BansilalRamnath Agarwal Charitable Trust's

Vishwakarma Institute of Information Techuology, Pune-48

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Curriculum for
Final Year B. Tech
(Mechanical Engineering)
2018 Pattern

Department of
Mechanical 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 current and future needs of the industry, higher studies as well as research.

Program Educational Objectives-

1. Graduatesoftheprogramwillbecomecompetentengineerssuitablefortbemechanicalengineering based industry and higher education.
2. Graduates of the program will acquire the neeessary foundation in fundamental mechanical engineering subjects for development of mathematical and analytical abilities.
3. Graduatesoftheprogramwillacquiretheknowledgeandskillsinmechanicalengineeringtoprovide 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 life long learning.

Program Outcomes-

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 reaehing substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
3. **Design/development of solutions-** 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. **Conductinvestigationsofcomplexproblems**-Useresearch-basedknowledgeandresearchmethods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tooi nsage-** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities withan understanding of the limitations.

6. **Theengineerandsociety-**Applyreasoninginformedbythecontextualknowledgetoassesssocietal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Euvironmentandsnstainahiiity-**Understandtheimpactoftheprofessionalengineeringsolutionsin societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics-** Apply ethieal principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individnal and team work-** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication-** 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 finanee-** Demonstrate knowledge and understanding of the engineering and management prineiples 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-iong 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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Vishwakarma Institute of Information Technology, Pune-48 (An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Department of Mechanical Engineering

FINAL YEAR B. TECH (MECHANICAL ENGINEERING), SEMESTER VII (PATTERN 2018) MODULE I

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
			L	T	P	CIE	ISE	SCE	ESE	PR/OR/TW		
MEUA40181	Professional Elective-IV	TH	3	-	2	20	30	20	30	25	125	4
MEUA40182	Professional Elective-V	TH	3	-	2	20	30	20	30	25	125	4
IOEUA40183	Open Elective-II	TH	3	-	-	20	30	20	30	25	125	4
IOEUA40184	Open Elective-III	TH	3	-	2	20	30	20	30	25	125	4
MEUA40185	Intellectual Property Rights	CE	2	-	-	-	-	50	-	-	50	2
MEUA40186	Project Work	CE-PR/OR	-	-	10	100	-	-	-	50	150	5
M4	Mandatory Course	AU	-	-	-	-	-	-	-	-	-	-
	Total	-	14	1	16	180	120	130	120	150	700	23

CIE: Continuous Internal Evaluation
ISE: In-Semester Examination
SCE: Skill and Competency Examination
ESE: End Semester Examination

Professional Elective-IV		Professionai Elective-V	
Course Code	Course Title	Course Code	Course Title
MEUA40181A	Finite Element Analysis	MEUA40182A	Industrial Fluid Power
MEUA40181B	Computational Fluid Dynamics	MEUA40182B	Mechanical System Design
MEUA40181C	Reliability Engineering	MEUA40182C	Total Quality Management
MEUA40181D	Design of Thermal System	MEUA40182D	Automobile Engineering

Open Elective -II		Open Elective -III	
Course Code	**Course Title**	**Course Code**	**Course Title**
IOEUA40183A	Project Planning and Management	IOEUA40184A	Robotics
IOEUA40183B	Software Testing	IOEUA40184B	Quantum Computing
IOEUA40183C	5G Mobile Networks	IOEUA40184C	Business Intelligence
IOEUA40183D	Cloud Computing	IOEUA40184F	Business Analytics
IOEUA40183E	Solar And Wind Energy		

BoS Chairman
B. Tech (Pattern 2018)

Dean Academics
Mechanical Engineering

Director

FINAL YEAR B. TECH (MECHANICAL ENGINEERING), SEMESTER VII (PATTERN 2018) MODULE II

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
			L	T	P	CIE	ISE	SCE	ESE	PR/ OR/ TW		
MEUA40187	Semester Internship	CE-PR/OR	-	-	24	100	-	-	-	50	150	12
M4	Mandatory Course	AU	-	-	-	-	-	-	-	--	-	-
	Total		-	-	24	100	-	-	-	50	150	12

FINAL YEAR B. TECH (MECHANICAL ENGINEERING), SEMESTER VIII (PATTERN 2018) MODULE III

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
			L	T	P	CIE	ISE	SCE	ESE	PR/ OR/ TW		
MEUA42181	Professional Elective/Professional core	TH	3	-	2	20	30	20	30	25	125	4
IOEUA42182	Open Elective-IV	TH	2	-	2	20	30	20	30	25	125	3
IOEUA42183	Open Elective-V (Humanities and Social Science)	TH	2	-	2	20	30	20	30	25	125	3
MEUA42184	Introduction to Research	CEPR/ OR	1	-	2	-	-	-	-	25	25	2
M4	Mandatory Course	AU	-	-	-	-	-	-	-	-	-	-
	Total	-	8	-	8	60	90	60	90	100	400	12

Professional Elective-VI	
Course Code	Course Title
MEUA42181A	Power Plant Engineering
MEUA42181B	Noise Measurement and Control

Open Elective-IV	
Course Code	Course Title
IOEUA42182A	Engineering Economics
IOEUA42182B	Computational Biology
IOEUA42182C	Software Quality Assurance System
IOEUA42182D	Technology and Financial Management
IOEUA42182E	Non-Destructive Techniques and Engineering Diagnosis

Open Elective-V	
Course Code	Course Title
IOEUA42183A	Inferential Statistics for Data Science
IOEUA42183B	E- Commerce
IOEUA42183C	Rural Technology
IOEUA42183D	Product Design Engineering
IOEUA42183E	Numerical Methods

BoSChairman

Dean Academics

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Director

FINAL YEAR B. TECH (MECHANICAL ENGINEERING), SEMESTER VIII (PATTERN 2018) MODULE IV

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
			L	T	P	CIE	ISE	SCE	ESE	PR/ OR/ TW		
MEUA40187	Semester Internship	CE-PR/OR	-	-	24	100	-	-	-	50	150	12
M4	Mandatory Course	AU	-	-	-	-	-	-	-	--	-	-
	Total		-	-	24	100	-	-	-	50	150	12

FINAL YEAR B. TECH (MECHANICAL ENGINEERING), SEMESTER VIII (PATTERN 2018) MODULE V

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
			L	T	P	CIE	ISE	SCE	ESE	PR/ OR/ TW		
MEUA40181	Professional Elective-IV	TH	3	-	2	20	30	20	30	25	125	4
MEUA40182	Professional Elective-V	TH	3	-	2	20	30	20	30	25	125	4
IOEUA40183	Open Elective-II	TH	3	I	-	20	30	20	30	25	125	4
IOEUA40184	Open Elective-III	TH	3	-	2	20	30	20	30	25	125	4
MEUA40185	Intellectual Property Rights	CE	2	-	-	-	-	50	-	-	50	2
MEUA40186	Projeet Work	CE-PR/OR	-	-	10	100	-	-	-	50	150	5
M4	Mandatory Course	AU	-	-	-	-	-	-	-	-	-	-
	Total	-	14	1	16	180	120	130	120	150	700	23

CIE: Continuous Internal Evaluation
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ESE: End Semester Examination

BoSChairman **Dean Academics** **Director**

V.I.I.T. PUNE 48. Vishwakarma Institute of Information Technology B.R.A.C.TRUST

Professional Elective-IV		Professional Elective-V	
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Course Code	**Course Title**	**Course Code**	**Course Title**
IOEUA40183A	Project Planning and Management	IOEUA40184A	Robotics
IOEUA40183B	Software Testing	IOEUA40184B	Quantum Computing
IOEUA40183C	5G Mobile Networks	IOEUA40184C	Business Intelligence
IOEUA40183D	Cloud Computing	IOEUA40184F	Business Analytics
IOEUA40183E	Solar And Wind Energy		

NOTE:

- Students who will register for Module-I in Semester VII have to register either of Module-III or Module IV in Semester VIII
- Students who will register for Module-II in Semester VII have to register for Module-V in Semester VIII

List of Mandatory Courses:

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

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

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MODULE-I/V

SEMESTER-VII/VIII

Professional Elective-IV
Finite Element Analysis (MEUA40181A)

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

Prerequisite:
Engineering Mechanics, Strength of Materials, Design of Machine elements, Engineering Mathematics, Heat Transfer, Dynamics of Machinery, Fundamentals of Programming Language

Course objectives:

- To understand the general procedure and philosophy of Finite Element Method as applied to solid mechanics and thermal analysis problems.
- To familiarize students with the displacement-based finite element method for displacement and stress analysis and to introduce related analytical and computer tools. It provides a bridge between hand calculations based on mechanics of materials and machine design and numerical solutions for more complex geometries and loading states.
- To study approximate nature of the finite element method and convergence of results are examined

Course Outcomes:

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

1. Understand the concept of finite element method and formulate element stiffness matrix for 1D bar element.
2. Analyze truss, beam and frame element to solve for displacements and stresses.
3. Obtain finite element formulation for two-dimensional plane stress and plane strain problems using constant strain triangle (CST) elements.
4. Interpret concepts of isoparametric quadrilateral and higher order elements in finite element formulation for 2D problems and solve numerical integration using Gaussian quadrature.
5. Develop finite element equations for 1D steady state heat conduction and convection problems in heat transfer using Galerkin weighted residual method
6. Analyze problems in solid mechanics and heat transfer by using commercial finite element analysis software

Unit 1: Fundamentals Concepts of FEA

Introduction to FEA, General Procedure for Finite Element Analysis, Brief history of Finite Element Method, Advantages and disadvantages of FEA , Applications of FEA in various fields, The Rayleigh-Ritz method

1D Bar Element: Finite element formulation of 1D linear bar element using Potential Energy approach (with general steps involved in FEA) - shape functions, element stiffness matrix, force terms, assembly of global stiffness matrix and load vector, treatment of boundary conditions- elimination approach, calculation of nodal displacement, strain and element stresses, reaction forces, properties of stiffness matrix, Quadratic shape functions, temperature effect- temperature load vector.

Numerical Examples: 1D linear bar element (with temp effect)

Unit 2: Plane Truss, Beam and Frame Elements

Analysis of Truss Element: Formulation of Element Matrices, Direction cosine, assembly of global stiffness matrix, element strains and stresses, Numerical Examples:

Analysis of Beam Element: Hermite Shape function (Derivation), element stiffness matrix, element load vector, Numerical Examples
Plane Frame Element: Introduction to element stiffness matrix

Unit 3: 2D Elements

Two-Dimensional Stress Analysis: Plane Stress/Strain problems in 2D elasticity, constitutive relations Constant Strain Triangle (CST), Liner Strain Rectangle (LSR), Displacement function, Pascal'striangle, compatibility and completeness requirement, geometric isotropy, Convergence requirements, strain filed, stress filed, Formulation of element stiffness matrix aud load vector for Plane Stress/Strain problems. Assembly of global stiffness matrix and load vector, Boundary conditions, solving for primary variables (displacement), stress calculations

Unit 4: Isoparametric Elements & Numerical Integration

Concept of isoparametric elements, Terms Isoparametric, super parametric and sub parametric, Isoparametric formulation of bar element.
Coordinate mapping - Natural coordinates, Area coordinates (for triangular elements), higher order triangular and quadrilateral elements (Lagrangean and serendipity elements), geometry associative mesh, quality checks, mesh refinement- p Vs h refinements, Uniqueness of mapping - Jacobian matrix. Numerical integration –Gauss Quadrature in 1 & 2 dimension, Order of Gauss integration, full and reduced integration

Unit 5: 1D Steady State Heat Transfer Problems

Introduction to Galerkin weighted residual method, One dimensional steady-state heat transfer problem-Governing differential equation, Finite Element formulation using Galerkin's approach for composite wall and thin Fin , Essential and natural boundary conditions and solving for temperature distribution

Unit 6: Dynamic Analysis

Types of dynamic analysis, General dynamic equation of motion, lumped and consistent mass, Mass matrices formulation of bar, truss and beam element.
Undamped-free vibration- Eigen value problem, Evaluation of eigen values and eigenvectors (characteristic polynomial technique),

Text Books:

1. Chandrupatla T. R. and Belegunda A. D., Introduction to Finite Elements in Engineering, Prentice Hall India, 2002
2. Fundamental of Finite Element Analysis, David V. Hutton, TataMcGraw-Hill,
3. A First Course in the Finite Element Method, Daryl L. Logan,2007.
4. Finite Element Analysis, G Lakshmi Narasaiah, B S Publications,2008.
5. Finite Element Method with Applications in Engineering, Y. M. Desai, T. I. Eldhoand A. H. Shah, Pearson Education,2011
6. Text book of Finite Element Analysis, P., Seshu, PHI Learning Private Ltd., NewDelhi, 2010.

Reference Books :

1. Finite Element Procedures, Bathe K. J., Prentice-Hall of India (P) Ltd., NewDelhi.
2. Concepts and Applications of Finite Element Analysis, R. D. Cook, et al. Wiley,India
3. Finite Element Method using MATLAB, Kwon Y. W., Bang H., CRC Press,1997
4. MATLAB Guides to Finite Elements- An Interactive Approach, Peter Kattan, Springer,2008.
5. Finite element analysis, theory and application with Ansys, S. Moaveni, PrenticeHall
6. The Finite Element Method and Applications in Engineering Using Ansys, Erdogan Madenci and Ibrahim Guven, Springer,2006.
7. Fundamental of Finite Element Analysis, David V. Hutton, Tata McGraw-Hill

PracticalFiniteElementAnalysisI,GokhaleN.S.,etal.,FinitetoInfinite,Pune,2008.

List of experiments :

The term work shall consist of record of any three from 1 to 4* and any three from 5 to 9** assignments of the problems based on following topic-

1. Computer program for stress analysis of 1D bar using linear and quadratic elements. Show the variation of stress and strain within the element for linear and quadratic barelement.
2. Computer program for stress analysis of 2-D truss subjected to plane forces
3. Computer programs for (i) modal analysis and, (ii) stress analysis for 1-D beam (simply supported or cantilever beams)
4. Computer program for 1-D temperature analysis
5. Statie stress concentration factor calculation for a plate with center hole subjected to axial loading in tension using FEA software.
6. Modal analysis of any machine component using FEA software.
7. Stress and deflection analysis of any machine component consisting of 3-D elements using FEA software.
8. Nonlinear elasto-plastic analysis of plate with hole using FEA software
9. Coupled Thermal-Structural Analysis using FEA software

Students can write the program in any of the programming language such as FORTRAN,C, C++, MATLAB, Python, VB.
Minimum number of elements considered should be 10 or more.
Validate results of the program with analytical method or FEA software such as Abaqus, ANSYS, Msc-Nastran, Optistruct/Radioss, Comsol-Multiphysics

**1. Students should do convergence study for all assignment problems.
2. Use different element types from element library, 3. If possible use sub model/symmetry option. Macro mechanical Analysis of lamina using MATLAB; (iii) macro mechanical Analysis of laminate using MATLAB

Prepared by: Dr. A .R. Mache

BOS Member: Dr A P kulkarni

BOS Chairman:

Professional Elective-IV
Computational Fluid Dynamics(MEUA40181B)

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

Prerequisite: Fluid Mechanics, Heat transfer, Numerical methods, Programming Languages.

Course Objectives:

- Students should be able to model fluid / heat transfer problems and apply fundamental
- Conservation principles.
- Students should be able to do discretize the governing equations by Finite Difference Method
- and Finite volume Method.
- Studentsshouldbeabletosolvebasicconvectionanddiffusionequationsandunderstandstbe role in fluid flow and heat transfer.
- To prepare the students for research leading to higher studies.

Course Outcomes:

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

1. Analyze and model fluid flow and heat transfer problems.
2. Generate high quality grids and interpret the correctness of numerical results with physics.
3. Solve two dimensional steady and unsteady heat conduction equation using finite volume method
4. Analyse different boundary conditions.
5. Formulate two dimensional steady and unsteady heat conveetion-diffusion equation
6. Apply proper turbulence model to solve fluid flow problems.

Unit 1: Introduction of CFD

Introduction to Computational Fluid Dynamics, How CFD Code work, Applications of CFD, Steps for problem solving with CFD.

Unit II: Governing equations of CFD

Derivation and physical interpretation of governing equations (conservation of mass, momentum and energy) in differential form, Concept of substantial derivative, divergence and curl of velocity, Mathematical behavior of Governing Equations and boundary conditions.

Unit 1II: Solution to Conduction Equation

Introduction to FEA, FDM and FVM, Solution of two dimensional steady and unsteady heat conduction equation using finite volume method (Implicit and Explicit) with Dirichlet, Neumann, Robbin boundary conditions, Stability Criteria.

Unit IV: Solution to Advection Equation

Solution of two dimensional steady and unsteady heat advection equation using finite volume method
(Implicit and Explicit) with Dirichlet BC, Stability Criteria, Introduction to first order upwind, CD,

Unit V: Solution to Convection-Diffusion Equation

Solution of two dimensional steady and unsteady heat convection-diffusion equation for slug flow, using finite volume method (Implicit and Explicit), Stability Criteria, 1-D transient convection-diffusion system, Peclet Number
Unit VI: Introduction to Turbulence Modeling
Introduction to turbulence models, Reynolds Averaged Navier-Stokes equations (RANS), One equation model (Derivation) and two equation model.
List of Practical:
1. One-dimensional steady state conduction meshing using finite volume method 2. Two-dimensional steady state conduction using finite volume method 3. Two-dimensional unsteady state conduction using finite volume method 4. Two-dimensional advection using finite volume method 5. One-dimensional conduction convection problem using finite volume method 6. Solution of Navier Stokes equation using SIMPLE algorithm for Lid Driven Cavity flow problem 7. Mini-project based on above practical's.
Text Books:
1. John D Anderson: Computational Fluid Dynamics- The Basics with Applications, McGraw- 2. Hill 3. Atul Sharma, Introduction to Computational Fluid Dynamics: Development, Application and 4. Analysis,Wiley 5. Suhas V. Patankar, Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing 6. Corporation 7. A. W. Date, Introduction to Computational Fluid Dynamics, Cambridge Univ. Press, USA. 8. H. Versteeg, and W. Malalasekara, An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Pearson. 9. T. J. Chung, Computational Fluid Dynamics, Cambridge University Press. 10. J. Tu, G.-H. Yeoh and C. Liu: Computational Fluid Dynamics: A practical approach, Elsevier. 11. H. Schlichting and K. Gersten, Boundary-Layer Theory,Springer.
Reference Books :
1. H. Tennekes and J. L. Lumley, A First Course in Turbulence, MIT Press. 2. David C. Wilcox, Turbulence Modeling for CFD, DCW Industries

Prepared by: Dr. S. S. Kore

BOS Member: Dr A. D. Kale

Dr BOS Chairman:

Professional Elective-IV
Reliability Engineering (MEUA40181C)

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

Prerequisite: Engineering Mathematics, Manufacturing Processes and Design Engineering

Course Objectives:

Understanding of basic principles of Reliability for ensuring sustainable product design. Application to system requirements, design, manufacturing and testing, with real-world examples. Understand in detail Asset Management, Maintenance, Quality and Productiveness.

Course Outcomes:

Upon completion of the course, students will be able to

1. Calculate MTTF, MTBF, failure rate and hazard rate for life characteristic phases of system
2. Analyze series, parallel, mixed configuration systems using probability concepts.
3. Apply different reliability apportionment techniques to improve reliability of system.
4. Calculate inherent, achieved, and operational availability of system.
5. Perform FEMA, FMECA and Design of Experiments
6. Apply different methods to test reliability.

Unit I: Fundamentals Concepts of Reliability

Reliability terminologies, Interrelationship of safety, quality and reliability, life characteristic phases, Introduction to maintainability, availability. Concepts of Failure, failure density, failure Rate, hazard rate, pdf, cdf. Modes of failure, Mean Time To Failure (MTTF), Mean Time Between Failure (MTBF), Numericals based on calculation of failure rate, hazard rate. Warranty Management and Life cycle cost.

Unit II: Probability Concepts and System Reliability

Basicprobabilityeoncepts,Discreteandcontinuousprobabilitydistributions,Analysisofseries,parallel, mixed configuration systems, Concept of k-out of n structure, Conditional probability method, delta-star method for conditional probability analysis, Tie-set, and Cut-Set method (Concepts and Numericals).

Unit III: System Reliability Analysis

Reliability Improvement- Redundancy, element redundancy, unit redundancy, standby redundancy (Numericals), Introduction to Reliability allocation or apportionment, reliability apportionment techniques: Equal apportionment, AGREE, ARINC, Minimum effort method (Numericals).

Unit IV: Reliability Management

Objectives and types of maintenance, Maintainability, system down time, availability - inherent, achieved, and operational availability (Numerical treatment). Introduction to Reliability Centered Maintenance. Design for maintainability and its considerations, Reliability and costs, Costs of Unreliability, Technology aspects in Reliability Management, BIT (Built in testing).

Unit V: Reliability in Design and Development

Reliability techniques- Failure mode, effects analysis (FMEA), Failure mode, effects, and criticality analysis (FMECA)- Case Studies, Basic symbols, Fault Tree construction and analysis, Introduction to Design of Experiments (DOE).

Unit VI: Reliability Testing

Introduction to reliability testing, Stress strength interaction, Testing for Reliability and Durability- Accelerated Life Testing and Highly Accelerated Life Testing (HALT), highly accelerated stress Screening (HASS). Reliability in manufacturing- Production FRACAS.

Lab Practice:

1. Calculation of MTTF, MTBF, failure rate and hazard rate for life characteristic phases of system using advanced Excel and/or Minitab software or Python
2. Assignment on analysis of series, parallel, mixed configuration systems using probability concepts.
3. Design of Experiments with ANOVA- One factor
4. Design of Experiments with ANOVA, Residual plot, Normal probability plot – Two factor analysis
5. Perform FEMA, FMECA of any mechanical system
6. Fault tree analysis of any mechanical system
7. Assessment of reliability of cutting tool during turning -I
8. Assessment of reliability of cutting tool during turning -II

Textbooks:

1. Kapur — Reliability in engineering Design, Wiley India

2. L. S. Srinath, Reliability Engineering, EWP , 4th Edition2011

Reference Books:

1. Alessandro Birolini, Reliability Engineering Theory and Practice, Springer

2. S S. Rao, Reliability Based Design, McGraw Hill Inc.1992

Prepared by: Dr. S. S. Chinchanikar

BOS Member: Dr A P Kulkarni

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

Professional Elective-IV
Design of Thermal System (MEUA40181D)

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

Prerequisite: Readers/students are expected to know all topics of basic engineering science courses in thermodynamics, fluid mechanics and heat transfer.

Course Objectives:

- To understand different kinds of heat exchangers, their working and applications
- To familiarize with different standards of heat exchangers design
- Students will able to understand different methods of heat exchanger design

Course Outcomes:

After successful completion of the course Student will be able,

1. To classify different types of heat exchangers and select as per the applications
2. To analyze sizing and rating of heat exchangers with different methods
3. Understand the different shell and tube heat exchanger design standards and apply the knowledge for the design of shell and tube heat exchanger
4. To analysis different heat transfer enhancement techniques and calculate the heat transfer arte and pressure drop
5. To formulate the sizing and rating of exiting Plate Fin Heat Exchanger
6. To understand physics of multiphase heat transfer and apply it for different applications

Unit I: Basics Heat Exchaugers

Heat exchange mechanism, Classification of Heat Exchangers, Construction and working of tubular, Plate and Compact heat exchangers. Selection of heat exchangers, Applications of heat exchangers in different areas.

Unit H: Design of Heat Exchangers

Introduction to thermal and hydraulic aspects, Pressure drop and heat transfer considerations, Sizing and rating of heat exchangers. F-LMTD and NTU method.

Unit III: Shell and Tube Heat Exchangers

Basic components, Types of shell and tube heat exchangers, TEMA standards, Basic design methodology, Heat transfer and pressure drop calculations, Shell side calculations-KERN,s and Bell Delaware method.

Unit IV: Compact Heat Exchangers

Heat transfer enhancement, extended surfaces, Plate fin and tube fin heat exchangers- Applications and construction. Heat transfer and pressure drop calculations.

Unit V: Plate Fin Heat Exchangers

Plate fine heat exchangers- Types and applications, Construction and fabrication, Flow arrangement and design of PFHE.

Unit VI: Phase Change Heat Exchangers

Introduction to evaporators and condensers, construction, working, design and operational considerations and thermal analysis.

List of Practical:

1. Basic design methods and tube heat exchangers
2. TEMA standards and applications to STHEX
3. Analysis of shell & tube heat exchanger using different methods
4. Thermal Analysis of compact heat exchangers
5. Analysis of plate fin type heat exchangers
6. Fouling analysis of heat exchangers
7. Trial on heat pipe to determine performance parameters
8. Industrial visit to heat exchanger manufacturing company

Text Books:

I. Heat Transfer by F. Incropera and D. DeWitt or other basic undergraduate heat transfer textbook.
2. Kakac, Sadik, Hongtan Liu, and AnchasaPramuanjaroenkij. *Heat exchangers: selection, rating, and thermal design*. CRC press, 2012.R K Shah, Fundamental of Heat Exchanger Design
3. Kay Kays and London, *Compact heat exchanger*, Krieger Pub Co,., 1998

Reference Books :

1. Fundamentals of Heat Exchanger Design -Ramesh K. Shah, Dusan P.Sekulic,Wiley-India
2. Heat exchanger, Design, rating and Selection, Sadik Kakac, CRCPress
3. Process Heat Transfer/D. Q. Kern/TMH
4. Heat Exchanger Design/ A. P. Fraas and M. N. Ozisick/ John Wiely& sons, New York.
5. Heat Exchangers Thermal Hydraulic Fundamentals and Design by S. Kakac, A. ,Bergles, F. Mayinger, McGraw-Hill BookCompany.

Prepared by: Dr. S. S. Kore

BOS Member: Dr A. D. Kale

BOS Chairman:

Professional Elective-V
Industrial Fluid Power (MEUA40182A)

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

Prerequisite: Engineering Mechanics, Engineering Mathematics, Fluid Mechanics and machines.

Course Objectives:

- To study governing laws used in fluid power systems
- To study fluid power applications
- To study working principles of various components
- To study selection of different components
- To study how to design fluid power systems
- To study low cost automation

Course Outcomes:

By the end of the course, students will able to

1. Explain and analyze the performance of pumps used in hydraulic systems.
2. Explain the working principle of actuators, power units and reservoirs of hydraulic system.
3. Explain the construction and working principle of various control valves used in hydraulic system.
4. Analyze and select appropriate hydraulic circuits for industrial/mobile applications
5. Illustrate the working principle of various components and circuits of Pneumatic system.
6. Design Hydraulic and Pneumatic system according to system requirements by using manufacturing catalog.

Unit 1: Basics of Fluid Power and Pumps

Fluid power basics, advantages and limitations, Hydraulic fluid – types, properties and requirements, applications, ISO standards and API standards etc.

Pumps - types, classification, principle of working and constructional details of vane pumps, gear pumps, radial and axial plunger pumps, screw pumps, power and efficiency calculations, characteristics curves, selection and applications of Pumps etc.

Unit 2: Actuators and Power Unit

Linear and rotary actuators- types, construction and characteristics. Cylinder mountings, cushioning of cylinders, Contamination control: Contamination, sources of contamination, suction strainer, filters, filtration, filter ratings.

Power units and accessories - types of power units, reservoir assembly, constructional details.

Accumulators, Intensifiers, Pressure and Temperature switches /sensors, level sensors. Pressure and temperature transmitters etc.

Unit 3: Fluid Power Control

Direction control valves - center positions, methods of actuation, two stage valves, Flow control valves - pressure and temperature compensated. Pressure control valves – pressure relief and reducing valves, sequence valve, unloading valve, counter balance valve, check valves, solenoid valves, proportional valves, gate valves and globe valves etc.

Unit 4: Hydraulic Circuits

Hydraulic circuits: Simple reciprocating, regenerative, speed control (meter in, meter out and bleed off), sequencing, synchronization, automatic reciprocating, fail safe circuit, counter balance circuit, actuator locking, unloading circuit, motor breaking circuit etc..

Unit 5: Pneumatics – Components, Control Valves and Circuits

Compressors - Types, principle of working and constructional details. Comparison of pneumatic with hydraulic power transmissions. Types of filters, pressure regulators, lubricators, mufflers, dryers, direction control valves, pneumatic actuators, shuttle valve, two pressure valve, quick exhaust valve and time delay valves. Speed regulating methods, pneumatic circuits, reciprocating, cascading time delay etc.

Unit 6: System Analysis and Design

Calculation of piston velocity, thrust under static and dynamic applications, considering friction, inertia loads, design considerations for cylinders, Design of hydraulic/pneumatic circuits for practical application, selection of different components such as reservoir, control elements, actuators, accumulator, intensifier, filters, pumps by using manufacturing catalog.(Students are advised to refer manufacturers' catalogues for design and use simulation tool like Automation Studio for analysis).

Lab Practice:

Lab practice consist of any eight experiments of the following -

1. Test on Gear / Piston pump and plotting of performance characteristics.
2. Study and demonstration of various control valves (pressure / directional /flow)
3. Study and demonstration of compressed air generation and distribution system.
4. Study & demonstration of various hydraulic circuits on hydraulic trainer.
5. Study & demonstration of various pneumatic circuits on pneumatic trainer.
6. Industrial visit to automation system and repot based on it.
7. Assignment on ISO symbols for different components of Hydraulic and Pneumatic system.
8. Assignment: Standard specifications of hydraulic/ pneumatic components using manufacturer's catalogues.
9. Design of simple hydraulic systems used in practice using manufacturers' catalogue and analysis using any suitable software.
10. Design of simple Pneumatic systems used in practice using manufacturers' catalogue and analysis using any suitable software.

Text books :

1. Esposito A, Fluid Power with application, Prentice Hall
2. Majumdar S.R, Oil Hydraulic system- Principle and maintenance ,Tata McGraw Hill
3. Majumdar S.R, Pneumatics Systems Principles and Maintenance ,Tata McGraw Hill
4. Stewart H. L, Hydraulics and Pneumatics , Taraporewala Publication

References books :

1. Pipenger J.J, Industrial Hydraulics, McGraw Hill
2. Pinches, Industrial Fluid Power, Prentice Hall
3. Yeaple, Fluid Power Design Handbook
4. Andrew A. Parr, Hydraulics and Pneumatics, Elsevier Science and Technology Books
5. ISO - 1219, Fluid Systems and components, Graphic Symbols
6. Standard Manufacturer's Catalogues

Prepared by: Mr. D.B. Nalawade

BOS Member: Dr. S. S. Kore

BOS Chairman:

Professional Elective-V
Mechanical System Design (MEUA40182B)

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

Prerequisite: Engineering Mechanics, Manufacturing Process, Engineering Mathematics, SOM, TOM, DME, IC Engines.

Course objectives:

1. To develop competency for system visualization and design.
2. To enable student to design machine tool gearbox.
3. To enable student to design material handling systems.
4. Ability to apply the statistical considerations in design and analyze the defects and failure modes in components
5. To enable student to design cylinders, pressure vessels and internal engine components and to use IS code.
6. To enable student to study and understand automobile suspension system

Course Outcomes:

By the end of the course, students will be able

1. To design machine tool gearbox for various system.
2. To design belt conveyer system for material handling system.
3. To study different statistical methods/ techniques/ principles and apply it to mechanical components.
4. To Design various types of cylinders and pressure vessels.
5. To Understand the design concept and procedure for IC engine components.
6. To Understand the concept for automobile suspension system.

Unit I - Design of Machine Tool Gearbox

Introduction to machine tool gearboxes, design and its applications, basic considerations in design of drives, determination of variable speed range, graphical representation of speed and structure diagram, ray diagram, selection of optimum ray diagram

Unit II - Design of Belt conveyer system for material handling

System concept, basic principles, objectives of material handling system, unit load and containerization. Belt conveyors, Flat belt and troughed belt conveyors, capacity of conveyor, rubber covered and fabric ply belts, belt tensions, conveyor pulleys, belt idlers, tension take-up systems, power requirement of horizontal belt conveyors for frictional resistance of idler and pulleys.

Unit III – Design of Cylinder

Design of Cylinders:
Thin and thick cylinders, Lame's equation, Clavarino,,s and Bernie's equations, design of hydraulic and pneumaticcylinders,auto-frettageandcompoundcylinders,(NoDerivation)gasketedjointsincylindrical vessels

Unit IV- Design of Pressure Vessel

Design of pressure Vessel:

Modes of failures in pressure vessels, unfired pressure vessels, classification of pressure vessels as per I. S.2825-categoriesandtypesofweldedjoints,weldjointefficiency,stressesindncedinpressurevessels, materialsforpressurevessel,thicknessofcylindricalshellsanddesignofendclosuresaspercode,nozzles andopeningsinpressurevessels,reinforcementofopeningsinshellandendclosures-areacompensation method

Unit V- Design of I. C. Engine components

Introduction to selection of material for I. C. engine components, Design of cylinder and cylinder head, construction of cylinder liners, design of piston and piston-pins, piston rings, design of connecting rod. Design of crank-shaft and crank-pin, (Theoretical treatment only).

Unit VI– Automobile Suspension System

Suspensions: Types of suspension linkages, types of suspension springs- leaf, coil, air springs, hydrogas, rubber suspension, interconnected suspension, self levelling suspension (active suspension), shock absorbers (hydraulic and air)

Text Books:

1. Bhandari V.B. —Design of Machine Elementsl, Tata McGraw Hill Pub. Co.Ltd.
2. Juvinal R.C, Fundamentals of Machine Components Design, Wiley,India

Reference Books:

1. Shigley J. E. and Mischke C.R., —Mechanical Engineering Designl, McGraw Hill Pub.Co
2. M. F. Spotts, —Mechanical Design Analysisl, Prentice HallInc.
3. Black P.H. and O. Eugene Adams, —Machine Designl McGraw Hill Book Co.Inc.
4. JohnsonR.C.,—MechanicalDesignSynthesiswithOptimizationApplicationsl,VonNostrandReynoldPub.
5. S.K. Basu and D. K. Pal, —Design of Machine Tools,,. Oxford and IBH PubCo.
6. Rudenko,lMaterialHandling Equipmentll. M.I.R. publishers. Moscow
7. P.Kannaiah,lDesignofTransmissionsystemsl,SCIETCHPublicationsPvtLtd.
8. Pandy, N. C. and Shah, C. S., —Elements of Machine Design—, Charotar Publishing House.
9. Mulani, I. G., —Belt Conveyorsl
10. Singiresu S. Rao, Engineering Optimization: Theory and Practice, , John Wiley &Sons.
11. M.V. Joshi, Process Equipment Design,Mc-Millan.
12. Design Data—, P.S.G. College of Technology, Coimbatore.
13. Bhandari, V. B. Machine Design data book, Tata McGraw Hill Publication Co. Ltd.
14. I.S. 2825: Code for unfired pressure vessels.

Lab Practice – Mechanical System Design (MEUA40182B)

Term work: Term work shall consist of

1. One design project

Thedesignprojectshallconsistoftwoimperialsizesheets(Preferablydrawnwith3D/2DCADsoftware) - one involving assembly drawing with a part list and overall dimensions and the other sheet involving drawings of individual components, manufacturing tolerances, surface finish symbols and geometric toleranees must be specified so as to make it working drawing. A design report giving all necessary calculationsofthedesignofcomponentsandassemblyshouldbesubmitted.Projectsshallbeintheform of design of mechanical systems including pressure vessel, conveyor system, mnlti speed gear box, I.C engine,etc.

2. Assignments

The assignment shall be internally presented in the form of power point presentation by a group of two or three students. A report of assignment (Max 8 to 10 pages) along with print out of PPT is to be submitted.

Each student shall complete any two of the following:

1. Design review of any product/ system for strengtb and rigidity considerations.
2. Design review of any product/system for manufacturing, assembly and cost considerations.
3. Design review of any product/system for aesthetic and ergonomic considerations.
4. Analysis of any product/system using reverse engineering.
5. Case study of one patent from the product design point of view.
6. Failure mode and effect analysis of one product/component.
7. Design of Experiments(DOE)
8. Selection of gear box for various mechanical system like epicyclic gear trains , differential gearboxes , speed reducer etc
9. Design of Human Powered system.
10. Application of composite material for different mechanical components.
11. Design of material handling system for specific / various applications such as chain and screw conveyors
12. Concurrent engineering

Prepared by: Prof. A.V .Salve

BOS Member: Dr A R Mache

BOS Chairman:

Professional Elective-V
Total Quality Management (MEUA40182C)

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

Prerequisite: Engineering Mathematics, Manufacturing Processes, Manufacturing Technology.

- **Course Objectives:** To facilitate the understanding of total quality management principles and processes.

Course Outcomes:

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

1.Understanding the basic concepts of TQM and tools.
2.Develop a thinking towards Quality systems and thinking.
3.Understand the application and processes of the various Quality Awards.
4.Analyse the importance of both internal and external customer.
5.Illustrate the concept of the PDSA, PDCA cycle and problem-solving method.
6.Understand the structure and functions of quality council in order to drive TQM Implementation

Unit I: Introduction to Quality

Introduction to Quality, The History and Importance of Quality; Defining Quality; Quality in Management Framework, Control Charts Control Chart for Variable (**X & R** Chart) & Attribute (**P & C** Chart), Process capability, Statistical Process Control (Numerical).

Unit II: Total Quality In Organization

Total Quality in Organization- Quality and Quality System Thinking; Quality in Manufacturing; Quality in Service; Quality in Small Business; Quality in Public Sector.

Unit III: Philosophies and Framework

Philosophies and Framework - The Deming Philosophy; The Juran Philosophy; The Crosby Philosophy. Quality Management awards and Frameworks, The Malcolm Baldrige National Quality Award, International Quality awards and Programs, ISO 9000:2000. Evolution of Six Sigma, Baldrige Award

Unit IV: Focusing on Customers

Focusing on Customers the Importance of Customer Loyalty and Satisfaction; Creating Satisfied Customers; Customer Relationship • Acknowledge the importance of both internal and external customer • Focus on Customer satisfaction through defined quality processes. • Use of Deming Philosophy in customer 4 Management: Measuring Customer Satisfaction

Unit V: Continuous Process Improvement

Continnous Process Improvement- Juran Triology, Improvement Strategies, Types of Problems, Thc PDCA, PDSA cycle, Problem solving Methods, Kaizen, Reengineering

Unit VI: Leadership And Strategic Planning

Leadership and Strategic Planning - Leadership theory and practices, Creating the leadership system, Strategic Planning, leadership, strategy and organization structure, leadership for Quality; The Seven Management and Planning tools

List of Practical's (Any Eight)

Use of computational tools [such as Minitab / Mat lab / MS Excel] are recommended

(I). Analyse the fault in given batch of specimens by using seven quality control tools for engineering application. Submission of these assignments USING STANDAEDFORMA1S.

(2). Determination of process capability from given components and plot variable control chart/ attribute chart.

(3) Red Bead experiment: Specnlate the probability of distribution of beads w.r.t quantity of input, Quality of input, and analyze w.r.t application of 7 QC tools. Plot distribution graphs with qualitative statistics to substantiate data generated by red bead experimentation

(4). Case study on various tools in Total Quality Management (TQM).

(5). Design an alternative system for above using DFSS approach.

(6). Case study and presentation on PDCA Cycle with industry experience

Funnel Experiment: To plan and study the effect of

(7) Contingent adjustment of funnel at the an of last five experiments. Repeating to understand an of ans. Plot all scenarios.

(8) Continuous error correction, and study the role of compensation and under/overcompensations, and plotconsistency

(9). Design of Experiments Software

Textbooks:

1. Dale H. Besterfield, Pearson, Total quality Management, Pearson Education
2. James R. Evans and William M. Lindsay, "The Management and Control of Quality",8th Edition, First Indian Edition, Cengage Learning,2012

Reference Books:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.

2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd.,2006.

3. Janakiraman. B and Gopal.R.K., "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt.Ltd., 2006.

Prepared by: Mr. A. A. Somatkar

BoS Member: Dr. S. S. Chinchanikar

BoS Chairman:

Professional Elective-V

Automobile Engineering (MEUA40182D)

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

Prerequisite: Strength of Materials, Theory of Machines, Machine Design, Workshop Practice I.

Course Objectives:

- To make the student conversant with fundamentals of automobile systems.
- To develop competencies in performance analysis of vehicles.
- To make the student conversant with automobile safety, and vehicle Standard.

Course Outcomes:

1. Iuterpret the function of each automobile component.
2. Enumerate different types of suspension and baking system.
3. Estimation of steering kinematics of four-wheel vehicle.
4. Analyse the tire ride properties for better vehicle performanee.
5. Identify the equation of motion used in vehicle to know the forces acting on it.
6. Understand safety parameters and emission standard of a vehicle.

Unit 1- Introduction automobile Engineering

Automobile history and development, Classification, vehicle layout- engine location and drive arrangement, safety regulations, specifications of vehicles, Type of vehicle bodies, Chassis types, constructional details, Frames, sub frames, frameless vehicles, vehicle dimensions), details of chassis material, Vehicle life development cycle overview.

Unit II - Suspension System and Brakes

Sprung and unsprung mass, roll center, Types of suspension linkages, Type of springs- leaf, coil, air springs, hydro gas suspension, rubber suspension, interconnected suspension, self-leveling suspension (active suspension), damping and shock absorbers Types of brake systems - drum, disc, Operation- mechanical, hydraulic, air brakes, servo and power braking, Stopping distance, electronic brake force distribution (EBD), ABS.

Unit III - Steering Kinematics

Terminology, definitions – reference frame, toe-in, toe-out, wheel camber, caster and kingpin angle, steeringoffset,Steeringgeometryandtypesofgearbox,powersteering,equivalentmechanisms(front view/sideview),anti-diveandsquatgeometry,rollcenteranalysis,steeringgeometry,error,steering force and moments.

Unit IV- Tire Characteristics

Tire – types, axis system, mechanics of pneumatic tires - tire forces and moments, rolling resistance of tires, tractive (braking) effort and longitudinal slip (skid), cornering properties of tires, performance of tires on wet surfaces, ride properties of tires.

Unit V- Vehicle Performance

Equation of motion and maximum tractive effort, aerodynamic forces and moments, vehicle body moments, roll over, road performance curves, acceleration time and distance, gradability, Parameters,

vehicle resistances, power requirement for propulsion, stability of vehicles, vehicle testing on chassis dynamometer.

Unit VI- Vehicle safety and Standards

Types of active and passive safety, vehicle interior and ergonomics, NVH in automobiles. Types of vehicle maintenance, Electronic Stability Control (ESC), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS), Alternative energy sources.

List of Practical:

1. Vehicle layout of four-wheeler to study the different components.
2. Design of chassis of FSAE using any design software.
3. Demonstration of suspension system of a vehicle.
4. Assembly and disassembly of gearbox.
5. Design and study of steering system of any four-wheeler.
6. Calculation of tire forces and moments.
7. Testing of vehicle parameter using any virtual software.
8. Study of front and rear axle of avehicle.
9. Study of vehicle emission standards.
10. Industrial Visit.

Text Books:

12. Hans Hermann Braess, Ulrich Seiffen, handbook of Automotive Engineering, SAE Publications ISBN-10: 0768007836 ISBN-13:978-0768007831.
13. A Textbook of Automobile Engineering by R.K. RajputISBN : 8170089913,978-8170089919
14. Joseph Heitner, Automotive Mechanics 2013 -C.B.S Publishers and Distributors ISBN-13: 9788176710152.
15. SAE Manuals and Standard.
16. Internal Combustion Engines by V Ganeshan ISBN : 1259006190,978-1259006197
17. Automobile Mechanics -.N. K. Giri ISBN-10: 81-7409-216-1 ISBN-13:978-81-7409-216-1.
18. Automobile Electrical Equipment -P. S. Kohali ISBN-10: 0074602160 ISBN-13: 9780074602164.
19. Narang G. B. S. Automobile Engineering - S. Chand and Company Ltd.
20. Singh Kripal - Automobile Engineering -Volume 2 New Chand Jain. EAN:9788180141775.

Reference Books :

3. Road Vehicle Dynamics – Problems & Solutions, Rao & Dukkipati, SAE ISBN: 0768020514, 9780768020519.
4. Theory of Ground Vehicles, J.Y. Wong, John Wiley & Sons ISBN:978-0-470-170380.
5. Fundamentals of Vehicle Dynamics, T.D. Gillespie, SAE ISBN-13: 978-1560911999.Kalpakjian and Schmid - Manufacturing Engineering and Technology,Prentice Hall, New Jersey,2013

Prepared by: Prof.P.P.Rathod
BOS Member: Dr A R Mache
BOS Chairman:

Open Elective II
Project Planning and Management (IOEUA40183A)

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

Course Objective(s):

1. To impart knowledge of project lifecycle.
2. To introduce students to Project Identification Process, Project Initiation, Pre-Feasibility Study and Project feasibility Studies,
3. To construct CPM, PERT network for a project.
4. To introduce students to Steps in Risk Management, Risk Identification, Risk Analysis and Reducing Risks
5. To introduce students to process of project Performancc Measurement, Evaluation and closeout.

Course Outcomes:

Upon completion of the course, students will be able to

1. Understand what a Project is, Essential of Project Management.
2. Understand the Project Identification Process, Project Initiation, Pre-Feasibility Study and Project feasibility Studies,
3. Apply project planning and controlling techniques.
4. Identify risks in a projcct and strategies for managing the project risks
5. Understand project risk Management and Quality control in a project.
6. Interpret the process of project Performance Measurement, Evaluation and closeout.

Unit I: Basics of Project Management

Introduction,Need,ProjectManagementKnowledgeAreasandProcesses,ConceptofOrganizational Structure and types, The Project Life Cycle (preferably with case study), Essentials Project Management Principles.

Unit II: Project Identification and Selection

Introduction, Project I dentificationProcess,ProjectInitiation,Pre-FeasibilityStudy,FeasibilityStudies, Project Break-even point. Case study is preferred

Unit III: Project Planning and controlling

Introduction, Need for Project Planning, Work Breakdown Structure (WBS), LOB, CPM and PERT, Resource Allocation, Monitoring and Control of project, Crashing, Resource Leveling, Updating

Uuit IV: Project Risk Management

Identifying potential risks in a project, categorizing of project risks, and defining the strategies for managing the project risks

Unit V: Project Monitoring

ProjectmonitoringProgressreporting,reviewmeetingsandreport.Commoncausesofscheduledelays, measuringproductivity,methodsofenhancingproductivity,issueinprojectdelays,Conceptofquality, aspects of quality, quality control and assurance, inspection, preparation of manuals and checklists

Unit IV: Project Performance Measurement, Evaluation and closeout

Introduction, Performance Measurement, Productivity, Project Performance Evaluation, Benefits and Challenges of Performance Measurement and Evaluation, Project Close-out, Steps for Closing the Project, Project Termination, and Project Follow-up. Case study is preferred
Term Work:
Assignments on all units
Textbooks:
1. Operations Research by Premkumar Gupta and D.S.Hira, S. Chand Publications(2014) 2. Project Management – K Nagrajan – New age International Ltd. 3. Project Management – Ahuja H.N. – John Wiely, New York. 4. Project Management-Planning and Control---Rory Burkey 4thed.—Wiley,India.
Reference Books:
1. Project Risk Management - Bruce Barkley- McGraw-Hill, 2004

Open Elective -II
Software Testing (IOEUA40183B)

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

Prerequisites :

- Software Engineering, Java Programming

Course Objectives :

- To study and understand software testing terminologies and framework
- To study and uuderstand the basics of software testing lifecycle
- To study and understand test and defect management
- To study and understand an automation testing
- To study and understand an automation testing tools
- To study and understand automation testing for web application

Course Outcomes :

After completion of the course, student will be able to

1. Understand complete software testing life cycle and various terms and technologies used in testing domain
2. Demonstrate understanding of generating test plan and designing test cases
3. Demonstrate understanding of test and defect management process
4. Demonstrate understanding of automation testing
5. Create test script and execute automated tests using Selenium IDE
6. Create test script and execute automated tests using Test NG Frame work

Unit I: Introduction to Testiug

Why is testing necessary? What is testing? Role of Tester, Testing and Quality, Overview of Software Testing Life Cycle, V model, SDLC vs STLC, different stages in STLC, document templates generated in different phases of STLC, different levels of testing, different types of testing

Unit II: Basics of test design techniques

Static techniques, reviews, walkthroughs, Various test categories, test design techniques for different categories of tests. Designing test cases using MS-Excel.

Unit III: Test and Defect Management

Test Management: Documenting test plan and test ease, effort estimation, configuration management, project progress management. Use of Testopia for test case documentation and test management. **Defect Management** Test Execution, logging defects, defect lifecycle, fixing / closing defects. Use of Bugzilla
for logging and tracing defects.

Unit IV : Basics of Automation testing

Introduction to automation testing, why automation, what to automate, tools available for automation testing.

Unit V : Automation testing using Selenium

Understanding to Selenium, using Selenium IDE for automation testing, using Selenium Web driver for automation testing.

Unit VI :	**Automation testing using Test NG Framework**
Understanding TestNG framework, Automation testing using Test NG Framework.	
Text Books :	
1.	M G Limaye, "Software Testing Principles, Techniques and Tools", Tata Mcgraw Hill, ISBN: 9780070139909 0070139903
2.	Srinivasan Desikan, Gopalswamy Ramesh, "Software Testing Principles and Practices", Pearson, ISBN-10: 817758121X
Reference Books :	
1.	Naresh Chauhan, "Software Testing Principles and Practices ", OXFORD, ISBN-10: 0198061846. ISBN-13: 9780198061847
2.	Dr.K.V.K. Prasad , "Software Testing Tools", Dreamtech Press ISBN: 10:81-7722-532-4

Prepared by: Dr Kirti Wanjale

BOS Member: Dr A P Kulkarni

BOS Chairman:

Open Elective -II
5G Mobile Network (IOEUA40183C)

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

Prerequisite: Students are expected to know the concepts studied in following courses:

- Basics of Analog and Digital Communication
- Basics of Mobile Communication
- Basics of Networking

Course Objectives:

- To understand evolution of 5G technologies with its challenges
- To describe 5G cellular structure and design to achieve appropriate gain
- To discuss fundamentals of 5G functional and physical architecture and its requirements
- To understand design principles for multi-user communications
- To design and interpret the 5g Usecases

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand evolution of 5G technologies with its challenges
2. Interpret the 5G cellular structure and design to achieve appropriate gain
3. Illustrate and explain the 5G functional and physical architecture and its requirements
4. Comprehend the Radio access technology in5G
5. Understand Cooperation in 5G systems and analysis in terms of QOS
6. Design and analysis of 5G Use Cases

Unit- I: Drivers For 5G (6 Hrs)

Historical Trend for Wireless Communication - Mobile Communications Generations: 1G to 4G – Evolution of LTE Technology to Beyond 4G – Pillars of 5G – Standardization Activities -Use cases and Requirements – System Concept – Spectrum and Regulations: Spectrum for 4G – Spectrum Challenges in 5G – Spectrum Landscape and Requirements – Spectrum Access Modes and Sharing Scenarios(R1)

Unit- II: Small Cells for 5G Mobile Network(6 Hrs)

IntroductiontoSmallCells,WiFiandFemtocellsasCandidateSmall CellTechnologies,performance-Indoor and Outdoor, Capacity Limits and Achievable Gains with Densification , Gains with Multi Antenna Techniques, Gains with Small Cells, Demand vs Capacity, Small Cell challenge (R1)

Unit –III: 5G Architecture And Channel Models(6 Hrs)

5G Architecture: Software Defined Networking, Network Function Virtualization , Basies about RAN Architecture ,High-Level Requirements for 5G Architecture ,Functional Architecture and 5G Flexibility ,Physical Architecture and 5G Deployment

5G wireless propagation channel models: Modeling requirements and scenarios, Channel model requirements,Propagationscenarios,TheMETISchannelmodels,Map-basedmodel,Stochasticmodel(R2)

Unit IV : - 5G Radio-Access Technologies and Millimeter wave communication(6 Hrs)

Access design principles for multi-user communications, Multi-carrier with filtering: a new waveform, Non-orthogonal schemes for efficient multiple access, Radio access for dense deployments, Radio access for V2X communication

Millimeter Wave Communication: Channel Propagation – Hardware Technologies for mmW Systems – Deployment Scenarios – Architecture and Mobility – Beam forming – Physical layer Teehniques.

Unit V: Cooperation for Next Generation Wireless Networks(6 Hrs)

Introduction to Cooperative Diversity and Relaying Strategies ,Cooperation and Network Coding, Cooperative ARQ MAC Protocols, PHY Layer Impact on MAC Protocol Analysis ,Impact of Fast Fading and Shadowing on Packet, Reception for QoS Guarantee, Impact of Shadowing Spatial Correlation

Unit VI: 5G Use Cases and Deployment(6 Hrs)

NB-IoT Devices, Smart Parking, Smart City, Smart Home, Message Queue Telemetry Transport (MQTT), MQTT telemetry. NB-IoT Baseline Deployment, Deployment bands and modes

Text Books :

1. Jonathan Rodriguez "Fundamentals of 5G Mobile Networks", Wiley Publication
2. AfifOsseiran, Jose F . Monserrat, Patrick Marsch "5G Mobile and Wireless Communications Technology", Cambridge University Press.
3. Hossam Fattah "5G LTE Narrowband Internet of Things(NB-IoT) ,CRC Press

Reference Books :

1. Fei Hu, "Opportunities in 5G Networks: A research& development perspective", CRC Press
2. Krzysztof Wesolowski, "Mobile Communication Systems", Wiley Student Edition
3. Mischa Schwartz, "Mobile Wireless Communications", Cambridge University Press
4. AdityaJagannatham, "Principles of Modern Wireless Communication Systems"

List of Experiments:

After completion of this course student should be able to

1. NS-3 simulation basics. Basic client server paradigm
2. Study of TCP internals and the difference between each of the variants. NS-3 tracing mechanism
3. Study of Queues, packet drops and their effect on congestion window size
4. Study of Optimised Link State Routing(MANETS)
5. Study of 802.11 working with and without RTS/CTS. An insight into why its hard to setup efficient wireless networks.
6. Study of effect of Radio channel models transmission. An insight into Identifying the channel model that is more appropriate for each case (indoor, outdoor, LoS, NLoS,etc.).

Mm Wave network simulator project implementation

Mini Project/Seminar(SCE)

Open Elective -II
Cloud Computing (IOEUA40183D)

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

Prerequisites : Computer Networks

Course Objectives:

- To understand cloud computing concepts.
- To study supporting technologies of cloud.
- To study open research problems of cloud computing.
- To study various platforms for cloud computing.
- To explore the applications based on cloud computing.
- To study and evaluate the contemporary technologies in cloud computing.

Course Outcomes:

After completion of the course, student will be able to

- Summarize the basic concepts of cloud computing(Remember)
- Explore the supporting technologies of cloud computing(Understand)
- Analyze the challenges and opportunities in the cloud computing(Analyze)
- Use the cloud services for deployment of his own applications(Create)
- How technologies are interrelated and use with each other(Apply)
- To explore future trends of cloud computing(Evaluate)

UNIT 1 - Basics of Cloud Computing

Overview, Applications, Intranets and the Cloud. Your Organization and Cloud Computing- Benefits, Limitations, Security Concerns. Software as a Service (SaaS)- Understanding the Multitenant Nature of SaaS Solutions, Understanding SOA. Platform as a Service (PaaS)-IT Evolution Leading to the Cloud, Benefits of Paas Solutions, Disadvantages of PaaS Solutions. Infrastructure as a Service (IaaS)-Understanding IaaS, Improving Performance through Load Balancing, System and Storage Redundancy

Case Study: Google Cloud Platform

UNIT II – Virtualization

Implementation Levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Types of

Hypervisors, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation. Common Standards: The Open Cloud Consortium, Open Virtualization Format. Standards for Security. Case study : Virtual Box, vmware
UNIT III - Data Storage and Security in Cloud
Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo Cloud data stores: Datastore and Simple DB Cloud Storage-Overview, Cloud Storage Providers. Case study: Firebase. Securing the Cloud- General Security Advantages of Cloud-Based Solutions, Introducing Business Continuity and Disaster Recovery. Disaster Recovery- Understanding the Threats. Case study: Discuss research problems of cloud security
UNIT IV - Amazon Web Services
Services offered by Amazon Hands-on Amazon, EC2 - Configuring a server, Virtual Amazon Cloud, AWS Storage and Content Delivery Identify key AWS storage options Describe Amazon EBS Creating an Elastic Block Store Volume Adding an EBS Volume to an Instance Snap shooting an EBS Volume and Increasing Performance Create an Amazon S3 bucket and manage associated objects. AWS Load Balancing Service Introduction Elastic Load Balancer Creating and Verifying Elastic Load Balancer.
UNIT V - Ubiquitous Clouds and the Internet of Things
Introduction to Ubiquitous computing, Cloud Trends in Supporting Ubiquitous Computing, Performance of Distributed Systems and the Cloud, Enabling Technologies for the Internet of Things (RFID, Sensor Networks and ZigBee Technology, GPS), Innovative Applications of the Internet of Things (Smart Buildings and Smart Power Grid, Retailing and Supply-Chain Management)
UNIT V1 -Future of Cloud Computing
Docker at a Glance: Process Simplification, Broad Support and Adoption, Architecture, The Docker Workflow. Docker compose file, Docker volume, Docker storage. Kubernetes : introduction to Kubernetes, Features of Kubernetes, Kubernetes API, Basic Architecture, Minikube.

Open Elective -II
Solar and Wind Energy (IOEUA40183E)

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

Prereqnisite: Basic Mechanical Engineering, Basic Electrical and Eleetronics Engineering and Heat Transfer

Course Objectives:

- To understand fundamentals of solar and wind energies.
- To understand constructions, working principle and design proccdure of solar and wind power plants.
- To apply basic engineering principle to design a simple solar and wind power system.

Course Outcomes:

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

1. Understand solar radiation and geometry principles.
2. Apply specifications of Solar Cell for different applications.
3. Recognize design process of solar pv system for domestic purpose.
4. Enumerate Wind Data for site selection.
5. Interpret types of Wind Plant for a given application.
6. Design miniature Mini/ Micro wind mill for Residential purpose.

Unit I : Solar Energy Basics

Present solar energy scenario in India, governing bodies (self-study), solar radiations and its measurements, solar constant, solar radiation geometry, solar radiation data, estimation of average solar radiation, solar radiation on tilted surface.

Unit II: Solar Cell Operation

Solar Spectrum, Solar Radiation Spectrum, Worked Problem - Total Irradiance, Solar Cell Fundamentals, Worked Problem - The I-V Characteristic, Solar Cell Types and Technologies, Multi-junctions. Conversion Efficiency Limitations, Worked Problem - Solar Cell under Concentration, From Cell to Module, Energy Audit of Home/Residence

Unit III: Design of Solar PV Systems

PVSizingandOutput,OrientationandTilt,TemperatureDependentOutput,TemperatureDependent Output as a Percent, Module and array conditions, Shading calculations using PV Watts, PV Sizing and output under different conditions, Inverter Sizing and Selection, Case Studies

Unit IV: Wind Energy and its assessment

Wind power scenario in India, Characteristics of Wind Energy: Wind movement, wind profile, roughness, effects of obstacles in wind path. wind data and site selection considerations, Comparison with Solar Energy, Types of Wind Turbine Blades, Blade Profile

Unit V: Wind Power Plants

Types of Wind Power Plants (WPPs): Small and large wind turbines; Horizontal and Vertical axis; Upwind and Downwind, One, Two and Three blades; constant and variable Speed; Geared, Direct-Drive and Semi-Geared (Hybrid) WPPs; WECS, WEGs, WTs, WPPs,
WPP Tower Types: Lattice; tubular: steel, concrete, hybrid, ladders, cables
WPP substation: Switchgear, transformers, electronic components.

Unit VI: Design and Control Aspects of Wind Mill/Plant

Design: horizontal and vertical axis wind turbines, blades, control mechanisms, drive train, tower, nacelle, foundation, choice of materials, manufacture, adaptation to different climates
Control: control targets, system modelling, control strategies (pitch and stall regulation), hardware
Systems: wind power parks, transports, erection, grid connection, operation, maintenance

List of Practical:

1: Design of solar food drier for domestic purpose referring existing system.

2: Measurement of Solar Insolation at Residence.

3: Design of Solar Pump for Farm Irrigation.

4: Design of solar photovoltaic system for domestic/ commercial building purpose.

5. Design of Solar Operated homeappliance.

6. Case study on designing miniature wind mill for domestic purpose referring existing system.

7. Visit to Solar PV System/wind power system used in commereial building.

Text Books:

1. S. P. Sukhatme, 'Solar Energy: Principles of thermal collections and storage', McGraw Hill
2. G. D. Rai, 'Non-Conventional Energy Sources', KhannaPublisher
3. Tiwari G N. 'Solar Energy: Fundamentals, design, modeling and Applications', Narosa,2002

Reference Books :

1. Mukund R. Patel, 'Wind And Solar Power Systems: Design, Analysis andOperation, Second Edition', CRC Press
2. Kreith And Kreider, Solar Energy Handbook, McGraw Hill
3. Ray Hunter, 'Wind Energy Conversion: From Theory to Practice', John Wiley and SonLtd
4. Gary L Johnson, 'Wind Energy Systems', Prentice-Hall Inc., New Jersey
5. Martin O L Hansen, 'Aerodynamics of Wind Turbines', James &James/Earthscan.
6. Goswami D Y, Kreith F, Kreider J F, 'Principles of Solar Engineering', Taylor &Francis
7. Robert Gasch, 'Wind Power Plant Fundamentals, Design, Construction And Operations', Springer
8. C S Solanki, 'Solar Photovoltaic: Fundamentals, Technology And Applications', PHI Learning

Prepared by: Prof.A.D Kale

BOS Member: Dr S S Kore

BOS Chairman:

Open Elective -III
Business Analytics (IOEUA40184F)

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

Prerequisites :

- Database Management System

Course Objectives :

- To study and understand the importance of Business Intelligence and need of data Visualisation for Business Intelligence.
- To study and understand the different components of analytics landscape and project cycle aligned with these components.
- To study and understand different data transformations, data modelling steps and visualize the data on the data models.
- To study and understand the ways of adding custom calculations needed and understanding the applications of different statistical concepts.
- To study and understand the BI deployments, administration cycle of BI implementations using Power BI
- To study and understand various topics and concepts in the areas of analytics and their industrial applications through study of different use cases.

Course Outcomes :

After completion of the course, student will be able to

1. Describe the importance of Business Intelligence and need of data visualisation for Business Intelligence.
2. Identify, deseribe, relate to the concepts of different components of analytics landscape and project cycle aligned with these components.
3. Design and develop different data transformations, data models, analyse and visualize the data.
4. Design and develop custom calculations based on business and technical needs and demonstrate and implement different statistical concepts.
5. Author BI deployments, BI environments.
6. Describe and compare industrial BI implementations, use cases and current and future trends.

Unit I:	**Introduction to Analytics and Data Preparation**
Introduction to Analytics: What is Analytics? Need of Analytics, Types of Analytics, Role of Analytics in Business **Data Sources:** Data Collection, Transactions Entry, Organizational Systems, Data Sources and Data Source Categories, Issues in Data and Need of Data Preparation **Power BI Desktop:** Need of visualisation, Different Visualisation tools, Why Microsoft Power BI Installation and configuration of Power BI Desktop, Setup of required connector **Data Visualization:** What are KPIs Dashboards, Reports and Scorecards, Types of Dashboards, Slicers and Filters, Setting interactivity, Drilldowns and Drill-through, Formatting your visualizations, Best practices of visualizations	
Unit II:	**Data& BI Landscape and Project Cycle**
Understanding Data and Databases: What is a database? What is a DBMS? What is SQL? What are tables? Organization of tables in databases, Types of Data, Database Keys, Relationships between tables, Joins and Unions, Type of Data: Structured, Unstructured and Semi-structured **BI Architecture:** BI Architecture, Data Security and Governance, Administration **BI Project Lifecycle:** Requirements Understanding, Data Understanding, Data Integration and Data warehouse, Reporting and Analysis, Dashboard development, Deployment, Documenting, Project Team and Roles, Challenges in Projects	
Unit III:	**Data Preparation and Data Modelling**
Data Integration and Data Warehouses: What is Data Integration? Need of Data Integration, ETL, what is Data Warehouse? Need of Data Warehouse, Facts and Dimensions Star Schema and Snowflake Schema, Data Marts **Need of Data Preparations:** What is Data Preparation? Joining data, Appending Data, New Calculations, Removing Inconsistencies, Transposing **Data Transformation [Basics]:** Merging and Appending Data, Filtering, Cleaning Data, Fixing Errors, Transforming Data, Aggregating Data **Data Modelling:** Setting Relationships, Creating Data Models	
Unit IV :	**Custom Calculations And Analytics**
Data Transformations [Advanced]: Pivot/Unpivot data, Split data, Handling inconsistent data, Conditional Column, Custom column **Calculations:** Introduction to DAX, Calculated Column, Calculated Measures, M-Query calculations, YTD, QTD, MTD calculations, Moving Averages and Running Total **Statistical Analysis:** Central Tendency: Mean, Mode, Median, Dispersion: Variance and Standard Deviation, Summarization data by using histogram	
Unit V :	**Power BI Deployment, Administration And Mobility**
Power BI Deployment: Overview of Power BI Service, Publishing reports to Power BI Service, Understanding the Power BI Service User Interface, Creating Dashboards in Power BI Service, Subscriptions, Comments and Data Driven Alerts, authoring reports within Power BI Service, sharing dashboards across your organization, Configuring Power BI Gateway, scheduling automated refresh of your reports using Data Gateway	

Power BI Mobile: Creating Dashboards for Mobiles, using dashboards and reports using Mobile App **Power BI Advanced Features:** Using NLP to creating dashboards, Influencers, Delivering Insights, Explain Analysis		
Unit VI :	**Industry Analytics Landscape**	
Tableau Overview: Introduction to Tableau, Tableau Products, Tableau architecture, Installation and Setup of Tableau Desktop, Visualizing with Tableau, Tableau online and Tableau server, Publish and share reports on Tableau online **Applications of Business Intelligence:** Manufacturing Use Cases, Retail Use Cases, Marketing use Cases, Banking use cases, Future Trends of Analytics		
Text Books :		
	1	"Business Intelligence Guidebook: From Data Integration To Analytics" by Rick Sherman, Elsevier Inc.
	2	"Successful Business Intelligence, Second Edition: Unlock The Value Of BI & Big Data" by Cindi Howson, McGraw Hill Edition
	3	"Data Analytics For Beginners: Your Ultimate Guide To Learn And Master Data Analysis. Get Your Business Intelligence Right – Accelerate Growth And Close More Sales" by Victor Finch
	4	Data Strategy: How To Profit From A World Of Big Data, Analytics And The Internet Of Things" by Beruard Marr, Koganpage Publicaitons, Auva Press
Reference Books :		
	1	"Performance Dashboards – Measuring, Monitoring, And Managing Your Business" by Wayne Eckerson, John Wiley & Sons, Inc
	2	"Business Intelligence Roadmap: The Complete Project Lifecycle For Decision-Support Applications" by Larissa T. Moss & Shaku Atre, Addison-Wesley information Technology Series
	3	"Artificial Intelligence: Building Intelligent Systems" by Dr. Parag Kulkami, Dr. Prachi Joshi, PHI publication (for understanding of concepts)

List of Assignments:

1	Creating multiple sample tables and joining them in Power BI
2	Connecting to data source and transforming data in Power BI
3	Connecting to data source and creating data models by establishing relationships
4	Connecting to data source and visualizing and analysing data
5	Connecting to data source and creating custom calculations
6	Deploying the dashboards and reports to Power BI Service
7	Administering and using advanced features of Power BI Service
8	Creating Mobile layouts in Power BI Desktop

Prepared by:

BOS Member:

BOS Chairman:

Open Elective -III
Quantum Computing (IOEUA40184B)

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

Prerequisites :

- Data Structures and Algorithms, Programming in Python / C#, Machine Learning and Data ScienceBasics,NeuralNetworksandDeepLearningBasics,InformationTheoryandModels of Computation, Classical Fourier Transform

Course Objectives :

- To provide introduction and necessary expertise to the learner in the upcoming discipline of Quantum Computing and Machine Learning.
- ToenablethestudentstolearnQuantumComputingandQuantumMachineLearninginpractical-oriented learning sessions so that he/she can independently use existing open-source Quantum Computing Hardware and Software Frame works.
- To teach the students to develop hybrid solutions by applying Quantum Machine Learning to potential business application areas.
- To study Quantum Information Theory and Quantum Computing Programming Model of Computation.
- To study Quantum Algorithms and apply these to develop hybrid solutions.
- TostudyQuantumConceptsnecessaryforunderstandingtheQuantumComputingParadigmand comparetheavailablehardwareandsoftwareinfrastructureandframeworksmadeavailableopen source by major players in the Industry andAcademia.

Course Outcomes :

After completion of the course, student will be able to

1. ExplaintheworkingofaQuantumComputingprogram,itsarchitectureandprogrammingmodel.
2. Develop quantum logic gate circuits.
3. Develop quantum algorithm(s).
4. Program quantum algorithm on major toolkits.
5. Develop Hybrid Solutions in Quantum Machine Learning for potential applications / use cases.
6. Compare existing features provided by potential hardware and software infrastructure and frameworks service providers.

Unit I:	**Introduction to Quantum Computing** (6 hours)
Motivation for studying Quantum Computing, Major players in the industry (IBM, Microsoft, Rigetti, D-Wave etc.), Origin of Quantum Computing, Overview of major concepts in Quantum Computing, Qubits and multi-qubits states, Bra-ket notation, Bloch Sphere representation, Quantum Superposition, Quantum Entanglement	
Unit II:	**Mathematical Foundation of Quantum Computing** (4 hours)
Matrix Algebra: basis vectors and orthogouality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, Dirac notation, Eigen values and Eigenvectors.	
Unit III:	**Building Blocks for Quantum Program** (8 hours)
ArchitectureofaQuantumComputingplatform,HybridApproachforApplicationDevelopment,Details ofq-bitsystemofinformationrepresentation:BlockSphere,Multi-qubitsStates,Quantumsuperposition of qubits (valid and invalid superposition), Quantum Entanglement, Useful states from quantum algorithmic perspective e.g. Bell State. Operation on qubits: Measuring and transforming using gates, Quantum Logic gates and Circuit: Pauli, Hadamard, phase shift, controlled gates, Ising, Deutsch, swap etc., Programming model for a Quantum Computing Program, Steps performed on classical computer, Steps performed on Quantum Computer, Moving data between bits and qubits, Models of Computation used by key players as OEMs in QuantumComputing	
Unit IV :	**Quantum Algorithms (8 hours)**
Basic techniques exploited by quantum algorithms, Amplitude amplification, Quantum Fourier Transform, Phase Kick-back, Quantum Phase estimation, Quantum Walks, Major Algorithms, Shor's Algorithm, Grover's Algorithm, Deutsch's Algorithm, Deutsch -Jozsa Algorithm, OSS Toolkits for implementing Quantum program, IBM quantum experience. Microsoft Q#, RigettiPyQuil (QPU/QVM) OR Cambridge Quantum Computing, Google's Tensorflow Quantum, Amazon Bracket, D-Wave Frameworks	
Unit V :	**Machine Learning and Deep Learning (6 hours)**
Machine Learning, Deep Learning and Artificial Intelligence Basics, Machine Learning Algorithms, Deep Learning Algorithms, Evolutionary Learning Algorithms	
Unit VI :	**Quantum Machine Learning (10 hours)**
Quantum Machine Learning and Quantum AI, Quantum Neural Networks, Quantum Natural Language Understanding, Quantum Cryptography, Application Domains for Quantum Machine Learning: Chemistry/Material Science, Space Tech, Finance related Optimisation Problems, Swarm Robotics, Cybersecurity	

Text Books:		
	1	Quantum Machine Learning (What Quantum Computing Means to Data Mining) by Peter Wittek, University of Boras, Sweden - Elsevier Publications
	2	Principles of Quantum Artificial Intelligence by Andreas Winchert, Instituto Superior Técnico - Universidade de Lisboa, Portugal - World Scientific Publishing, British Library Cataloguing-in-Publication Data
Reference Books :		
	1	Michael A. Nielsen, "Quantum Computation and Quantum Information", Cambridge University Press.

	2	David McMahon, "Quantum Computing Explained", Wiley
	3	IBM Quantum Experience: https://quantumexperience.ng.bluemix.net https://quantum-computing.ibm.com/docs/
	4	Microsoft Quantum Development Kit https://www.microsoft.com/en-us/quantum/development-kit
	5	Forest SDK PyQuil: https://pyquil.readthedocs.io/en/stable/
	6	Amazon Bracket Documentation on AWS: https://aws.amazon.com/braket/
	7	D-Wave Systems Documentation: https://docs.dwavesys.com/docs/latest/index.html

Prepared by:

BOS Member:

BOS Chairman:

Open Elective -III
Business Intelligence (IOEUA40184C)

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

Prerequisites :

- Database Management System

Course Objectives :

- To study and understand the importance of Business Intelligence and need of data Visualisation for BusinessIntelligence.
- To study and understand the different components of analytics landscape and project cycle aligned with thesecomponents.
- To study and understand different data transformations, data modelling steps and visualize the data on the datamodels.
- To study and understand the ways of adding custom calculations needed and understanding the applications of different statisticalconcepts.
- To study and understand the BI deployments, administration cycle of BI implementations using Power BI
- To study and understand various topics and concepts in the areas of analytics and theirindustrial applications through study of different usecases.

Course Outcomes :

After completion of the course, student will be able to

7. Describe the importance of Business Intelligence and need of data visualisation for Business Intelligence.
8. Identify, describe, relate to the concepts of different components of analytics landscape and project cycle aligned with thesecomponents.
9. Design and develop different data transformations, data models, analyse and visualize thedata.
10. Design and develop custom calculations based on business and technical needs and demonstrate and implement different statisticalconcepts.
11. Author BI deployments, BIenvironments.
12. Describe and compare industrial BI implementations, use cases and current and futuretrends.

Unit I:	**Introduction to Analytics and Data Preparation**
Introduction to Analytics: What isAnalytics?Need of Analytics, Types of Analytics, Role of Analytics in Business **Data Sources:** Data Collection, Transactions Entry, Organizational Systems, Data Sources and Data Source Categories, Issues in Data and Need of Data Preparation **Power BI Desktop:** Need of visualisation, Different Visualisation tools, Why Mierosoft Power BI?Installation and configuration of Power BI Desktop, Setup of required connector **Data Visualization:** What are KPIs?Dashboards, Reports and Scorecards, Types of Dashboards, Slicers and Filters, Setting interactivity, Drilldowns and Drill-through, Formatting your visualizations, Best practices of visualizations	
Unit II:	**Data& BI Landscape and Project Cycle**
Understanding Data and Databases: What is a database? What is a DBMS? What is SQL?What are tables?Organization of tables in databases, Types of Data, Database Keys, Relationships between tables, Joins and Unions, Type of Data: Structured, Unstructured and Semi-structured **BI Architecture:** Bl Architecture, Data Security and Governance, Administration **BI Project Lifecycle:** Requirements Understanding, Data Understanding, Data Integration and Data warehouse, Reporting and Analysis, Dashboard development, Deployment, Documenting, Project Team and Roles, Challenges in Projects	
Unit III:	**Data Preparationand Data Modelling**
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Unit IV :	**Custom Calculations And Analytics**
Data Transformations [Advanced]: Pivot/Unpivot data, Split data, Handling inconsistent data, Conditional Column, Custom column **Calculations:** Introduction to DAX, Calculated Column, Calculated Measures, M-Query calculations, YTD, QTD, MTD calculations, Moving Averages and Running Total **Statistical Analysis:** Central Tendency: Mean, Mode, Median, Dispersion: Variance and Standard Deviation, Summarization data by using histogram	
Unit V :	**Power BI Deployment, Administration And Mobility**
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Power BI Advanced Features: Using NLP to creating dashboards, Influencers, Delivering Insights, Explain Analysis		
Unit VI :	**Industry Analytics Landscape**	
Tableau Overview: Introduction to Tableau, Tableau Products, Tableau architecture, Installation and Setup of Tableau Desktop, Visualizing with Tableau, Tableau online and Tableau server, Publish and share reports on Tableau online **Applications of Business Intelligence:** Manufacturing Use Cases, Retail Use Cases, Marketing use Cases, Banking use cases, Future Trends of Analytics		
Text Books :		
	1	"Business Intelligence Guidebook: From Data Integration To Analyties" by Rick Sherman, Elsevier Inc.
	2	"Successful Business Intelligence, Second Edition: Unlock The Value Of BI & Big Data" by Cindi Howson, McGraw Hill Edition
	3	"Data Analytics For Beginners: Your Ultimate Guide To Learn And Master Data Analysis. Get Your Business Intelligence Right – Accelerate Growth And Close More Sales" by Victor Finch
	4	Data Strategy: How To Profit From A World Of Big Data, Analytics And The Internet Of Things" by Bernard Marr, Koganpage Publicaitons, Auva Press
Reference Books :		
	1	"Performance Dashboards – Measuring, Monitoring, And Managing Your Business" by Wayne Eckerson, John Wiley & Sons, Inc
	2	"Business Intelligence Roadmap: The Complete Project Lifecycle For Decision-Support Applications" by Larissa T. Moss & Shaku Atre, Addison-Wesley information Technology Series
	3	"Artificial Intelligence: Building Intelligent Systems" by Dr. Parag Kulkarni, Dr. Prachi Joshi, PHI publication (for understanding of concepts)

List of Assignments:

1	Creating multiple sample tables and joining them in Power BI
2	Connecting to data source and transforming data in Power BI
3	Connecting to data source and creating data models by establishing relationships
4	Connecting to data source and visualizing and analyzing data
5	Connecting to data source and creating custom calculations
6	Deploying the dashboards and reports to Power BI Service
7	Administering and using advanced features of Power BI Service
8	Creating Mobile layouts in Power BI Desktop

Prepared by:

BOS Member:

BOS Chairman:

Open Elective -III
Robotics (IOEUA40184A)

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

Prerequisite: NA

Course Objectives:

- To acquire basic understanding of Industrial Robots and its technological applications
- To understand peripherals of Robotic system and their use.

Course Outcomes:

Upon completion of the course, students will be able to

1. Recognize and differentiate between different types of Robots, and their features.
2. Understand industrial applications of Robots.
3. For the given industrial application students will be capable of selecting the appropriate Robot considering all the parameters.
4. Understand different concepts related to industrial Robotics like Robot programming methods, end effectors, sensors, actuators etc.

Unit I: Fundamental of Robotics

Evolution of Robots, Types of Robots, Reason behind use of Robot, Robot Uses cases, Advantages of Robot, Disadvantages of Robot, Defining Robot, Laws of Robotics, Future of Robot.

Unit II: Performance Specifications of Industrial Robots

DOF of Robot, Joints and Links in Robot, Singularity in Robots, Industrial Applications of Robot, Selection parameters and Robot Specification.

Unit III: Insight Industrial Robot

Actuators: Pneumatic, Hydraulic and Electric, Brakes, Transmission, Gears, Soft limits and Hard Limits. Controller, Teach Pendant, End Effectors, Fixtures, Pneumatic System, Communication between System Peripherals.

Unit IV: System Peripherals

Controller, Teach Pendant, End Effectors, Field Sensors, Fixtures, Communication between System Peripherals, Pneumatic System, PLC, SCADA, IIOT.

Unit V: Robot Programming

Robot Programming Concepts, Programming Methods, Offline Programming, Programming Languages, Program Organization, Writing Robot Program of Instructions, Robot Simulation, Coordinate Systems.

Unit VI: Social Issues Related to Robotics
Reasons for installing Robots, Economic costs and benefits of installing industrial Robots, AcceptabilityofindustrialRobotsbytheworkforce,EmploymentandOthersocialissuesofRobotics.
Text/Reference Books :
1. Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta,"Industrial Robotics, Technology programming and Applications", McGraw Hill,2012. 2. Craig. J. J. "Introduction to Robotics- mechanics and control", Addison- Wesley,1999. 3. Saeed B. Niku, " Introduction to Robotics – Analysis, Systems and Application" : PHI2006 4. D J Todd, "Fundamentals Of Robot Technology" Kogan Page,1986
Practical :
1. System Peripherals 2. Jogging in Different Modes and their Differences 3. Path Planning 4. Robot Programming

Extended Support from iRobotics:

1. **Internship:** After the conductiou of subject, iRobotics may provide an internship opportunity to some students subject to vacancy and eligibility.
2. **Project Assistance:** iRobotics will provide the project assistance to some students group in Robotics and Automation.

Lecturers:

I. PranavLad : Head, Research and Development Department,iRobotics

2. SopanKadam : Senior Robotic Engineer, Application Department,iRobotics

3. RohitEkatpure : Senior Robotics Engineer, Proposal Department,iRobotics

Intellectuai Property Rights (MEUA40185)

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

Course objectives:

- The course is designed to introduce fundamental aspects of Intellectual property Rights.
- The course introduces all aspects of the IPRActs.
- It also includes case studies to demonstrate the application

Course outcomes:

Upon completion of course, students will be able to

1. Demonstrate and develop awareness and impact of patent law on their academics and professional life.
2. Understand the procedure of patent filing.
3. Understand and aware importance of trade mark in industry.
4. Apply knowledge to read the patent document.

Unit 1: Overview of Intellectual Property

Introduction and the need for intellectual property right (IPR) IPR in India – Genesis and Development IPR in abroad Some important examples of IPR

Unit II : Patents

Macro economic impact of the patent system, Patentability, Types of IP tools, Copyright, trademarks, Patent databases, Patent document and its search, Rights of a patent,

Unit III : Patent Search

Searchingapatent,Patentdatabase,Patentfreedatabase.Patentstructure,PatentgrantsProcedureinIndia, Different layers of the international patent system (National, Regional and international options). Copyright- Definition of copyright, Content of copyright, What are related rights, Rights covered by copy right.

Unit IV : Trademark

Definition of trademark, Rights of trademark, Kind of signs can be used as trademarks, Types of trademark function, Protection of trademark, Trademark registration.

Text Books :

1. Resisting Intellectual Property by Halbert ,Taylor & Francis Ltd,2007
2. Industrial Design by Mayall, McGrawHill
3. Intellectual Property Rights Under WTO by T. Ramappa, S.Chand
4. Encyclopedia of Ethical, Legal and policy issue in Biotechnology by T. M. Murray andM. J. Mehlman, John Wiley and Sons 2000.

Reference Books :

1. Nanotechnology Intellectual Property Rights: Research, Design, and Commercializationby Dr. S. K. Jabade, CRCPress
2. Product Design by Niebel, McGrawHill
3. Introduction to Design by Asimov, PrenticeHall
4. Intellectual Property in New Technological Age by Robert P. Merges, Peter S. Menell,Mark A. Lemley

Prepared by: Dr. D.A.Kamble

BoS Member: Dr S S 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

Project Work (MEUA40186)

Teaching Scheme	Examination Scheme						
Credits : 5	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L) : -- hrs./week Tutorial (T): --hr. Practical (P): 10 hrs./week	100	-	-	-	50	-	150

Prerequisite: All Mechanical Engineering Subjects till semester VI

Course objectives:

To train the students to apply their engineering knowledge to real life problem solving. And to plan. implement and execute project work to satisfy the stated objectives of the project

Course Outcomes:

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

1. Identify and formulate the problem related to mechanical engineering based on literature survey
2. Apply concepts and modern engineering tools to design the solution for identified problem
3. Develop a system, component or process to meet desired needs considering the standards and codes
4. Prepare a plan of activities according to the time frame and budget
5. Prepare and present technical report.
6. Work in a group as a part of multidisciplinary team with professional responsibility.

The students in a group of not more than FOUR will work under the guidance of the faculty member on the project work undertaken by them. The completion of work, the submission of the report and assessment should be done at the end of BE semester I/II.

The project work could be of the following nature:

- Design/development and Fabrication of models. Machines and prototypes based on new ideas, robotic and automation systems, Experimental set ups. Test rigs equipment.
- Thermal Systems
- Energy audit conservation studies
- Extensive computational analysis of problems relevant to mechanical engineering.
- CAD/CAM/CAE
- Modeling/simulationofproduct(s).mechanism(s)orsystem(s)anditsvalidationorcomparison with available bench mark results

A report containing maximum 50 pages shall be submitted based on the project. Report should contain following points:

- Background, need and scope of the project,
- Project specifications,
- Activities involved in the project and activity plan.
- Study of literature and basic theory.

Prepared by: Prof. P.R. Anerao

BoS Member: Dr A P Kulkarni

BoS Chairman: Dr D N kamble

Professional Elective-VI
Power Plant Engineering (MEUA42181A)

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

Pre-Requisites: Thermodynamics and Heat Transfer

Course Objectives:

1. To study the power generation scenario, the components of thermal power plant, improved Rankin cycle, Cogeneration cycle
2. To understand details of steam condensing plant, analysis of condenser, the an environmental impacts of thermal power plant, method to reduce various pollution from thermal powerplant
3. To study layout, component details of hydroelectric power plant, hydrology and elements , types of nuclear powerplant
4. To understand components; layout of diesel power plant , components; different cycles ; methods to improve thermal efficiency of gas powerplant
5. To study the working principle , construction of power generation from non-conventional sources ofenergy
6. To learn the different instrumentation in power plant and basics of economics of powergeneration.

Course Outcomes:

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

1) Understand the power generation scenario, the layout components of thermal power plant and analyze the improved Rankin cycle, Cogeneration cycle
2) Analyze the steam condensers, recognize the an environmental impacts of thermal power plant and method to control the same
3) Recognize the layout, component details of hydroelectric power plant and nuclear power plant
4) Realize the details of diesel power plant, gas power plant and analyze gas turbine power cycle
5) Emphasize the fundaments of non-conventional power plants
6) Understand the different power plant electrical instruments and basic principles of economics of power generation.

Unit 1 - Thermal Power Plant

Introduction: General layout of modern power plant with different circuits, working of thermal power plant, coal classification and its CV, high pressure boilers (Latest three), Rankine cycle with reheat and regeneration (Separate Numerical with Mollier Diagram) , Cogeneration power plant (with numerical

Unit 2 Steam Surface Condenser and Cooling Tower

Steam Condenser: Necessity of steam condenser, Classification, Cooling water requirements,

Condenser efficiency, Vacuum efficiency,(Numerical) Cooling towers (Performance Parameters), air Leakage, Effects of Air Leakage on condenser performance, (Numerical Treatment)

Unit 3 – Hydroelectric Power Plant:

Introduction, Site Selection, Advantages and Disadvantages of HEPP,
Hydrograph, Flow duration curve, (Numerical) Mass Curve, Classification of HEPP with layout.
Nuclear Power Plants: Elements of NPP, Nuclear reactor & its types, fuels moderators, coolants, control rod, classification of NPP, N-waste disposal (No Numerical)

Unit 4 - Gas Turbine Power Plant

Layont of Gas Turbine Power Plant with Important Systems, Brayton Cycle analysis, Thermal Efficiency, Work ratio, maximum & optimum pressure ratio, Isentropic Efficiency of Compre-ssor and Turbines, Inter-cooling, reheating, & regeneration cycle, (Separate Numerical) Combined power cycle plant. Layout of Diesel Power Plant/ DGSet

Unit 5 - Non-Conventional Power Plants

Wind Power Plant: Introduction, wind availability measurement, types of wind machines, site selection, and wind power generation.
Solar Power Plant : Low & High Temperature Solar Power Plant, Photovoltaic Power System (Case Study), Heliostat, Challenges in commercialization of Non-Conventional Power Plants.

Unit 6 Power Plant Instrumentation

Generator, Transformers, Exciters, Switch Gear, Circuit breakers, Protective Devices and Control Systems, Boiler Instrumentation and Control

Term-Work

The Term-Work shall consist of any eight experiments

1) Study of High Pressure boilers.
2) Visit to thermal Power plant /Co-generation Power plant to understand layoutand specifications of main components.
3) Visit to any Non-Conventional Power Plants.
4) Trial on steam power plant.
5) Simulated performance of Steam Power plant with suitable software.
6) Simulated performance of Gas Turbine Powerplant.
7) Trial on Diesel Power Plant to understand performance parameters by Graphs.
8) Power plant Instrumentation.

Case study on Solar/Wind with numerical or suitable software.

Text Books

1) P.K.Nag,—Power PlantEngineering I,McGrawHillPublicationsNewDelhi.
2) Mahesh M Rathore, - Thermal Engineering, Tata McGraw Hill, New Delhi
S.P.Sukhatme,—SolarEnergy‖TataMcGraw-HillPublications,NewDelhi(Latest Edition)

Reference Books :

1. Domkundwar&Arora,—PowerPlantEngineering‖,DhanpatRai&Sons,NewDelhi.
2. R.K.Rajput, —Power Plant Engineering‖, Laxmi Publications NewDelhi.
3. R.Yadav,—Steam and Gas Turbines‖, Central Publishing House, Allahabad.
4. Cengel Boles, Thermodynamics An Engineering approach, The Tata McGraw Hill, New Delhi
5. G.D.Rai, — Non-Conventional Energy Sources‖ Khanna Publishers, Delhi

Professional Elective-VI
Noise Measurement and Control (MEUA42181B)

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

Prerequisite: Applied Mathematics, Theory of Machines ,Dynamics of Machinery, Mechanical Vibrations.

Course Objectives:

1. To know the fundamentals of acoustics and Indian standards of Noise
2. To know the sound absorbing materials and its practical applications.
3. To know the measurement and control techniques of vibration and noise.
4. To understand the effect of noise on human comfort and environment.

Course Outcomes:

Upon completion of the course, students will be able to

1. Apply the knowledge of acoustics in practice.
2. Apply the knowledge of noise measurement techniques.
3. Analyze the sources, effects of noise and vibration.
4. Understand the measurement and control techniques of Vibration and Noise.
5. Enumerate the acoustic material characterization.
6. Illustrate the importance of noise regulation.

Unit 1 : Fundamental of sound

Introduction to Sound, Sound propagation, Quantification of sound- frequency and wave length ,Sound levels and decibels, sound power level sound pressure level, Sound intensity level, Octave & 1/3 octave bands, A weighting, Sound field, Sound reflection ,absorption and transmission - concept & governing equation with correlation of each other, Loudness. Introduction to noise, Noise induced hearing losses.

Unit II: Noise measurement and instrumentation

Noise measuring instruments- microphones, types of microphones Sound pressure measurement, Sound power measurement, Sound intensity measurement , Measurement of sound transmission loss ,sound level meter, sound frequency analyser, noise dosimeter, recorder, calibrators. Sound intensity probes, Acoustic exciters, Data acquisition system, Digital signal processing, sampling, aliasing and resolution.

Unit III: Noise Source Identification and Analysis

Introduction to anechoic chamber and reverberation chamber, , Frequency and order domain analysis, Sound intensity and sound power mapping ,Introduction to array techniques - Acoustic holography & beam forming.

Unit IV: Major source of noise- Automotive and non-Automotive

Major Sources of noise, noise due to construction equipment and domestic applications,InteriorNoiseof Automobiles - Interior noise sources, Structure borne noise, airborne noise. Industrial noise, industrial noise controi- strategies, noise control at the source, noise control at the path, Acoustic barriers, noise controi at the receiver. Active noise control techniques.

Unit V: Passive Noise Treatments

Ducts & Mufflers – Types of mufflers, performance parameters – acoustics and backpressure, Reactive and absorptive silencers and Overall design considerations.
Acoustic Material Characterization–Sound transmission, absorption and damping , Behavior of acoustic material with respect to sound absorption and transmission, Standard methods for evaluating sound absorption coefficient and transmission loss, Types of sound absorbers, Prediction of transmission loss and flanking transmission, Damping materials and their applications.

Unit VI: Noise Regulations

Non auditory and auditory effect noise on human beings, Noisc standards and limits in India, Ambient emission noise standards in India,Hazardousnoiseexposure–legalaspects,Daynightsoundlevel,Noise specificationsforautomotivevehicles–pass-by&stationaryandNoisespecificationsforgeneratorsets, fire crackers and household articles, warning devices.

List of Practical:

1. Measurement of noise parameters like frequency, sound pressure level (dB) of any system by using microphone.
2. Noise Measurement & analysis using appropriate instrument. Analysis of SPL signature using any analysis software package
3. Determination of Airflow resistivity of foam material using Airflow resistivity instrument
4. Determination of sound absorption coefficient of acoustic material by using impedance tube
5. Determination of transmission loss of reactive silencer by using impedance tube.

Assignments:
1) Determination of gear noise-numerical
2) Determination of fan noise-numerical

Text Books:

1. RaoS.S.—MechanicalVibrations‖,PearsonEducationInc.NewDelhi.(ISBN978-0-13-212819-3)
2. GroverG.K.—MechanicalVibrations‖,NewChandandBros.,Roorkee(ISBN-10: 9788185240565)
3. Clarence W. de Silva , "Vibration Monitoring, Testing, and Instrumentation ",CRC Press, 2007(ISBN9781420053197)
4. David A.Bies and Colin H.Hansen "Engineering Noise Control: Theory and Practice"Spon Press, London, 2009 (ISBN0-203-16330-3)
5. C.Sujatha " Vibration and Acoustics : MaGrawhill Publication 2010(ISBN 10:0070148783)
6. M.L.Munjal –" Acoustics of Ducts and Mufflers" Willy publications(ISBN9780471847380)
7. A.G.Ambekar – "Mechanical Vibration and Noise Engineering" PHIpublications.(ISBN. 9788120329003)

Reference Books :

1. Bell,L.H.andBell,D.H.,IndustrialNoiseControl–FundamentalsandApplications‖, Marcel Dekker Inc.(ISBN 10:0824790286)
2. Meirovitch,—ElementsofMechanicalVibrations‖,McGrawHill(ISBN-10:0070413401)
3. Ver,NoiseandVibrationControlEngineering‖,WileyIndiaPvt.Ltd,NewDelhi(ISBN: 978-0-471-44942-3)
4. Bies,D.andHansen,C.—EngineeringNoiseControl-TheoryandPracticel,(ISBN 9781498724050 - CAT#K25710)
5. Kelly S. G. —Mechanical Vibrations—, Schaum_s outlines, Tata McGraw Hill Publishing

Co. Ltd., New Delhi (ISBN 13: 9780070616790)
6. Allan G. Piersol ,Thomas L. Paez "Harris' Shock and Vibration Handbook" , McGraw-Hill , New Delhi, 2010(ISBN:0071508198)
7. William Thomas and Marie Dillon Dahleh-Theory of Vibration with Applications.Pearson Publishing,2007(ISBN-10:013651068)

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 Elective IV
Engineering Economics (IOEUA42182A)

Teaching Scheme	Examination Scheme						
Credits: 3	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 2 hrs./week Tutorial (T): 1 hr/week Practical (P): -hrs/week	20	30	20	30	-	25	125

Prerequisite: Students are expected to know the concepts studied in following courses:

1.Basic Maths

Course Objectives:

- To learn the basics of economics and cost analysis relevant to engineering
- To identify conditions for present worth comparison and future worth comparison and find appropriate solutions for the information challenges.
- To learn and calculate the Rate of interest, different costs and overheads ,profit and loss accounts

Course Outcomes: At the end of this course, students will demonstrate the ability to

1.Understand the economics and cost analysis
2.Compare present worth and future worth
3.Identify rate of return and different taxes
4.Calculate profit and loss

Unit- I: Introduction (6 Hrs)

Engineering and Economics, Law of demand and supply, Theory of the Firm and Market Structure. Basic Macro-economic Concepts (including GDP/GNP/NI/Disposable Income), Law of returns, Interest and Interest factors: Interestrate,Simpleinterest,Compoundinterest,Cash-flowdiagrams,Personalloansand EMI Payment. Price Indices(WPI/CPI),

Unit- II: Present-Worth and Annual Worth Comparisons(6 Hrs)

Present-Worth Comparisons: Conditions for present worth comparisons, Basic Present worth comparisons, Present-worth equivalence, Net Present worth, Future-worth comparison, Pay-back comparison, Exercises, Discussions and problems. Equivalent Annual-Worth Comparison methods, Situations for Equivalent Annual-WorthComparisons,Considerationofassetlife,Comparisonofassetswithequalandunequallives, Use of shrinking fund method.

Unit –III: Rate-Of-Return And Depreciation(6 Hrs)

Rateofreturn,Minimumacceptablerateofreturn,InvestmentAnalysis–NPV,ROI,IRR,PaybackPeriod, Time value of money, Components of costs such as Direct Material Costs, Direct Labor Costs CausesofDepreciation,Basicmethodsofcomputingdepreciationcharges,Taxconcepts,corporateincome tax.

Unit IV: Finance and Banking(6 Hrs)

Statements of Financial Information: Introduction, Source of financial information, Financial statements, Balance sheet, and Profit and Loss account, relation between Balance sheet and Profit and Loss account. Financial Institutions, Finance Commissions, Budget Analysis. Indian Banking, Role of Reserve bank of India International Economy

Text Books :

1 Leland T. Blank and Anthony J. Tarquin , "Engineering Economy" 4th Edition ,McGrawHill Publication.
2 Chan S. Park "Contemporary Engineering Economics", 3rd Edition, PHI Publications.
3 Dr.K.K.Dewett and M. H. Navalur ," Modern Economic Theory" Revised Edition, S Chand Publication.

Reference Books :

1.V. Mote, S. Paul, G. Gupta(2004), Managerial Economics, Tata McGraw Hill
2. Misra, S.K. and Puri (2009), Indian Economy, Himalaya

List of Tutorials:

1. Study of cash flow diagram and interestrates
2. Study of Present worth Comparison
3. Study of Annual worth Comparison
4. Study of Investmen tAnalysis
5. Study of Financial statements and Balance sheet

Open Elective- IV

Computational Biology (IOEUA42182B)

Teaching Scheme	Examination Scheme						
Credits: 3	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 2 hrs./week Tutorial (T): 1 hr/week Practical (P): -hrs/week	20	30	20	30	-	25	125

Prerequisites :	Mathematics
•	
Course Objectives :	
•	To study and understand the concept of information generation from protein sequences, DNA sequences, whole genome.
•	To study information extraction from large databases and Computer modelling
•	To study and understand various elements of computational biology such as genomic networks, algorithms, and models.
•	To design and develop current applications of computational biology.
Course Outcomes :	
	Students will be able to:
1.	Demonstrate the concept of information generation from protein sequences, DNA sequences, whole genome.
2.	Extract information from large databases and to use this information in computer modelling.
3.	Evaluate various elements of computational biology such as genomic networks, algorithms, and models
4.	Design and develop current applications of computational biology.
Unit I:	**Introduction**
MolecularBiologyIntroductiou,Cell,Nucleus,Genes,DNA,RNA,Proteins,AndChemicalstructure of DNA, RNA, Transcription and Translation Process. Protein Structure and Functions, Nature of Chemical Bonds Molecular Biology tools, -- Polymerase chain reaction [6Hrs]	
Unit II:	**Sequence Alignment**
Simple alignments, Gaps, Scoring Matrices, Global and Local Alignments, Smith-Waterman Algorithm, Multiple sequence Alignments, Gene Prediction, Statistical Approaches to Gene Prediction	
Unit III:	**Genome Algorithms**

Genome Rearrangements, Sorting by Reversals, Block Alignment and the Four-Russians Speedup, Constructing Alignments in Sub-quadratic Time, Protein Sequencing and Identification, the Peptide Sequencing Problem		
Unit IV:	**Microarray Data Analysis**	
Microarray technology for genome expression study, Image analysis for data extraction, Data analysis for pattern discovery, gene regulatory network analysis		
Text Books :		
	1	• DanE.Krane,MichaelL.Raymer,"FundamentalConceptsofBioinformatics,",Pearson Education, Inc. Fourth Edition, 9780805346336. •Harshvardhan P. Bal, "Bioinformatics Principles and Applications", Tata McGraw-Hill, seventh reprint, 9780195692303. Reference Books
	2	• Teresa Attwood, David Parry-Smith, "Introduction to Bioinformatics",Pearson Education Series,9788180301971
Reference Books :		
	1	• R. Durbin, S. Eddy, A. Krogh, G. Mitchison., "Biological Sequence Analysis: Probabilistic Models of proteins and nucleic acids", Cambridge University Press9780521629713.,

List of Assignment:

List of lab assignment will be framed by the subject teacher based on theory syllabus.

Open Elective –IV

Software Quality Assurance System (IOEUA42182C)

Teaching Scheme	Examination Scheme						
Credits: 3	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 2 hrs./week Tutorial (T): 1 hr/week Practical (P): -hrs/week	20	30	20	30	-	25	125

Prerequisites : Software Engineering, Java Programming

Course Objectives :

- To study and understand software testing terminologies and framework
- To study and understand the basics of software testing lifecycle
- To study and understand test and defect management
- To study and understand an automation testing
- To study and understand an automation testing tools
- To study and understand automation testing for web application

Course Outcomes :

After completion of the course, student will be able to

1. Understand complete software testing life cycle and various terms and technologies used in testing domain.
2. Demonstrate understanding of generating test plan and designing test cases.
3. Demonstrate understanding of test and defect management process.
4. Demonstrate understanding of automation testing.
5. Create test script and execute automated tests using Selenium IDE.

Unit I:	**Introduction to Testing**
Why is testing necessary? What is testing? Role of Tester, Testing and Quality, Overview of Software Testing Life Cycle, V model, SDLC vs STLC, different stages in STLC, document templates generated in different phases of STLC, different levels of testing, different types of testing	
Unit II:	**Basics of test design techniques**
Static techniques, reviews, walkthroughs, Various test categories, test design techniques for different categories of tests. Designing test cases using MS-Excel.	
Unit III:	**Test and Defect Management**
Test Management: Documenting test plan and test case, effort estimation, configuration management, project progress management. Use of Testopia for test case documentation and test management. **Defect Management** Test Execution, logging defects, defect lifecycle, fixing / closing defects. Use of Bugzilla for logging and tracing defects.	
Unit IV :	**Basics of Automation testing**
Introduction to automation testing, why automation, what to automate, tools available for automation testing. Understanding to Selenium, using Selenium IDE for automation testing, using Selenium Web driver for automation testing.	

List of assignment:

With intent to get some exposure in the software testing domain, students apply Technical, Behavioral, Process concepts learnt in the course by executing near real-life project and working in teams (project teams will ideally comprise of 4 members)

There will be 3 projects:
Project 1: Use of Testopia for test ease management.
The project will consists of test plan, test design for a sample web application and maintaining Requirement Traceability Matrix using the tool

Project 2: Use of Bugzilla for defect management.
The project will include execution of tests designed in previous project, identifying, logging and tracing the defect and maintaining the Requirement Traceability Matrix

Project 3: Use of Selenium for automation testing.
The project will consists of identifying which tests from project 1 can be automated, then creating script for those tests using tool, executing the tests with the help of tool and generating report for the tests cases.

Text Books :

1.	M G Limaye, "Software Testing Principles, Techniques and Tools", Tata Mcgraw Hill, ISBN: 9780070139909 0070139903
2.	Srinivasan Desikan, Gopalswamy Ramesh, "Software Testing Principles and Practices", Pearson, ISBN-10: 817758121X

Reference Books :

1.	Naresh Chauhan, "Software Testing Principles and Practices ", OXFORD. ISBN-10: 0198061846. ISBN-13: 9780198061847
2.	Dr. K. V. K. Prasad , "Software Testing Tools", Dreamtech Press ISBN: 10:81-7722-532-4

Open Elective-IV
Technology and Financial Management (IOEUA42182D)

Teaching Scheme	Examination Scheme						
Credits : 3	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L) :2hrs./week Tutorial (T): --1hr. Practical (P): -- hrs./week	20	30	20	30	-	25	125

Prerequisite: Statistical and quality control

Course objectives:
The rapid strides in competitiveness in global markets, it is felt that successful corporate managers will be those who can take advantage of the growing sophistication of financial markets, cost accounting, management of projects, human resources and quality. To make mechanical engineers a successful corporate manager in their professional career this course is introduced.

Course Outcomes:
By the end of this course, students will
1. Understand the importance of budget and impact of it.
2. Implement various costing techniques.
3. Interpret analysis of engineering economics.
4. Implement various Human Resource and quality management techniques.

Unit 1 - Finance

Definition and scope of finance; Real & financial assets, Investment Decision, Financing decisions, Dividend decisions and liquidity decisions. Long term financing, Primary & secondary capital markets, Role of merchant banking, Types of shares and debentures. Need, sources and functions - Investment banks, portfolio management, Domestic institutional investors, ADB, IMF, World bank and IMF, Importance of finance Methods of capital budgeting, Production, sales, production cost budget and flexible budget along with the numerical problems related to these budgets.

Unit 2 – Costing

Concept of cost center and profit center, Elements of cost with illustrations.
Procedure/Methodology, limitations of absorption costing along with numerical problems.
Marginal costing concept, CVP analysis along with numerical problems, Applications and limitations of marginal costing. Methodology, Recording cost in contracts, value and profit of contract, Profit of incomplete contracts along with numerical problems. Meaning, stages and flow of costs in ABC, classification of activities, advantages and limitations (No numerical problems) Characteristics, procedures, process costing having no opening and closing WIP along with numerical problems.

Unit 3 – Engineering Economic Analysis

Macro and micro economics differences and price theory. Law of demand and supply, Elasticity of demand, Method stomeasureelasticity,Exceptionstothelawofdemandandassumptions.Utility analysis&indifferentcurveanalysis,Marshalianslawofdiminishingmarginalutility,Incomeeffect andsubstitutioneffectLawofproduction,Lawofvariableproportion,Lawofreturntoscalefor

long term production Monopoly, oligopoly, monopolistic and pure competition & their equilibrium Inflation and its effect on business and economy, types Importance of foreign trade & hedging Balance of payments – exchange rates, Fixed and flexible exchange rates

Unit 4 - Human Resource and Quality Management

Definition of HR and personnel management, significance and the differences. Describe the HR manager's role. Objectives, importance & process of manpower planning. Merit rating methods, need and benefits. Need ,importance and method softraining & development. Meaning of retirement and separation, types of separation like VRS, resignation, sacking etc., Meaning and fundamentals of Organizational Behavior (OB), OB models MBO, Process of MBO and benefits. Characteristics of quality, TQM principles and critical processes, TQM cycle, Deming fourteen pointsofQM,PCDA,Jurantenstepstoqualityimprovementandtrilogydiagram ConceptofKaizen Concept and components of JIT, push and pull system, Kanban, Critical success factors in JIT, Application of JIT and JIT cycle Quality management system, ISO – 9001-2000 series, Objectives, principles and categories ISO 14000 family of standards, Benefits of implementing ISO14000.

Tutorial Assignment

Case Study on each unit.

Text Books

1. Pandey, Financial Management, Tata McGraw-Hill publications, New Delhi. ISBN: 812591658X.
2. A.R. Aryasri, Managerial Economics and Financial Analysis, Tata McGraw-Hill Publications, New Delhi. ISBN:0070078033

Reference Books :

1. Prasanna Chandra, Financial Management, Tata McGraw-Hill publications.ISBN:0070656657
2. Jawaharlal, Cost Accounting, Tata McGraw-Hill publications, New Delhi. ISBN:0070221626.
3. K. K. Dewett. Modern Economic Theory, S. Chand publications, New Delhi. ISBN: 8121924634.
4. J. Juran, Juran's Quality handbook, McGraw-Hill International. ISBN:0-07-034003-X.
5. Sahay and Saxena, World Class Manufacturing, McMillan publications, New Delhi. ISBN: 9780333934746.
6. Vohra, Quantitative Techniques in Management, ISBN:0070611939.
7. C.B. Mamoria, Personnel Management, Himalaya publishing house, ISBN:8178669951.
8. French & Bell, Organizational Behavior, ISBN:013242231X.

OPEN ELECTIVE – IV
Non-Destructive Techniques and Engineering Diagnosis
(IOEUA42182E)

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

Prerequisite: Applied Physics, Basic Electronics, Engineering Chemistry

Course Objectives: The course will help students

1. To **understand** basic concepts and need of health monitoring.
2. To **recognize** the purpose of specific nondestructive technique and **interpret** its results for damage evaluation.

Course Outcomes:

Upon completion of the course, students will be able to

1. **Understand** and **explain** the need for health monitoring in the field of engineering.
2. **Explain** working principle and applications of transducers understress.
3. **Demonstrate** use of ultrasonic pulse velocity technique for damage detection.
4. **Demonstrate** use of acoustic emission technique for damage detection.

Uuit I: Concept of Health monitoring

Basic concepts of health monitoring with regard to structures, machines and electronic components.

Unit II: Transducers

Introduction, types of transducers, working principle of transducers, applications of transducers to various fields of engineering.

Unit III: NDT - Ultrasonic pulse velocity

Introduction, working principle of ultrasonic pulse velocity technique, application to various fields of engineering.

Unit IV: NDT- Acoustic Emission

Introduction, working principle of acoustic emission technique, application to various fields of engineering.

Term Work:

1) At least two assignments on each unit
2) Demonstration of NDT for damage detection

Reference Books:

1. Ian R. Sinclair – "Sensors and Transducers"
2. Christian u. Grosse and MasayasuOhtsu -"Acoustic emission Testing" Basics for Research – Applications in Civil Engineering.
3. IS13311 (Part1):1992 "Non-destructive testing of concrete - methods of test" Part 1 Ultrasonic Pulse Velocity

Open Elective V

Inferential Statistics for Data Science (IOEUA42183A)

Teaching Scheme	Examination Scheme						
Credits: 3	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 2 hrs./week Tutorial (T): -1 hr/week Practical (P): - hrs/week	20	30	20	30	-	25	125

Prerequisite: Readers/students are expected to know the following concepts:

1. Basics of Probability

Course Objectives:

- To equip students with the basic understanding of the fundamental concept of data and the nature of datasets
- To understand the fundamentals of probability distributions and their application for data analysis
- To derive the conclusions from the data sets with Bayesian and Inferential statistics

Course Outcomes:

1. Comprehendandcorrelatethenatureandcentraltendencyofgivendatasetsusingappropriate probability distribution for the given dataset.
2. Implement the fundamentals of Bayesian statistics to find out probability of unknown parameters of statistical model
3. Analyze and conclude the hypothesis using inferential statistical tests
4. Evaluate the prominent characteristics of data sets with exploratory data analysis methods

Unit- I : Understanding Data and probability distributions **(6 HRs)**

Understanding Data, Frequency Tables, Distributional Shapes, Central Tendency Describing Spread: Range, Interquartile Ranges and Standard Deviation ,Measuring Data ,Measurements of Central Tendency, Measurements of Dispersion, Bi-variate Data and Covariance ,Pearson Correlation Coefficient, Uniform Distribution, Binomial Distribution, Poisson Distribution, Normal Distribution, Normal Distribution - Formulas and Z Scores

Unit-II : Bayesian Statistics(6 HRs)

Likelihood function and maximum likelihood, The minimaxity, Computing the MLE, Computing the MLE: examples ,Continuous version of Bayes' theorem, Priors and prior predictive distributions Prior predictive: binomial example, Posterior predictive distribution, Bernoulli/binomial likelihood with uniform prior, Conjugate priors

Unit III: Inferential analysis **(6 HRs)**

Central limit theorem and Hypothesis Testing , t-tests, Sensitivity Analysis ,chi square test, Correlation values and confidence intervals, Use Analysis of Variance (ANOVA) or Analysis of Covariance (ANCOVA),Regression analysis

Unit IV:Exploratory Data Analysis(6 HRs)

Univar ate data: measures of center and spread, transformations, visualization. – Bivariate data: Simple regression, curve fitting, – Trivariate/Hypervariate data: Multiple regression, model selection, principal components. – Binary responses: Logistic regression, residuals. – Categorical data: Contingency tables, correspondence analysis. – Distance data: Multi-dimensional scaling, non-linear dimensionality reduction. – Graph data: Descriptive statistics, spectral methods, visualization.

Text Books :

1.**Sahu**, Pradip Kumar, **Pal**, SantiRanjan, **Das**, Ajit Kumar, "Estimation and Inferential Statistics", Springer

2 S.C. Gupta and V. K. Kapoor : Fundamentals of Mathematical Statistics, Sultan Chand and Sons, 88, Daryaganj, New Delhi, 2.

3.**Manoj** Kumar Srivastava, Abdul Hamid Khan, Namrata Srivastava, "Statistical Inference, Theory of estimation", PHI

Reference Books :

1.**George** Casella, Roger Berger," Statistical Inference ",CENGAGE Learning, SecondEdition
2.**Malcom** O, Asadoorian, Demetri Kantarelis, "Essentials of Inferential Statistics", University Press of America

Tutorials : Tutorials can be done using Python/R

1. Study of Hypothesis testing(One sample t test, ztest)
2. Analysis of variance(ANOVA)
3. To study Linear regression to predict the outcome of a variable
4. **Study** of outlier in Predictive analysis
5. **Finding** the most important predictor variable in a dataset for feature Selection
6. **Model** selection and analysis for a real world dataset
7. **Study** of Logistic Regression
8. **To build** an application: Time series forecasting

Open Elective-V
E- Commerce (1OEUA42183B)

Teaching Scheme	Examination Scheme						
Credits: 3	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 2 hrs./week Tutorial (T): -1 hr/week Practical (P): - hrs/week	20	30	20	30	-	25	125

Prerequisites :	Mathematics
•	
Course Objectives :	
•	Demonstrate an understanding of the foundations and importance of E-commerce
•	Understand the impact of Information and Communication technologies, especially of the Internet in business operations
•	Comprehend risk,legalissuesandprivacyinE-CommerceandAssesselectronicpayment systems 4. Analyze the critical building blocks of E-Commerce and different types of prevailing business models employed by leading industrialleaders
•	Evaluate the opportunities and potential to apply and synthesize a variety of E Commerce concepts and solutions to create business value for organizations, customers, and business partners.
Course Outcomes :	
1.	Demonstrate an understanding of the foundations and importance of E-commerce
2.	Understand the impact of Information and Communication technologies, especially of the Internet in business operations
3.	Comprehendrisk,legalissuesandprivacyinE-CommerceandAssesselectronicpayment systems 4. Analyze the critical building blocks of E-Commerce and different types of prevailing business models employed by leading industrial leaders
4.	Evaluate the opportunities and potential to apply and synthesize a variety of E-Commerce concepts and solutions to create business value for organizations, customers, and business partners.
Unit I:	**Introduction**
E-Commerce: meaning advantages & disadvantages, incentives for engaging in electronic commerce, impact of e-commerce on business and e business, electronic commerce framework, types of e-commerce, web background	
Unit II:	**Risk and Legal Issues in E-Commerce**

Risksandbarriersintheadoptionofe businessenvironment,theimpactofICTincontemporary business operations, entrepreneurial development in e commerce, cloud computing ande Commerce, e-commerce in India – laws for e-commerce in India, crypto currency and e commerce
Unit III: Ethical and Social and Political issues related to Electronic Commerce
Protecting privacy, protecting Intellectual property, copyright, trademarks and patents, taxation, and encryption policies
Unit IV: E-Commerce Business Models
Key element of a business model, major B2C business models, major B2B business models, business models in emerging e-commerce areas E-Government: issues in e-governance applications, benefits, and reasons for the introduction of e- governance, e-governance models

Text Books :

	1	Kenneth C Lauden, Carol G. Traver, "E-Commerce", Perason Education, ISBN 97881317812.
	2	• DoingBusinessontheInternetE-COMMERCE(ElectronicCommerceforBusiness): S. Jaiswal, Galgotia Publications, ISBN 9788175153059.
	3	• E-Business, Bookseller Code (AG) OXFORD, 1st edition ParagKulkarni, SunitaJainabadkar&PradipChande, ISBN9780198069843.

Reference Books :

	1	P. T. Josef, "Electronic Commerce- A managerial perspective" Prentice-Hall International, ISBN 8120320891.
	2	•Kamlesh K. Bajaj, Debjani Nag, "Electronic Commerce: The cutting edge of business", Tata McGraw-Hill Publishing Co. Ltd, 2000, ISBN9780070585560.
	3	• JeffreyF.Rayport,BernardJ.Jaworski,"e-Commerce",TataMcGrawHill,2002,ISBN 9780072510249.
	4	• Pete Loshin, Paul A. Murphy, "Electronic Commerce", Jaico Publishing House, 2000, ISBN9788172246662.
	5	• Ravi Kalakota, Andrew B. Whinston, "Frontiers of Electronic Commerce", Addison Wesley,2002, ISBN 0201845202

List of Assignments:

I	Study of different e Commerce Platform e.g. Prestashop, WooCommerce, Kickstart, OpenCart or any other. Installation of any one EC platform (Any one you want)
2	Addingcategories,productandproductdetails,attributes,tagstotheecommercedevelopment tool you have chosen in activity1.
3	Adding header, footer, slider and any other design as per your project to the e commerce development tool you have chosen in activity
4	Adding theme and various module management to the e commerce development tool you have chosen from activity 1
5	Restoring DB, payment taxes promotion discount to the e commerce development tool you have chosen from activity 1
6	Adding order management to the e commerce development tool you have chosen from activity 1

Open Elective-V
Rural Technology (IOEUA42183C)

Teaching Scheme:	Examination Scheme					
Credits : 3	CIE	ISE	SCE	ESE	PR/OR/TW	Total
Lectures / Week :2 Hrs/week Practical/ week : 2Hrs/week	20	30	20	30	25	125

Pre-requisites: -

Course objectives:

- Understand theories and practices in the rural development model.
- Learn and analyze rural life and ruraleconomy.
- Understand different measures and technologies used in ruraldevelopment.
- To participate in visits and case studies for better understanding for rural development and its impact on overalleconomy.

Course Outcomes:

On completion of the course, student will be ableto–

1. Understand rural development model
2. Learn different measures in rural development and its impact on overall economy
3. Understand and learn importance of technologies in rural and community development
4. Understand challenges and opportunities in rural development

UNIT-I INTRODUCTION TO RURAL DEVELOPMENT

Concepts and connotations, Basic Elements, Growth Vs. Development, Why rural development, Rising expectations and development, Development and Change, Human beings as cause and consequences of development.

RURAL ECONOMY OF INDIA - Introduction, size and structure, The characteristics of rural sector, The role of agricultural sub-sector, The role of non-agricultural sub-sector, Challenges and opportunities.

UNIT - II: RURAL DEVELOPMENT – MEASURES AND PARADIGMS

Measures Of Development - Introduction, Measures of level of rural development, Measures of income distribution, Measures of development simplified, Concepts and measures of rural poverty

Paradigms Of Rural Development - Introductiou, The modernization theory, The dependency theory of Marxist School, Rosenstein- Rodan's theory of 'Big Push', Lewis' model of economic development,The human capital model of development, The Gandhian Concept of Rural Development theories from other social sciences.

UNIT - III TECHNOLOGIES FOR RURAL DEVELOPMENT

Using Water Resources - Water quality testing, Water filtering ,Extraction from Groundwater ,Pumps Rope and washer pump ,Manuel pumps, Treadle pump, Irrigation for agriculture, Channel systems, Sprinkler systems, Drip systems Water diversion ,Water storage

Building Infrastructures, Creating Energy - Basic energy uses , Energy Sources - Firewood, Solar Energy, Hydroelectricity, Hydromechanical, Wind Energy, Energy Storage, Connecting to the Electrical Network, Environmental Considerations

UNIT-IV COMMUNITY DEVELOPMENT – RURAL ENTREPRENEURSHIP

- Introduction, Service Learning and community development, Theory and practice of community development, Community development issues. The diverse meaning of community development, The knowledge base of community development, International community development,

Different forms of Rural Entrepreneurship, Significance , Business planning for a new venture: the concept of planning paradigm, Forms of business enterprises-Sole proprietorship, partnership and corporations, Product and Process development, Marketing analysis and competitive analysis, strategies; Financial resources; debt financing, banks and financial institutions and other non-bank financial sources; Government programmes : direct loan assistance and subsidies; Industrial and legal issues for rural enterprises

Text Books:	1. "Rural Development: Principles, Policies and Management" - Katar Singh , SagePublications 2. "Introduction to Community Development - Theory, Practice and Service Learning", Edited by J W Robinson, SagePublications 3. G. N. Tiwari, Solar Energy: Fundamentals, Design, Modeling and Applications, Narosa,2002. 4. "Fundamentals of Entrepreneurship", H. Nandan, Third Edition, PHL Learning Pvt.Ltd., 5. "Monetary Economics-Institutions, Theory and Policy" ,First Edition, S B Gupta, S Chand Publications, ISBN-9788121904346
Reference Books:	1. KURUKSHETRA" - A Journal on RuralDevelopment 2. "Energy conversion" , R. Y. Goswami, Frank Kreith, CRC Press, 2007. 3. "Solar Energy: Fundamental and Application" , H. P. Garg andS. Prakash,Tata McGraw Hill,1997. 4. "Technologies for Sustainable Rural Development: Having Potential of Socio Economic Upliftment" , TSRD 2014 , editedby Jai Prakash Shukla, Allied Publishers Pvt. Ltd.

Practical List: Rural Technology

Case Studies and Field Visit:

1. **Use of ICT in Rural and agricultural development** - Education, Healthcare, Agriculture, Business, Resource Mapping, Digital and Social MediaMarketing
2. **Decision Support Systems for soil conservation and farmmanagement**
3. **Waste Management andSanitation**
4. **Water management :** Watershed Management - Water-Cup Competition by Paani Foundation, Community Safe WaterSolutions
5. **Energyresources**
6. **Role of Micro-Finance institutions in rural development:** Visit to a 'Woman Self help group' nearby and study of its functioning and its role indevelopment.
7. **Visit to model villages in nearby region -** Ralegan-Siddhi, Dist - Ahemadnagar, Hiware Bazar Dist - Ahemadnagar, Tikekarwadi - Dist. - Pune, BuchekarwadiDist- Puneetc.

Open Elective- V
Product Design Engineering (IOEUA42183D)

Teaching Scheme	Examination Scheme						
Credits:3 Lecture (L): 2hrs./week Tutorial (T): 1hr. Practical (P): -- hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	25	125

Prerequisite: Basic Engineering Science , Material Science, Engineering Metallurgy, Manufacturing processes, Machine Design, Computer Aided Engineering

Course Objectives:

- To understand basic techniques for particular phases of product development.
- To understand basic Customer needs, satisfaction and commercialization of product.
- To understand Forward and Reverse Engineering and its role in designing a product

Course Outcomes:

Upon completion of the course, students will be able to

- Describe an engineering design and development process.
- Design product as per customer needs and satisfaction.
- Apply engineering, scientific, and mathematical principles to execute a design from concept to finished product.
- Analyze methods and processes of Forward and Reverse engineering and methods of Design for manufacturing and analysis.

Unit I : Introduction to Product Design

Definition of product design, Essential Factors for product design, Modern approaches to product design, Characteristics of Successful Product Development, Innovative Thinking, Challenges to Product Development, product development versus product design. Customer Needs and Satisfaction.

Unit II: Product Development Process

Product development process- Identification of customer needs- customer requirements, product development process flows, Product specifications, concept development and concept generation, concept selection, concept screening, concept scoring, concept testing.

Unit III: Reverse Engineering

Introduction of reverse engineering, Product Teardown Process, Tear Down Methods, Force Flow Diagrams, Measurement and Experimentation, Applications of Product Teardown, Benchmarking Approach and Detailed Procedure, Tools Used in Benchmarking, Indented Assembly Cost Analysis, Function –Form Diagrams, Trend Analysis, Setting Product Specifications, Introduction to Product Portfolio and Product Architecture.

Unit IV: Design for X

Design for manufacture, Design for assembly, Design for robustness, Design for safety, Design for reliability, Design for environment, Design for piece part production, manufacturing cost analysis. Local, Regional and Global issues, basic life cycle assessment - basic method, Design Failure mode effect analysis.

List of Tutorial Assignment:

1) Design of concept of Innovative product.
2) Development of concept of Innovative product using any modeling software.
3) Development of standard process for gathering customer needs related to new product.
4) Prepare product development process flows for new innovative product.
5) Application of reverse engineering technique using benchmarking of product.
6) Application for design for manufacturing and assembly.

Text Books:

1. Product Design-Techniques in Reverse Engineering and New Product Development, KevinOtto, Kristion Wood, Pearson Education, ISBN978-81-7758-821-7.
2. Karl T.U. And Steven D.E., Product Design and Development, McGraw Hill, Ed2000
3. K. Chitale; R.C. Gupta, Product Design and Manufacturing, Prentice HallIndia.

Reference Books :

1. Dieter George E., Engineering Design McGraw Hill Pub. Company,2000
2. Grieves, Michael, Product Lifecycle Management McGrawHill
Bralla, James G., Handbook of Product Design for Manufacturing, McGraw Hill Pub

OPEN ELECTIVE – V
Numerical Methods (IOEUA42183E)

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

Course Objective:

- To prepare the students to apply numerical methods to solve differential equations, integrations and simultaneous equations and perform regression analysis.

Course Outcomes:

Upon completion of the course, students will be able to

1. Applycurvefittingtechniques;carryoutregressionandinterpolationanalysisofanyengineering problem.
2. Solve simultaneous equations using numerical technique.
3. Perform numerical integration for any engineering problem.
4. Solve differential equation of any engineering problem using numerical technique.

Unit I: Curve Fitting, Regression and Interpolation

Curve fitting with Linear Equation, Criteria for a Best Fit, Linear Least Square Regression, Linear Regression Analysis, Coefficient of Determination, Polynomial Regression, Multiple Linear Regression, Lagrange's Interpolation, Newton's Forward Interpolation, Hermit Interpolation, Inverse Interpolation

Unit II: Simultaneous Equations

Gauss Elimination Method, Partial Pivoting, Gauss Seidel Method, Gauss Jordan Method and Thomas Algorithms for Tridiagonal Matrix.

Unit III: Numerical Integration

Trpezoidalrule,Simpson'sRule(1/3rdand3/8th),GaussQuadrature2pointand3pointmethod,Double Integration- Trapezoidal Rule, Simpson's 1/3rdRule

Unit IV: Numerical Solution of Differential Equations

Euler Method, Modified Euler Method (Iterative), Runga-Kutta Fourth Order Method, Simultaneous Equations using Runga-Kutta Second Order Method, Introduction to Finite Difference Method.

Term Work:

Students are required to submit at least two assignments on each unit.

Textbooks:

1. Numerical methods- Rao V. Dukkipati- New Age InternationalPublishers
2. Introductory Methods of Numerical Analysis- S. S. Sastry - UniversityPress

Reference Books:

1. Numerical Methods in Engineering with Python 3 – JaanKiusalaas-Cambridge UniversityPress
2. Numerical Methods -S. Balachandra Rao and C.K.Shantha, University Press

List of Tutorial Assignments:

1	Study of different e Commerce Platform e.g. Prestashop, Woo Commerce, Kickstart, OpenCart or any other. Installation of any one EC platform (Any one you want)
2	Adding categories, product and product details, attributes, tags to the e commerce development tool you have chosen in activity 1.
3	Addingheader,footer,sliderandanyotherdesignasperyourprojecttotheecommerce development tool you have chosen in activity
4	Adding theme and various module management to the e commerce development tool you have chosen from activity 1
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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

[Introduction to Research] (MEUA42184)

Teaching Scheme	Examination Scheme						
Credits: 2 Lecture (L): 1 hr./week Tutorial(T): NA Practical(P): 2 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	-	-	-	-	-	25	25

Course Objective:

- To study fundamental concepts of Research
- To study Technical Writing

Course Outcomes:

Upon completion of the course, students will be able to

1. Describe the basics of research methodology
2. Write research article in conference or journal

Unit I : Introduction to Research

Overview of Research, Meaning of Research, Objectives, Types, Research Approaches, Significance, Research Methods vs Methodology, Research and Scientific Methods, Research Process. Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Techniques involved in defining a problem Data Collection, Preparation and analysis

Unit II: Technical Writing and Research Ethics

Technical Presentation and Technical Writing, Why Technical Writing, Layout of Technical Report/Article, Abstract, Introduction, Literature Survey-Overview of Literature Survey-Searching literature, Sources of Literature, Literature Survey and Reviewing Literature, Organizing Literature, Some Terminology-ISBN, ISSN, DOI, Bib TeX, Strategies to SearchKeyword search, Backward and Forward Chronological Search, Adding References to document, New Findings, Experimental Details, Results and Discussion. Plagiarism tools, Publication process of Technical articles

Term Work:

List of Assignments:

1 Assignment based on Data Collection and Data Preparation Process

2 Assignment based on statistical tools.

3 Adding References in Research paper using BibTex Referencing in Latex or Using Bibliography citations in Microsoft word.

4 Project: Write AND Publish a Research Article.

Textbooks:

S. Kothari C.R., Research Methodology (2nd Ed.), New Age International, (2004); ISBN(13): 978-81-224-1522-3 2.

Reference Books:

1. Berkman, Elliot T., A Conceptual Guide to Statistics Using SPSS, Sage Publications, 2011; ISBN: 978-1-4129-7406-6 2 Kumar, Ranjit,
2. Research Methodology (3rd Ed); Sage Publications, 2011; IBSN: 978- 1- 8492-0301-2

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

(PATTERN 2018) MODULE IV

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
			L	T	P	CIB	ISE	SCE	ESB	PR/ OR/ TW		
MEUA40187	Semester Internship	CE-PR/OR	-	-	24	100	-	-	-	50	150	12
	Total		-	-	24	100	-	-	-	50	150	12

Course Objective:

- To Provide possible opportunities to learn, understand and sharpen the real time technical/managerial skills required at the joh.
- To Familiarize with various materials, processes, products, and their applications along with relevant aspects of quality control
- To Understand the social, economic, and administrative considerations that influence the working environment of industrial organizations.
- To Understand the psychology of the workers and their habits, attitudes, ethics, and approach to problem-solving

Course Outcomes:

Upon completion of the course, students will be able to

1. Understand the industrial requirement in terms of ethics, skillsets for future employees/entrepreneurs
2. Apply knowledge gained in academics to the industrial applications
3. Function effectively as an individual and as a member of the multidisciplinary team
4. Get a good opportunity as a potential employer