application of bio-gas in engines, advantages.

Hydrogen Energy Storage & Transportation Methods

Hydrogen Energy : Properties of Hydrogen with respected to its utilization as a renewable form of energy, sources of hydrogen, production of hydrogen, electrolysis of water, thermal decomposition of water, thermo chemical production bio-chemical production. Storage & Transportation Methods : Gaseous, cryogenic and metal hydrides, application of hydrogen, domestic and industrial safe burning of hydrogen.

Text Books:

1. Non Conventional Energy Sources/G. D Rai, Khanna Publishers
2. Fundamentals of Renewable Energy Systems, D. Mukherjee and S. Chakrabarti, New Age International Publishers.

Reference Books:

1. Solar Energy by S.P. Sukhatme, Tata McGraw Hill.2nd Edition, 1996
2. Non Conventional Energy Sources, S. K. Dubey, Dr. S. K Bhargava, Dhanpat Rai and Co.

Question Paper Pattern for Semester End Examination (SEE):

1. Total of eight question with two from each unit to be set uniformly covering the entire syllabus.
2. Each question should not have more than four sub divisions.
3. Any five full questions are to be answered choosing at least one from each unit.

UMEXXX E: Computational Fluid Dynamics
3 Credits (3 – 0 – 0)

Semester: 08
Total Teaching Hours: 40

Course Objectives:

1) To develop an understanding for the major theories, approaches and methodologies used in CFD
2) To build up the skills in the actual implementation of CFD methods (e.g. boundary conditions, turbulence modelling etc.) in using commercial CFD codes
3) To gain experience in the application of CFD analysis to real engineering designs.

Course outcomes:

After studying this course, students will be able to:

1) Differentiate the FDM, FVM and FEM
2) Perform the flow, structural and thermal analysis.
3) Utilize the discretization methods according to the application.

UNIT – I

Introduction: 10 Hours

CFD Applications. Need for Parallel Computers in CFD algorithms. Models of flows. Substantial derivative, Divergence of velocity. Continuity, Momentum, and Energy Equations-Derivation in various forms. Integral versus Differential form of equations. Comments on governing equations. Physical boundary conditions. Forms of equations especially suitable for CFD work. Shock capturing, and shock fitting.

UNIT – II

Grid Generation and Adaptive Grids: 10 Hours

Need for grid generation and Body-fitted coordinate system. Structured Grids-essential features. Structured Grid generation techniques- algebraic and numerical methods. Unstructured Grids-essential features. Unstructured Grid generation techniques- Delaunay-Voronoi diagram, advancing front method. Surface grid generation, multi-block grid generation, and meshless methods. Grid quality and adaptive grids. Structured grids adaptive methods and unstructured grids adaptive methods.

UNIT – III

Discretisation & Transformation: 10 Hours

Discretisation: Finite differences methods, and difference equations. Explicit and Implicit approaches. Unsteady Problem -Explicit versus Implicit Scheme. Errors and stability analysis. Time marching and space marching. Reflection boundary condition. Relaxation techniques. Alternating direction implicit method. Successive over relaxation/under relaxation. Second order Lax-Wendroff method, mid-point Leap frog method, upwind scheme, numerical viscosity, and artificial viscosity.

Transformation:

Transformation of governing partial differential equations from physical domain to computational domain. Matrices and Jacobians of transformation. Example of transformation. Generic form of the Governing flow equations in Strong Conservative form in the Transformed Space.

UNIT – IV

Finite Volume Technique and Some Applications:

10 Hours

Spatial discretisation- cell centered and cell vertex techniques (overlapping control volume, duel control volume). Temporal discretisation- Explicit time stepping, and implicit time stepping. Time step calculation. Upwind scheme and high resolution scheme. Flux vector splitting, approximate factorisation. Artificial dissipation and flux limiters. Unsteady flows and heat conduction problems. Upwind biasing.

Text Books:

1. Fletcher, C.A.J., "Computational Techniques for Fluid Dynamics", Springer, Berlin,2nd edition, 2002,ISBN-13: 978-3540543046
2. John D. Anderson, "Computational Fluid Dynamics", McGraw Hill, 2013, ISBN-13: 978-0070016859.

Reference Books:

1. John F. Wendt, "Computational Fluid Dynamics - An Introduction", Springer, 3rd edition,2013
2. Charles Hirsch, "Numerical Computation of Internal and External Flows", Elsevier,1st edition, 2007, ISBN-13: 978-9381269428.
3. Klaus A Hoffmann and Steve T. Chiang. "Computational Fluid Dynamics for Engineers", Vols. I & II Engineering Education System, P.O. Box 20078, W. Wichita, K.S., 67208 - 1078 USA, 1993.

Question paper pattern:

1. The question paper will have Eight questions.
2. Each full question will have sub questions covering all the topics under each Unit.

The students will have to answer 5 full questions, selecting one full question from each Unit.

UME 811 P: PROJECT PHASE – II
10 Credits (5 days, daily 2 Hours)

Course Objective and outcomes:

The explore the problems in the society ,Industry, Agriculture etc and plan and design the solution

- Literature Survey
- Project problem definition
- Submission of project proposal
- Completion of Project Model

Scheme of examination

CIE – 50 Marks
SEE – 50 Marks Presentation Viva-voce

Annexure - IV

Basaveshwar Engineering College, (Autonomous), Bagalkot
Department of Mechanical Engineering
Abstract of Scheme for B.E. Mechanical from Academic Year 2018 - 19
1st Year – 40 Credits
Higher Semester – 135 Credits
Distribution of Credits (Total Credits – 175)

FINAL COPY

SL. No.	Sub Type	Credits								
		1st Sem	2nd Sem	3rd Sem	4th Sem	5th Sem	6th Sem	7th Sem	8th Sem	Total
1	HSS	-	-	-	1	4	4	-	-	**9**
2	Basic Science (PCM)	9.5	9.5	3	3	-	-	-	-	**25**
3	Engineering Science	10.5	10.5	-	-	-	-	-	-	**21**
4	Professional Core	-	-	17	18	16	14	5	-	**70**
5	Professional Elective	-	-	-	-	3	-	9	9	**21**
6	Open Elective	-	-	-	-	-	3	3	-	**6**
7	Project/ Internship	-	-	-	-	-	3	$5^{+}+2^{\bullet}$	12^{++}	**22**
8	Online Courses	-	-	-	-	-	-	1	-	**1**
Semester Total		**20**	**20**	**20**	**22**	**23**	**24**	**25**	**21**	**175**

*Mini Project
+Final year project phase-I
++Final year project phase-II
• Internship

Basaveshwar Engineering College, Bagalkot
Department of Mechanical Engineering
Academic Year 2018 – 2019

***** Mandatory subject, Question paper will be of objective type. Students have to pass the subject compulsorily, however marks will not be considered for awarding Grade/Class/Rank.
****** Only for students who have studied Kannada at primary level.
*******For students who have not studied Kannada at primary level.

CHEMISTRY GROUP

Sl No	Subject Code	Subject	Credits	Hours/Week			Examination Marks		
				Lecture	Tutorial	Practical	CIE	SEE	Total
1	UMA161C	Engineering Maths-I	4.0	3	2	-	50	50	100
2	UCH168C	Engineering Chemistry	4.0	3	2	-	50	50	100
3	UEC169C	Basic Electronics	3.0	2	2	-	50	50	100
4	UCV170C	Engineering Mechanics	3.0	2	2	-	50	50	100
5	UBT133M	Environmental Studies*	-	2	-	-	50	50	100
6	UME171L	Computer Aided Engineering Graphics	2.5	1	-	3	50	50	100
7	UCH172L	Engineering Chemistry Laboratory	1.5	-	-	3	50	50	100
8	UBE173L	Basic Engineering Laboratory	2.0	-	-	4	100	-	100
9	UHS174K	English for Engineers	-	2	-	-	-	-	-
		Total :	20	15	08	10	450	350	800

* Mandatory subject, Question paper will be of objective type. Students have to pass the subject compulsorily, however marks will not be considered for awarding Grade/Class/Rank.

Basaveshwar Engineering College, Bagalkot
Department of Mechanical Engineering
Academic Year 2018 – 2019

2nd Semester (175 Credits Regular) **PHYSICSGROUP**

Sl No	Subject Code	Subject	Credits	Hours/Week			Examination Marks		
				Lecture	Tutorial	Practical	CIE	SEE	Total
1	UMA261C	Engineering Maths-II	4.0	3	2	-	50	50	100
2	UPH262C	Engineering Physics	4.0	3	2	-	50	50	100
3	UME263C	Elements of Mechanical Engineering	3.0	2	2	-	50	50	100
4	UEE264C	Basic Electrical Engineering	3.0	2	2	-	50	50	100
5	UCS265C	Programming with C	3.0	3	-	-	50	50	100
6	UHS226M	Constitution of India*	-	2	-	-	50	50	100
7	UPH266L	Engineering Physics Laboratory	1.5	-	-	3	50	50	100
8	UCS267L	C Programming Laboratory	1.5	-	-	3	50	50	100
9	UHS244K	Kannada Manasu**	-	2	-	-	-	-	-
10	UHS245K	Kannada Kali***	-	2	-	-	-	-	-
		Total :	20	17	8	6	400	400	800

* Mandatory subject, Question paper will be of objective type. Students have to pass the subject compulsorily, however marks will not be considered for awarding Grade/Class/Rank.
** Only for students who have studied Kannada at primary level.
***For students who have not studied Kannada at primary level.

Basaveshwar Engineering College (Autonomous), Department of Mechanical Engineering
Scheme Autonomous Syllabus (175 credits)2018 - 19
B.E. III SEMESTER

Sl. No	Subject Code	Subject	Credits	Hours/Week			Examination Marks		
				Lecturer	Tutorial	Practical	CIE	SEE	Total
01	UMA333C	Computational Methods for Mechanical Sciences	3	3	-	-	50	50	100
02	UME 303C	Basic Thermodynamics	4	3	2	-	50	50	100
03	UME 304C	Strength of Materials	4	3	2	-	50	50	100
04	UME 311C	Material Science & Metallurgy	3	3	-	-	50	50	100
05	UME 312C	Foundry and Welding Techonology	3	3	-	-	50	50	100
06	UME 307L	Material Science & Material Testing Lab	1	0	0	2	50	50	100
07	UME 308L	Foundry & Forging Lab	1	0	0	2	50	50	100
08	UME 310L	Mechanical Drawing Lab	1	0	0	2	50	50	100
09	UMA 330M	*Advanced Mathematics-I	0	3	0	-	50	50	100
		Total Credits :	**20**	**18**	**4**	**6**	**450**	**450**	**900**

* Advanced Mathematics – I is a mandatory subject only for students having diploma and admitted to 3rd Semester through Lateral Entry scheme during 2019-20 onwards. Passing the subject is compulsory: however marks will not be considered for awarding grade/class. A PP/NP grade will be awarded for passing/not passing the subject.

Basaveshwar Engineering College (Autonomous), Department of Mechanical Engineering
Scheme Autonomous Syllabus (175 credits) 2018 - 19
B.E. IV SEMESTER 2019-20

Sl. No	Code	Subject	Credits	Hours/Week			Examination Marks		
				Lecturer	Tutorial	Practical	CIE	SEE	Total
01	UMA433C	Mathematical Methods for Mechanical Sciences	3	3	-	-	50	50	100
02	UME 416C	Metrology & Instrumentation	3	3	-	-	50	50	100
03	UME 417C	Machining and Machine Tools	3	3	-	-	50	50	100
04	UME 415C	Applied Thermodynamics	3	2	2	-	50	50	100
05	UME 405C	Theory of Machines	4	3	2		50	50	100
		OR							
	UME418C	Theory of Machines	3	2	2	-	50	50	100
		and							
	UHS001N	Fundamentals of Quantitative Aptitude and Soft Skills	1		2		50	50	100
06	UME407L	Metrology & Instrumentation Lab	1	-	-	2	50	50	100
07	UME 408L	Machine Shop Lab	2	-	-	4	50	50	100
08	UME 411L	CAMD Lab	3	1	-	4	50	50	100
09	UMA430M	*Advanced Mathematics-II	0	3	---	---	50	50	100*
	Total Credits		**22**	**18**	**8**	**10**	**450**	**450**	**900**

* Advanced Mathematics – II is a Mandatory Subject only for students having Diploma and admitted to 3rd Semester through Lateral Entry scheme during 2019-20 onwards. Passing the subject is compulsory: however marks will not be considered for awarding grade/class. A PP/NP grade will be awarded for passing/not passing the subject.

Basaveshwar Engineering College (Autonomous), Department of Mechanical Engineering
Scheme Autonomous Syllabus (175 credits) 2018-19 Regular and 2019-20 (Lateral Entry) Batch

V Sem. B. E (Mechanical)

Sl. No	Code	Subject	Credits	Hours/Week		Examination Marks			
				Lecturer	Tutorial	Practical	CIE	SEE	Total
01	UME 509C	Design of Machine Element	3	2	2	-	50	50	100
02	UME 512C	Metal Forming	3	2	2	-	50	50	100
03	UME 513C	Fluid Mechanics	3	2	2	-	50	50	100
04	UME 514 C	Turbo Machines	3	2	2	-	50	50	100
05	UME 506 H	Management and Entrepreneurship	3	3	-	-	50	50	100
06	UME 5XXE	Dept Elective - I	3	3	-	-	50	50	100
07	UHS002N	Advanced Quantitative Aptitude and Soft Skills	1	-	2	-	50	50	100
08	UME 514L	Fluid Mechanics &Machinery Lab	1	-	-	3	50	50	100
09	UME 515L	Fuels & I.C Engine Lab	1	-	-	3	50	50	100
10	UCS 559 L	Advanced C programming Lab	2	-	2	2	50	50	100
Total Credits			**23**	**14**	**08**	**10**	**450**	**450**	**900**

Department Electives List

The Students have to select any one elective from the following table

Subject Code	Subject
UME 511 E	Quality and Reliability Engineering
UME 535 E	NTM

***Online course – I should be of minimum 04 weeks duration to earn 01 credit.**

For awarding B.E. (Mechanical Engineering) degree, each student is required to complete minimum of 04 weeks or (02 weeks + 02 weeks) of Internship between 3rdand 6th semester to earn 02 credits which will be awarded during 8th Semester.

Basaveshwar Engineering College (Autonomous), Department of Mechanical Engineering
Scheme Autonomous Syllabus (175 credits) 2018-19 Regular and 2019-20 (Lateral Entry) Batch

VI Sem. B. E (Mechanical) 2019-20

Sl. No	Code	Subject	Credits	Hours/Week			Examination Marks		
				Lecturer	Tutorial	Practical	CIE	SEE	Total
01	UME 622C	Mechanical Vibrations	3	2	2	-	50	50	100
02	UME623C	Heat Transfer	3	2	2	-	50	50	100
03	UME 640 C	Engineering Economics	3	2	2	-	50	50	100
04	UME 641 C	Project Management	3	3	-	-	50	50	100
05	UME604H	Operation Research	3	2	2	-	50	50	100
06	UHS 003 N	Career Planning & Professional Skills	1	-	2	-	50	50	100
08	UME 6XX N	*Open Elective - I	3	2	-	-	50	50	100
09	UME 606 L	Heat and Mass Transfer Lab	1	-	-	3	50	50	100
10	UME 608 L	Dynamics Lab	1	-	-	3	50	50	100
11	UME 613P	Mini Project	3	-	-	6	50	50	100
Total Credits			**24**	**13**	**10**	**12**	**500**	**500**	**1000**

For awarding B.E. (Mechanical Engineering) degree, each student is required to complete minimum of 04 weeks or (02 weeks + 02 weeks) of Internship between 3rd and 6th semester to earn 02 credits which will be awarded during 8th Semester.

***Open elective - I is offered by other department to Mechanical Engineering Students**

Basaveshwar Engineering College (Autonomous), Department of Mechanical Engineering
Scheme Autonomous Syllabus (175 credits) 2018-19 Regular and 2019-20 (Lateral Entry) Batch
VII Sem. B. E (Mechanical)

Sl. No	Code	Subject	Credits	Hours/Week			Examination Marks		
				Lecturer	Tutorial	Practical	CIE	SEE	Total
01	UME 701C	Finite Element Methods	3	2	2	-	50	50	100
03	UME709 O	*On line course	1	-	-	-	-	-	-
04	UME 7XX E	Dept Elective – 2	3	3	-	-	50	50	100
05	UME 7XX E	Dept Elective – 3	3	3	-	-	50	50	100
06	UME 7XX E	Dept Elective – 4	3	3	-	-	50	50	100
07	UME 705L	CAE Lab	1	-	-	2	50	50	100
08	UME 706 L	CNC Lab	1	-	-	2	50	50	100
09	UME 7XX N	**Open Elective- 2	3	-	-	-	-	-	-
10	UME 711P	Project Phase –I + Internship	5+2	-	-	10	50	50	100
11	UXXXXX N	**Open Elective	2	2	-	-	50	50	100
		Total Credits	**25**	**14**	**4**	**12**	**400**	**400**	**800**

***Online course should be of minimum 04 weeks duration to earn 01 credit.**

****Open elective - I is offered by other department to Mechanical Engineering Students**

Electives offered by the Department:

The students have register for any three-elective selecting maximum one from each group

Group – I	Group – II	Group – III	Group - IV
UME 732 E: Non-Destructive Testing UME 716 E: Advanced Manufacturing Technology UME 712 E: Composite Materials	UME 727 E: Control Engineering UME 733 E: Tool Design	UME 720 E: Power Plant Engineering UME 729 E: Refrigeration & Air conditioning	UME 730 E: Operation Management UME 731 E: Six Sigma

*** For awarding B.E. (Mechanical Engineering) degree,each student is required to complete minimum of 04 weeks or (02 weeks + 02 weeks) of Internship between 3rd and 6th semester to earn 02 credits which will be awarded during 7th Semester.**

Basaveshwar Engineering College (Autonomous), Department of Mechanical Engineering
Scheme Autonomous Syllabus (175 credits) 2018-19 Regular and 2019-20 (Lateral Entry) Batch
VIII Sem. B. E (Mechanical)

Sl. No	Code	Subject	Credits	Hours/Week			Examination Marks		
				Lecturer	Tutorial	Practical	CIE	SEE	Total
01	UME 8XXE	Dept Elective -5	3	3	-	-	50	50	100
02	UME 8XXE	Dept Elective -6	3	3	-	-	50	50	100
03	UME 8XXE	Dept Elective -7	3	3	-	-	50	50	100
04	UME 809P	Project Phase II	12	-	-	24	50	50	100
		Total Credits:	**21**	**09**	**-**	**26**	**200**	**200**	**400**

Electives offered by the Department:

The Students have register for any three-elective selecting maximum one from each group

Group – I	Group – II	Group – III	Group - IV
UME 833 E: Advanced Metal Joining Processes **UME 834 E: Product Design & Rapid Prototyping** **UME 828 E: Information Technology Approaches in Manufacturing**	**UME 835 E: Theory of Elasticity** **UME 821 E: Design of Mechanism**	**UME 811 E: Hydraulics and Pneumatics** **UME 830 E: Non Conventional Energy** **UME 836 E: Computational Fluid Dynamics**	**UME 829 E: Reliability Engineering and Experimental Design.** **UME 831 E: Supply Chain Management**