CURRICULUM & SYLLABUS

For

B.E. (PART TIME)

(MECHANICAL ENGINEERING)

(Choice Based Credit System)

(With effect from 2018)

DEPARTMENT OF MECHANICAL ENGINEERING
Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya

SCSVMV

(Deemed to be University U/S 3 of UGC Act 1956)

Accredited with "A" Grade by NAAC

Enathur, Kanchipuram – 631 561

CURRICULUM
(Regulation 2018)
Course / Branch: B.E. (Mechanical Engineering) - Part Time

SEMESTER - I

Sl. No	Category	Course Title	Hours per week			Credits
			Lecture	Tutorial	Practical	
Theory						
1.	BMEP181T10	Mathematics - I	3	1	-	**4**
2.	BMEP181T20	Engineering Mechanics	3	-	-	**3**
3.	BMEP181T30	Engineering Thermodynamics	3	-	-	**3**
4.	BMEP181T40	Basic Electronics Engineering	3	-	-	**3**
5.	BMEP181T50	Materials Engineering	3	-	-	**3**
Total Credits						**16**

SEMESTER - II

Sl. No	Category	Course Title	Hours per week			Credits
			Lecture	Tutorial	Practical	
Theory						
1.	BMEP182T10	Mathematics - II	3	1	-	**4**
2.	BMEP182T20	Applied Thermodynamics	3	-	-	**3**
3.	BMEP182T30	Fluid Mechanics & Fluid Machines	3	-	-	**3**
4.	BMEP182T40	Strength of Materials	3	-	-	**3**
5.	BMEP182T50	Instrumentation & Control	3	-	-	**3**
Total Credits						**16**

SEMESTER- III

Sl. No	Category	Course Title	Hours per week			Credits
			Lecture	Tutorial	Practical	
Theory						
1.	BMEP183T10	Heat and Mass Transfer	3	-	-	**3**
2.	BMEP183T20	Kinematics of Machines	3	-	-	**3**
3.	BMEP183T30	Manufacturing Processes	3	-	-	**3**
4.	BMEP183T40	Engineering Economics	3	-	-	**3**
Practical						
5.	BMEP183P50	I.C. Engines & Heat transfer Lab (Mechanical Lab – 1)	-	-	4	**2**
Total Credits						**14**

SEMESTER- IV

Sl. No.	Category	Course Title	Hours per week			Credits
			Lecture	Tutorial	Practical	
Theory						
1.	PCC-ME	Design of Machine Elements	3	-	-	**3**
2.	PCC-ME	Dynamics of Machines	3	-	-	**3**
3.	PCC-ME	Metrology and Quality Control	3	-	-	**3**
4.	PCC-ME	Power Plant Engineering	3	-	-	**3**
Practical						
5.	PCC-ME	Dynamics and Measurement Lab (Mechanical Lab - 2)	-	-	4	**2**
Total Credits						**14**

SEMESTER- V

Sl. No	Category	Course Title	Hours per week			Credits
			Lecture	Tutorial	Practical	
Theory						
1.	PCC-ME	CAD/CAM	3	-	-	**3**
2.	PCC-ME	Manufacturing Technology	3	-	-	**3**
3.	PEC-MEL	**Elective-I**				
		Finite Element Analysis	3	-	-	**3**
		Engineering Fracture Mechanics				
		Product Design & Development				
		3D Printing				
		Tribology				
4.	OEC	**Open Elective – I**				
		Cloud Computing	3	-	-	**3**
		Web Design				
		Digital Image Processing				
		Data Analytics				
Practical						
5.	PCC- ME	CAD/CAM Lab (Mechanical Lab – 3)	-	-	4	**2**
Total Credits						**14**

SEMESTER- VI

Sl. No.	Category	Course Title	Hours per week			Credits
			Lecture	Tutorial	Practical	
Theory						
1.	PCC-ME	Automation in Manufacturing	3	-	-	**3**
2.	PCC-ME	Mechatronics	3	-	-	**3**
3.	PEC-MEL	**Elective – II**	3	-	-	**3**
		Refrigeration & Air Conditioning				
		I.C. Engines				
		Turbo Machines				
		Gas Dynamics & Jet Propulsion				
		Energy Conservation in Industries				
4.	OEC	**Open Elective - II**	3	-	-	**3**
		Autotronics				
		Artificial Intelligence & Machine Learning				
		Nano Technology & Surface Engineering				
		Disaster Management & Mitigation				
Practical						
1.	PCC-ME	Mechanical Lab - 4 (Mechatronics Lab)	-	-	4	**2**
2.	PROJ-ME	Project Work Phase - I	4 hrs/week			**2**
Total Credits						**16**

SEMESTER- VII

Sl. No	Category	Course Title	Hours per week			Credits
			Lecture	Tutorial	Practical	
Theory						
1.	PCC-ME	Automobile Engineering	3	-	-	**3**
2.	PCC-ME	**Elective – III**	3	-	-	**3**
3.		Sustainable Manufacturing				
4.		Design for Manufacturing				
5.		Digital Manufacturing				
6.		Composite Materials				
7.		Theory of Metal Cutting				
8.	PEC-MEL	**Elective – IV**	3	-	-	**3**
		Total Quality Manufacturing				
		Entrepreneurship Development				
		Non Traditional Machining				
		Flexible Manufacturing Systems				
		Fluid Power Systems				
Practical						
9.	PROJ-ME	Project Work Phase - II	16 hrs/week			**10**
Total Credits						**19**

SEMESTER – I

BMEP181T10	MATHEMATICS - I (Calculus and Linear Algebra)	L T P C 3 1 0 4

OBJECTIVES

- To familiarize the prospective engineers with techniques in calculus, multi-variable calculus and sequence and series.
- To equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics.

Unit-I: Calculus

Evaluation of definite and improper integrals- Beta and Gamma functions and their properties - Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit-II: Numerical Methods

Solution of polynomial and transcendental equations – Bisection method-Newton-Raphson method-Regula-Falsi Method. Interpolation- Newton's forward and backward difference formulae- Interpolation with unequal intervals-Newton's divided difference and Lagrange's formulae-Numerical Differentiation.

Unit-III: Sequences and Series

Convergence of sequence and series-tests for convergence- Comparison test- D'Alembert's ratio test-Raabe's test-Logarithmic test- Cauchy's root test- Fourier series: Half range sine and cosine series-Parseval's theorem.

Unit-IV: Multivariable Calculus (Differentiation)

Limit-Continuity - Partial derivatives, total derivatives- Directional Derivatives-Tangent plane and normal line-Maxima, minima and saddle points-Method of Lagrange multipliers – Gradient Curl-Divergence.

Unit-V: Matrices

Matrices: Rank of a matrix-rank-nullity theorem-System of linear equations- Symmetric matrices-Skew symmetric matrices- Orthogonal matrices; Eigen values and Eigenvectors-Cayley-Hamilton theorem-Diagonalization of matrices.

TEXT BOOKS

B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2000.

REFERENCES

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, Pearson, 2002.
2. T. Veerarajan, Engineering Mathematics, McGraw-Hill, New Delhi, 2008.
3. B. V. Ramana, Higher Engineering Mathematics, McGraw Hill, New Delhi, 2010.
4. N.P. Bali and M. Goyal, A text book of Engineering Mathematics, Laxmi Publications,2010.
5. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2006.

BMEP181T20 ENGINEERING MECHANICS L T P C

3 0 0 3

OBJECTIVES

1. To familiarize the basics laws of physics, vector operations and forces.
2. To understand the principles of beams, supports and equilibrium of rigid bodies.
3. To know the area and mass property calculations of various sections and solids.
4. To study and analyse the dynamics of particles by various methods.
5. To understand the applications of friction and rigid body dynamics.

UNIT-I STATICS OF PARTICLES

Introduction – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces, Principle of transmissibility, Vectors – Vectorial representation of forces and moments – Vector operations: additions, subtraction, dot product, cross product – Coplanar Forces – Resolution and Composition of forces – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Single equivalent force.

UNIT-II EQUILIBRIUM OF RIGID BODIES

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions – Examples

UNIT-III PROPERTIES OF SURFACES AND SOLIDS

Determination of Area and Volume – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, - Angle section, Hollow section by using standard formula – second and product moments of plane area – Rectangle, triangle, circle from integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principal moments of inertia of plane areas – Principal axes of inertia – Mass moment of inertia – Derivation of mass moment of inertia for rectangular section, prism, sphere from first principle – Relation to area moment of inertia.

Unit-IV DYNAMICS OF PARTICLES

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion – Newton's law – Work Energy Equation of particles – Impulse-Momentum principle – Impact of elastic bodies.

UNIT-V FRICTION AND RIGID BODY DYNAMICS

Frictional force – Laws of Coloumb friction – simple contact friction – Rolling resistance – Belt friction-Ladder friction- Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of bodies.

TEXT BOOKS:

1. Rajasekaran, S, Sankarasubramanian, G., "Fundamentals of Engineering Mechanics", Vikas Publishing House Pvt. Ltd., (2007)3rd Edition.
2. Dr. N. Kotteswaran, "Engineering Mechanics – Statics & Dynamics", Sri Balaji Publications 2004.
3. Beer, F.P and Johnson Jr. E.R. "Vector Mechanics for Engineers", Vol. 1 Statics and Vol. 2 Dynamics, Tata McGraw-Hill International Edition, 2017, 11th edition

REFERENCES

1. Hibbeler, R.C., "Engineering Mechanics", Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., (2017).
2. Palanichamy, M.S., Nagam, S., "Engineering Mechanics – Statics & Dynamics", Tata McGraw-Hill, (2001).
3. Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", IV Edition – Pearson Education Asia Pvt. Ltd.,(2008).
4. Ashok Gupta, "Interactive Engineering Mechanics – Statics – A Virtual Tutor (CDROM)", Pearson Education Asia Pvt., Ltd., (2002).
5. K.L. Kumar, "Engineering Mechanics" Tata McGraw-hill, 2017, 4th Edition
6. S.S. Bhavikatti, " Engineering Mechanics", New Age International Publishers, 2006
7. R. S. Khurmi, " Engineering Mechanics", S. Chand Publishers, 2018.

BMEP181T30 ENGINEERING THERMODYNAMICS L T P C
3 0 0 3

(Use of approved Thermodynamic property tables like Steam tables, Mollier chart, Psychrometric chart are permitted in all the examinations**)**

OBJECTIVES:

- To learn about the basic concepts of thermodynamics & first law of thermodynamics
- To learn about application of II law and to understand the concept of entropy/availability
- To evaluate the changes in properties of pure substances
- To understand various thermodynamic relations & ideal gas concept
- To learn about the concept of psychrometry

UNIT - I BASIC CONCEPTS AND FIRST LAW

Concept of continuum- microscopic and macroscopic approach-Path and point functions - Properties – Thermodynamics system and their types - Thermodynamic Equilibrium - State, path and process - Quasi-static, reversible and irreversible processes - Modes of work - P-V diagram - Zeroth law of thermodynamics – Concept of temperature & heat - First law of thermodynamics - application to closed and open systems – steady and unsteady flow processes.

UNIT- II SECOND LAW & AVAILABILITY ANALYSIS

Statements of second law and its corollaries – Carnot theorem - Carnot cycle & Reversed Carnot cycle - Clausius inequality. Concept of entropy, entropy of ideal gas - Principle of increase in entropy. Applications of II Law. Available and non-available energy of a source and finite body. Energy and irreversibility. Expressions for the energy of a closed system and open systems. Energy balance and entropy generation. Irreversibility. I and II law Efficiency.

UNIT - III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE

Formation of steam & its thermodynamic properties - P-v, P-T, T-v, T-s, h-s diagrams. P-v-T surface. Use of Steam Table & Mollier Chart - Application of I and II law for pure substances. Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles.

UNIT - IV IDEAL GAS & THERMODYNAMIC RELATIONS

Properties of Ideal gas- Ideal and real gas comparison- Equations of state for ideal and real gases- Reduced properties. Compressibility factor- Generalized Compressibility Chart -. Simple Calculations.

Maxwell relations, Tds equations, Specific heat capacities - Energy equation - Joule-Thomson co-efficient, Clausius -Clapeyron equation – Third law of thermodynamics.

UNIT V PSYCHROMETRY

Psychrometric properties - Psychrometric chart - Psychrometric processes – Adiabatic saturation - Sensible heating and cooling, humidification, dehumidification, Evaporative cooling and adiabatic mixing of air streams - Property calculations.

OUTCOMES

Upon the completion of this course the students will be able to

1. Apply the first law of thermodynamics for simple open and closed systems under steady and unsteady conditions.
2. Apply second law of thermodynamics to open and closed systems and calculate entropy and availability.
3. Apply Rankine cycle to steam power plant and compare few cycle improvement methods
4. Derive simple thermodynamic relations of ideal and real gases
5. Calculate the properties of gas mixtures and moist air and its use in psychometric processes

TEXT BOOKS

1. R. K. Rajput, "Engineering Thermodynamics" 5th edition, 2017.
2. Yunus A, Cengel & Michael A. Boles, "Thermodynamics – An Engineering Approach", 8th edition, 2015.

REFERENCES

1. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2012.
2. Borgnakke & Sonnatag, "Fundamental of Thermodynamics", 8th edition, 2016.
3. Chattopadhyay P, "Engineering Thermodynamics", Oxford University Press, 2016.
4. J.P Holman, Thermodynamics – Tata McGraw Hill, 1995, 4th edition.
5. Nag. P. K., "Engineering Thermodynamics", 6th edition, Tata McGraw-Hill, New Delhi, 2017.
6. Vanwvylen & Sonntag, Introduction to Thermodynamics, Classical & Statistical – Wiley Eastern, 4th edition.

BMEP181T40 BASIC ELECTRONICS ENGINEERING L T P C
3 0 0 3

Objectives:
To provide an overview of electronic device components to Mechanical engineering students.

UNIT -I
Semiconductor Devices and Applications: Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.

UNIT -II
Operational amplifier and its applications: Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator.

UNIT -III
Timing Circuits and Oscillators: RC-timing circuits, IC 555 and its applications as astable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.

UNIT -IV
Digital Electronics Fundamentals :Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.

UNIT -V
Electronic Communication Systems: The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.

TEXT /REFERENCE BOOKS:

1. Floyd ," Electronic Devices" Pearson Education 9th edition, 2012.
2. R.P. Jain , "Modern Digital Electronics", Tata Mc Graw Hill, 3rd Edition, 2007.
3. Frenzel, "Communication Electronics: Principles and Applications", Tata Mc Graw Hill, 3rd Edition, 2001

OUTCOMES:
At the end of this course students will demonstrate the ability to
- Understand the principles of semiconductor devices and their applications.
- Design an application using Operational amplifier.
- Understand the working of timing circuits and oscillators.
- Understand logic gates, flip flop as a building block of digital systems.
- Learn the basics of Electronic communication system.

BMEP181T50 MATERIALS ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

- Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.
- To provide a detailed interpretation of equilibrium phase diagrams.
- Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

UNIT-I: Crystal Structure

Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

UNIT-II: Mechanical Property measurement

Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength. Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, Introduction to nondestructive testing (NDT)

UNIT–III: Alloys, substitutional and interstitial solid solutions-Phase diagrams

Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron-carbon phase diagram and microstructure aspects of ledeburite, austenite, ferrite and cementite, cast iron.

UNIT–IV: Heat treatment of Steel

Annealing, tempering, normalizing and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening

UNIT–V: Metals and Alloys

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminum and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys

OUTCOMES

- Student will be able to identify crystal structures for various materials and understand the defects in such structures.
- Understand how to tailor material properties of ferrous and non-ferrous alloys. How to quantify mechanical integrity and failure in materials

TEXT BOOKS

1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 2004, 5th Edition.
4. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011..

SEMESTER – II

BMEP182T10 **MATHEMATICS - II** **L T P C**

(Calculus, Ordinary Differential Equations, and Complex Variables) **3 1 0 4**

OBJECTIVES

- To familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables.
- To equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

UNIT-I: **Multivariable Calculus (Integration)**

Multiple Integration: Double and Triple integrals (Cartesian) - Change of order of integration in double integrals - Problems on Green, Gauss and Stokes theorems.

UNIT-II: Ordinary Differential Equations of Higher Orders

Operator D – Rules for finding complementary function – Rules for finding particular integral - Second order linear differential equations with variable coefficients: Cauchy-Euler equation - Method of variation of parameters.

UNIT-III: **Partial Differential Equations of Higher Orders**

Definition of Partial Differential Equations- Formation of Partial differential equations, solutions of a Partial differential equation -Linear equations of the first order - Solution to homogenous and non-homogenous linear partial differential equations of second order by complementary function and particular integral method.

UNIT-IV: Complex Variable – Differentiation

Differentiation - Cauchy-Riemann equations - Analytic functions - Harmonic functions, Finding Harmonic conjugate - Conformal mappings: $z+c$, $1/z$, cz, z^2, $z+1/z$, e^z - Mobius transformations and their properties.

UNIT-V: Complex Variable – Integration

Contour integrals: Cauchy - Goursat theorem (without proof) - Cauchy Integral formula (without proof) - Taylor's series - Laurent's series - Zeros of analytic functions –singularities – Residues - Cauchy Residue theorem (without proof) – Simple problems.

TEXT BOOKS

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

REFERENCES

1. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India, 2009.
2. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

BMEP182T20 APPLIED THERMODYNAMICS L T P C
3 0 0 3

(Use of standard refrigerant property data book, Steam Tables, Mollier diagram and Psychrometric chart permitted)

OBJECTIVES

- To apply the concept of thermodynamic`s to steam Nozzle & to understand the velocity triangle diagram of various turbines
- To understand the various systems of I.C. Engines
- To analyse the different gas power cycles
- The principles of reciprocating & rotary air compressors are studied
- To apply the concepts of thermodynamics to refrigeration & Air conditioning

UNIT–I Flow Through Nozzle & Steam Turbines
One-dimensional flow of steam through nozzle – Nozzle types - Critical pressure ratio – Nozzle efficiency - Super saturated flow in nozzles.
Impulse and Reaction turbine Principles - Compounding – Types - Velocity diagrams for simple and multistage turbines - Speed regulations – Governors.

UNIT–II I.C. Engines
Classification – Working Principle - Components and their function. Valve timing & port timing diagram - actual and theoretical p-V diagram of four stroke and two stroke engines. Simple Carburettor Diesel pump and injector system - Ignition System - Principles of Combustion and knocking in SI and CI Engines. Lubrication and Cooling systems. Performance calculations

Unit-III Gas Power Cycles 9
Air Standard Cycles - Otto, Diesel, Dual & Brayton cycle Analysis – methods of cycle improvement. Regenerative, intercooled, reheated cycles and their combinations – Performance Calculations.

UNIT–IV Air Compressors 9
Reciprocating Air Compressors – Classifications - Working principle – work done - Effect of clearance volume - Single and multi-stage compressors, Volumetric efficiency – calculation of power requirement – Rotary compressors (Working Principle).

UNIT–V Refrigeration & Air Conditioning 9
Refrigeration cycles- Reversed Carnot – Bell Coleman cycle - Vapour compression system – Super heating/Sub cooling - Vapour absorption refrigeration system- Properties of refrigerants. – Simple Problems on VCR system
Principles of air-conditioning - Types of A/C Systems –Industrial, Summer, Winter - Comfort and Year-round air conditioners – Window & Centralised A/C - Concept of GSHF – RSHF - ESHF

OUTCOMES:

- Upon completion of this course, the students will be able to
- Analyse the problems of nozzles & turbines.
- Explain the functioning & features of I.C. Engines & Calculate the performance of I.C.Engines.
- Analyse & solve the problems of air standard cycles.
- Analyse the performance behaviour of single & multi stage reciprocating air compressors.
- Understand the different Refrigeration & A/C systems and solve the problems of VCR system.

TEXT BOOKS

1. Kothandaraman.C.P., Domkundwar. S,Domkundwar. A.V., "A course in thermal Engineering", Fifth Edition, "Dhanpat Rai & sons , 2016
2. Rajput. R. K., "Thermal Engineering" S.Chand Publishers, 2017

REFERENCES

1. Arora.C.P, "Refrigeration and Air Conditioning ," Tata McGraw-Hill Publishers 2008
2. Ganesan V.." Internal Combustion Engines",3rd Edition, Tata Mcgraw-Hill 2012
3. Ramalingam. K.K., "Thermal Engineering", SCITECH Publications (India) Pvt. Ltd., 2009.
4. Rudramoorthy, R, "Thermal Engineering ",Tata McGraw-Hill, New Delhi,2003
5. Sarkar, B.K,"Thermal Engineering" Tata McGraw-Hill Publishers, 2007
6. P. L. Ballaney, Thermal Engineering, Khanna Publishers, 2007, 24th Edition.

BMEP182T30 **FLUID MECHANICS & MACHINES** **L T P C**

3 0 0 3

OBJECTIVES

- To understand the properties of fluids and concept of control volume.
- To understand the applications of the conservation laws to flow through pipes.
- To understand the importance of dimensional analysis
- To understand the importance of various types of flow in pumps.
- To understand the importance of various types of flow in turbines.

UNIT–I FLUID PROPERTIES & FLOW CHARACTERISTICS

Units and dimensions - Types of flows - Properties of fluids - mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure – Gas laws - Surface tension and capillarity. Flow characteristics – concept of control volume – Bernoulli's Theorem – Concept of control volume – Application of continuity equation, energy equation, momentum equation and moment of momentum equation.

UNIT II FLOW THROUGH CIRCULAR CONDUITS

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli- Hydraulic and energy gradient-Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation –friction factor- Moody diagram- commercial pipes- minor losses – Flow through pipes in series and parallel.

UNIT–III-DIMENSIONAL ANALYSIS

Dimensional analysis – methods of dimensional analysis - Similitude –types of similitude – Dimensionless parameters- Application of dimensionless parameters – Model analysis.

UNIT–IV HYDRAULIC PUMPS

Impact of jets - Euler's equation - Theory of roto-dynamic machines – various efficiencies - velocity triangles - Centrifugal pumps– Multi stage centrifugal pumps - working principle - work done by the impeller - performance curves – Priming – Cavitation - Reciprocating pump- working principle – Air vessels – Indicator diagram - Rotary pumps – Working Principles.

UNIT–V HYDRAULIC TURBINES

Hydraulic turbines – Classification - working principles - Pelton wheel, Kaplan turbines - Francis turbines - velocity triangles - theory of draft tubes – Performance – Specific speed – Unit Quantities - Selection of turbines - governing of turbines - hydraulic coupling - Torque converters.

OUTCOMES:

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

- Apply mathematical knowledge to predict the properties and characteristics of a fluid.
- Analyse and calculate major and minor losses associated with pipe flow in piping networks.
- Mathematically predict the nature of physical quantities
- Analyse the performance of pumps
- Analyse the performance of turbines.

TEXTBOOKS

1 K.L. Kumar, Engineering Fluid Mechanics, S. Chand Publishing, 2008.

2 Modi P.N. & Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi 2013.

REFERENCES

1. R.K Bansal, Fluid Mechanics & Hydraulic Machines. 2008, 9th Edition.
2. S. K. Som, G. Biswas, S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill, 2017, 3rd Edition.
3. K. R. Arora, Fluid Mechanics Hydraulics and Hydraulic Machines, Standard Publishers, 2009, 9th Edition
4. C. P. Kothandaraman & R. Rudramoorthy. Fluid Mechanics and Machinery, New Academia Science, 2011, 3rd Edition
5. Douglas J.F, Solving Problems in Fluid Mechanics Vol I & II, John Wiley & Sons Inc., 1986.
6. Victor L. Streeter and E. Benjamin Wylie & Keith W.Bedford. Fluid Mechanics, Mc Graw-Hill 2002, 9th Edition.

BMEP182T40 **STRENGTH OF MATERIALS** **L T P C**
3 0 0 3

OBJECTIVES

- To understand the nature of stresses developed in simple and composite bars.
- To understand the nature of stresses developed in beams.
- To understand the slope and deflection developed in beams.
- To calculate the elastic deformation occurring in various simple geometries for different types of loading.
- To understand the nature of stresses developed in cylinders and spheres for various types of simple loads.

UNIT - I SIMPLE STRESS AND STRAIN

Deformation in solids– Hooke's law– stress and strain –tension, compression and shear stresses– composite bars - elastic constants and their relations–Volumetric, linear and shear strains.

UNIT - II SHEAR FORCE AND BENDING MOMENT DIAGRAM

Beams and types–Transverse loading on beams– shear force and bending moment diagrams– Types of beam supports–Simply supported, over-hanging beams and cantilevers– Theory of bending of beams–bending stress distribution and neutral axis–shear stress distribution– point and distributed loads.

UNIT – III DEFLECTION OF BEAMS

Deflection of a beam using double integration method, moment area method and macaulay's method– computation of slopes and deflection in beams–Maxwell's reciprocal theorems.

UNIT – IV TORSION OF SHAFT AND SPRINGS

Torsion–Stresses and deformation in circular and hollow shafts– stepped shafts–Deflection of shafts fixed at both ends–Stresses and deflection of helical springs, laminated or spring - principal stresses and principal planes– Mohr's circle.

UNIT – V THIN AND THICK CYLINDER

Axial and hoop stresses in cylinders subjected to internal pressure–Deformation of thick and thin cylinders–Deformation in spherical shells subjected to internal pressure.

OUTCOMES

The Students can able to

- Recognize various types loads applied on machine components of simple and composite bars.
- Recognize the stresses developed on various types of beams.
- Recognize the slope and deflection developed on various types of beams.
- Evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading.
- Understand the nature of internal stresses.

TEXTBOOKS

1 S. Ramamrutham and R. Narayan, Strength of Materials, Dhanpat Rai and Sons, New Delhi.2007, 15th Editon.

2 Dr. R. K. Bansal, Strength of Materials, Lakshmi Publishers, 2007, 4th Edition.

3 L.S. Srinath, Advanced Mechanics of Solids, TMH, 2009, 3rd Edition

REFERENCE BOOKS

1 Beer & Johnson, Mechanics of materials, SI Metric Edition, McGraw Hill, ISE

2 Gere and Timensenko, Mechanics of Materials, CBS, 1986.

3 S.P. Timoshenko J.N Goodier, Theory of Elasticity, Mc Graw Hill International Edition.

4 S.M.A.Kazimi, Solid Mechanics, Tata McGraw Hill Publishing Company Ltd.

5 Timoshenko & Young, Engineering Mechanics, Tata McGraw Hill

6 J. B. K Das, Mechanics of Materials, Sapna Book House, 2007.

BMEP182T50 INSTRUMENTATION AND CONTROL L T P C
3 0 0 3

OBJECTIVES:
The course focuses on imparting the principles of measurement which includes the working mechanism of various sensors and devices, that are in use to measure the important physical variables of various mechatronic systems.

UNIT - I
General concept – Generalised measurement system-Units and standards-measuring instruments: sensitivity, stability, range, accuracy and precision-static and dynamic response-repeatability-systematic and random errors-correction, calibration - Introduction to Dimensional and Geometric Toleranceing - interchangeability,

UNIT - II
PRESSURE MEASUREMENT: Gravitational, Bourdon, Elastic transducers, strain gauge, Pressure cells, Measurement of high and low pressure, Dynamic characteristic of pressure measuring devices.

TEMPERATURE MEASUREMENT: Bi-metallic, pressure and resistance thermometer, Thermocouples, Pyrometer and Thermistors, Calibration. Pressure and temperature measurement in rotating systems – slip rings.

FLOW MEASUREMENTS: Orifice, flow nozzle, venturi, pitot tube, rotometer, Turbine type Anemometer, Hot-wire anemometer, Magnetic flow meter, Ultrasonic flow meter - Calibration.

DENSITY MEASUREMENT: Phenometer, Hydrometer, differential bubbling, Liquid level Measurements.

VISCOSITY: Capillary tube viscometer, efflux viscometer, falling sphere viscometer, Rotating cylinder viscometer.

HUMIDITY: Sling psychrometer, Absorption hydrometer, Dew point meter.

UNIT - III
STRAIN: Strain gauges, types, surfaces preparation and bonding technique, Wheatstone Circuit, Temperature compensation, Gauge rosettes, Calibration.
FORCE MEASUREMENT: Scales and balance, Elastic force meter, Strain gauge, Load cells Hydraulic and pneumatic load cells.

TORQUE MEASUREMENT: Mechanical torsion meter, Optical torsion meter, Electrical torsion meter, Strain gauge torsion meter.

UNIT - IV CONTROL SYSTEMS
Open and closed systems, Servomechanisms, Transfer function, Signal flow graphs, Block diagram algebra, Hydraulic and pneumatic control systems. Two-way control, proportional control, differential and integral control. Simple problems.

UNIT - V
Time response of first order and second order systems. Concept of stability. Necessary Condition for stability, Routh stability constraint, Polar and Bode plots, Nyquist stability Criterion. Simple problems.

OUTCOMES:
After undergoing the course the student can select appropriate device for the measurement of parameters like temperature, pressure, speed, stress, humidity, flow velocity etc., and justify its use through characteristics and performance.

TEXTBOOKS

1. Instrumentation and control systems by W. Bolton, 2nd edition, Newnes, 2000
2. Thomas G. Beckwith, Roy D. Marangoni, John H. LienhardV , Mechanical Measurements (6th Edition) 6th Edition, Pearson Education India, 2007
3. Gregory K. McMillan, Process/Industrial Instruments and Controls Handbook, Fifth Edition, McGraw-Hill: New York,1999.

REFERENCES

1. KUMAR. D.S. Mechanical Measurements & Control, Metropolitan Book Co., 1989
2. SIROHI RS. & RADHAKRISHNAN H.C, Mechanical Measurement, New Age International (P) Ltd., 2005, 3rd Edition.
3. RANGAN C.S, SARMA G.S & MANI VSV, Instrumentation Device and Systems, TMH, 1989
4. DOEBLIN, Measurement Systems Application and Design, TMH, 1990
5. A. K. Sawhney, Mechanical Measurements and Instrumentation, Dhanpat Rai & Company (P) Ltd, 2007, 12th Edition
6. R.K. Jain, Mechanical and Industrial Measurements, Khanna Publishers, 2004, 12th Edition.
7. M. Gopal, Control Systems, TMH, 2007, 2nd Edition.
8. Dr, D. Ganesh Rao, Control Systems, Sanguine, Technical Publishers, 2006

SEMESTER – III

BMEP183T10 **HEAT AND MASS TRANSFER** **L T P C**
3 0 0 3

(Use of approved Heat and Mass transfer Data book & Steam Tables permitted for all examinations)

OBJECTIVES

- To understand the mechanisms of steady state conduction heat transfer & fins
- To understand the concepts of unsteady state heat conduction.
- To learn the mechanisms of free & forced convection.
- To study the radiation & block body concept
- To understand the basic concepts of phase change heat transfer, heat exchanger & mass transfer.

UNIT-I CONDUCTION

Introduction to conduction heat transfer, Fourier's law of conduction, thermal conduction equation – derivation in Cartesian, cylindrical coordinates. One dimensional steady state conduction in plane wall and composite wall – thermal resistance, electrical analogy. Radial system – cylinder, sphere. Convective boundary condition, overall heat transfer coefficients, critical thickness of insulation, heat generation in plane wall, cylinder and sphere. Conduction and convective system – fins with different boundary conditions, thermal contact resistance, variable conductivity.

UNIT–II 2D- HEAT CONDUCTION & TRANSIENT CONDUCTION

Steady state conduction in two-dimension, conduction shape factor numerical method of analysis, unsteady state conduction – Lumped heat capacity system, significance of Biot and Fourier numbers, transient heat flow in a semi-infinite solid, use of Heisler and Grober charts - Heat transfer in multi-dimensional system,

UNIT–III CONVECTION

Review of boundary layer and thermal boundary layer. Differential and integral equation for hydrodynamic and thermal boundary layer. Similarity between heat, mass and momentum boundary layer. Significance of non-dimensional number in convection. Dimensional analysis for free and forced convection.

FORCED CONVECTION - Heat transfer from flat plate, flow through pipes, use of empirical relations.

FREE CONVECTION - Heat transfer from vertical, horizontal and inclined surfaces.

UNIT–IV RADIATION

Nature of thermal radiation, Black body concept, Grey body, Radiation shape factor, Relationship between shape factor, radiation heat transfer between two surfaces, Electrical analogy, reradiating surface, radiation shield, gas radiation, heat exchange between gas volume and enclosure.

UNIT–V HEAT EXCHANGER, PHASE CHANGE HEAT TRANSFER

Heat exchanger – Types - Fouling factor, overall heat transfer co-efficient - LMTD and NTU Methods.

Phase change heat transfer – boiling –condensation.

Mass Transfer – convective and diffusion mass transfer- Fick's law- equimolar counter diffusion- isothermal evaporation of water into air.

OUTCOMES

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

1. Apply heat conduction equations to different surface configurations under steady state conditions & solve problems.
2. Apply heat conduction equations to different surface configurations under unsteady state conditions & solve problems.
3. Apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems
4. Explain basic laws for Radiation and apply these principles to radiative heat transfer between different types of surfaces to solve problems
5. Explain the phenomena of boiling and condensation, apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and solve problems. Also apply diffusive & convective mass transfer phenomena.

TEXT BOOKS:

1. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 9th Edition 2008.
2. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 5th Edition 2015

REFERENCES:

1. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 1998.
2. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 1998.
3. Nag, P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, 3rd Edition 2011.
4. Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.
5. R.C. Sachdeva, “Fundamentals of Engineering Heat & Mass transfer”, New Age International Publishers, 2009.
6. Domkundwar, Heat and Mass Transfer, Dhanpat Rai India Ltd, 2008, 7th Edition.

BMEP183T20 **KINEMATICS OF MACHINES** **L T P C**

3 0 0 3

OBJECTIVES

- To understand the basic components and layout of linkages in the assembly of a system / machine.
- To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
- To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
- To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.

UNIT–I: Introduction to links, Pairs and Chains

Links, Pairs, Chains, Mechanisms, Inversion of machines, Structure - Degrees of freedom, inversion, Four bar chains. Velocity and acceleration: Velocity and acceleration of simple mechanism by relative velocity method. Klein's constructions for slider crank chain oscillating cylinder and swivel bearing mechanisms. Analytical solution for slider crank mechanisms.

UNIT–II: Cams

Introduction to Cams, Types of cams and followers, displacement, velocity & acceleration curves for uniform velocity, uniform acceleration and retardation. SHM, cycloidal curves, lay out of profile of plate cams of the above types with reciprocating and oscillating followers – knife edge rollers and flat faced followers, cylindrical and face cams, polynomial cams, cams with special contours.

UNIT–III: Theory of gearing

Introduction to Toothed gears, law of gearing, minimum number of teeth, length of arc of contact, interference.

UNIT–IV: Gear trains

Introduction to gear trains, Types, velocity ratio and torque calculation in epicyclic gear trains and differential gear train.

UNIT-V: Drives and Lubrication

Belt and rope drives, single plate, multiple plate, cone clutches, power transmitted, Brakes. Lubrication: Theory of lubrication, hydrostatic and hydrodynamic bearings, frictional loss, power in bearing.

OUTCOMES

Upon the completion of this course the students will be able to

- Understand the basics of mechanism
- Calculate velocity and acceleration in simple mechanisms
- Develop CAM profiles
- Solve problems on gears and gear trains
- Examine friction in machine elements

TEXTBOOKS

1. Amitabh Ghosh and Ashok Kumar Mallik, Theory of mechanism and Machines – 3nd Edition, Affiliated East West Press Limited, 2017.
2. J.E.Shigley and J.J.Vicker Jr. Theory of Machines and Mechanism, 2nd ed. Mc GrawHill ISE 1995
3. R.S. Khurmi & Gupta. J.K, A text book of Theory of Machines, S. Chand & Co., 2008, 14th Edition.

REFERENCES

1 J. Hannah and R.C Stephens Arnold, Mechanics of Machines – ISE 1999.
2 Beer & Johnson 11th Edition, Vector Mechanics for Engineers. McGraw Hill. ISE 2017.
3 Thomas Bevan – 3rd Edition, The Theory of Machines – CBS, Pearson 2009.
4 P.L. Ballaney, Theory of Machines, Khanna Publishers, 2005, 24th Edition.
5 S.S.Rattan, Theory of Machines, TMH. 2017, 2nd Edition, 2017.
6 Rao .J.S. & Dukkipati. R.V. Mechanism and Machine Theory, 2nd ed. Wiley Eastern Ltd., 2007,
7 Hamilton H. Mabie & Charles F. Reinnoltz, Mechanisms and Dynamics of Machinery, 4th ed. John Wiley & Sons, 1995
8 Thomson W.T, Theory of Vibration and Applications, PHI, 1997.
9 Sadhu Singh, Theory of Machines, Pearson Education Ltd, 2011.
10 Ashok G. Ambekar, Mechanism and Machine Theory, Eastern Economy Edition. 2007.
11 John. J. Uicker, Theory of Machines and Mechanisms, Oxford University Press, 2008, 3rd Edition.

BMEP183T30 **MANUFACTURING PROCESSES** **L T P C**

3 0 0 3

OBJECTIVES:

- To motivate and challenge students to understand the basic casting techniques.
- To introduce the concepts of basic metal forming processes
- To provide the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling and drilling.
- To learn the various joining process.
- To learn the basic concepts of unconventional machining processes

UNIT–I: Casting and molding

Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses.

UNIT–II: Metal forming processes

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.

UNIT–III: Metal cutting

Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining, Additive manufacturing: Rapid prototyping and rapid tooling

UNIT–IV: Joining/fastening processes

Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes; Adhesive bonding.

UNIT–V: Unconventional Machining Processes

Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters, Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire cut EDM; Electro-chemical machining (ECM), etchant &maskant, process parameters, MRR and surface finish. Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining.

OUTCOMES

Upon the completion of this course the students will be able to

- Apply the concepts of different metal casting processes, associated defects
- Gain the knowledge in various sheet metal making processes.
- Understand the mechanism of material removal processes
- Compare the different metal joining processes
- Understand the different unconventional Manufacturing Methods employed for making different products.

TEXT BOOKS

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, 2009.
3. Degarmo, Black & Kohser, Materials and Processes in Manufacturing, 12th Edition 2017.

REFERENCES

1 Banga T.R, Agarwal. R.K. & Manghrani. T.M., "Foundry Engineering", Khanna Publishers, New Delhi, 1995

2 Jain.R.K. "Production Technology" Khanna Publishers, 1988

3 Bhattacharyya.A. "Metal Cutting Theory and Practice", Central Book Publishers, 1984

4 S. K. Hajra Chowdhery, & A. K. Hajra Chowdhery, Elements of Workshop Technology, Vol 1 & 2, Media Promoters and Publishers, 2007, 14th Edition.

5 C. Elanchezhian, Production Technology, Easwar Press, 2005.

BMEP183T40 **ENGINEERING ECONOMICS** **L T P C**
3 0 0 3

OBJECTIVES

- To enable students to understand the fundamental economic concepts applicable to engineering and to learn the techniques of incorporating inflation factor in economic decision making.

UNIT-I: Introduction to Economics 8

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics – Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis – V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.

UNIT-II: Value Engineering 10

Make or buy decision, Value engineering – Function, aims, Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor – Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

UNIT-III: Cash Flow **9**

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

UNIT-IV: Replacement and Maintenance Analysis 9

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

UNIT-V: Depreciation 9

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

OUTCOMES

- Upon successful completion of this course, students will acquire the skills to apply the basics of economics and cost analysis to engineering and take economically sound decisions.

TEXT BOOKS

1. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2nd Edition 2013.

REFERENCES

1. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2011.
2. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2010.
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 2011.
4. Zahid A khan: Engineering Economy, "Engineering Economy", Dorling Kindersley, 2012

BMEP183P50 **MECHANICAL LAB-I (I.C. ENGINES & HEAT TRANSFER LABORATORY)** **L T P C**

0 0 4 2

OBJECTIVES

- To study the valve timing and Port timing diagram of I.C. Engines.
- To conduct the performance test on single / twin cylinder I.C. engines using different loading arrangements.
- To build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation

INTERNAL COMBUSTION ENGINES LABORATORY

LIST OF EXPERIMENTS

1. Valve timing diagram on single cylinder four stroke petrol engine
2. Port timing diagram on single cylinder two stroke petrol engine
3. Load test on single cylinder petrol engine
4. Load test on single cylinder diesel engine
5. Performance test on high speed diesel engine with alternator loading
6. Performance test on Twin cylinder diesel engine

HEAT TRANSFER LABORATORY

LIST OF EXPERIMENTS

1. Heat Transfer through Composite Walls
2. Heat Transfer through a Pin- Fin
3. Heat Transfer by Natural Convection
4. Heat Transfer by Forced Convection
5. Stefen Boltzman Apparatus
6. Heat Transfer through Parallel Flow / Counter Flow Heat Exchanger

COURSE OUTCOMES

Upon the completion of the course, the students will able to

- Analyse the performance behaviour of petrol / diesel engine.
- Understand the various strokes & scavenging process of I.C. engines.
- Formulate and analyze a heat transfer problem involving any of the three modes of heat transfer.
- Obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer.
- Design a devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.

SEMESTER- IV

DESIGN OF MACHINE ELEMENTS **L T P C**

3 0 0 3

(Use of approved PSG Design Data book permitted for all examinations)

OBJECTIVES

- To familiarize various steps involved in the design process.
- To understand the design principles of shafts, coupling and bearings.
- To know the design procedures of different types of gear drives.
- To study and analyze the components like springs and different joints.
- To understand the mechanisms and design procedures for clutches and brakes.

UNIT-I INTRODUCTION TO DESIGN PROCESS

Design considerations - limits, fits and standardization, Review of failure theories for static and dynamic loading, Stress concentration factor.

UNIT-II DESIGN OF SHAFTS AND BEARINGS

Design of shafts under static and fatigue loadings, Design of couplings, Analysis and design of sliding and rolling contact bearings.

UNIT-III DESIGN OF GEARS AND DRIVES

Design of transmission elements: spur, helical, bevel and worm gears based on beam strength and life, Design of belt and chain drives.

UNIT-IV DESIGN OF SPRINGS AND JOINTS

Design of springs: helical compression, tension, torsional and leaf springs, Design of joints: threaded fasteners, pre-loaded bolts and welded joints, Design of riveted joints, Design of knuckle and cotter joints.

UNIT-V DESIGN OF SCREWS, CLUTCHES AND BRAKES

Analysis and applications of power screws, Analysis of clutches- Pressure and load calculations. Brakes-shoe brakes, band brakes-simple, differential.

OUTCOMES

- The students will get familiarized in various steps involved in the design process.
- The design of shafts, coupling and bearings would be done.
- The students will be able to design different types of gear drives.
- The students will be able to analyse the components like springs and different joints.
- Design of clutches and brakes would be done easily.

TEXT BOOKS

1. R. S. Khurmi & J. K. Gupta, A Text Book of Machine Design, S. Chand & Co., 11th Edition 1996
2. S. Jalaludeen, Machine Design, Anuradha Publishers, 2004.
3. Dr. V. Jayakumar, Design of Transmission Systems, Laxmi Publications, 2016.

REFERENCE BOOKS

1. Joseph Edward Shigley, Mechanical Enginering Design, McGraw Hil, 2008.
2. Tool design 4th Edition, Cyrill Donaldson, George H. LeCain, Joyjeet Ghose, V.C. Goold 2012, Tata McGraw Hil & Co.
3. Hall & S. Allen, Machin Design, Schuam's Series, 2008.
4. M. F. Spolts, Design of Machine Elements, Pearson Education, 2005.
5. J. B. K. Das, Design of Machine lements, Sapna Book House, 2007.
6. A. S. Ravindra, Design of Machine Elements, Best Publishers, 2005.

DYNAMICS OF MACHINES L T P C

3 0 0 3

OBJECTIVES

- To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
- To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
- To understand the effect of Dynamics of undesirable vibrations.
- To understand the principles in mechanisms used for speed control and stability control.

UNIT-I: Balancing

Static and dynamic balancing of rotating masses in different planes, partial balancing of reciprocating masses of in – line, V, W and radial engines. Hammer blow and swaying couple in locomotive, direct and reverse crank method.

UNIT–II: Inertia Force

Inertia force and inertia torque calculation. Turning moment diagrams, reciprocating engine mechanisms, fluctuation of energy and speed, Weight of flywheels.

UNIT-III: Governors and Gyroscope

Introduction to Governors, Function of governors – porter, proell and spring-loaded governors, sensitivity, stability, hunting and isochronism's, effect of friction, calculation of equilibrium speeds and ranges of speed of governors.

Gyroscope – couple and effect, in ship and motor cycle, car, aircraft and space vehicles, Gyroscope stabilization.

UNIT-IV: Free Vibration

Introduction to free vibration - Undamped free vibration of single degree of freedom system, simple pendulum, compound pendulum, inclined spring-mass system, equivalent stiffness of spring combinations – springs in series, springs in parallel, combined series and parallel springs.

Damped free vibration of single degree of freedom systems, types of damping, free vibrations with viscous damping, critically damped system, under damped system.

UNIT–V: Forced Vibration

Introduction to forced vibration - Forced vibration of single degree of freedom system. Constant harmonic excitation, steady state vibration, magnification factor with frequency ratio for various damping.

Transverse vibrations of beams –natural frequency by energy method, Dunkerly method-Vibration isolation and transmissibility, whirling of shafts.

Torsional vibrations: Torsional vibrations of single and multiple rotor systems, Equivalent shafts, Geared systems, Holzer's method.

OUTCOMES

- Upon completion of this course, the Students can able to predict the force analysis in mechanical system and related vibration issues and can able to solve the problem.

TEXTBOOKS

1 Amitabh Ghosh and Ashok Kumar Mallik, Theory of mechanism and Machines – 3nd Edition, Affiliated East West Press Limited, 2017.
2 J.E.Shigley and J.J.Vicker Jr. Theory of Machines and Mechanism, 2nd ed. Mc GrawHill ISE 1995
3 R.S. Khurmi & Gupta .J.K, A text book of Theory of Machines, S. Chand & Co., 2008, 14th Edition.
4 G.K. Groover, Mechanical Vibrations, New Chand and Brothers, Roorkee, 2009.

REFERENCES

1 Beer & Johnston 11th Edition, Vector Mechanics for Engineers. McGraw Hill. ISE 2017.
2 Thomas Bevan – 3rd Edition, The Theory of Machines – CBS 1984, Pearson 2009.
3 S.S.Rattan, Theory of Machines, TMH. 2008, 2nd Edition.
4 Sadhu Singh, Theory of Machines, Pearson Education Ltd, 2011.
5 S. S. Rao, Mechanical Vibrations, Pearson Education, 5th Edition, 2009.
6 J. B. K. Das, Dynamics of Machinery, Sapna Book House, 2018.

METROLOGY AND QUALITY CONTROL L T P C

3 0 0 3

OBJECTIVES

1. To provide knowledge on relevant terms in Metrology like accuracy, precision, calibration, sensitivity, repeatability
2. To provide knowledge on measurements using gauges, Interferometers and Surface Roughness
3. To provide knowledge on measurements of threads, gears and aadvanced measurement techniques
4. To Introduce the concept of quality and tools used in quality
5. To introduce the concept of SQC

Unit – I Measurement standards and comparators

Principles of Engineering metrology, Measurement standards, Types and sources of errors, Accuracy and Precision, introduction to uncertainty in measurement, linear and angular measuring instruments and their applications. Calibration: Concept and procedure, traceability, Gauge R&R Comparators: Mechanical, Pneumatic, Optical, Electrical (LVDT).Checking all geometrical forms.

Unit – II Design of gauges, Interferometers and Surface Roughness measurements

Design of Gauges: Tolerances, Limits and Fits, Taylors principle, Types of gauges and gauge design (numerical). Interferometer: Principle, NPL Interferometer, Laser Interferometer and their applications. Surface Roughness Measurement: Surface texture, Parameters for measuring surface roughness, Contact & non-contact type surface roughness measuring instruments.

Unit – III Metrology of Thread, Gears and Advance Metrology

Measurement of Thread form: Thread form errors, Measurement of Minor, Major and Effective diameter (Three Wire Method), Flank angle, pitch, Floating Carriage Micrometer (Numerical). Gear Metrology: Types of errors, Gear tooth Vernier, Constant chord, Base tangent (Numerical), Gear Rolling Tester. Profile Projector, Tool maker‟s microscope and their applications. Advancements in Metrology: Introduction & applications of: Co-ordinate Measuring Machine, Universal Measuring Machine, Laser in Metrology, Automatic inspection system, Machine vision for online-offline inspection.

Unit – IV Introduction to Quality and Quality Tools

Quality: Dimensions, Statements, Cost of quality & value of quality, Deming‟s cycles & 14 Points, Juran Trilogy approach, Seven Quality Tools, Introduction to N Seven Tools, Quality Circle, Criteria for Quality Award (National & International). University of Pune

Unit –V Statistical quality control

Statistical quality control: Statistical concept, Frequency diagram, Concept of variance analysis, Control Chart for Variable (X & R Chart) & Attribute (P & C Chart), Process capability(Indices: cp, cpk, ppk), Statistical Process Control (Numerical). Production Part Approval Method (PPAP). Acceptance Sampling: Sampling Inspection, OC Curve and its characteristics, sampling methods, Sampling Plan: Single, Double (Numerical), Multiple, Comparison of Plan, calculation of sample size, AOQ, Probability of Acceptance (Numerical).

OUTCOMES

1. Describe the concepts of measurements to apply in various metrological instruments
2. An ability to design gauges to meet desired needs within realistic constraints.
3. Explain the procedure for advanced measurement techniques and computer aided inspection
4. Summarize the concept of Quality and tools used.
5. An understanding of Quality Control Techniques and its applications in engineering industries

TEXT BOOKS

1. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2018.
2. Jain R.K. "Engineering Metrology", Khanna Publishers, 2009.
3. M. Mahajan, "Statistical Quality Control", Dhanpat Rai & Sons,2016.
4. R.C.Gupta, "Statistical Quality control & quality Management", Khanna Publishers, 1998

REFERENCES:

1. Alan S. Morris, "The essence of Measurement", Prentice Hall of India 1996.
2. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education , 2014.
3. Charles Reginald Shotbolt, "Metrology for Engineers", 5th edition, Cengage Learning EMEA,1990.
4. Donald Peckman, "Industrial Instrumentation", Wiley Eastern, 2004.
5. Raghavendra ,Krishnamurthy "Engineering Metrology & Measurements", Oxford Univ. Press, 2013.
6. Danny Samson, "Manufacturing & Operations Strategy", Prentice Hall, 1991
7. Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 1993.

POWER PLANT ENGINEERING **L T P C**

3 0 0 3

OBJECTIVES:

- Providing an overview of Power Plants , operation and maintenance of Power Plant equipment.

UNIT - I POWER PLANT EQUIPMENT

Essential of steam power plant equipment – power station design – characteristics of steam power plant – layout – Stokers - Types– pulverized fuel firing – principles of FBC – Types of FBC – Arrangement of different FBC plants – advantages of FBC systems – Ash handling – dust collectors – draft measurements – chimneys – calculation of chimney heights – feed water treatment – air preheater – types of superheaters, condenser, cooling towers.

UNIT - II STEAM GENERATORS

Boilers – types of modern high pressure boiler – boiler mountings and accessories – thermal efficiency of boiler – boiler performance – selection of fuel for boiler – boiler maintenance – selection of boiler – heat balance sheet for boiler – Indian boiler act.

UNIT - III POWER PLANT LAYOUTS

Gas turbine power plant : layout Classification or comparison of different types of gas turbine power plants – different arrangements of plant components – governing system for gas turbine power plant.

Diesel power plant layout :Different systems of diesel power plant – advantages & disadvantages of diesel power plant over thermal plant.

Hydroelectric power plant layout :Classification – storage reservoir plants – pump storage plants – advantages of hydro-electric power plants.MHD power plant

UNIT - IV NUCLEAR POWER PLANT

Nuclear Reactor: General components of nuclear reactors – different types of reactors – pressurized water reactor (PWR), Boiling water reactors (BWR), heavy water cooled and moderated - reactors, gas cooled reactors, liquid metal cooled reactors, fast breeder reactors, location of nuclear power plant, comparison of nuclear power plants with thermal plants. Nuclear materials – fuels – coolant – moderators & reflecting materials – control rod – shielding materials.

UNIT - V POWER PLANT ECONOMICS

Load curves – different terms & definitions – effect of variable load on power plant design & operation – requirement of peak load plants – fixed or operating cost – load diversion – tariff methods for electrical energy – comparison of economic of different types of power plants – environmental hazards of various power plants.

OUTCOMES:

- Upon completion of this course, the students can able to understand different types of power plant, and its functions and their flow lines and issues related to them.

TEXT BOOKS

1. M. N. EI. Wakil, Power Plant Technology, Mc Graw Hill, 1985.
2. P. K. Nag, Power Plant Engineering, TMG, 2008.3rd Edition.
3. G. R. Nagpal & S.C. Sharma, Power Plant Engineering, Khanna Publishers, 1995.

REFERENCES

1. Vopal and Stortzki, Power Plant Engineering, PHI, 2007.
2. Domkundwar, Arora Domkundwar, Power Plant Engineering, Dhanpat Rai & Sons, 2016.
3. Joel Weisman and Roy Eckart, Morden Power Plant Engineering, PHI, 1985
4. G. D. Rai, Non Conventional Sources of Energy, Khanna Publishers, Delhi. 2007, 4th Edition.
5. V. Kadambi, An Introduction to Energy Conversion, New Age Publication Ltd, 2004.

(MECHANICAL LAB – II)
DYNAMICS AND MEASUREMENTS LABORATORY

L T P C

0 0 4 2

OBJECTIVES:

1. To understand the kinematic and dynamic characteristics of mechanical devices
2. To familiar with different measurement devices

LIST OF EXPERIMENTS

1. Determination of M.I by suspension of simple and compound pendulum method.
2. Cam & follower and motion studies
3. Determination of critical speed for whirling of shaft.
4. Determination of natural frequency and damping coefficient for spring mass system.
5. Determination of torsional natural frequency for single rotor system.
6. Strain measurement using Rosette strain gauge
7. Torque measuring device – Rope and prony brake arrangements
8. Temperature measuring device- Thermocouples
9. Pressure measuring devices – Pressure and vaccum gauge calibration
10. Displacement measuring devices- LVDT
11. Checking straightness of a surface plate using Autocollimator
12. Use of electronic , pneumatic and mechanical comparator for determining flattness

OUTCOMES

Students who have undergone the course will be able to characterize the dynamic behavior of mechanical systems and to understand the mechanical measurement devices.