Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institnte of Information Technology, Pnne-48

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Curriculum for
T. Y. B. Tech.
(Mechanical Engineering)
2018 Pattern

Department of
Mechanical Engineering

Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Information Technology, Pune-48

(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Department of Meehanieai Engineering

VISION

Excellence in Mechanical Engineering for Global Acceptance

MISSION

- Make spirited mechanical engineers with morals, values and principles for sustainable development of society.
- Strive continuously to impart knowledge and skills of the highest standards.
- Our engineers will respond to the eurrent and future needs of the industry, higher studies as well as research.

Program Edncatioual Objectives-

1. Graduates of the program will become competent engineers suitable for the mechanical engineering based industry and higher education.
2. Graduates of the program will acquire the necessary foundation in fundamental mechanical engineering subjects for development of mathematical and analytical abilities.
3. Graduates of the program will acquire the knowledge and skills in mechanical engineering to provide technological solutions.
4. Graduates of the program will learn managerial, financial and ethical practices such as, project and financial management skills, multidisciplinary approach and soft skills.
5. Graduates of the program will respond to growing demands of society through lifelong learning.

Program Outeomes-

At the end of the program, a student will be able to

1. **Engineering knowledge-** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis-** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
3. **Design/development of solutioos-** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
4. **Conduct investigations of complex problems-** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid eonclusions.

5. **Modern tool nsage-** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society-** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability-** Understand the impact of the professional engineering solutions in societal and environmental eontexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics-** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Indlvidual and team work-** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Commnnication-** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance-** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning-** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Program Specific Outcomes-

At the end of the mechanical engineering program, a student will be able to-

1. Identify, automate and apply manufacturing processes for production of mechanical components considering effective use of man, machines, and material resources.
2. Design, formulate, develop and analyze mechanical components and systems using design engineering principles and modern CAD/CAE tools
3. Specify, analyze, evaluate, audit, design and build thermal and fluid systems using modern engineering tools

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Department of Mechanical Engineering

T.Y. B. TECH (MECHANICAL ENGINEERING), SEMESTER V (PATTERN 2018)

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
			L	T	P	CIE	ISE	SCE	ESE	PR/ OR/ TW		
ES31181ME	Numerical Methods*	TH	3	-	2	20	30	20	30	25	125	4
MEUA31182	Heat Transfer*	TH	3	-	2	20	30	20	30	25	125	4
MEUA31183	Professional Elective-I	TH	3	-	-	20	30	20	30	-	100	3
MEUA31184	Design of Machine Elements-II	TH	3	-	-	20	30	20	30	-	100	3
MEUA31185	Kinematics and Theory of Machines	TH	3	-	2	20	30	20	30	25	125	4
MEUA31186	Automation in Manufacturing	CE	2	-	2	-	-	50	-	25	75	3
M3	Mandatory course	AU	-	-	-	-	-	-	-	-	-	-
	Total	-	17	-	8	100	150	150	150	100	650	21

*Courses having Practical/Oral

CIE: Continuous Internal Evaluation SCE: Skill and Competency Examination

ISE: In-Semester Examination ESE: End Semester Examination

Professional Eleetive-I-

MEUA31183A	Energy Conservation and Management
MEUA31183B	Composite Materials
MEUA31183C	Advanced Manufacturing Processes
MEUA31183D	Advanced Metallurgy

List of Mandatory Courses-

Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge

Vishwakarma Institute of Information Technology, Kondhwa (Bk.), Pune 48. Dept. of Mechanical Engineering

BoS Chairman **Dean Academics** **Director**

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(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Departmeut of Mechanical Engineeriug

T.Y. B. TECH (MECHANICAL ENGINEERING), SEMESTER VI (PATTERN 2018)

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
			L	T	P	CIE	ISE	SCE	ESE	PR/ OR/ TW		
MEUA32181	Professional Elective-II	TH	3	-	2	20	30	20	30	25	125	4
MEUA32182	Professional Elective – III	TH	3	-	2	20	30	20	30	25	125	4
MEUA32183	Mechanical Vibration*	TH	3	-	2	20	30	20	30	25	125	4
ES32184ME	Operation Research	TH	3	-	-	20	30	20	30	-	100	3
IOEUA32185	Open Elective-I	TH	3	-	-	20	30	20	30	-	100	3
MEUA32186	Computer Aided Engineering	CE	2	-	2	-	-	50	-	25	75	3
M3	Mandatory Course	AU	-	-	-	-	-	-	-	-	-	-
	Total	-	17	-	8	100	150	150	150	100	650	21

*Courses having Practical/Oral

Professional Elective-II		Professional Elective-III		Open Elective-I	
MEUA32181A	Refrigeration and Air Conditioning	MEUA32182A	I. C. Engines	IOEUA32185A	Information and Cyber Security
MEUA32181B	Tribology	MEUA32182B	Solid Mechanics	IOEUA32185B	Automotive Electronics
MEUA32181C	Design for Manufacturing and Assembly	MEUA32182C	Hybrid and Electric Vehicles	IOEUA32185C	Industrial Engineering
MEUA32181D	Data Analytics	MEUA32182D	Robotics	IOEUA32185D	Artificial Neural Network in Engineering
				IOEUA32185E	Social Media Analytics

List of Mandatory Courses-

Environmental Sciences, Induction training, Indian Constitution,Essence of Indian Traditional Knowledge

BoS Chairman **Dean Academics** **Director**

Vishwakarma Institute of Information Technology, Kondhwa BK, Pune 48. Dept. of Mechanical Engineering

Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Informatiou Technology, Pune-48

(An Autonomons Institute Affiliated to Savitribai Phule Pune University)

Department of Mechanical Engineeriug

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11	MEUA32181B	Tribology	29
12	MEUA32181C	Design for Manufacturing and Assembly	31
13	MEUA32181D	Data Analytics	34
14	MEUA32182A	I. C. Engines	36
15	MEUA32182B	Solid Mechanics	38
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18	MEUA32183	Mechanical Vibration	44
19	ES32184ME	Operation Research	47
20	lOEUA32185A	Information and Cyber Security	49
21	IOEUA32185B	Automotive Electronics	51
22	IOEUA32185C	Industrial Engineering	53

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Semester – I

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Department of Mechanicai Eugineering

Numerical Methods (ES31181ME)

Teaehing Scheme	Examination Scheme						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): -- hr Practical (P): 2 hrs./week.	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	25	-	I25

Prerequisite: Engineering Mathematics I, II and III

Course objectives:

- To recognize the difference between analytical and numerical methods and to provide the necessary concepts of a few numerical methods for solving complex Mechanical engineering Problems
- To offer hands-on experiencc for developing programming skills to provide solutions to mechanical problems using numerical methods.

Coursc Outcomcs:

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

1. Determine the root to given equations using appropriate numerical method.
2. Interpret appropriate numerical mcthod to solve linear systems of equations.
3. Demonstrate the use of regression/interpolation methods to find values based on the graphical and/or tabulated data.
4. Apply numerical methods to obtain approximate integration for given problem.
5. Evaluate an approximate solution of ordinary differential equation.
6. Solve a partial differential equation using finite difference approach.

Unit I–Errors, Approximations and Roots of Equation

Errors & Approximations- Significant figures, Accuracy & Precision, Errors Round-Off Error, Truncation Error, Error Propagation

Roots of Equations-Bisection Method, Newton Raphson method, Successive approximation method, Convergence and Divergence

Uuit II - Simultaneons Equations

Gauss Elimination Method, Partial Pivoting, Gauss-Seidal method and Thomas algorithm for Tri-Diagonal Matrix.

Unit III -Curvc Fitting and Interpolatiou

Curve Fitting- Least Square Technique- Straight Line, Power Equation, Exponential Equation and Quadratic Equation.

Interpolation- Lagrange's Interpolation, Newton's Forward Difference interpolation, Inverse Interpolation

Unit IV- Numericai Intcgration

Trapezoidal rule, Simpson's1/3rdRule, Simpson's3/8thRule, Gauss Quadrature Method. Double Intcgration

Unit V- Ordinary Differentiai Equations

Taylor series method, Euler Method, Modified Euler Method, Runge-Kutta Second Order Method, Runge-Kutta fourth order Method, Simultaneous equations using RungeKutta2nd order method.

Unit VI - Partiai Differentiai Equatious

Finite-Difference Approximations to Partial Derivatives, Solution of Elliptical and ParabolicEquations, Solution of One-Dimensional Heat Equation, Solution of Wave Equation

Lab practicc/Term Work-

Term work shall consist of following assignmcnts.

1. Program on Roots of Equation
   a) Bisection Method or False position Method,
   b) Newton Raphson method or Successive approximation method
2. Program on Simultaneous Equations
   a) Gauss Elimination Method,
   b) Gauss-Seidal method.
3. Program on Numerical Integration
   a) Trapezoidal rule,
   b) Simpson's Rules ($1/3^{rd}$& $3/8^{th}$)[In one program only]
   c) Double integration
4. Program on Curve Fitting
   a) Straight line,
   b) Power equation Or Exponential equation
   c) Quadratic equation
5. Program on Interpolation
   a) Lagrange's Interpolation,
   b) Newton's Forward interpolation,
6. Program on Ordinary Differential Equations
   a) Euler Method
   b) Runge-Kutta Methods- Second order,
8. Program on Partial Differential Equations

Text Books:

1. B. S. Garewal, Numerical Methods in Engineering and Science- With Programs in C, C++ and MATLAB, New Delhi, Khanna Publishers
2. Jain M K, Iyengar S R K, Jain R K, Numerical Methods for Scientific and Engineering Computation, New Age International (P) Ltd. Publisher
3. Rao V. Dukkipati, Applied Numerical Methods using Mat lab, New Age International Publishers

Rcfercnce Books:

1. Mathews John H,Fink Kurtis , Numerical Methods Using MATLAB, Dorling Kindersley (India) Pvt. Ltd
2. Stanton Ralph G , Numerical Methods for Science and Engineering, Prentice Hall of India
3. Chapra Steven C; Canale Raymond P , Numerical Methods for Engineers- with Software and Programming Applications, Tata McGraw Hill
4. Balagurusamy, Numerical Methods, Tata McGraw Hill
5. Thangaraj, Computer Oriented Numerical Methods, Prentice Hall of India
6. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India

Vishwakarma Institute of Information Technology, Kondhwa (B.K.), Pune
Dept. of Mechanical Engineering

Prepared by-Mr. P.R. Anerao

BOS Member-Dr. A.P. Kulkarni

BOS Chairman-

Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Information Techuology, Pune-48

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Departmeut of Mechanical Engineering

Heat Transfer (MEUA31I82)

Teaching Scheme	Examination Scheme						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): -- hr Practical (P): 2 hrs./week.	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	25	-	125

Prerequisite: Thermodynamics, Fluid Mechanics, Engineering Mathematics

Coursc objectives:

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

Course Outcomes:

Upon the completion of the course, students will able to

1. Understand the various modes of heat transfer and implement the basic heat conduction equations for Steady, one dimensional thermal system with and without internal heat generation.
2. Apply heat conduetion in extended surfaces.
3. Formulate and analyze a transient heat transfer problem.
4. Determine the heat transfer rate in natural and forced convection.
5. Interpret heat transfer by radiation between objects with simple geometries.
6. Analyze the heat exchangers and investigate the performance.

Unit I - Steady State Conduction

Introductiou-Applications of heat transfer, Modes of heat transfer, Thermal conductivity, Thermal diffusivity

Unidirectional steady state conduction without internal heat generation-Fourier's law, Application of Fourier's law to infinite slab, infinite long hollow cylinder and hollow sphere, Electrical Analogy of conduction, concept of conduction and film resistances, critical insulation thickness, (Numerical) Three dimensional general differential equation of conduction in Cartesian, cylindrical and spherical geometry (no derivation for Cylindrical and spherical geometry), Laplace, Fourier's and Poisons equation.

Unidirectional steady state conduction with internal heat generation-Boundary conditions, Application of Poisons equation (No Numerical)

Unit II - Heat conduction through Extended Surfaces – Fins

Types of fins and its applications, Fin effectiveness and fin efficiency, concept of pin fin, Differential equation of pin fin, boundary condition based classification of pin fins, Analysis of pin fin

Unit III - Unsteady state conduction

Validity and criteria of lumped system analysis, Biot and Fourier number, Time constant and response of thermocouple, (Numerical) Transient heat analysis using Heisler and Grober charts.

Unit IV- Convection

Fundamentals of Convection-Heat conveetion, velocity and thermal boundary layers (No Numerical)
Forced Convection-Governing equation of forced convection, physical significance of dimensionless numbers, Correiations for flow through Duct/Internal flow and flow over flat plate/ External flow (Numerical)

Natural Convection-Mechanism of natural convection, Governing equation of natural convection, physical significance of dimensionless numbers, correlations for simple geometry eases (Numerical)
Condcnsation and boiling-Film wise and drop wise condensation, Typical pool boiling curve (No Numerical)

Unit V-Radiation

Fundamental concepts, Laws of radiation, solid angle, intensity of radiation, (No Numerical); Radiation between two blaek surfaces, shape factor, coneept of electrical analogy, Radiation between two finite grey surfaces, Radiation shields (Numerical)

Unit VI- Heat Exchanger

Types of heat exchangers, Overall heat transfer coefficient with scaling effect, Analysis and design of heat exchangers using both LMTD and NTU – ε method, Introduction mass transfer, Similarity and difference between heat and mass transfer.

Lab practice consists of the following -
1. Determination of Thermal Conductivity of metal rod.
2. Determination of Thermal Conductivity of insulating powder.
3. Determination of Thermal Conduetivity of Composite wall.
4. Determination of heat transfer coefficient in Natural Convection.
5. Determination of heat transfer coefficient in Forced Convection.
6. Determination of temperature distribution, fin efficiency in Natural Convection.
8. Determination of Emissivity of a Test surface.
8. Determination of Stefan Boltzmann Constant.
9. Determination of critical heat flux.
10. Determination of NTU/effectiveness of a heat exchanger (Evaporator/Condenser).

Text Books:

1. F.P. Incropera, D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley.
2. Mahesh M. Rathod, Engineering Heat and Mass Transfer, Third Edition, University Science Press,2016
3. Y. A. Cengel and A.J. Ghajar, Heat and Mass Transfer – Fundamentals and Applications,Tata McGraw Hill Education Private Limited.
4. S.P. Sukhatme, A Textbook on Heat Transfer, Universities Press.
5. R.C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age Science.
6. P.K. Nag, Heat & Mass Transfer, McGraw Hill Education Private Limited.
7. V. M. Domkundwar, Heat Transfer
8. Holman, Fundamentals of Heat and Mass Transfer, McGraw – Hill publication

Prepared by-Dr. A. D .Kale

BOS Member-Dr. D. A. Kambale

BOS Chairman-

Vishwakarma Institute of Information Technology, Kondhwa B.K., Pune 48. Dept. of Mechanical Engineering

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Department of Mechanical Engineering

Energy Couservation and Management (MEUA31I83A)

Teaching Scheme	Examination Scheme						
Credits: 3 Lecture (L): 3hrs./week Tutorial (T): – hr Practical (P): – hrs.	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite: Environment Studies, Thermodynamics, Applied Thermodynamics

Course objectives:

- The course is prepared to provide detailed understanding of energy conservation and management, 3Es (Energy, Economics and Environment) and their interaction, energy andit and financial managemcnt.

Course Ontcomes:

After successful completion of the course, student will be able to

1. Understand the basic knowledge of different terms & principles of energy conservation norms.
2. Evaluate the energy saving different mechanieal utilities.
3. Interpret energy conservation in mechanical utilities.
4. Understand simple payback period, energy rates.
5. Understand efficient heat & electricity utilization, saving and recovery in different thermal and electrical system.
6. Prepare energy audit report for different energy conservation instances

Unit I- Energy scenario and Energy conservation Act

Energy Scenario- Classification of Energy, Indian energy scenario, energy pricing, energy security, energy conservation and its importance, energy strategy for the future.

Energy Conservation Act 2001 and related policies- Energy conservation Act 2001 and its features, notifications under the Act, Schemes of Bureau of Energy Efficiency (BEE) including Designated consumers, State Designated Agencies, Electricity Act 2003, Integrated energy policy, National action plan on climate change, ECBC code for Building Construction.

Unit II-Financial Management and Energy Monitoring and Targeting

Financial Management and Energy Monitoring and Targeting- Investment-need, appraisal and criteria, financial analysis techniques simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options.

Energy Monitoring and Targeting- Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques – energy consumption, production, cumulative sum of differences (CUSUM). Energy Management Information Systems (EMIS)

Unit III-Energy Management & Audit

Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering

Unit IV-Energy Efficiency in Thermal Utilities and systems

Energy conservation in power producing devices- Boilers, Steam Systems, Furnaces, Heat Exchangers

Energy conservation in power absorbing devices- Heating ventilation air conditioning (HVAC) and Refrigeration System, turbines, compressors and pumps. Thermal insulations and its calculations.

Unit V-Eleetrical ntility systems
Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors – Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.
Uuit VI-Energy conservation case studies
Energy eonservation in vehieles, energy conservation in buildings, Power quality issues related to Energy Efficient Technologies, Energy Conservation Practice – Case Studies of Hospitals, Industry, Residential buildings etc.
Text Books:
1. C.B.Smith, Energy Management Principles, Pergamon Press, New York, 1981. 2. W.C. Turner, Energy Management, Hand Book. 3. W.F.Kenny, Energy Conservation in Process Industry. 4. Trivedi, P.R, Jolka K.R., Energy Management, Commonwealth Publication, New Delhi,1998
Reference Books :
1. Energy Conservation Guidebook, Dale R Patrick, Stephen W Fardo, 2nd Edition, CRC Press 2. Handbook of Energy Audits, Albert Thumann, 6th Edition, The Fairmont Press 3. Bureau of Energy Efficiency Reference book- No.1, 2, 3 4 4. Energy Management Handbook, W.C. Turner, John Wiley and Sons, A Wiley Interscience publication 5. Carbon Capture and Sequestration- Integrating Technology, Monitoring, and Regulation edited byE J Wilson and D Gerard, Blackwell Publishing 6. Heating and Cooling of Buildings - Design for Efficiency, J. Krieder and A. Rabl, McGraw Hill Publication, 1994

Prepared by-Dr.D.A.Kamble

BOS Member-Dr.A.D.Kale

BOS Chairman-

Composite Materlals (MEUA31183C)

Teaehing Scheme	Examination Seheme						
Credits: 3 Lecture (L): 3hrs./week Tutorial (T): -- hr Practical (P): -- hrs.	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite:

1. Strength of Material
2. Design of Machine Elements
3. Material Science

Course Objeetives :

- To understand importance of composite materials in various applications such as aerospace, automotive
- To understand various fabrication methods of composite material
- To know various composite testing methods and standards of testing
- To develop an understanding of the micro and macro mechanical analysis of composite materials

Course Outcomes :

By the end of the course, students will able to

1. Identify different types of composite materials and its constituents and list its applications in various fields
2. Understand the various manufacturing methods of composite materials
3. Apply various ASTM testing standards for characterizing composite materials
4. Apply strength of material approach to analyze lamina at micromechanical level
5. Analyze composite lamina at macro mechanical level
6. Apply Classical Lamination Theory for the analysis of composite laminates

Unit I - Introduction to Composite Material

Introduction to Composite Materials, classification of composite materials, Matrices and Reinforcement, Types of Fiber Reinforcement, Types of matrix materials- Thermo set and Thermoplastic, , Advantages and Disadvantages, Applications of composite materials, Mechanics Terminology

Uuit II -Manufacturing of Composite Material

Composite Manufacturing Processes, Hand Lay-up process, Compression molding process, Vacuum Impregnation Methods, Resin Transfer molding, Filament winding , Pultrusion, Prepregs, Stacking of reinforcements

Unit III -Composite Material Characterization

Composite testing, Need for testing ,Major types of testing, Physical testing, Mechanical testing as per ASTM standards- Tensile, compression, shear, flexural, impaet, fatigue and creep test, Chemical testing , Thermal testing

Volume and Mass Fractions, Density, and Void Content
Unit IV-Micromechanical Analysis of a Lamina
Evaluation of the Elastic Moduli- Strength of material approach- Representative Volume Element (RVE), Rule of Mixtures, Inverse Rule of Mixtures. Ultimate Strengths of a Unidirectional Lamina, Coefficient of thermal expansion ,Coefficient of moisture expansion
Unit V-Macromechanical Analysis of Lamina
Hooke's Law for Different Types of Materials- Anisotropic Material, Orthotropic/Specially Orthotropic, Hooke's Law for a Two-Dimensional Unidirectional Lamina, Plane Stress Assumption, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina, Two-Dimensional Angle Lamina, Strength Failure Theories of an Angle Lamina- Tsai–Wu Failure Theory
Unit VI-Macro meehanical Analysis of Laminates
Laminate Code, Classical Lamination Theory- Stress–Strain and Strain-Displacement Equations, Strain and Stress in a Laminate, Force and Moment resultants related to Mid plane Strains and Curvatures, extensional, conpling, and bending stiffness matrices, analyzing a laminated composite. Special Cases of Laminates- Symmetric Laminates, Cross-Ply Laminates, Angle Ply Laminates, Anti symmetric Laminates, Balanced Laminate, Quasi-Isotropic Laminates
Text Books :
1. Autar K. Kaw, Mechanics of Composite Materials, , CRC, Taylor and Francis 2006, ISBN-10-0-8493-1343-0. 2. Robert M. Jones, Mechanics of Composite Materials, Taylor and Francis 2010, ISBN-10-1-56032-812-X. 3. Madhujit Mukhopodhyay , Mechanics of Composite Materials and Structures , University Press (India) PVT Ltd, 2009, ISBN- 9888183814881 4. Mallick PK, Fiber-reinforced composites- materials, manufacturing, and design. CRC press, Taylor and Francis Group 2008; ISBN- 13- 988-0-8493-4205-9.
Reference Books :
1. Isaac M. Daniels, Orilshai, "Engineering Mechaincs of Composite Materials", Oxford University Press, 1994. 2. Bhagwan D. Agarwal, Lawrence J. Broutman, "Analysis and Performance of fiber composites", John Wiley and Sons, Inc. 1990. 3. Mathews, F. L. and Rawlings, R. D., "Composite Materials- Engineering and Science", CRC Press, Boca Raton, 03. 4. Mazumdar S. K., "Composite Manufacturing – Materials, Product and Processing Engineering", CRC Press, Boca Raton, 02.

Prepared by-Dr. A.R. Mache

BOS Member-Dr. S.C. Chinchanikar

BOS Chairman-

Advanced Mannfactnring Processes (MEUA31183D)

Teaching Scbeme	Examination Scheme						
Credits: 3 Lecture (L): 3hrs./week Tutorial (T): -- hr Practical (P): -- hrs.	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prereqnisite: Engineering Mathematics, Manufacturing Processes and Material Science

Course Objectives :

- To demonstrate working principles, process parameters and applications of advanced manufacturing processes such as special forming processes, advanced joining proeesses, hybrid non-conventional machining techniques, micro and nano fabrication techniques and additive manufacturing processes
- To demonstrate working principles and applications of material characterization techniques for knowing composition and structure of a material

Conrse Outcomes:

Upon completion of the course, students will be able to

1.Analyze special forming processes in terms of working principle, applications, process parameters and characteristics
2.Analyze advanced joining processes in terms of working principle, applications, process parameters and characteristics
3.Analyze hybrid non-conventional machining techniques in terms of working principle, applications, process parameters and characteristics
4.Select and characterize micro and nano fabrication techniques for engineering applications
5.Characterize and select appropriate additive manufacturing technique(s) for product development
6. Understand working principle and applications of material characterization techniques.

Unit I- Special Forming Processes

Principle, Process variables, characteristics, advantages, limitations and applications of High Energy Rate Forming process, High Velocity Forming, Explosive forming, Magnetic pulse forming, Electro hydraulic forming, Metal spinning, Flow forming, Stretch forming, Incremental sheet metal forming, Petro-forge forming, Micro forming, Micro coining, Micro extrusion, Micro bending/laser bending, fine blanking.

Unit II- Advanced Joining Processes

Friction stir welding, Electron Beam welding, Laser beam welding, Ultrasonic welding, Under water welding, Cryogenic welding, Thermal spray coatings, Welding of plastics and composites, Explosive joining, Adhesive bonding

Unit III- Hybrid Non-eonventional Maehiniug Techniques

Introduction to hybrid processes, Abrasive flow finishing, Magnetic abrasive finishing, Abrasive water-jet machining, Wire electric discharge machining, Electrochemical grinding,

Electrochemical Deburring, Shaped tube electrolytic machining, Electro-jet Machining, Electrolytic In-process dressing, Ultrasonic assisted EDM, Rotary EDM, Electrochemical discharge Machining, Laser surface treatments.
Unit IV- Micro Maehining and Nano Fabrication Techniqnes
Introduction, need of micro and nano machining, Machine/setup, Process parameters, Mechanism of material removal, Applications, Advances of the Diamond Turn machining, Ultrasonic micromachining, Focused Ion Beam Machining, Lithography, photochemical machining, Challenges in micro and nano fabrication techniqnes.
Unit V- Additive Manufacturing Processes
Introduction and prineiple of the additive manufacturing process; Generalized additive manufacturing process chain; Classification of additive manufacturing processes and its principle, process steps and materials; Post-processing of parts manufactured by Additive Manufacturing (AM) processes, Software issues in AM, Design For Additive Manufacturing (DFAM), Applications of Additive Manufacturing in Medical and Aerospace technologies
Unit VI- Material Characterization Techniques
Introduction- Material Characterization Microscopy- Electron Microscopes, Scanning Electron Microscope, Transmission Electron Microscope, Scanning Tunneling Microscope, Atomic Force Microscope, Field Ion Microscope; Spectroscopy- Energy-dispersive X-ray spectroseopy, X-Ray Diffraction, X-Ray Photoelectron Spectroscopy (XPS), Nuclear Magnetic Resonance Spectroscopy (NMR), Electron Backscatter Diffraction (EBSD)
Text Books:
1. V. K. Jain, "Advanced Machining Processes", Allied Publishers Pvt. Ltd. 2. M. P Groover., Fundamentals of Modern Manufacturing- Materials, Processes, and Systems, 6 th Edition, Wiley 2015 3. 3. A. Ghosh, A. K. Mallik, Manufacturing Science, Affiliated East-West Press Pvt. Ltd., New Delhi
Reference Books :
1. ASM- Metal Handbook, Volume 6, "Welding, Brazing and Soldering", Metal Park, Ohio. 2. ASM- Metal Handbook, Volume 14, "Forming", Metal Park, Ohio. 3. V. K. Jain, Micro manufacturing Processes, CRC Press ISBN-13- 988-1138086426 ISBN-

Prepared by-Dr. S. S. Chinchanikar
BOS Memher-Dr. A. P Kulkarni
BOS Chairman-

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Vishwakarma Institute of Information Technology, Pune-48

(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Department of Mechanical Engineering

Advanced Metallnrgy(MEUA31183B)

Teaching Seheme	Examination Seheme						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): -- hr Practical (P): -- hrs.	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite: Material Science and Ferrous Metallurgy

Conrse ohjectives:

1 Apply the fundamentals of metals do decide properties of polymers and composites.
2 To understand fundamentals of different surface hardening and surface improvement process
3 To understand the use of powder metallurgy in indnstries.

Course Outcomes:

1 Describe the importance polymers and composites with its mechanical properties for industrial applications.
2. Apply the knowledge of stainless-steel in the selection process and to know different surface coating processes.
3. Understand different surface hardening treatments to improve hardness of surface hardness.
4. Estimate different nonferrous materials and their uses.
5. Describe the importance, processing and applications of powder metallurgy.
6. Understand different technology and materials.

Unit I-Materiais

Classification of Engg. Materials, Polymers and its types. Ceramics classification its types and uses, calculation about iso-stain and iso-stress conditions Ceramic and Polymeric used in industry.

Unit II-Stainiess steels and Surface coating processes

Classification & Effect of alloying elements added in stainless stecl, examples of stainless steels types and uses, sensitization & weld decay of stainless steel, Basic concept of corrosion, surface coating processes and its advantages, introduction of PVD, CVD, Ion implantation.

Unit III-Surface Treatments

Hardenability & hardenability testing, classification of Modified heat treatments, surface hardening treatments, carburizing, nitriding, flame hardening, and induction hardening.

Unit IV-Non Ferrous Metals & Alloys

Classification, Composition, Properties &applications of- Copper and Its alloys, Nickel and Its alloys, Aluminum and Its alloys, Titanium and Its alloys. Specific alloys- soldering & brazing alloy, Precipitation hardening alloys. Bearing materials and their applications.

Unit V-Powder Metallurgy

Basic steps of powder metallurgy process, powder manufacturing, Conditioning of metal powders, Compacting (cold compaction, hot compaction), Pre-sintering & sintering secondary operations Advantages, limitations and applications of powder metallurgy. Production of typical P/M components

(with flow charts), self lubricated bearing, cemented carbides.
Unit VI-Introductiou to Advauced Materials
Classification of biomaterials - Comparison & properties of some common biomaterials, Introduction to bio sensors. Basic concepts of Nano science, Properties and technological advantages of Nano materials, Carbon Nanotubes and applications.Introduction toSmart materials and super alloys.
Text Books:
1) Dr. V.D. Kodgire& S. V. Kodgire, "Material Science & Metallurgy For Engineers", Everest Publication 2008, ISBN 81-86314-00-8. 2) Callister W. D., Materials Science and Engineering, John Wiley, ISBN 9880480419988
Refereuce Books :
1. Smith W.F., "Principles of Material Science and Engineering", McGraw Hill Book Co., 2002.ISBN- 0080591695 2. Donald R. Askland, Phule P. P., "Science and engineering of materials", Thomson Learning, 2003.ISBN- 0534553966 3. Higgins R. A., "Engineering Metallurgy", Viva books Pvt. Ltd., 2000,*ISBN 0340568305* 4. Raghvan V., "Material Science &Engg." Prentice Hall of India , New Delhi. 2003 5. Avner, S.H., Introduction to Physical Metallurgy, Tata McGraw-Hill, 1998.*ISBN* 10- 0084630068 6. T.E. Reed-Hill and R. Abbaschian, Physical Metallurgy Principles, Thomson, 3rd edition,2003, ISBN-13- 988-0-495-08254-5 7. A.K.Sinha, "Powder Metallurgy ",Dhanpat Rai Publishing,ISBN13- 988938318214

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BOS Chairman-

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Department of Mechanical Engineering

Design of Machine Elements-II(MEUA31184)

Teaching Scheme	Examinatiou Scheme						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): -- hr Practical (P): -- hrs.	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite: Basic Mechanical Engg., Engg. Graphics, Strength of Materials, Theory of Machines, CAMD, Machine Design I

Course objectives:

1. Enable students to attain the basic knowledge required to understand, analyze, design and select machine elements.
2. Broaden skills in team work, critical thinking, communication, planning and scheduling through design projects.
3. Enable students to apply engineering tools/techniques to product design.
4. Give practice in longer open-ended problems using design methodology.

Course Outcomes:

1. Understand and develop machine elements subjected to fluctuating loads.
2. Understand and apply principles of gear design to spur and Helical gears for required applications.
3. Design the Bevel Gears for required applications.
4. Interpret and select different types of bearings from manufaeturer's Catalogue.
5. Achieve an expertise in design of Sliding contact bearing in industrial applieations.
6. Design fasteners and welded joints subjected to different loading conditions.

Unit I-Design of Fluctuating load

Stress concentration - causes & remedies, Fluctuating stresses, fatigue failures, S-N curve, endurance strength and modifying factors, design for finite and infinite life, cnmulative damage in fatigue failure, Soderberg, Gerber, Goodman, Modified Goodman diagrams, Fatigue design of components under combined stresses.

Unit II-Desigu of Spur and Helical Gear

Gears basics-Selection of materials for gears, Standard systems of gear tooth, and Basic modes of gear tooth failures.

Spur Gears-Number of teeth and face width, Beam strength (Lewis) equation, Effective load on gear, Wear strength (Buckingham's) equation, Estimation of module based on beam and wear strength, Estimation of dynamic tooth load by velocity factor and Buckingham's equation, Design of spur gear, Force analysis (Nnmerical Treatment).

Helical Gears-Beam and wear strengths, Effective load on gear tooth, Estimation of dynamic load by velocity factor and Buckingham's equation, Design of helical gears, Force analysis (Numerical Treatment).

(Self-Learning)-Velocity factor, Service factor, Load concentration factor

Unit III-Design of Bevel gears

Bevel Gear-Beam strength of bevel gears, Wear strength of bevel gears, and effective load on gear tooth, gear design for maximum power transmission Force analysis (Numerical Treatment).

(Self-Learning)-Spiral Bevel Gears. Gear Terminology, Virtual number of teeth

Unit IV- Rolling contact beariug

Types, Static and dynamic load carrying capacities, Load-life relationship, Selection of rolling contact bearings from manufacturer's catalogue, Design for cyclic loads and speed, bearing with probability

of survival other than 90%, Mounting of bearings. **(Self-Learning)**-Materials, maintenance of bearings, condition monitoring, major failures in bearing. etc.
Unlt V- Sliding Contact Bearing
Hydrostatic step bearing, Petroff's equation, Reynolds's equation, Somerfield number, Raimondi and Boyd method, Temperature Rise, minimum oil film thickness, selection of bearing parameters **(Self-Learniug)-** Types of Lnbrication, Modes of lubrication, advantages and disadvantages, Tribology of bearing design.
Unit VI-Welded Joints and Threaded Joints
Strength of Welds Stress in Welds, Axially loaded unsymmetrical welded joints, eccentric load in plane of welds, welded joints subjected to bending. Basic types of screw fasteners, bolts of uniform strength, I.S.O. Metric screw threads, bolts under tension, eccentrically loaded bolted joint in shear, eccentric load perpendicular and parallel to axis of bolt, eccentric load on circular base(Threaded joints Theoretical treatment only)
Text Books:
1. Bhandari V.B. – " Design of Machine Elements" – Tata McGraw Hill Publ. Co. Ltd., ISBN-0080681891 2. Shigley J.E. and Mischke C.R. – "Mechanical Engineering Design" McGraw Hill Publ. Co. Ltd., ISBN- 0081088839
Refereuce Books :
1. Spotts M.F. and Shoup T.E. – "Design of Machine Elements" – Prentice Hall International. ISBN-8188584219. 2. Design Data Book– P.S.G. College of Technology, Coimbatore. 3. Juvinal R.C. – "Fundamentals of Machine Compouents Design" – John Wiley and Sons. ISBN-1118214110 4. Allen Strickland Hall, A. Holowenko, Herman G. Laughlin – "Schaum's Outline of Machine Design". ISBN-0080255954 5. R. L. Norton-"Machine Design- An Integrated Approach"; Pearson Education India. ISBN-8131805331

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BOS Cbairman-

Kinematics and Theory of Machines (MEUA31185)

Teachiug Scheme	Examination Scheme						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): -- hr Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	25	125

Prerequisite: Engineering Mathematics –I & II, Engineering Physies, Engineering Graphics & Design

Course objective:

- Make the student conversant with eommonly used mechanisms for industrial applications and develop competency in solving kinematic problems related to it.

Conrse Outcomes:

Upon completion of the course, students will be able to

1. Identify different mechanisms used in simple mechanical systems.*(Practical 2)*
2. Apply graphicalor analytical method for kinematic analysis of simple mechanisms.
3. Analyze motion conversion of mechanism using relative polygon method.
4. Understand fundamental concepts required for gear design.
5. Compute speed and torque in different gear trains
6. Calculate various parameters involved in clutch and brake system.

Unit I -Fundamentals of Kiuematics and Mecbanisms

Kinematic link, Kinematic Pair, Mechanism, Machine, Degree of freedom, Kutzbach Criterion, Grubler' scriterion, our bar chain and its inversions, Grashoff's law, Slider crank chain and its inversion, Double slider crank chains and its inversion, Universal Joint. Pantograph and Geneva mechanism.

Unit II -Kinematic Analysis of Mechanisms - I

Instantaneous center of rotation (ICR) method- Definition & Types of ICR, Kennedy's Theorem, Methods of locating ICRs

Analytical method for displacement, velocity and acceleration analysis of slider crank Mechanism, Loop closure equation, Velocity and acceleration analysis of slider crank mechanisms using complex algebra method

Unit III - Kinematic Analysis of Mechanisms - II

Relative polygon method- Velocity & acceleration polygons for simple mechanisms. Velocity and acceleration diagrams for the mechanisms involving Coriolis component of acceleration. Klein's construction.

Unit IV -Gears

Classification, spur gear- definition, terminology, fundamental law of toothed gearing, involute and cycloidal profile, path of contact, arc of contact, conjugate action, contact ratio, minimum number of teeth, interference and under cutting, force analysis, +

Unit V - Gear Trains

Types of Gear Trains, Analysis of epicyclic gear trains, Holding torque , Simple, compound and epicyclic gear trains, torque on sun and planetary gear train, compound epicyclic gear train, Bevel

epicyclic Gear train.

Unit VI - Frictiou Clutches aud Brakes

Torqne transmitting capacity of Pivot and collar friction, Plate clutches, Cone clutches, Centrifugal clutch, Braking torques of different types of brakes, introduction to dynamometer.

Lab practice sball be consisting of any ten from tbe following asslgnments-

1. Draw (any 4) configurations of mechanisms and determine types of pairs, links, degree cf freedom.
2. Build a working model or CAD model of any one quick return motion mechanism or straight-line motion mechanism or inversion of slider crank mechanism.
3. Build and execute a computer program to solve problem on velocity and aceeleration analysis using analytical methods and eompare results.
4. Perform veloeity analysis using Instantaneous center of rotation (ICR) method.
5. Perform velocity and acceleration analysis using relative polygon method.
6. Perform velocity and acceleration analysis for mechanism involving Coriolis component.
7. Measure torque transmitting capacity of friction clutch or power transmitted by the dynamometer or power absorbed by the brake
8. Draw conjugate profile for any general type of gear tooth.
9. Generate involute gear tooth profile using rack shift model
10. Perform analysis of the epicyclic gear train
11. Velocity ratios of simple, eompound and differential gear trains

Drawings of design project should be on any Cad Software.

Text Books:

4. Rattan S.S., "Theory of Machines", 2nd., TataMcGraw-hill publishing, 2005, ISBN 008-059120-2
5. Thomas Bevan, "Theory of machines", CBS publishers and Distributors, 1984. ISBN-8131829656

Reference Books:

1. Ghosh Amitabh and Malik Ashok Kumar, "Theory of mechanisms and Machines", 3ed, Affiliated East West press, 2000, ISBN 81-85938-93-8
2. Allen Strickland, Jr. Hall, "Kinematics and Linkage Design", Waveland PrIne (1986) ISBN 10- 0881332820
3. Wilson C.E., Sandler J. P. "Kinematics and Dynamics of Machinery", Person Education. ISBN 020135099-8
6. Erdman A.G. and Sandor G.N., "Mechanism Design, Analysis and Synthesis" Volume-I, Prentice –Hall of India.
7. Shigley Joseph Edward and Vicker John Joseph. "Theory of Machines and Mechanisms", 3ed., 1995, Oxford University Press. ISBN 0-19-515598-x.
8. Ballaney P. L., "Theory of Machines and Mechanisms", Khanna Publisher Delhi, 1999. ISBN-818409122X.

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BOS Chairman

Automation in Mannfacturing (MEUA31186)

Teaching Scheme	Examination Scheme						
Credits: 3 Lecture (L): 2 hrs/week Tutorial (T): -- hr Practical (P): 2hrs/week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	-	-	50	-	-	25	75

Prerequisitc: Engineering Graphics, Computer aided Machine drawing

Coursc objectivcs:

- To understand the importance of automation in the field machine tool based manufacturing
- To get the knowledge of various elements of manufacturing automation CAD/CAM
- To understand the basic of product design and the role of manufacturing automation

Conrse Outcomes:

After successful completion of the course, student will be able to

1. Generate CNC program for Turning / Milling and generate tool path using CAM software
2. Comprehensive pieture of computer based automation of manufacturing operation
3. Recognize the need of automation and RP in industry.
4. Comprehend the basic components and total functionality of an industrial robot

Unit I- Computer Aided Manufactnring (CAM)

Numerical Control Machines, Computer Numerical Control , Types of CNC, Coordinate Systems, Direct & Distributed Numerical Control Machines, CNC part program, Computer aided part programming, Tooling, Controllers used, Computer Integrated Manufacturing, Computer Aided Process Planning, Computer Aided Quality Control

Unit II- Antomation

Automation- Introduction, Automation strategies, Types of Automation - Hard and Soft Automation, Flexible Manufacturing System Types, Advantages, Limitations, AGVs and AS/RS, Group Technology

Unit III- Rapid prototyping

Rapid Prototyping - Introduction, classification of RP Processes (SLA, LOM, SLS, FDM, 3D printing), Working principle.

Unit IV- Robotics

Robotics- RIA, definition of Robot, Laws of robotics, Classification of robots, robot anatomy, Joints, End Effectors

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Dept. of Mechanical Engineering

List of Practical-

1. Tool path generation and simulation for Turning, and drilling with help of suitable software.
2. Tool path generation and simulation for Grooving and Threading with help of suitable software
3. Tool path generation and simulation for Milling Facing, Pocketing. with help of suitable software.
4. Tool path generation and simulation for Milling , Pocketing, Contouring and drilling, etc. with help of suitable software
5. Manufacturing of product using additive manufacturing.
6. Case Study/ Industrial Visit based on Rapid prototyping
7. Case Study/ Industrial Visit based on Automation
8. Computer Simulation of Robot
9. Build a model based on any configuration of robot

Manufacturing of component using CNC Machine

Text Books:

1. Ibrahim Zeid and R. Sivasubramanian - CAD/CAM - Theory and Practice Tata McGraw Hill
2. S.K. Sinha, CNC Programming using Fanuc Custom Macro B, McGraw-Hill Professional
3. S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill.
4. Radhakrishnan P; SubramanyanS , CAD/CAM/CIM , New Age International

Reference Books :

1. IbraimZeid, Mastering CAD/CAM,Tata McGraw Hill Publishing
2. Groover M. P, Automation Production Systems and Computer Integrated Manufacturing, PHI
3. Rao P. N., Introduction to CAD/CAM Tata McGraw Hill
4. M.P Groover , Automation , Producyion System and Computer integrated manufacturing , Prentic Hall

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BOS Member-Dr.S.C.Chinchanikar

BOS Chairman-

SEMESTER- II

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(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Department of Mechanical Engineering

Refrigeration and Air-conditioning (MEUA3218IA)

Teaching Scbeme	Examination Scheme						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): -- hr Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	25	125

Prerequisite: Basics of thermodynamics, Fluid Mechanics and Heat Transfer

Conrse objectives:

1. Learning the fundamental principles and different methods of refrigeration and air conditioning.
2. Understand various refrigeration cycles and evaluate performance using Mollier charts and/ or refrigerant property tables.
3. Comparative study of different refrigerants with respect to properties, applications and environmental issues.
4. Study the basic air conditioning processes on psychometric charts, calculate cooiing load for its applications in comfort and industrial air conditioning.
5. Study of the various equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems.

Course Ontcomes:

By the end of the course, students will

1. Illustrate the fundamental principles and applications of refrigeration and air conditioning system.
2. Analyze vapour compression refrigeration system
3. Understand the vapour absorption system
4. Apply psychrometric terms for different processes
5. Calculate cooling load for air conditioning systems used for various applications.
6. Apply different principles of duct design for refrigeration and air conditioning systems.

Unit I - Fundamentais & Applications of Refrigeration and Air Conditioning

Reverse Carnot cyele, block diagram of refrigerator & heat pump, modified reverse Carnot cycle (Bell Coleman cycle), Applications of Refrigeration and Air Conditioning, Refrigerants, environmental issues and selection of Compressor

Unit II - Vapour Compression Cycle and systems

Working of simple vapour compression system, representation of vapour compression cycle (VCC) on T-s and P-h diagram, COP, EER, SEER, IPLV, NPLV, effect of operating parameters on performance of VCC(Numerical), actual VCC, methods of improving COP using flash chamber, sub-cooling and liquid vapour heat exchanger, comparison of VCC with Reverse carnot cycle.

Unit III - Vapour Absorption System

Introduetion, Working of simple vapour absorption system (VAS), desirable properties of binary mixture (aqua-ammonia), performance evaluation of simple VAS (simple numerical treatment), actual VAS, Li-Br absorption system, three fluid system (Electrolux refrigeration), applications of VAS, comparison between VCC and VAC.

Unit IV - Psycbrometry aud Air conditioning Processes

Introdnction to air couditioning, psychrometry, psychrometric properties and terms, psychrometric

relations, Psychrometric processes and its representation on psychrometrie chart, BPF of coil, ADP, adiabatic mixing of two air streams. (Numerical)

UnIt V - Air conditiouing system- Cooling Load Calculations

Psychrometric chart with numerical on SHF, RSHF, GSHF, ESHF. factors contributing to cooling load. Cooling Load Calculations (Numerical), Concept of infiltration and ventilation
Thermodynamics of human body, comfort and comfort chart, factors affecting human comfort, , Indoor air quality requirements,

Unit VI - Air Conditioning systems and Ducts

Air handling unit, Classification of ducts, duct material, pressure in ducts, pressure losses in duet (friction losses, dynamic losses), Working of summer, winter and all year round AC systems and their materials, all air system, all water system, air water system, unitary and central air conditioning.

Term-Work

The Term-Work shall consist of any eight experiments

1) Test on Domestic Refrigerator for evaluation of EER
2) Test on vapour compression test rig
3) Test on air conditioning test rig
4) Test on ice plant test rig
5) Test on vapour absorption test rig
6) Visit to Vapour absorption refrigeration plant
7) Estimation of cooling load of simple air conditioning system (case study)
8) Case study on cold storage
9) Visit to any refrigeration or air conditioning plant
10) Thermal analysis of refrigeration eycle using suitable software

Text Books:

1. Arora C. P., Refrigeration and Air Conditioning, Tata McGraw-Hill
2. Arora and Domkundwar, Refrigeration & Air Conditioning, Dhanpatrai& Company, New Delhi
3. Khurmi R.S. and Gupta J.K., Refrigeration and Air conditioning, Eurasia Publishing House Pvt. Ltd, New Delhi,1994.
4. Sapali S.N., Refrigeration and Air Conditioning, PHI learning Pvt. Ltd, New Delhi.

Rcference Books :

1. Dossat Ray J, Principles of refrigeration, S.I. version, Willey Eastern Ltd, 2000
2. Stockers W.F and Jones J.W., Refrigeration and Air conditioning, McGraw Hill International editions 1982.
3. Threlkeld J.L, Thermal Environmental Engineering, Prentice Hall Inc., New Delhi
4. Aanatnarayan, Basics of refrigeration and Air Conditioning, Tata McGraw Hill Publications
5. Roger Legg, Air Conditioning System Design, Commissioning and Maintenance
6. ASHRAE & ISHRAE handbook

Prcpared by-Dr.A.D.Kale

BOS Member-Dr.D.A.Kamble

BOS Chairman-

Tribology (MEUA32I82B)

Teaching Scheme	Examination Scheme						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): -- hr Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	25	125

Prerequisite: Fluid Mechanics, Engg. Mathematics, SOM, Material Science and Metallurgy

Course Outcomes:
At the end of the course-

1. For these simplified course contents, student develops confidence in him/her to fulfill course objectives. –
2. Term work includes simple case study/assignment/seminar/visit and in-semester theory examination as a part of learning process encourages students. –
3. He/she proves himself/herself to be excellent practical engineer in any tribological industry.

Conrse objectives:
After successful completion of this course, students will be able to-

1. Understand the properties of lubricants, modes of lubrication, additives etc.
2. Select suitable/proper grade lubricant for specific application.
3. Select suitable material combination for tribological contact.
4. Apply the basic theories of friction, wear and lubrications about frictional behavior commonly encountered sliding surfaces.
5. Suggest an explanation to the cause of tribological failures.
6. Design bearing, friction, wear test rig for laboratory purposes

Unit i- introdnction To Tribology

1. Tribology definition. 2. Tribology in design- bearing material its properties and construction Tribological design of oil seals and gasket. 3. Tribology in industry (Maintenance). 4. Lubrication- Definition, basic modes of lubrication, properties of lubricants, additives, EP lubricants, Recycling of used oil, oil conservation, oil emulsion. 5. Bearing Terminology-Types of Sliding contact, rolling contact bearings. 6. Comparison between sliding and rolling contact bearing. (Theoretical treatment only)

Unit II- Introdnction to Friction

1. Friction- Introduction, laws of friction, Friction classification, causes of friction. 2. Theories of dry friction. 3. Friction measurement. 4. Stick-slip motion and friction instabilities.

Unit III-Hydrndynamic lubrication

1. Theory of hydrodynamic lubrication, mechanism of pressure development in oil film. 2. Two dimensional Reynolds equation and its limitations, Petroff's equation. 3. Infinitely long journal bearing, infinitely short journal bearing and finite bearing, designing journal bearing using Raimondi and Boyd approach.

Unit IV-Hydrostatic lubrication

1. Hydrostatic lubrication-Basic concept, advantages, limitations, viscous flow through rectangular slot, load carrying capacity, flow requirement of hydrostatic step bearing, energy losses, optimum design of stepped bearing, compensators and their actions. 2. Squeeze film lubrication- Basic concept, circular and rectangular plate approaching a plane

Unit V Elasto-hydrodynamic lubrication

1. Elasto-hydrodynamic lubrication-Principle and applications, pressure viscosity term in Reynold's equation, Hertz theory, Ertel-Grubin equation, lubrication of spheres.

Unit VI – Wear

Types of wear - Simple theory of sliding wear mechanism -Abrasive wear - Materials for adhesive and abrasive wear - Corrosive wear - Surface fatigue wear - Wear of ceramics and polymers - Wear measurements

Lab Work- The Lab Work shall consist of,

A] Any two case study of the following-

1. Lubrication and lubrication type.
2. Surface friction
4. Surface engineering and materials for bearing

B] Assignment based on the Tribological design of the system like I C Engine, Machine Tool, Rolling Mill.

OR

Industrial visit- students should visit the industry to study the lubrication systems or to study the techniques of surface coating.

OR

Seminar on recent trends in Tribology or related areas- A seminar on recent trends in Tribology or related areas shall be given by the student. A seminar report shall be submitted as a part of term work.

Instrument/Equipment- Required for Measurement of Material wear. **(Pin on disk wear test).**

Text Books:

1. Hutchings.I.M, "Tribology, Friction and Wear of Engineering Material", Edward Arnold, London, 1992
2. Williams.J.A, "Engineering Tribology", Oxford University Press, 2005.
3. GwidonStachowiak, Andrew W Batchelor., "Engineering tribology", Elsevier Butterworth – Heinemann, USA, 2005.

Reference Books :

1. Stolarski.T.A, "Tribology in Machine Design", Industrial Press Inc., 1991.
2. Bowden.F.P, and Tabor.D, "Friction and Lubrication", Heinemann Educational Books Ltd., 2001.
3. Cameron.A, "Basic Lubrication theory", Longman, U.K., 1981.
4. Neale.M.J, (Editor), "Tribology Handbook", Newnes Butter worth, Heinemann, U.K., 1999.

Prepared by-Dr.D.N.Kambale

BOS Member-Dr.S.C.Chinchanikar

BOS Chairman-

Design for Manufacturing and Assembly (MEUA3218IC)

Teaching Scheme	Examination Scheme						
Credits: 4 Leeture (L): 3 hrs./week Tutorial (T): -- hr Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	25	125

Prerequisite: Engineering Graphics, Manufacturing Processes-I &II, Machine Design I&II, nufacturing Basics, CAD /CAM Software modeling knowledge.

Course ohjectives:

To develop the ability, to know the concepts of Engineering Mathematics and to apply these to solve engineering problems in various fields. The Tutorial sessions and assignments will help the students to practice more problems on all the topies mentioned in the course contents.

Coursc Outcomes:

1. Understand various the concept of DFMA and its importance in designating.
2. Recognize the various casting design recommendation
3. Apply various design recommendations for various machining processes
4. Categorize various design recommendation for sheet metal and additive manufacturing
5. Describe various design recommendation for basic joining and cleaning processes
6. Develop different part assemblies considering its design recommendations using CAD tools

Unit I- Introduction to DFMA

Introduction, History of DFMA, steps for applying DFMA during product design, Advantages of applying DFMA during product design, Introduction to Manufacturing Process- Classification of manufacturing process, Basic manufacturing processes.

General design principles for manufacturability- Responsibilities of Design Engineers, Responsibilities of Manufacturing Engineers, Basic Principles of Designing for Economical Production. General Design Rules.

Unit II- Design for Casting and Injection Molding

Introduction to casting, Design consideration for casting, investment casting- Introduction, Steps, Typical characteristics and applications, Die casting- Introduction, Advantages, Disadvantages, Applications, Suitable material consideration, General design consideration, Specific design recommendation,

Injection molding- Introduction, Design recommendations, Design for powder metal processing- Introdnction to powder metal processing, Typical characteristics and applications, Limitations, Design recommendations.

Unit III- Design for machining

Introduction to machining, Recommended materials for machinability, Design recommendations, Design for tuning, milling, planning, shaping and slotting operations- Process description, Typical characteristics and applications, Suitable materials, Design recommendations, Design for machining round holes- Introduction, Suitable materials, Design recommendations, Recommended tolerances, Design for broached parts- Process description, Typical characteristies of broached parts, Suitable materials for broaching, Design recommendations
Unit IV- Designing For Sheet Metai and additive manufacturing
Introduction to Sheet MetalProcess, Typical Sheet Metal Parts, Recommended Materials for Sheet metal. Typical defects in sheet metal components, Design recommendations for different Sheet Metal Process like punching, bending, forming, Laser cutting, plasma cutting Introduction to Additive manufaeturing, Typical additive manufacturing parts, Design Recommended Materials for additive manufacturing.
Unit V- Design for cleaning aud joining prncesses
Introduction to cleaning and polishing proeesses- Design recommendations, Design for plated surface- Electroplating proeess, Typical characteristics, Design recommendations for plating, Design for welding, soldering and brazing- Design recommendations, Typical characteristics, Suitable materials, Design for adhesively bonded assemblies- Introduction, characteristics, Suitable materials, Design recommendations for adhesive joint.
Unit VI- Designing For Assembly using CAD
The assembly process, Characteristics and applications, Economie significance of assembly, Design for Assembly- Introduction, Design consideration, Design for Fasteners- Introduction, Design recommendation for fasteners. Introduction to CAD- Geometric Representation in CAD, Extraction of part feature information from CAD Model- Introduction, Feature recognition techniques, Free Form Features, Hybrid Techniques, Extraction of assembly feature information from CAD Model- Introduction, Assembly features, Top down and bottom-up design approach. Typical Industrial challenges in Design for assembly process Definition of assembly feature attributes,
List of Practical- 1. Introduction to Various DFM tools 2. Demonstration o DFM Pro 3. Manufacturability Analysis for Casting 4. Manufacturability Analysis for Injection Molding 5. Manufacturability Analysis for Turning 6. Manufacturability Analysis for Milling 7. Manufacturability Analysis for Sheet metal component 8. Manufacturability Analysis for component produced using Additive manufacturing Manufacturability Analysis for Sub Assembly
Text Books:
1. Geoffrey Boothroyd, Peter Dewhurst and Winston Knight (2002) Product Design for Manufacture and Assembly, Third Edition, CRC press, Taylor & Franeis, Florida, USA

2. O. Molloy, S. Tilley and E.A. Warman (1998) Design for Manufacturing and assembly, First Edition, Chapman & Hall, London, UK.
3. A.K. Chitale and R.C. Gupta, (1999) Product design and Manufacturing, Prentice Hall of India, New Delhi.

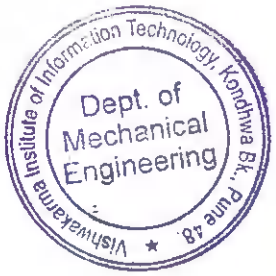
Reference Books :

1. J. Lesko, (1999) Industrial Design, Materials and Manufacture Guide, John Willy and Sons, Ine
2. George E. Dieter and Linda C. Schmidt (2009), Engineering Design, Fourth edition, McGraw-Hill companies, New York, USA
3. D. E. Whitney, (2004) Mechanical Assemblies- Their Design, Manufacture, and Role in Product Development, Oxford University Press, New York
4. James G. Bralla (1998) Design for Manufacturability Handbook, Second Edition, McGraw-Hill companies, New York, USA
https-//dfmpro.com/cad-systems/dfx/

Prepared by-Dr.A.P.Kulkarni

BOS Member-Dr.S.S.Chinchanikar

BOS Chairman-



Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Information Technology, Puue-48

(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Departmeut of Meehanical Engiueering

Data Aualytics (MEUA32182D)

Teaching Scheme	Examination Scheme						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): -- hr Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	25	i25

Preqnisite- Engineering Mathematics

Conrse ohjectives:

To introduce conceptual understanding using simple and practical examples and make you comfortable using analytics in your career. This course will make you know how to work with real data and choose the right methodology; especially fundamental understanding of why to use particular technique, how to use it correctly and how to correctly interpret the result.

Conrse Outcomes:

Upon completion of the course, students will be able to

1. Learn the concepts of descriptive and inferential statistics, and levels of data measurement and basic statistics that will be used to summarize data.
2. Apply statistical concepts and probability theory to analyze data that can assist present and future business managers in making better decisions.
3. Estimate the population mean with a known and an unknown population standard deviation with the z statistic, and t statistic respectively and population variance using the chi-square distribution.
4. Develop both one- and two-tailed null and alternative hypotheses that can be tested in a business setting by examining the rejection and non-rejection regions in light of Type I and Type II errors and test hypotheses about the difference in two population variances using the F distribution.
5. Test a completely randomized design using a one-way and two-way analysis of variance and calculate the coefficient of determination and confidence intervals to measure the fit for regression models and to estimate the conditional mean of the dependent variable respectively.
6. Calculate the residual, standard error of the estimate, coefficient of multiple determination, and adjusted coefficient of multiple determination of a regression model.

Unit I- Introduction to Data Analytics

Classification of data analytics, importance of data analytics, levels of data, types of variables, central tendency- mean, mode, percentile and dispersion- skewness, kurtosis, range, variance, coefficient of variation

Uuit II- Prohabiiity Theory

Probability and it's terminology, conditional probability, independent events, Bayes'rule, pdf, cdf, mean and variance of random variable and their properties, covariance, correlatiou coefficent, probability distributions- Binomial, Poission, Hypergeometric, Exponential, Normal, and central limit theorem.

Unit III- Sampling Theory

Population, sample, sampling techniques, errors, types of sampling distributions- sample mean, sample proportion and sample variance, point and interval estimates, confidence intervals, student's t distribution, chi-square distribution

Unit IV- Hypothesis Testing
Hypothesis testing- null and alternative hypothesis, typeI and II errors, power of a test, approahes for hypothesis testing- p-value, critical value and confidence interval value, test for population mean, proportion and variance- one sample and two sainple test, F-distribution.
Unit V- ANOVA and Regressiou Analysis - I
Conceptual overview, one-way (CRD) and two-way ANOVA (RBD), factorial experiment, simple linear regression- model assumptions, parameter estimation (least square methcd), test for significance (t and F test), confidence interval for parameters, coefficient of determination.
Unit VI- Regression Analysis - II
Multiple linear regression- model assumptions, parameter estimation (least square method), test for significance (t and F test), confidence interval for parameters, coefficient of determination, Residual analysis, dummy variable, logistic regression, confusion matrix and ROC analysis, curvilinear relatonship.
Tntorial- 1. Assignment of central tendency and dispersion. 2. Assignment on Baye's rule and probability distributions. 3. Assignment on sampling distribution. 4. Assignment on testing of hypothesis 5. Assignment on one-way and two-way ANOVA 6. Assignment on factorial experiment 8. Assignment on simple linear rand multiple linear regression 8. Assignment on logistic regression and confusion matrix
Text Books:
1. Jay L. Devore, Probability and Statistics for Engineering and the Sciences, 8thEdition, Cengage Learning, 2010. 2. P.V. Sukhatme, Sampling Theory of Surveys with Applications, Indian Society for Agricultural Statistics, New Delhi. 3. Douglas C. Montgomery, George C. Runger,Applied Statistics and Probability for Engineers, Wiley, Year- 2018, ISBN- 1119409535 4. Ken Black, Business Staatistics for Contemporary Decision Making, 6thEdition, Wiley
Rcference Books :
1. Douglas C. Montgomery,Design and Analysis of Experiments, John Wiley, Year- 2001 2. Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, Introduction to Linear Regression Analysis, Wiley, 2012

Prepared by-Dr. S.C. Chinchanikar

BOS Member-

BOS Chairman-

Iuternal Comhustiou Engiues (MEUA32182A)

Teacbing Scheme	Examination Scheme						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): -- hr Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	25	125

Prereqnisite: Engineering Chemistry, Basic Mechanical Engineering, Thermodynamics.

Course objcctives:

- To get familiar with the fundamentals of IC engines, construction and working principle of an engine, and testing of an engine for analyzing its performance.
- To study the combustion and its controlling factors.
- To study emissions from IC engines and its controlling methods and emission norms.

Course Ontcomes:

By the end of the course, students will able to

1. Classify various types of Engines, Compare Air standard, Fuel Air and Actual cycles and make out various losses in real cyeles.
2. Understand S. I. & C. I. Engine systems.
3. Describe the stages of combustion in S. I. Engines.
4. Describe the stages of combustion in CI Engines
5. Carry out Testing of I. C. Engines and analyze its performance.
6. Enumerate methods to minimize environmental hazards caused by IC engines.

Unit I-Basics of IC Engines

a) Heat Engine, IC and EC engines, IC Engine construction - components and materials, Engine nomenclature, Valve timing diagram, Intake and exhaust system, Engine classification, Applications.
b) Gas Power Cycles- Otto Cycle, Diesel Cycle, Duel Cycle and its Comparison.
c) Fuel air cycle, Assumptions, Comparison with air standard cycle, Effect of variables on performance,Actual cycle and various losses.

Unit II- Engine Systems

a) Fuel Injection System for S. I. Engines- Principle of carburetion, Simple or elementary carburetor, Complete carburetor, Types of carburetors, MPFI System.
Fuel Injection System for C. I. Engines- Direct & Indirect Fuel Injection System, Types of fuel pump and Injector.
b) Cooling System, Lubrication System, Ignition System, Starting System, Supercharging and turbo-charging methods and their limitations, Timing System.

Unit III- Combustion in SI Engincs

a) Stages of combustion, Flame propagation, Rate of pressure rise, abnormal combustion, Phenomenon of Detonation in SI engines, Effect of engine variables on Detonation.
b) Combustion chamber designs.

Unit IV- Combnstion in CI Engines

a) Stages of combustion, Factors affecting combustion, Phenomenon of knocking in CI engine. Effects of knocking, Methods to control knock, Comparison of knocking in SI & CI engines.
b) Combustion chamber design

Unit V-Testing of IC Engiues

a) Objective of testing, Various performance parameters for IC Engine - Indicated power, brake power, friction power, SFC, AF ratio etc. Methods to determine various performance parameters, characteristic eurves, Heat balance sheet.

Unit VI-IC Engine Systems, Emissions & its control

a) Air pollution due to IC engine and its effect, Sources of emissions, Euro norms, Bharat stage norms, Emission control methods for SI and CI engines.
b) Developments in IC engines (CNG / LPG / Solar / Hybrid).

Any eight experiments of the following-

1. Overhauling of petrol / diesel engine.
2. Demonstration & study of commercial exhaust gas analyzers.
3. Test on Multi cylinder Petrol / Gas engine for determination of Friction power (Mores Test).
4. Test on diesel engine to determine various efficiencies, SFC and Heat balance sheet.
5. Test on variable speed diesel / petrol engine.
6. Visit to Automobile service station / engine manufacturing plant.
7. Assignment using engine simulation software.
8. Assignment on any one advanced technology related to I.C. Engine such as VVT, VGT, HCCI, CRDI.

OR

Assignment on alternative fuels used in I.C. Engines.

Text Books:

1. V. Ganesan - Internal Combustion Engines, Tata McGraw-Hill
2. M.L. Mathur and R.P. Sharma - A course in Internal combustion engines, Dhanpat Rai
3. H.N. Gupta - Fundamentals of Internal Combustion Engines, PHI Learning Pvt. Ltd.

Refercnce Books :

1. Heywood - Internal Combustion Engine Fundamentals, Tata McGraw-Hill
2. Domkundwar&Domkundwar - Internal Combustion Engine, Dhanpat Rai
3. R. Yadav - Internal Combustion Engine, Central Book Depot, Allahabad

Prepared by-Mr.C.R.Ramthirthkar

BOS Member-Dr.A.D.Kale

BOS Cbairman-

Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Informatiou Technology, Pnue-48

(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Departmeut of Mechauical Engiueering

Solid Mechanics (MEUA32182B))

Teaching Scbeme	Examination Scheme						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): -- hr Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	25	125

Prerequisite: Physics, Engineering Mathematics.

Coursc objectives:

- To develop ability to understand the effect of force and motion in design engineering..

Conrse Ontcomes:

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

1. Understand the theory of elasticity including strain/displacement
2. Apply Hooke's law relationships in context with stability of mechanical components.
3. Characterize the magnitude of combined stresses in individual members and complete structures.
4. Develop an understanding of material behavior under torsion of thin walled sections.
5. Evaluate buckling of beams under loading.
6. Analyze and design thin and thick shell for applied pressure

Unit I –Introdnction to Solid Mechanics

Generalized Hooke's law, Linear elasticity,Plane stress and plane strain problems, Mohr's circle

Unit II –Tbeory of Elasticity

Introduction to governing equations in Cartesian coordinates, Equations of equilibrium in cylindrical coordinate system, Stress and strain matrices

Unit III Bending of Beams

Asymmetrical bending, Shear centre, Bending of curved beams, Stress distribution in beam with rectaugular, eircular and trapezoidal cross section, stresses in crane hooks, ring and chain links

Unit IV- Torsion

Torsion of general prismatic bars of solid section, Torsion of Thin walled tubes, Torsion of Thin walled Multiple-Cell closed sections

Unit V- Buckling of columns

Concept of buckling of columns, Expression for crippling load for various end conditions of column, Limitations of Euler's formula, Rankine's formula, safe load on columns

Unit VI –Tbick and thin Cyiinders

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

Lab practice shall be consisting of any ten from the following assignments-

1. Assignment 1- Stress analysis using Mohr's Circle
2. Assignment 2- Evaluating Airy's stress function for Cartesian coordinate system.
3. Assignment 3- Evaluating Airy's stress function for Polar coordinate system.

4. Assignment 4- Evaluating shear center of thin walled section (04 Problems)
5. Assignment 5- Torsional analysis of open section (04 Problems)
6. Assignment 6- Torsional analysis of closed section (04 Problems)
7. Assignment 8- Demonstration of buckling of beam.

Assignment 8- Thin and thick cylinder (02 Problems each)

Text Books:

9. Kazmi, S. M. A., "Solid Mechanics" TMH, Delhi, India.
10. Strength of Materials by R. Subramanian, Oxford University Press, New Delhi.
11. Laboratory Manual of Testing Materials - William Kendrick Hall

Reference Books:

7. Timoshenko, S. and Young, D. H., "Elements of Strength of Materials" ,DVNC,New York, USA.
8. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ- Pearson Prentice Hall, 2004
9. Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY- McGraw Hill, 1989
10. Mechanics of Materials - Ferdinand P. Beer, E. Russel Jhonston Jr., John T. DEwolf TMH 2002.

Prepared by-Mr. A.R. Deshapande

BOS Member-Dr. D.N. Kambale

BOS Chairman-

Hybrid and Electric Vehicles (MEUA32182C)

Teaching Scheme	Examination Scheme						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): -- hr Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	25	125

Prerequisite: DME, SOM,I&C, Electronics and Electrical Engineering.

Course Objective:
To understand the comprehensive overview of Eleetric and Hybrid Electric Vehicles.

Course Outcomes:
After successful completion of this course, students will able to
1. Understand the importance of hybrid electrical vehicle and its performance.
2. Describe the different electrical propulsion unit and battery storage unit.
3. Design electric drive train and its components.
4. Illustrative the various concepts of hybrid electric drive train and power flow control.
5. Apply vehicle dynamics fundamental to model the HEV
6. Identify the energy management system and power electronics in HEV

Unit I- Introduction to Hybrid Eiectric Vehicles

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Conventional Vehicles- Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.

Unit II-Electric Propulsion and Battery Storage Unit

Introduction to electric components used in hybrid and electric vehicles,Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Basics – Battery Types, Batterybased energy storage, Fuei Cell based energy storage, Hybridization of different energy storage devices..

Unit III-Eiectric Vehicle Drive Train

Electric Drive-trains-Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motor sizing.

Unit IV- Hybrid Electric Drive-trains

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies- series, parallel and series, parallel configuration – Design – Drive train, sizing of components, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Unit V–Vehicle Dyuamics Fundamentals for HEV Modeling aud Computer Simulation

Various strategies for improving vehicle energy/fuel efficiency, Vehicle chassis mathematical model in various operation conditions (steady motion, acceleration, regenerating braking, coasting, moving up and down a hill).Series HE power train mathematical model.

Unit VI -Power Electronics in Hybrid Electric Vehicles

Rectifiers, Buck convertor, Voltage source inverter, Current source inverter, DC-DC convertor, Plug-in Hybrid Electric Vehicles- Introduction to energy management strategies, PEV configurations, Power management problems, Component sizing, comparison of different energy management strategies

Practical -
1. Study practically layout of electric vehicle.

2. Study Battery management system
3. Demonstrate components of electrical vehicle.
4. Demonstration of electrical drive train of electric BAJA
5. Demonstration of HEV drive train.
6. study and analyze two strategies for ICE/Battery power split
7. HEV modelling using any simulation software.
8. Performance characteristic of HEV using software
9. Four wheel alignment test

Industrial Visit

Text Books :

1. Iqbal Hussein, Electric and Hybrid Vehicles- Design Fundamentals, CRC Press, 2003.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

Reference Books :

1. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Celi Vehicles- Fundamentals, Theory and Design, CRC Press, 2004.
2. Sandeep Dhameja, "Electric Vehicle Battery Systems", Newnes, 2000.

Prepared by-Mr. P.P. Rathod

BOS Member-Dr.S.C.Chinchanikar

BOS Chairman-

Robotics (MEUA32182D)

Teaching Scheme	Examination Scheme						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): -- hr Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	25	125

Prereqnisite: Engineering graphics, Engineering mathematics, CAMD, Strength of materials, Manufacturing Process, Instrumentation and Control

Course ohjectives:

- Understand the basic components of an industrial robot.
- Mechanism involved in robotic system
- Different Robot programming methods
- Important role of automation and robots in manufacturing Environments

Course Ontcomes:

After successful completion of this course, students will able to

1. Describe basic concepts in robotics, grippers, actuators, drivers, control systems, kinematics and dynamics
2. Understanding of Design and modeling of grippers.
3. Suggest robots for simple and industrial applications.
4. Formulate programming of robot for different applications.
5. Illustrate industrial relevance of robotics and automation
6. Analyze automated manufacturing system

Unit I – Introduction to Robotics

Basic concepts, Three laws of robotics, Robot anatomy, Classification, structure of robots, Point to point and continuous path robotic systems, Robot performance- resolution, accuracy, repeatability, dexterity, compliance, RCC device, Fixed and Euler angle representation..

Unit II – Rohot Grippers, Seusors and Drives

Types of grippers , Design aspect for gripper, Force analysis for various basic gripper systems, Gripper applications, Characteristics of sensing devices, Classification, Selection and applications of sensors, Types of Sensors, Types of Drives, Actuators and its selection while designing a robot system.

Unit III - Rohot Direct and Inverse Kinematics

Transformation matrices and their arithmetic, Link and joint description, Denavit – Hartenberg parameters, Frame assignment to links, Direct kinematics, Kinematics redundancy, Inverse kinematics, Velocities and static forces in manipulators, Jacobians, singularities, Static forces, Jacobian in force domain, Trajectory generations, Manipulator mechanism design

Unit IV- Motion Planniug and Robot Programming

Joint and Cartesian space trajectory planning and generation, Methods of robot programming, Lead through programming, Motion interpolation, Branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages - Introduction to various types such as RAIL and VAL II, Features of each type and development of languages for recent robot systems.

Unit V- Antomation in Rohotics

Automation in production system, Principles and strategies of automation, Basic elements of an automated system, Levels of automations. Flow lines & transfer mechanisms, Fundamentals of transfer

lines, Robotic vision system, image acquisition, spatial and amplitude digitization, image processing and analysis.

Unit V- Automated mannfacturing system

Components, Classification and overview of manufacturing systems, Manufacturing cells, GT and Cellular manufacturing, FMS, FMS and its application. Automated storage system, Robot applications in material handling, machine loading/unloading, assembly, inspection and processing.

List of Practical's (Any 8)

1. Study of degrees of freedom, no of links & other robot parameters and different types of robots using a Robot Simulating software
2. Design, Modelling and analysis of any two types of gripper.
3. Study of end effect of an industrial robot using suitable software.
4. Motion study and simulation of a robotic manipulator using suitable software
5. Trajectory planner for a robotic manipulator using Matlab.
6. Determination of manipulator Jacobian by Matlab code.
7. Study of Eyantra ATMEGA robot motion.
8. Design of feedback control system.
9. Design of feed forward control system.
10. Study of automated manufacturing system practically.

Text Books:

1. S. K. Saha, Introduction to Robotics, TataMcgraw Hill Education Private Limited, ISBN-13-978-0-07-066900-0
2. M. P. Groover, Automation, Production Systems and Computer Integrated Manufacturing, Pearson Education, 5th edition, ISBN-13- 978-0132393218

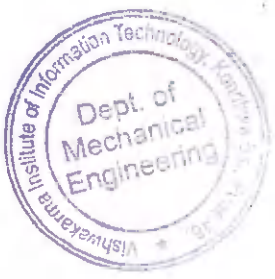
Reference Books:

11. John J. Craig, Introduction to Robotics (Mechanics and Control), Addison-Wesley, 2nd Edition, 2004, ISBN-13-978-81-317-1836-0
12. Mittal R. K. and Nagrath J. J., Robotics and control, Tata McGraw Hill, New Delhi, ISBN- 13-0-07-048293-7
13. Groover M. P., Wiess M., Nagel R. N. and Odery N. G. Industrial Robotics- Technology, Programming and Applications, McGraw Hill Inc. Singapore 2000, ISBN-13-978-0-07-026509-7
14. Viswanandham, Performance Modeling of Automated Manufacturing Systems, PHI, 1st edition,2009, ISBN-0-13-658824-7

Prepared hy-Mr. P.R. Rathod

BOS Member-Dr. A. P. Kulkarni

BOS Chairman-



Mechanical Vibration (MEUA32183)

Teaching Scheme	Examination Scheme						
Credits: 4 Lecture (L): 3 hrs./week Tutoriai (T): -- hr Practical (P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	25	-	125

Prereqnisite: Engineering Mathematics, Strength of Materials, Theory of Machines.

Conrse ohjectives:

- To understand the fundamentals of free and forced vibrations.
- To develop analytical competency in solving vibration problems.
- To study vibration characteristics of the multi degrees of freedom system.
- To familiar with various vibrations measurement instruments and vibration control techniques.

Conrse Ontcomes:

After successful completion of the course, student will be able to

1. Understand the need and importance of vibration analysis in mechanical design of machine parts that operate in vibratory conditions.
2. Analyze the mathematical model of a linear vibratory system to determine its response
3. Estimate natural frequency for single DOF undamped free vibratory systems.
4. Determine response to forced damped vibrations due to harmonic excitation, base excitation.
5. Estimate natural frequencies, mode shapes for 2 DOF undamped free longitudinal and torsional vibratory systems.
6. Demonstrate vibration measuring instruments for industrial/real life applications along with suitable method for vibration control.

Unit I- Fnndamentals of Vibration

Brief history of mechanical vibration, importance of the study of vibration, Terminology of vibratory system, Elements of vibratory system, modeling of system. degree of freedom, discrete and continuous system, Equivalent systems- Springs in series and parallel, types of vibration.

Unit II- Undamped Free Vibration of Singie Degree Freedom System

Evaluation of natural frequency, Equilibrium method, Energy method and Rayleigh's methods, Natural frequency for longitudinal, transverse ,and torsional vibratory systems.

Unit III- Damped Free Vibration of Singie Degree Freedom System

Different types of damping, Damped free vibrations with viscous damping, study of vibration response of over damped, critically damped and under damped systems, logarithmic decrement, introduction to damped free torsional vibrations.

Unit IV- Forced Vibrations- Singie Degree Freedom System

Types of source of excitation, resonance phenomenon, forced damped vibrations of longitudinal systems with constant harmonic excitation ,magnification factor, frequency response to harmonic excitationphase difference, excitation due to reciprocating and rotating unbalance, forced vibration due to base excitation. Force and Motion transmissibility. Quality factor and bandwidth.

Unit V- Undamped Vibration of Two Degree Freedom Systems

Introduction of two degree of freedom system, Free undamped longitudinal vibrations of two degrees of freedom system, natural frequency and mode shapes, Evaluation of Eigen value and Eigen vector by Matrix method. Free torsional vibrations of two rotor system.

Unit VI- Measnrcment and Control of Vibration

Vihration measnrements- vibration measuring devices, accelerometers, impact hammer, vibration shaker-construction, principles of operation and uses, vibration analyzer, analysis of vibration spectrum, standards related to measurement of vibration and accepted levels of vibration.
Vibration control- vibration control methods, passive and active vibration control, control of natural frequency, vibration isolators and undamped dynamic vibration absorbers. Types of failures on account of uncontrolled vibrations.

Tntorials-

List of tutorials-

1. To determine natural frequency and stiffness of spring-mass system.
2. To determine the natural frequency of damped vibration of single degree freedom system and to find it's damping coefficient.
3. To determine natural frequency of transverse vibration of beam using vibration analyzer.
4. To determine the frequency response curve under different damping conditions for single degree freedom system of vibration.
5. To verify natural frequency of torsional vibration of two rotor system and position of node.
6. Analysis of machine vibration signature using any analysis software package.
7. Noise measurement and analysis using vibration Analyzer
8. Experimental verification of principle of Dynamic Vibration Absorber.
9. Determine the free response of an SDOF damped system with different damping using suitable software.
10. Determine total response of SDOF damped system to harmonic excitation using suitable software.

Text Books:

1. S. S. Rao, "Mechanical Vibrations", 4th Edition, Pearson Education Inc. New Delhi, ISBN-9888188588843
2. G. K.Grover, "Mechanical Vibrations", 8th Edition, New Chand and Bros,Roorkee, ISBN-988-81-85240-56-5
3. V. P.Singh, " Mechanical Vibrations", DhanpatRai and Sons, New Delhi, ISBN- 1234568150209
4. S. G. Kelly, "Mechanical Vibrations", Schaum's outlines, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 0080340412
5. V. Ramamurti, "Mechanical Vibration Practice and Noise Control", Narosa Publishing House, ISBN-988-81-8488-199-9

Reference Books :

1. W.T. Thomson, Marie Dillon Dahleh, "Theory of vibrations with applications", 5th Edition, Pearson Education Pvt. Ltd., ISBN- 9888131804820
2. W. Weaver, Jr., S. P. Timoshenko, D. H. Young, "Vibration Problems in Engineering", 5th Edition ISBN- 988-0-481-63228-3.
3. Leonard Meirovitch, "Fundamentals of vibrations", Waveland PrInc; Reissue edition, ISBN-10-1588666918
4. J. P. Den Hartog, "Mechanical Vibrations", Dover Publications INC, New York, ISBN- 0-486-64885-4

Prepared hy-Mr.N.H.Ambhore

BOS Memher-Dr.P. P. Hujare

BOS Chairman-

Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Information Technology, Pune-48

(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Department of Mechanieai Engineering

Operations Research (ES32184ME)

Teaching Scheme	Examination Scheme						
Credits: 3 Lecture (L): 3hrs./week Tntorial (T): -- hr Practical (P): -- hrs.	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite: Engineering Mathematics

Conrse ohjectives:

- To familiarize the studcnts with various tools of optimization, probability and statistics as applicable scenarios in industry for better management of various resources

Conrse Outcomes:

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

1. Solve linear programming problems using appropriate techniques
2. Propose the best strategy using decision making methods under uncertainty and game theory
3. Apply the concept of transportation/assignment models to optimize available resources
4. Develop mathematical skill to solve inventory and replacement problems
5. Perform minimization of process time
6. Use CPM and PERT techniques, to plan, schedule, and control project activities.

Unit I - Introduction to Operations Research

Introduction to Operations Research- Basics definition, scope, objectives, phases, models and limitations of Operations Research.

Linear Programming Problem- Formulation of LPP, Graphical solution of LPP. Simplex Method, Artificial variables, Two-phase method, Duality

Unit II – Decision Theory and Theory of Games

Decision Theory- Meaning and Steps in Decision Making, Types of Management Decisions, Decision under Certainty, Decision under Risk, Decision under Uncertainty, Decision Trees

Theory of Games- Introduction, Minimax and Maximin Principle, Solution of Game with Saddle Point, Solution by Dominance, Solution by Graphical Method, m x n size Game Problem

Unit III – Transportation and Assignment Model

Transportation Model- Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test- the stepping stone method and MODI method.

Assignment model- Formulation. Hungarian method for optimal solution. Solving unbalanced problem

Unit IV – Inventory Control and Replacement Analysis

Inventory Control-Basic Concepts, fixed order quantity inventory model, economic order quantity inventory models, probabilistic inventory model

Replacement Analysis- Replacement of Items that Deteriorate, Replacement of Items that Fail Suddenly- Individual replacement policy, Group replacement policy.

Unit V – Quening Theory and Sequencing Model

Queuing Theory- Introduction, Basis Structure, Terminology (Kendal's Notations), Queuing Model M/M/1- /FIFO, M/M/c.

Sequencing models- Solution of sequencing Problem - Processing of n jobs through two machines, Processing of n jobs through three machines, Processing of two jobs through m Machines, Processing of n jobs through m Machines.

Unit VI – Projeet Management

Fundamentals of CPM and PERT networks, CPM- Construction of networks, Fulkerson's rule ,Critical paths, Forward and backward pass, Activity Float analysis, Crashing Analysis, PERT- Time estimates, Construction of networks, Probability of completing projects by given date.

Text Books:

1. Sharma S.D., "Operations Research", Kedarnath Ramnath and company publications. ISBN-13-1234568142552
2. Gupta P.K., Hira D.S., "Operations Research", S Chand and Co. Ltd., New Delhi.ISBN 13-9888121902816
3. Taha H.A., "Operations Research - An introduction", Prentice Hall Pvt. Ltd. ISBN-13- 988-0132555938

Reference Books:

1. Hillier F.S., Lieberman G.J., "Introduction to Operations Research", Tata McGraw-Hill. ISBN 988-0-08-338629-5
2. Wagner H.M., "Principles of Operations Research", Prentice-Hall India ISBN 988-0-9843388-2-8
3. Ravindran A., "Operations Research", Tata McGraw-Hill. New Delhi ISBN-13- 988-0481086086
4. Basu S.K., Pal D.K., and Bagchi H., "Operations Research for Engineers", Oxford and IBH Publishing ISBN 81-204-1251-6
5. Panneerselvam R., "Operations Research", Prentice Hall of India Ltd., New Delhi ISBN 81-203-1923-0

Prepared hy-Mr. P.R.Anerao

BOS Memher-Dr.S.C. Chinchanikar

BOS Chairman-

Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Information Technology, Pune-48

(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Department of Mechanical Engineering

Open Eleetive- Information and Cyber Security(IOEUA32185A)

Teaching Scheme	Examination Scheme						
Credits: 3 Lecture (L): 3hrs./week Tutorial (T): -- hr Practical (P): -- hrs.	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisites : Fundamentals of Computer Networks

Conrse Objeetives :

- To know the need and basic of security
- To learn various types of Cryptographic algorithm algorithm
- To learn various authentication techniques
- To acquire knowledge of protocols employed to provide
- Confidentiality and integrity
- To understand various threats
- To acquaint with current security scenario

Conrse Outcomes :

After completion of the course, student will be able to

1. Identify the ueed and basic of security (Knowledge)
2. Summarize various Cryptographic algorithm (Understand)
3. Infer various authentication techniques(Understand)
4. Summarize protocols for confidentiality and integrity (Understand)
5. Identify various threats(Knowledge)
6. Relate with current industry trends (Understand)

Uuit I -Security Basics and Introduction to cryptography

Introduction, Elemeuts of Information Security, Understanding coucepts: threat, exploit, vulnerability and policy, Types of Attacks, Operational Model of Network Security, Cryptography, Substitution Ciphers, Transposition Ciplıers, Steuography applications limitations

Unit II- Symmetric Key Cryptography

Introduction, Encryption Methods: Symmetric, Asymmetric, Block Ciphers and methods of Operations, Data Encryption Standard (DES), Advance Encryption Standard (AES).

Unit III -Asymmetrie Key Cryptography

Public Key Cryptography, RSA Algorithm: Working, Key length, Security, Key Distribution Deffie-Hellman Key Exchange, Authentication methods, Message Digest, Kerberos, X.

Authentication service. Digital Signatures: Implementation, Algorithms, Standards (DSS), Authentication Protocol
Unit IV -Network Layer Secnrity
IP Security: IPSec protocols, and Operations, AH Protocol, ESP Protocol, ISAKMP Protocol, Oakkey determination Protocol, VPN. WEB Security: Introduction, Secure Socket Layer (SSL), SSL Session and Connection, SSL Record Protocol, Change Cipher Spec Protocol, Alert Protocol, Handshake Protocol. Electronic Mail Security: Introduction, Pretty Good Privacy, MIME, S/MIME, Comparison. Secure Electronic Transaction(SET)
Unit V -Firewall Aud Intrusion
Introduction, Computer Intrusions. Firewall Introduction, Characteristics and types, Benefits and limitations. Firewall architecture, Trusted Systems, Access Control. Intrusion detection, IDS: Need, Methods, Types of IDS, Password Management, Limitations and Challenges.
Unit VI -Introdnction to OWASP
Introduction, Top 10 Vulnerabilities, understanding Top 10 Vulnerabilities.
Text Books : 1 AtulKahate, "Cryptography aud Network Security", McGraw Hill Publication, 2nd Edition, 2008,ISBN : 978-0-07-064823-4 2 Dr.V.K.Pachgare, "Cryptography and Network Security", PHI, 2nd Edition, 2015
Reference Books : 1 William Stallings, "Cryptography and network security principles and practices", Pearson, 6th Edition, ISBN : 978-93-325-1877-3 2 Forouzan, "Cryptography and Network Security (SIE)", MeGraw Hill, ISBN, 007070208X, 9780070702080
Web Resource: 1 www.owasp.org

Prepared by- Dr Laxmi Bewwor

BOS Member- Dr. S.C. Chinchanikar

BOS Chairman-

Open Elective I
Automotive Electrouics(IOEUA32185B)

Teacbing Scheme	Examiuation Scheme						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): -- hr Practical (P): -- hrs.	ClE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite: Readers/students are expected to know the following concepts-
Basics of seusors and actuators, general automotive system, basics of OS

Conrse objeetives:

1. To make familiar about automotive system operations.
2. To illustrate need for automation in automotive operations and appropriate electronics for the same.
3. To discuss suitability of electronics hardware and software platform for control, compute and communication systems in automotive.
4. To discuss control algorithms used in automotive.
5. To introduce various communication standards used for intra and inter-cluster communication in automotive electronic system.
6. To make awareness of fault diagnosis system in automotive.

Conrse Outcomes:

After successfully completing the course students will be able to
1. understand powertrain and transmission mechanism of Sl and Dl engine.
2. identify need of automation in automotive operations and appropriate electronics for the same.
3.select suitable electronics hardware and software platform for design and development of various control, compute and communicate oriented automotive systems.
4.understand control theory for automotive systems
5.understand communication and fault diagnostic protocols used in automotive
6. able to use the techuiques, skills, and modern engineering tools necessary for automotiveengineering practice

Unit I- Power Train Engineering and fundamentais of Automotive.

Fundameutals of Petrol, diesel and gas engines aud electric motors. Basic Automotive System. Alternators and charging, battery technology, Ignition systems. Basic of Hybrid designs (solar power, electric/gasoline, LPG, fuel cells). Basic Transmission systems.

Unit II- Sensors and actuators in Automotive

In-vehicle sensors- Working principles, Characteristics, limitations and use within the automotive context of the following- Temperature sensing e.g. coolant. Position sensing e.g. crankshaft, throttle plate. Pressure sensing e.g. exhaust differential, tyre pressure measurement system. Distance sensing e.g. auti-collision, Velocity sensing e.g. speedometer, anti-skid, Torque sensing e.g. automatic transmission, Vibration seusing e.g. Airbags, Flow sensing and measurement e.g. Fuel injection.
Use of Actuators- Types, working principle, Characteristics, limitations and use within the automotive context of each type.

Unit –III- Electrouics processing System in automotive

Interfacing electronics- Operational amplifier circuits, Instrumentation amplifiers, Comparators. Level shifting, Wave-shaping, Filters. Noise mechanisms and reduction.
Electronics control unit- Automotive processors and OS, typical design consideration of ECU.

Unit IV- Automotive Control Systems

Control system approacb in Automotive- Analog and Digital control methods. Cruise control, traction control, actuator limiting, wind-up, gain scheduling, adaptive control.
Special Controi Sehemes- Vehicle braking fundamentals, Antilock systems, Variable assist steering and steering control, Controls for Lighting, Wipers, Air-conditions/Heating, Remote keyless Entry and Anti-theft System. Spark Ignition and Compression Ignition Engines and their electronic controls.
Engine management testing- Engine management system strategies and implementation, Simulation and implementation methods.

Unit V- Automotive Communication Systems

Communication iuterface with ECUs- Interfaeing techniques and interfacing with infotainment gadgets. Automotive Buses- Use of various buses such as CAN, LIN, Flexural, Recent trends in automotive buses (Such as OBDII, MOST, IE, IELLl, D2B, and DSI- Only Comparative study).
Application of Teiematics in Automotive- Global Positioning Systems (GPS) and General Packet Radio Service (GPRS), for use in au automotive environment.

Unit VI- Diagnostics and Safety iu Automotive.

Fundamentais of Diagnosties- Basic wiring system and Multiplex wiring system. Preliminary checks and adjustments. Self-Diagnostic system. Fault finding and corrective measures. Eleetronic transmission checks and Diagnosis. Diagnostic procedures and sequence. On board and off board diagnostics in Automotive.
Safety in Automotive-Safety norms and standards. Passenger comfort and security systems. Electromagnetic environment and Automotive EMC Standards. SAE and IEEE Standards.

Text Books:

1. Williams. B. Ribbeus, "Understanding Automotive Electronics", 6th Edition, 2003, Elsevier Science, Newness Publication.
2. Robert Bosch, "Automotive Electronics Handbook", John Wiley and Sons, 2004.
3. K.P. Ramchandran, G.K. Vijayraghavan, M.S. Balsundaram, "Mechatronics- Integrated Mechanical and Electronic System", Wiley India, 2010.

Reference Books :

1. Ronald K Jurgen, "Automotive Electronics Handbook", 2nd Editiou, **McGraw-Hiii, 1**999.
2.James D Halderman, "Automotive Electricity and Electronics", PHI Publicatiou 2005.

Prepared by- Dr S V Kulkarni

BOS Member-Dr. S.C. Chinchanikar

BOS Chairman-Dr. A.R.Mache

Vishwakarma Institute of Information Technology, Kondhwa Bk, Pune 48. Dept. of Mechanical Engineering

Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Information Techuoiogy, Pune-48

(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Departmeut of Mechanical Engineering

Open Elective-I

INDUSTRIAL ENGINEERING (IOEUA32185C)

Teacbing Scbeme	Examination Scheme						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): -- hr Practical (P): -- hrs.	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Course objectives:

- To introduce the concepts, principles and framework of contents of Industrial Eugineering.
- To acquaint the students with various productivity enhancement techniques.
- To acquaint the students with different aspects of Production Planning and Control and Facility Design.
- To introduce the concepts of various cost accounting practices as applied in industries
- To acquaint students with different aspect of simulation modeling for various industrial engineering applications.

Course Outcomes:

After successful completion of the course, student will be able to

1. Compute the partial productivity and total productivity indexes considering different influencing factors
2. Analyse each operation with a view to eliminate unnecessary operations, avoidable delays and other forms of waste.
3. Compute the standard time for a qualified worker to carry out a specified job at a defined level of performance.
4. Design a physical arrangement of facilities most economically at optimum plant location.
5. Design the production system considering an estimate of future event through past data.
6. Calculate optimum inventory level by establishing the relationship among the factors affecting profit.

Unit I-Introduction to Iudustrial Engineering and Productivity

Definition and Role of Industrial Engineering, Types of production systems and organization structure, Functions of management. Measurement of productivity- Factors affeeting the productivity, Productivity Models and Index (Numerical), Productivity improvement techniques.

Unit II- Methods Study

Work Study- Definition, objective and scope of work-study, Human factors in work-study.

Method Study- Definition, objective and scope of method study, work content, activity recording and exam aids.

Charts to record movements- Operation process charts, flow proeess charts, travel chart, two-handed chart and multipie activity eharts.

Principles of Motion Economy- Classification of movements, SIMO chart, and micro motion study. Definition and installation of the improved method, brief coneept about synthetic motion studies. Introduction to Value Engineering and Value Analysis.

Unit III- Work System Design

Work Measurements- Definition, objectives and uses, Work measurement techniques.
Work Sampling- Need, confidence levels, sample size determinations, random observation, conducting study with the simple problems.
Time Study- Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information, Rating and standard rating, standard performance, scales of rating, factors affecting rate of working, allowances and standard time determination.
Introdnction to PMTS, MTMand MOST.

Unit IV- Prodnction Planning and Control

Introdnction- Types of production systems, Need and functions of PPC, Aggregate production planning. Capacity Planning, ERP- Modules, Master Production Schedule, MRP and MRP-II.
Forecasting Technlques- Causal and time series models, moving average, exponential smoothing, trend and seasonality (Numerical), Demand Control strategies (MTO, MTA, MTS).
Introduction to Snpply Chain Management- Basic terminologies.

Unit V-Facility Design

Plant Location- Need and factors influencing plant location, Plant Layout- Objectives, principles, types of plant layouts.
Introduction to Assembly Line Balancing and Layout parameters to evaluate.
Material Handling systems- Objectives, relation with plant layout, principles. Types and purpose of different material handling equipment, Selection of material handling equipment.
Inventory control and Management- Types of inventories, Need of inventories, terminology, costs, Inventory Models- Basic production models, (with and without shortage and discount), ABC, VED Analysis.

Unit VI- Engineering Economy, Human Resource and Indnstrial Safety

Introdnction to Costing- Elements of Cost, Break-Even Analysis (Numerical). Introduction to Debit and Credit Note, Financial Statements (Profit and loss account and Balance Sheet), Techniques for Evaluation of capital investments.
Human Resource Development- Functions- Manpower Planning, Recruitment, Selection, Training. Concept of KRA (Key Result Areas), Performance Appraisal (Self, Superior, Peer, 360°). Industrial Safety- Safety Organization, Safety Program

Text Books:

1. M Mahajan, Industrial Engineering and Production Management, Dhanpat Rai and Co.
2. O. P. Khanna, Industrial engineering and management, Dhanpat Rai publication
3. MartendTelsang, Industrial Engineering, S. Chand Publication.
4. Banga and Sharma, Industrial Organization& Engineering Economics, Khanna publication

Reference Books :

1. Introduction to Work Study by ILO, ISBN 978-81-204-1718-2, Oxford &IBHPublishing Company, New Delhi, Second Indian Adaptation, 2008.
2. H. B. Maynard, K Jell, Maynard 's Industrial Engineering Hand Book, McGraw Hill Education.
3. Askin, Design and Analysis of Lean Production System, Wiley, India

4. Zandin K.B., Most Work Measurement Systems, ISBN 0824709535, CRCPress,2002
5. Martin Murry, SAP ERP- Functionality and Technical Configuration, SAP Press; 3rdNew edition (2010).
6. Barnes, Motion and time Study design and Measurement of Work, Wiley India
7. Raid Al-Aomar, Adwerd J Williams, Onur M. Uigen 'Process Simulation using WITNESS', Wiley

Prepared by- Prof. M G Gadge

BOS Member-Dr. S.C. Chinchanikar

BOS Chairman- Dr.D.N.Kamble

Open Elective – I
Artificial Neural Network iu Engineering (IOEUA32I85D)

Teaching Scheme	Examination Scheme						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): -- hr Practical (P): -- hrs.	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Course objectives:

1. To make students aware of various soft computing techniques in general and Artificial Neural Networks in particular, giving details about its working and analogy with Biological Neural networks.
2. To give students ideas about designing and training an Artificial Neural network using different algorithms to solve uinvariate and multivariate time series problems.

Course Ontcomes: At the end of the course the students will have an ability to-

1. Understand ANN as AI, soft computing and data driven model and describe its types
2. Compute the Net information given components of neuron
3. Describe various network training algorithms
4. Determine various design related aspects of ANN namely architecture, stopping criteria, performance function, overfitting
5. Describe working of Recurrent networks, Radial basis function networks, Generalized regression neural networks, Self-organizing maps using case studies
6. Design, train, and test 2 or 3 layered Feed forward back propagation neural network for time series and cause effect models

Unit I – Introduction to Artificial Neural Networks

Biological Neural Network, Introduction to Artificial Intelligence, soft computing techniques, Data driven modeling, ANN as AI, Soft computing and data driven technique, Artificial Neuron, ANN- history and general properties, ANN types according to architecture and Neuro-Dynamics, ANN Vs empirical, statistical, physical, physics based models

Unit II–Artificial Neuron

Components of artificial neuron, methods of computing net information, Activation functions (linear, sigmoidal, hyperbolic tangent, hard limiter, soft-lin), perceptron, Multi-layered perceptron (MLP)

Unit III – Network traiuing

Pre-training procedures- data normalization, network initialization, Types of training-Supervised and un-supervised, Network training using supervised training algorithms – Standard back propagation algorithm or gradient descent algorithm (mathematical treatment), introduction to Network training using conjugate gradient, resilient back propagation, Broydan-Fletcher-Goldfarb-Shanno algorithm, One step secant algorithm, Levernberg-Marquardt algorithm

Unit IV– Important Aspects of ANN design

Network architecture- inputs, outputs, number of hidden layers, number of hidden neurons, stopping criteria, over fitting, validation, testing, De-normalization, Evaluating model performance, data division, performance function

Unit V– Types of ANN

Recurrent networks, Radial basis function networks, Generalized regression neural networks, Self-

organizing maps (discuss using case studies of each referring to published papers and literature).

Unit VI – Applications of Feed Forward Back Propagation Neural Networks

Time series (univariate and multivariate) models, cause-effect models, Applications in Civil engineering, Electronics and Telecommunications, Mechanical Engineering, Computer Engineering, design, train and test simple 2 or 3 layered feed forward back propagation ANN for time series and cause effect models. Image Classifications using ANN

Continnons Evaluation

1. Calculation of network output for any given ANN with sigmoidal, hyperbolic tangent and linear activation functions
2. Implementing standard backpropagation algorithm manually, Using WEKA or any other software
3. Designing, training, and testing 2-3 layered FFBP ANN using standard backpropagation algorithm for any time series problem (univariate)
4. Evaluating the performance of ANN developed in Experiment 3 by varying number of hidden neurons, activation functions, normalization ranges
5. Designing, training, and testing 2-3 layered FFBP ANN using standard backpropagation algorithm for any time series problem (multi-variate)
6. Evaluating the performance of ANN developed in Experiment 5 by varying number of hidden neurons, activation functions, normalization ranges
7. Designing, training, and testing 2-3 layered FFBP ANN using standard backpropagation algorithm for any cause effect problem
8. Evaluating the performance of ANN developed in Experiment 7 by varying number of hidden neurons, activation functions, normalization ranges
9. Demonstration of MNIST digit classification using ANN.

Textbooks:

1. Wasserman, P.D., (1993), " Advanced methods in neural computing", Van Nostrand Reinhold, New York
2. Kosko, B., (1992), "Neural Networks and Fuzzy systems", Prentice Hall, Englewood Cliffs, NJ
3. Bose, N. K., Liang, P. (1998), "Neural Network Fundamentals with Graphs, Algorithms and Applications", Tata McGraw-Hill Publieation.

Prepared by- Dr.Sachin Sakhare

BOS Memher-Dr. S.C. Chinchanikar

BOS Chairman- Dr.D.N.Kamble

Open Eiective I

Social Media Analytics (IOEUA32185E)

Teaching Scheme	Examination Scheme						
Credits: 3 Lecture (L): 3 hrs./week Tutorial (T): -- hr Practical (P): -- hrs.	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisites-

1.Basic knowledge of Graphs.
2. Data mining.
3. Data Analysis.

Conrse objeetives:

1. To understand foundations of Social Media Analytics.
2. To Visualize and understand the data mining aspects in social networks.
3. To solve mining problems by different algorithms.
4. To understand network measures for social data.
5. To understand behavioral part of web applications for Analysis.
6. To analyze the data available on any social media applications.

Conrse Outcomes:

By the end of the course, students should be able to

1. Understand the basics of Social Media Analytics.
2. Understand the visualization of social networks and the significance of Data mining in Social media.
3. Demonstrate the algorithms used for text mining.
4. Compare and Apply network measures for social media data.
5. Explain Behavior Analytics techniques used for social media data.
6. Apply social media analytics for Facebook, LinkedIn and Twitter kind of applications.

Unit I – Introduction to social media analytics (sma) and types of analytics tools

Social media landscape, Need for SMA; SMA in Small organizations; SMA in large organizations; Application of SMA in different areas,

The foundation for analytics, Social media data sources, Defining social media data, data sources in social media channels, Estimated Data sources and Factual Data Sources, Public and Private data, data gathering in social media analytics

UNIT II -The social networks perspective and its visualization

Unit III – Text Mining in Social Networks

Introduction, Keyword search, Classification Algorithms, Clustering Algorithms-Greedy Clustering, Hierarchical clustering, k-means clustering, Transfer Learning in heterogeneous Networks, Sampling of online social networks, Comparison of different algorithms used for mining, tools for text mining.

Unit IV - Network Measnres

Centrality- Degree Centrality , Eigenvector Centrality, Katz Centrality , PageRank, Betweenness Centrality, Closeness Centrality ,Group Centrality ,Transitivity and Reciprocity, Balance and Status, Similarity- Structural Equivalence, Regular Equivalence

Unit V – Behavior Analytics

Individual Behavior- Individual Behavior Analysis, Individual Behavior Modeling, Individual Behavior Prediction Collective Behavior- Collective Behavior Analysis, Collective Behavior Modeling, Collective Behavior Prediction

Unit VI - Case Study

Mining Twitter- Overview, Exploring Twitter's API, Analyzing 140 Characters
Mining Facebook- Overview, Exploring Facebook's Social Graph API's, Analyzing Social Graph Connections.
Mining Linked In- Overview, Exploring Linked In API

Text Books:

1. Reza Zafarani Mohammad Ali Abbasi Huan Liu, Social Media Mining, Cambridge University Press, ISBN- 10- 1107018854.
2. Charu C. Aggarwal, Social Network Data Analytics, Springer, ISBN- 978-1-4419-8461-6.
3. Matthew Ganis, AvinashKohirkar Social Media Analytics- Techniques and Insights for Extracting Business Value Out of Soeial Media,Pearson publications,2016

Refercnce Books :

1. Marshall Sponder, Social Media Analytics- Effective Tools for Building, Interpreting, and Using Metrics, McGraw Hill Education, 978-0-07-176829-0. 2.
2. Matthew A. Russell, Mining the Social Web, O'Reilly, 2nd Edition, ISBN-10-1449367615.
3. Jiawei Han University of Illinois at Urbana-Champaign Micheline Kamber, Data Mining- Concepts and Techniques, Morgan Kaufmann, 2nd Edition, ISBN- 13- 978-1-55860-901-3 ISBN- 10- 1-55860-901-6.
4. Bing Liu, Web Data Mining - Exploring Hyperlinks, Contents and Usage Data, Springer, 2nd Edition, ISBN- 978-3-642-19459-7

Prepared hy- Dr. Prachi Joshi
BOS Member-Dr. S.C. Chinchanikar
BOS Chairman- Dr.D.N.Kamble

Computer Aided Engineerlng (MEUA32186)

Teaehing Scheme	Examination Scheme						
Credits:2 Lecture (L); 2hrs./week Tutorial (T): -- hr Practical (P): 2 hrs/week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	-	-	50	-	-	25	75

Prerequisite: Engineering Graphics, Engineering Mathematics, Computer Aided Machine Drawing, Strength of Materials, Manufacturing Processes.

Course objectives:

- Develop an understanding of the advanced aspects of enabling computer aided technologies used in design, engineering, manufacturing and rapid product development

Course Outcomes:

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

1.Apply homogeneous transformation matrix for geometrical transformations of 2D CAD entities for basic geometric transformations

2.Analyze the simple component using suitable analysis software

3.Generate CNC program for Turning / Milling and generate tool path using CAM software

4.Recognize the need of automation and RP in industry

Unit I -Geometric Modeling and Computer Graphics

Transformations (2D & 3D) - Geometrical Transformation, Mapping of geometric models, Projections - Orthographic, Isometric, Perspective projections

Analytical Curves, Surfaces, Synthetic Curves and Surfaces, Solids - Introduction, Geometry and Topology, Solid Representation, Boundary Representation, Euler's equation, Constructive Solid Geometry (CSG), Boolean operation for CSG

Unit II - Finite Element Analysis

Introduction - Brief History of FEM, Finite Element Terminology (nodes, elements, domain, continuum, Degrees of freedom, loads and constraints), General FEM procedure, Applications of FEM in various fields, Advantages and disadvantages of FEM

One Dimensional Problem- Finite element modeling, coordinate and linear shape function, Assembly of Global Stiffness Matrix and Load Vector, Properties of Stiffness Matrix, Finite Element Equations, Temperature Effects. Trusses - Introduction, 2D Trusses, Assembly of Global Stiffness Matrix

Unit III -Computer Aided Mauufacturing (CAM)

Numerical Control Machines, Computer Numerical Control , Types of CNC, Coordinate Systems, Direct & Distributed Numerical Control Machines, CNC part program, Computer aided part programming, Tooling, Controllers used, Computer Integrated Manufacturing, Computer Aided Process Planning, Computer Aided Quality Control

Uuit IV-Automation and Rapid Prototyping

Automation- Introduction, Automation strategies, Types of Automation - Hard and Soft Automation, Flexible Manufacturing System Types, Advantages, Limitations, AGVs and AS/RS, Group Technology-

Robotics- RIA, definition of Robot, Laws of robotics, Classification of robots, robot anatomy, Joints, End Effectors

Rapid Prototyping - Introduetion, classification of RP Processes (SLA, LOM, SLS, FDM, 3D printing), Working principle,

Lab Practice-

1. Build and execute a computer program on concatenated Transformation
2. Demonstration of Application Programming Interface (API).
3. 1D, 2D, 3D meshing and quality check
4. Static structural analysis of Beams
5. Static struetural analysis of Trusses
6. Static structural analysis of any mechanical element/part/component
7. Static structural analysis of any mechanical assembly
8. Unstressed and Pre-stressed Modal analysis of any mechanical element/part/component
9. Nonlinear Analysis of any mechanical Component

2D Steady State Heat Conduction Analysis

Text Books:

4. Ibrahim Zeid and R. Sivasubramanian - CAD/CAM - Theory and Practice Tata McGraw Hill
5. S.K. Sinha, CNC Programming using Fanuc Custom Macro B, McGraw-Hill Professional
6. Chandrupatla T. R. and Belegunda A. D. -Introduction to Finite Elements in Engineering - Prentice Hall India.
7. S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill.
8. Radhakrishnan P; SubramanyanS , CAD/CAM/CIM , New Age International

Reference Books:

1. IbraimZeid, Mastering CAD/CAM Tata McGraw Hill Publishing
2. Groover M. P, Automation Production Systems and Computer Integrated Manufacturing, PHI
3. Rao P. N., Introduction to CAD/CAM Tata McGraw Hill
4. Groover M.P.- - Prentice Hall of India
5. Seshu P. Text book of Finite Element Analysis, PHI Learning Private Ltd. New Delhi, 2010

Prepared by-Mr Naren Kate

BOS Member-Dr. Atul P. Kulkarni

BOS Chairman- Dr.D.N.Kamble