BansilalRamnathAgarwal Charitable Trust's

Vishwakarma Institute of Information Technology, Pune-48

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Curriculum for

S. Y. B. Tech.

2020 Pattern

(Mechanical Engineering)

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

Program 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 reaching 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. **Conduct investigations of complex problems-** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage-** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society-** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability-** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics-** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual 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 finance-** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning-** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Program Specific Outcomes-

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

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

S.Y. B. TECH. (MECHANICAL ENGINEERING), SEMESTER III (PATTERN 2020)

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
			L	T	P	CIE	ISE	SCE	ESE	PR/OR/TW		
ES21201ME	Probability and Statistics	TH	3	1	0	20	30	20	30	25	125	4
MEUA21202	Manufacturing Process	TH	3	0	2	20	30	20	30	25	125	4
MEUA21203	Material science and Engineering Metallurgy	TH	3	0	2	20	30	20	30	25	125	4
MEUA21204	Thermodynamics	TH	3	0	2	20	30	20	30	25	125	4
ES20205	Universal Human Values-2	TH	2	1	0	20	30	20	30	25	125	3
MEUA21206	Computer Aided Machine Drawing	CE	2	0	2	-	-	-	-	50	50	3
MEUA21207	Data Structure and Algorithm	CE	1		2					50	50	2
M2	Mandatory Course	AU	-	-	-	-	-	-	-	-	-	-
	Total		17	1	12	100	150	100	150	225	725	24

L: 1Hr. = 1 Credit, P: 2 Hrs. = 1 Credit, T : 1 Hr. = 1 Credit, AU: No Credits

CIE: Continuous Internal Evaluation SCE: Skill and Competency Examination

ISE: In-Semester Examination ESE: End Semester Examination

List of Mandatory Courses: Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge ?

S.Y. B. TECH. (MECHANICAL ENGINEERING), SEMESTER IV (PATTERN 2020)

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
			L	T	P	CIE	ISE	SCE	ESE	PR/OR/TW		
MEUA22201	Instrumentation and Control	TH	3	0	2	20	30	20	30	25	125	4
MEUA22202	Applied Thermodynamics	TH	3	0	2	20	30	20	30	25	125	4
MEUA22203	Fluid Mechanics and Machines	TH	3	0	2	20	30	20	30	25	125	4
MEUA22204	Strength of Materials	TH	3	0	2	20	30	20	30	25	125	4
MEUA22205	Manufacturing Technology	TH	3	0	0	20	30	20	30	0	100	3
MEUA22206	Metrology & Quality Control	CE	2	0	2	-	-	-	-	50	50	3
MEUA22207	Data Analytics	CE	1	0	2					50	50	2
M2	Mandatory Course	AU	-	-	-	-	-	-	-	-	-	-
	Total		18	0	12	100	150	100	150	200	700	24

L: 1Hr. = 1 Credit, P: 2 Hrs. = 1 Credit, T : 1 Hr. = 1 Credit, AU: No Credits

CIE: Continuous Internal Evaluation SCE: Skill and Competency Examination

ISE: In-Semester Examination ESE: End Semester Examination

List of Mandatory Courses: Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge

BoS Chairman Dean Academics Director

INDEX

Sr. No.	Course Code	Course Name	Page No
SECOND YEAR B. TECH. SEMESTER–III			
1	ES21201ME	Probability and Statistics	08
2	MEUA21202	Manufacturing Process	10
3	MEUA21203	Material science and Engineering Metallurgy	12
4	MEUA21204	Thermodynamics	14
5	ES20205	Universal Human Values-2	16
6	MEUA21206	Computer Aided Machine Drawing	18
7	MEUA21207	Data Structure and Algorithm	20
SECOND YEAR B. TECH.SEMESTER–IV			
8	MEUA22201	Instrumentation and Control	24
9	MEUA22202	Applied Thermodynamics	26
10	MEUA22203	Fluid Mechanics and Machines	28
11	MEUA22204	Strength of Materials	30
12	MEUA22205	Manufacturing Technology	32
13	MEUA22206	Metrology and Quality Control	34
14	MEUA22207	Data Analytics	37

Semester - III

Probability and Statistics (ES21201ME)

Teaching Scheme	**Examination Scheme**						
Credits: 4 Lecture (L): 3 hrs./week Tutorial (T): -- 1 hr Practical (P): 0 hrs./week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	25	125

Prequisite- Engineering Mathematics

Course objectives:
Engineers with the ability to analyze the data for a given problem and represent in the mathematical and statistical form
2) Engineers with ability to systematically solve the problems using knowledge of probability, distributions, sampling and formulating hypothesis
3) Engineers with the ability to carry out test of hypothesis, and apply the concept of correlation and regression, goodness of fit and distributions

Course Outcomes:
Upon completion of the course, students will be able to
1. Explain the concepts of basic statistics that will be used to summarize data.
2. Apply statistical concepts and probability theory to analyze data for making better decisions.
3. Estimate the population mean with a known and an unknown population standard deviation.
4. Test both one- and two-tailed null and alternative hypotheses
5. Test a completely randomized design using a one-way and two-way analysis of variance.
6. Calculate the residual, standard error of the estimate, coefficient of multiple determination, and adjusted coefficient of multiple determination of a regression model.

Unit I- Statistical Methods

Introduction, collection, classification and representation of data, various databases related to Mechanical Engineering applications measures of central value (mean, median, mode), measures of dispersion,-Skewness, moment, Kurtosis, range, variance, coefficient of variation

Unit II- Probability Theory

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

Unit III- Sampling Theory

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

Unit IV- Hypothesis Testing

Hypothesis testing- null and alternative hypothesis, typeI and II errors, power of a test, approahes for hypothesis testing- p-value, critical value and confidence interval value, test for population mean, proportion and variance- one sample and two sample test, F-distribution.

Unit V- Single Variable Regression

Conceptual overview, one-way (CRD) and two-way ANOVA (RBD), factorial experiment, simple linear regression- model assumptions, parameter estimation (least square method), test for significance

(t and F test), confidence interval for parameters, coefficient of determination.
Unit VI- Multi Variable Regression
Multiple linear regression- model assumptions, parameter estimation (least square method), test for significance (t and F test), confidence interval for parameters, coefficient of determination, Residual analysis, dummy variable, logistic regression, confusion matrix and ROC analysis, curvilinear relationship.
Tutorial- 1. Assignment of central tendency and dispersion. 2. Assignment on Baye's rule and probability distributions. 3. Assignment on sampling distribution. 4. Assignment on testing of hypothesis 5. Assignment on one-way and two-way ANOVA 6. Assignment on factorial experiment 7. Assignment on simple linear rand multiple linear regression 8. Assignment on logistic regression and confusion matrix
Text Books:
1. Jay L. Devore, Probability and Statistics for Engineering and the Sciences, 8thEdition, Cengage Learning, 2010. 2. P.V. Sukhatme, Sampling Theory of Surveys with Applications, Indian Society for Agricultural Statistics, New Delhi. 3. Douglas C. Montgomery, George C. Runger,Applied Statistics and Probability for Engineers, Wiley, Year- 2018, ISBN- 1119409535 4. Ken Black, Business Staatistics for Contemporary Decision Making, 6thEdition, Wiley
Reference Books :
1. Douglas C. Montgomery,Design and Analysis of Experiments, John Wiley, Year- 2001 2. Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, Introduction to Linear Regression Analysis, Wiley, 2012

Prepared by-Dr. S.C. Chinchanikar

BOS Member- Dr. P.P.Hujare

BOS Chairman- Dr. D. N. Kamble

Manufacturing Processes (MEUA21202)

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

Prerequisite: Physics, Chemistry, Mathematics, Workshop Practices.

Course objectives:

- To familiarize students with major manufacturing processes
- To correlate the material type with the possible fabrication processes
- To describe the operations and tools for major manufacturing processes
- To interpret the knowledge about manufacturing processes, parameters and their effects on performance.

Course Outcomes:

Upon completion of the course, students will be able to

1. Analyze heating, pouring and filling up of mould in casting processes.
2. Analyze bulk deformation processes in terms of power requirement and causes for defects.
3. Explain merits, demerits, applications and calculate energy requirements of various joining and assembly processes.
4. Describe various shaping processes for plastics, polymer matrix composites and rubber in terms of their merits, demerits and applications.
5. Design sheet-metal cutting, bending and drawing processes for various applications.
6. Determine force and energy requirements, machining time, tool life and necessary calculations for thread cutting and taper turning operations.

Unit I–Metal Casting Processes

Typical sand mould (important casting terms), Patterns and cores, Moulds and mould making, Sand testing, Gating system design, Heating and pouring of the molten metal, Analysis of pouring and filling up of mould, Solidification and cooling, Riser design, aspiration effect, Preventing impurities and turbulence in casting, Gating ratios, Effect of friction and velocity distribution, Expandable and permanent moulding processes, casting defects, New technology research and environmental issues.

Unit II - Metal Forming

Bulk deformation processes, Material behavior and temperature in metal forming, Rolling, Forging, Other deformation processes related to Rolling and Forging, Extrusion and Wire drawing, Analysis of Rolling, Forging, Extrusion and Wire drawing, Design for Hot Forging, Environmental Issues - Metal Forming, Forming of Components: Recent Advances (Advanced Forming Technologies).

Unit III - Joining and Assembly processes

Welding: Physics of welding, classification of welding, Features of a fusion welded joint, Power source of welding, Physics and principle of arc welding, resistance welding, oxyfuel gas welding, Other fusion welding processes, Solid state welding FSW, Weld quality, Weldability, Nomenclature and symbol of welding joints, Design considerations in welding, Welding defects and inspection, Brazing, Soldering, Adhesive Bonding,

Mechanical Assembly: Threaded fasteners, rivets and Eyelets, Stitching, stapling and sewing.

Safety in Welding and Allied Processes.

Unit IV- Plastics Processes

Plastics and Composite Standards, Polymer Composites Sustainability: Environmental Perspective, Future Trends and Minimization of Health Risk. Shaping Processes for Plastics: Extrusion, Production of sheet, film, Injection moulding, Compression and transfer moulding, Blow moulding, and thermoforming

Unit V- Sheet Metal Working

Sheet metal working: cutting and bending operations, drawing, Dies and presses for sheet metal processes, Engineering analysis of sheet-metal cutting, bending and drawing, stretch forming, roll bending and forming, Spinning and High-energy rate forming, Environmental aspects of sheet metal forming, Recent trends in sheet metals and their formability in manufacturing automotive panels.

Unit VI – Center Lathe

Lathe, types of lathe, construction of lathe machine, accessories and attachments of lathe, specification of lathe, taper and taper turning, thread cutting, drilling on lathe, cutting speed, feed, depth of cut and machining time.

List of Practical:

1. Design of pattern, pattern making, moulding and casting.
2. Job of assembly, consisting of at least three components with tolerance involving use of machine tools or processes.
3. Spur Gear cutting in milling machine on a work piece
4. Demonstration about following processes

A) Sheet metal working Processes: Introduction, hand press, different dies such as simple die, compound die, progressive die and its application. Demonstration of one utility job.

B) Plastic Injection Moulding: Introduction, principle, equipment & operation and video on one utility job.

C) Welding Processes: Arc Welding, Resistance Welding, Soldering and Brazing

Text Books:

1. Hajara Choudhari, Bose S.K. – Elements of workshop Technology Vol. I &II, Asian Publishing House, ISBN0713136227
2. M.P Grover – Fundamentals of modern manufacturing: Materials and systems, John Wiley& Sons, Inc, New Jersey, 2010, ISBN978-0470-467008.
3. R. K. Jain, Production Technology, Khanna Publishers, 16th Edition,2003
4. R.K. Rajput – Manufacturing Technology, Laxmi Publications (P)Ltd.

Reference Books:

1. B. Ravi – Metal Casting – Computer Aided design and analysis- Prentice Hall of India ISBN: 8120327268,9788120327269.
2. Reikher – Casting: An analytical approach – Springer ISBN9781846288494.
3. Materials and Processes in Manufacturing, DeGarmo, Black, and Kohser, John Wiley &Sons, Inc,New York,2011.
4. Kalpakjian and Schmid - Manufacturing Engineering and Technology, Prentice Hall, NewJersey, 2013

Course Coordinator: Mr. M. G. Gadge

BoS Member: Dr. S. S. Chinchanikar

BoS Chairman: Dr. D N. Kamble

Material Science and Engineering Metallurgy (MEUA21203)

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: Mathematics, Physics and Chemistry

Course objectives:

- To Describe importance of crystal structure
- Importance phase diagram and co-relation of different phases with different mechanical properties.
- Perform various heat treatments tests for material properties and characterization of industrial samples

Course Outcomes:

Upon completion of the course, students will be able to

1. Define the basics of crystal structure and structure of metal
2. Compare deformation in different metals and understand importance od NDT.
3. Define importance of equilibrium diagram for Metallurgy and Mechanical Engineering
4. Understand importance of Iron Carbon equilibrium diagram and classify different types of steels
5. Differentiate alloy steels and cast iron based on Iron Carbon equilibrium diagram.
6. Explain proper heat treatments and their importance in steels

Unit I : Structure of Materials

Crystal Structure: Unit cells, Metallic crystal structures, Miller direction and calculations Imperfection in solids: like Point, line defects; dislocation plastic of single crystal and calculation, deformation mechanisms like twinning and slip, Annealing and its stages.

Unit II: Mechanical Testing

Study of destructive testing, Tensile test, engineering stress-strain curve, true stress-strain curve, types of stress-strain curves, Numerical based on Evolution of properties, compression test, different hardness tests-Vickers, Rockwell, Brinell, Poldi, Micro Hardness Test, Impact test, Introduction to different Non-destructive test and its uses. importance.

Unit III: Metallography and Equilibrium Diagrams

Microscopy, macroscopy. Importance of Equilibrium diagram with basic terms. Hume Rotheyr's rule of solid solubility allotropy and polymorphism, eutectic system and Partial eutectic system.

Unit IV: Iron-Carbon Equilibrium Diagram

Iron-iron carbide equilibrium diagram, non-equilibrium cooling of steels, Classification and application of plain carbon steels specification of steels,

Unit V: Alloy Steels and Cast Irons and Introductions Nonferrous metals

Introduction to cast Iron and its basic types, Effect of different alloying elements on IC diagram,

Introduction to tool steel, transformation products of austenite, time temperature transformation diagrams, critical cooling rate, Basics Introduction to nonferrous materials (Basics of Brasses and Bronzes).

Unit VI: Heat- Treatment of Steels

Heat treatment of steels like Annealing, normalizing, hardening & tempering, retention of austenite: effects of retained austenite, elimination of retained austenite, introduction to case hardening processes.

List of Practical:

Any 8

1. Study and trial on Tensile test.
2. Study and trial on compression test.
3. Study and trial on Brinell hardness test
4. Study and trial on Vickers hardness test
5. Study and trial on impact test
6. Study and performance on magnetic particle & dye penetrant test
7. Study of metallurgical microscope, Study & demonstration of specimen preparation for microscopic examination
8. Study and trial on Jominy end hardenability test
9. Study and drawing of microstructure of steels and cast Iron.(min 2)
10. Heat treatment of plain carbon steel and determination of relative hardness

Text Books:

1.Dr. V.D. Kodgire & S. V. Kodgire, "Material Science & Metallurgy For Engineers", Everest Publication 2008 , ISBN 81-86314-00-8.

2. K. Bhargava, C.P. Sharma "Mechanical Behavior & Testing Of Materials",. P H I Learning Private Ltd.., ISBN: 978-81-203-4250-7

Reference Books :

1. Donald R. Askl and, Phule P. P., "Science and engineering of materials", Thomson Learning 2003.ISBN: 0534553966.
2.Callister W. D, "Materials Science and Engineering", John Wiley, ISBN 9780470419977
3. Higgins R. A., "Engineering Metallurgy", Viva books Pvt. Ltd., 2000, ISBN 0340568305.
4. Raghvan V. "Material Science & Engg.", Prentice Hall of India , New Delhi. 2003
5. Avner, S.H. Introduction to Physical Metallurgy, Tata McGraw-Hill, 1997. ISBN 10: 0074630067

Course Coordinator: Dr. Sampada Dravid

BoS Member: Dr. A.R.Mache

BoS Chairman: Dr .D N. Kamble

Thermodynamics (MEUA21204)

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: Engineering Mathematics, Engineering Physics and Chemistry

Course Objectives:

- To understand applications of thermodynamics laws to various energy conversion devices.
- To evaluate the changes in properties of substances in various processes.

Course Outcomes:

Upon completion of the course, students will be able to

1. Apply the first law of thermodynamics to analyze thermodynamic devices and ideal gas processes.
2. Explain second law of thermodynamics and concepts of reversibility and irreversibility.
3. Evaluate entropy change during processes.
4. Estimate the available energy/ unavailable energy in a given process.
5. Evaluate various properties of steam using the steam table.
6. Analyze the performance of steam generator.

Unit I : First Law of Thermodynamics

Review of basic terms and definitions, Microscopic and Macroscopic approach, Thermodynamic processes, throttling process, Thermodynamic equilibrium, Point and path function, Heat and work,
Perfect gas laws, PMM I, Applications of first law to non-flow processes (Constant Pressure, Constant Volume, Isothermal, Adiabatic, and Polytropic). Calculations of heat transfer, work done, internal energy, enthalpy.
Applications of first law to flow Processes SFEE (Pump, compressor, turbine, boiler, nozzle)

Unit II: Second Law of Thermodynamics

Limitations of First law, Clausius and Kelvin Plank Statement and their equivalence, PMM II, Reversibility and irreversibility, Causes and Conditions of reversibility, Carnot cycle for heat engine, heat pump and refrigerator, Carnot theorem, Clausius inequality.

Unit III: Entropy and Availability

Concept of entropy, entropy changes for an ideal gas during reversible process, entropy of isolated system, principle of entropy increase, Definition of Isentropic efficiency for compressors, turbines. and nozzles.
Available and unavailable energy, Availability function for systems and Control volumes undergoing different processes, Lost work.

Unit IV: Properties of Steam

Definition of pure substance, Formation of steam, Phase changes, Properties of steam, Use of Steam Tables, Study of P-V, T-S and Mollier diagram for steam, Dryness fraction and its determination, Study of steam calorimeters (Barrel, Separating, Throttling and combined) Non-flow and Steady flow vapour processes, Change of properties, Work and heat transfer.

Unit V: Gas and Vapour Power Cycle:

Air standard Otto, Diesel and Dual cycles, Air standard Brayton cycle, Basic Rankine cycle , Reversed Carnot Cycle, Vapor compression refrigeration cycles.

Unit VI: Boiler

Classification of boiler, Boiler mounting and accessories, Boiler draught (natural and artificial draught) Boiler performance calculations-Equivalent evaporation, Boiler efficiency Energy balance. IBR Act.

List of Practical:

Any 8 (expt. 9 compulsory)

1. Validation of first law of thermodynamics using Joules experiment.
2. Determination of energy interaction in any thermal system using SFEE.
3. Determination of thermal efficiency of heat engine.
4. Determination of Carnot COP of heat pump.
5. Determination of dryness fraction of steam using any one of calorimeter.
6. Demonstration of Boiler mountings
7. Demonstration of Boiler accessories.
8. Performance test on Boiler and its heat balance sheet analysis.
9. Performance estimation of any thermal system using any suitable software.
10. Industrial visit to any processing unit having boiler.

Text Books:

1. P. K. Nag, Engineering Thermodynamics, Tata McGraw Hill Publications, ISBN-13: 978-1-25-906256-8
2. R. K. Rajput, Engineering Thermodynamics, EVSS Thermo Laxmi Publications, ISBN: 978-81-318- 0058-4
3. M M Rathod, Thermal Engineering, Tata McGraw Hill Publications,ISBN(13)978-0-07-068113-2

Reference Books :

1.Y. Cengel & Boles: Thermodynamics – An Engineering Approach, Tata McGraw Hill Publications, ISBN 13:9780072884951
2. P. L Ballany: Thermal Engineering, Khanna Publishers, ISBN-13: 978-81-7409-031-2
3.C.P. Arora: Engineering Thermodynamics, Tata McGraw Hill Publications, ISBN - 9780074620144

Prepared By: Mr. C.R. Ramtirthkar
BOS Member: Dr. S.S. Kore
BOS Chairman: Dr. D.N. Kamble

Universal Human Values 2 (ES20205)

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

Course Objectives:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding of the harmony in the human being, family, society and nature/existence.
- Strengthening of self-reflection.
- Development of commitment and courage to act.

Course Outcomes:

Upon completion of the course, students will be able to

1. Perform self-exploration on human values to ensure fulfillment of basic universal human aspirations.
2. Commit to lead a life of responsibility by becoming aware of their individual reality.
3. Apply understanding of human- human relationship in family and society to behave ethically and professionally
4. Demonstrate awareness and sensitivity towards nature/existence leading to ethical and sustainable solution to engineering problem.

Unit I–Introduction - Need, Basic Guidelines, Content and Process for Value Education

Purpose and motivation for the course,
Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority,
Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Unit II – Understanding Harmony in the Human Being - Harmony in Myself!

Understanding human being as a co-existence of the sentient 'I' and the material 'Body',
Understanding the needs of Self ('I') and 'Body' - happiness and physical facility,
Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer),
Understanding the characteristics and activities of 'I' and harmony in 'I',
Understanding the harmony of I with the Body, correct appraisal of Physical needs, meaning of Prosperity in detail.

Unit III: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness, Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and Competence, Understanding the meaning of Respect, Difference between respect and Differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals,

Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Unit IV- Understanding Harmony in the Nature and Existence - Whole existence as Coexistence with Implications of the Holistic Understanding of Harmony on Professional Ethics

Understanding Harmony in the Nature,
Inter disconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Exploring the Four Orders of Nature, Realizing Existence as Co-existence at All Levels,
The Holistic Perception of Harmony in Existence,
Exploring Co-existence in Existence,
Discussion on -the conduct as an engineer or scientist.

Laboratory Work:

List of Tutorial: (Any 7 tutorials can be taken)

1. Practice session to discuss natural acceptance in human being.
2. Practice session to discuss the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.
3. Practice session to discuss the role others have played in making material goods available to me, Identifying from one's own life.
4. Practice session to differentiate between prosperity and accumulation.
5. Practice session to discuss program for ensuring health vs dealing with disease.
6. Practice session to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc.
7. Practice session to reflect on Gratitude as a universal value in relationships. Discuss with scenarios.
8. Practice session to reflect on Gratitude Elicit examples from students' lives.
9. Practice session to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.
10. Case Study session e.g. to discuss the conduct as an engineer or scientist etc.

Text Books:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference Books:

1. Jeevan Vidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak,1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).

Course Coordinator: Dr. S. V. Dravid

BoS Member: Dr. A.P. Kulkarni

BoS Chairman: Dr .D. N. Kamble

Computer Aided Machine Drawing (MEUA21206)

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

Prerequisite: Engineering Graphics and Mechanical Workshop.

Course Objectives:

- To understand engineering drawings.
- To understand parametric modeling concept, create sketches, solid models, assembly models of simple machines.
- To develop the ability to apply limits, fits and geometric tolerances to components and assemblies and generate manufacturing/production drawings.

Course Outcomes:

Upon completion of the course, students will be able to

1. Interpret engineering drawings as per I.S. conventions.
2. Generate the solid and surface models from drawings.
3. Create the assemblies of machine components.
4. Interpret tolerances using production drawings of machine components.

Unit I– Introduction to Machine Drawing

Introduction – Machine Drawing Standards, I.S. Code and Conventions, Thread Terminology, Thread Engagement, I.S. Conventions for Threads, Nut Bolt Description, Types of Bolts, I.S. Conventions for Bolts, Types of Nuts, I.S. Conventions for Nuts, I.S. Conventions for Screws,
Representation of machine elements and parts such as keys, gears, couplings, welds, etc.

Unit II –Part Modeling

Introduction to Graphical User Interface (GUI) of commercially used drafting and solid modeling software, Fundamentals of modeling, Solid modeling, application &modification of constraints and dimensions, Geometrical and Dimensional Constraints, transform the 2-dimensional sketch into 3 dimensional solid, CAD Modules – Sketcher, Solid Modeling, Feature operations, List of Toolbars, Generating Basic Surfaces, Performing Operations.

Unit III: Assembly Modeling

Assembly modeling – defining relationship between various parts of machine, Top down and Bottom Up Assembly approaches, List of Toolbars, applications of tools, Creation of constraints, Generation of exploded view**,** Demonstrations using applications,
Examples of Shaft joints, Shaft couplings, Machines assemblies.

Unit IV: Production Drawing

Dimensioning Techniques, Limit, fits and tolerances, Need of Geometrical Tolerance, Geometrical Characteristics of Symbols, Geometric dimensioning and tolerancing (GD & T), Indication of Maximum

Material Condition, Least Material Condition, Tolerance stack up analysis.
Generation of 2-dimensionalproduction drawings from 3-Dimensional parts and assembly using CAD software, Drafting concepts, Appropriate dimensioning and tolerance.

Laboratory Work:

List of assignments:

1. Introduction to mechanical CAD Packages and demonstration of part modeling, assembly and detailing with simple examples.
2. Machine drawing conventions using 2 D modeling tool.
3. Two dimensional drawings of machine components using sketcher workbench.
4. Part modeling of machine components using commands of the CAD Software e.g. shafts, springs, forks, connectors, pins, pulleys etc.
5. Parametric Solid Modeling of shaft couplings using CAD software.
6. Solid Modeling of the machine components using CAD software.
7. Assembly modeling applications using CAD software.
8. Surfacing modeling applications using CAD software.
9. Tolerances stack up analysis.
10. Manufacturing/Production Drawings of the parts and assemblies with appropriate tolerance.

Text Books:

1. N. D. Bhatt and V.M. Panchal, "Machine Drawing", Charoter Publications ISBN-13:9789380358888
2. Ajeet Singh, "Machine Drawing", McGraw Hill Publications, New Delhi 2012.

Reference Books:

1. Ibrahim Zeid, Mastering CADCAM, McGraw-Hill ISBN-10: 0072868457 ISBN-13: 978-0072868456
2. Help Manuals and Tutorials of Referred CAD Softwares.

Course Coordinator: Mr. N. B. Kate

BoS Member: Dr. A.P. Kulkarni

BoS Chairman: Dr .D. N. Kamble

Data Structure and Algorithm (MEUA21207)

Teaching Scheme	Examination Scheme						
Credits:2 Lecture (L): 1 hrs./week Practical (P): 2 hrs./week Tutorial (T): 0 hr.	CIE	ISE	SCE	ESE	PR/OR	TW	Total
					50	-	50

equisite: Fundamental knowledge of programming language and basics of algorithms Companion Course Engineering

Course objectives:

- To study data structures and their implementations and applications.
- To learn different searching and sorting techniques.
- To study some advanced data structures such as trees, graphs and tables.
- To learn algorithm development and analysis of algorithms

Course Outcomes:

Upon completion of the course, students will be able to

1. Perform basic analysis of algorithms with respect to time and space complexity.
2. Select appropriate searching and/or sorting techniques and Implement data structures for given application.

Unit I–Introduction

A) **Introduction to Data Structures:** Concept of data, Data object, Data structure, Concept of Primitive and non-primitive, linear and Nonlinear, static and dynamic, persistent and ephemeral data structures, Definition of ADT Analysis of algorithm: Frequency count and its importance in analysis of an algorithm, Time complexity & Space complexity of an algorithm, Sequential Organization: Single and multidimensional array, Linked Organization: Concept of linked organization, Singly Linked List, Doubly Linked List, Circular Linked List (Operations: Create, Display, Search, Insert, Delete).

B) **Searching and Sorting**: Need of searching and sorting, Concept of internal and external sorting, sort stability, Searching methods: Linear and binary search algorithms, Sorting methods: Bubble, insertion, Quick, Merge and comparison of all sorting methods w.r.to its worst case time complexity.

Unit II –Stack, Que and Trees

~~A)~~ **Stack:-**Concept of stack, Concept of implicit and explicit stack, stack as an ADT using sequential and linked organization, Applications of stack: recursion,

B) **Queue:** Concept of queues as ADT, Implementation of queue using array and linked organization, Concept of circular queue, priority queue, Applications of queue:

C) **Trees :** Trees and binary trees-concept and terminology, Expression tree, Binary search tree, Recursive algorithms for binary search tree traversals Applications of trees.

D) Graph -Concept and terminologies

List of Assignments (1 Assignment 2 turns each)

1. Represent matrix using two dimensional arrays and perform following operations
i. Addition
ii .multiplication
iii. Transpose
iv. Saddle point
v. Lower and Upper triangular Matrix
2. Write a menu driven Program in C++ for the following operations on Singly Linked List (SLL) of Student Data with the fields: PRN, Name, Branch, Semester, Cell Number
a. Create a SLL of N Students
b.Display the SLL and count the number of nodes in it
c.Perform Insertion
d. Perform Deletion
3. Perform implementation of STACK using Array
a. Push an Element on to Stack
b. Pop an Element from Stack
c. Demonstrate Overflow and Underflow situations on Stack
d. Display Stack
Support the program with appropriate functions for each of the above operations
4. Implement FCFS (Queue) algorithm of job scheduling in operating system with the help of suitable data structure.

5. Write C++ program to maintain club members, sort on roll numbers in ascending order. Write function for Binary Search and Linear Search to search whether particular student is member of club or not.
6. Department maintains student's database. The file contains roll number, name, division and address. Write a program to create a sequential file to store and maintain student data. It should allow the user to add, delete information of student. Display information of particular student. If record of student does not exist an appropriate message is displayed. If student record is found it should display the student details.
7. Represent graph as adjacency matrix or list and perform Depth first Traversal and Breadth First Traversal

OR

7. Create BST and perform Depth first Traversal and Breadth First Traversal
However sir I came across few applications from Mech which uses Graph data structure. I don't know I detail plz see if possible
1) Simple applications involve temperature analysis in a continuously varying process (like *power plant, furnaces in metal plants*)
2) Velocity gradient, acceleration gradient, displacement gradient, etc in the *automotive industries*.
3) Motions constrains and force propagation analyses of various assemblies- *Machineries, automobile industries* etc
4) Stress- Strain Curve -Youngs modulus determination - *Material Sciences/ Metallurgy*
5) Projectile/ Trajectory monitoring
6) Force distribution in structures, trusses, etc
7) Localisation process, etc
Take any system/ process- you can apply graph theory making its working and reactions in the process parameters easy to understand.

Text Books:

1. E. Horowitz, S. Sahni, D. Mehta, "Fundamentals of Data Structures in C++", Galgotia Book Source, New Delhi, 1995, ISBN 16782928

2. Y. Langsam, M. Augenstin, A. Tannenbaum, "Data Structures using C and C++", 2nd Edition, Prentice Hall of India, 2002, ISBN-81-203-1177-9.

Reference Books:

1. G. A.V, PAI , "Data Structures and Algorithms ", McGraw Hill, ISBN -13: 978-0-07-066726-6

2. A. Tharp ,"File Organization and Processing", 2008 ,Willey India edition, 9788126518685

3. M. Folk, B. Zoellick, G. Riccardi, "File Structure An Object Oriented Approach with C++", Pearson Education, 2002, ISBN 81 - 7808 - 131 - 8.

4. M. Welss, "Data Structures and Algorithm Analysis in C++", 2nd edition, Pearson Education, 2002, ISBN81-7808-670-0

Course Coordinator: Dr. A.P.Kulkarni

BoS Member: Dr. S. S. Chinchanikar

BoS Chairman: Dr .D N. Kamble

Semester - IV

Instrumentation and Control (MEUA22201)

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	--	100

Prerequisite: Electronics, Electrical Engineering, Smart Sensor

Course Objectives:

- To understand the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical and Electronic Systems

Course Outcomes:

Upon completion of the course, students will be able to

1. Discuss the key elements of mechatronics system and types of sensors and actuators.
2. Explain Electrical Motor and actuators by considering the Mechanical aspects.
3. To Know the Interfacing of Sensors, Actuators using appropriate DAQ and different block diagram technique
4. Analyze the time and Frequency domain analysis of system model for control application and PID control system.
5. Apply Program Logic Controller for implementation on real time systems.
6. Identify the Stability mechatronics system via identification of poles and zeros.

Unit I : Sensors and Transducers

Definition, Multidisciplinary Scenario, Introduction to Measurement system, characteristics: - Static and Dynamic Sensors: Position Sensors: - Potentiometer, Linear variable differential transformer (LVDT), Digital Transducers (optical encoder), Nozzle Flapper, Tachometers, theory of accelerometer and vibrometers, Flow sensors, strain gauge, hall effect sensor, anemometer, digital manometer, calibration of thermocouple.

Unit II: Electrical Actuating System

Basic Principle of Electromechanical Switching, Solenoids, Electrical Relays, Electrical Motor, Lenz Law, Fleming's right hand rule, Construction working and Principle: AC Motor, DC Motor, Stepper Motor & Servo Motor, mechanical aspects of motor selection.

Unit III: Block Diagram Representation & Data Acquisition System

Open and Closed loop Control System; Concept of Transfer Function; Block Diagram & Reduction principles, Introduction to Signal Communication & Types-Synchronous, Asynchronous, Serial, Parallel, Data Acquisition system, Bit width, Sampling theorem, Aliasing, Sample and hold circuit, Sampling frequency; Interfacing of Sensors / Actuators to Data Acquisition system.

Unit IV: Programmable Logic Controller

Introduction to PLC, PLC Architecture, Latching, Timers, Counter, Different scans in PLC, Ladder diagram programming for different types of logic gates, Practical Examples of Ladder Programming, Data Handling.

Unit V: Control System

Proportional (P), Integral (I) and Derivative (D) control actions; PI, PD and PID control systems, Unit step Response analysis via Transient response specifications: Percentage overshoot, Rise time,

Delay time, Steady state error; Manual tuning of PID control.

Unit VI: Modelling and Analysis of Mechatronics System

Transfer Function based modeling of Mechanical system, Stability Analysis via Poles & Zeros; Stability Analysis using Routh Hurwitz Criterion, Frequency Domain Parameters-Natural Frequency, Damping Frequency and Damping Factor, Introduction to Pneumatic and hydraulic actuation systems, Different components of Hydraulic systems, Servo valves, Stages in designing Mechatronics Systems

List of Practical:

Any 8

1. Measurement of displacement using LVDT.
2. Study of different types of sensor using sensor board
3. Interfacing of any one sensor to Data Acquisition System
4. PLC control system: - ladder logic implementation on real time system.
5. Speed control of DC motor.
6. Demonstration of water level control/Indicator system using PLC.
7. Demonstration of bottle filling plant using PLC.
8. Real Time Temperature / Flow Control using PID Control system.
9. PID control Design, Tuning using suitable Simulation Software
10. Study of Modeling and Analysis of a typical Mechanical System

Text Books:

1. 1. K.P. Ramchandran, G.K. Vijyaraghavan, M.S. Balasundaram, Mechatronics: Integrated
2. Mechanical Electronic Systems, Willey Publication. ISBN: 9788126518371.
3. Bolton, Mechatronics - A Multidisciplinary approach, 4th Edition, Prentice Hall. ISBN 13: 9780132407632.
4. Smaili.A and Mrad.F, "Mechatronics integrated technologies for intelligent machines", Oxford university press, 2008.
5. Nitaigour Premchand Mahalik, Mechatronics-Principles, Concepts and Applications, Tata
6. McGraw Hill, 1stEdition, 2003 ISBN.No. 0071239243, 9780071239240.

Reference Books :

1. Bishop (Editor), Mechatronics – An Introduction, CRC Press, 2006. ISBN 13: 9780849363580.
2. Mahalik, Mechatronics – Principles, concepts and applications, Tata Mc-Graw Hill publication, New Delhi.ISBN 13: 9780070483743.
3. C. D. Johnson, Process Control Instrumentation Technology, Prentice Hall, New Delhi. ISBN-13:978-0134413051.
4. Rajput. R.K, A textbook of mechatronics, S. Chand & Co, 2007.

Course Coordinator: Mr. P P Rathod

BoS Member: Dr. A.P.Kulkarni

BoS Chairman: Dr .D N. Kamble

Applied Thermodynamics (MEUA22202)

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: Thermodynamics, Engineering Mathematics

Course Objectives:

- To apply concepts of thermodynamics to power producing and power absorbing devices in order to understand their functioning and improve their performance.

Course Outcomes:

Upon completion of the course, students will be able to

1. Estimate performance parameters of various thermodynamic cycles.
2. Determine stoichiometric air required for fuel combustion.
3. Use of Psychrometric charts and estimate various properties related to Psychrometry and processes.
4. Analyze flow through nozzles and turbine.
5. Illustrate construction and working of reciprocating air compressor and analyze its performance.
6. Analyze centrifugal air compressor performance.

Unit I : Introduction to I C Engines

Classification of I C Engines, Components of Engines, Two stroke and four stroke engines, Petrol engine, Diesel engine, Alternative fuel, Hybrid engines and comparison. Introduction to soft tools for I C Engines.

Unit II: Combustion Thermodynamics

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy.

Unit III: Psychrometry Basics

Properties of dry and wet air, use of psychometric chart, processes involving heating/cooling and humidification/dehumidification, concept of dew point.

Unit IV: Flow through Nozzle and Steam turbines

Flow of steam nozzle, super saturation- compressible flow in diffusers, efficiency of nozzle and diffuser, Analysis of steam turbines, velocity and pressure compounding of steam turbines.

Unit V: Reciprocating Compressor

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.

Unit VI: Centrifugal Compressors

Classification of compressors, Construction, velocity diagram, flow process on T-S Diagram, Euler's work, slip and slip factor, actual work input, performance characteristics, various losses in

centrifugal compressor, Surging & Chocking.

List of Practical: Any 8 experiment

1. Demonstration of two stroke and four stoke I C Engines
2. Determination of theoretical COP of vapor compression cycle.
3. Determination of calorific value using Bomb calorimeter.
4. Determination of calorific value using Junker gas calorimeter.
5. Measurement of fuel properties such as Flash point, Pour point, Cloud Point.
6. Demonstration of Psychrometric processes.
7. Determination of performance of air Nozzles.
8. Performance test on reciprocating air compressor.
9. Study and trial on centrifugal air compressor and plotting its characteristics
10. Performance estimation of any thermal system using any suitable software.
11. Visit to any processing industry having steam turbine.

Text Books:

1. Y. Cengel & Boles: Thermodynamics – An Engineering Approach, Tata McGraw Hill Publications
2. R. K. Rajput, Engineering Thermodynamics, EVSS Thermo Laxmi Publications
3. P. L Ballany: Thermal Engineering, Khanna Publishers
   C.P. Arora: Engineering Thermodynamics, Tata McGraw Hill Publications

Reference Books :

1. Domkundwar, Thermal engineering, Dhanpat Rai & Co.
2. P. K. Nag, Engineering Thermodynamics, Tata McGraw Hill Publications
3. V. Ganeshan, Internal Combustion engines, Tata McGraw Hill Publications
   0071336648, 9780071336642

Prepared By: Mrs. H Y Kolekar

BOS Member: Dr. A D Kale

BOS Chairman: Dr. D.N. Kamble

Fluid Mechanics and Machines (MEUA22203)

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

Prerequisite: Engineering Mechanics, Engineering Mathematics - I, II & III, Engineering Physics.

Course objectives:

- To understand various fluid properties and learn fluid statics and dynamics.
- To understand the importance of dimensional analysis and energy losses in pipes.
- To obtain the velocity and pressure variations in various types of simple flows
- To analyze the flow in water pumps and turbines.

Course Outcomes:

Upon completion of the course, students will be able to

1. Explain the significance of fluid properties and apply fluid static systems.
2. Apply Continuity and Bernoulli's equations in solving the problems in fluids.
3. Calculate energy losses through various pipes and apply dimensionless numbers in fluid system.
4. Analyze the internal flow through pipe and external flows over the bodies.
5. Evaluate the performance of hydraulic turbines.
6. Evaluate the performance of centrifugal pump.

Unit I–Fluid Properties and Statics

Fluid Properties - Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension.
Fluid Statics – Introduction, Hydrostatics law, Pascal's law, Total pressure, Center of pressure, Buoyancy and floatation. .

Unit II –Fluid Kinematics and Dynamics

Fluid Kinematics – Introduction, flow visualization, flow classifications, Continuity equation,velocity and acceleration, stream function and velocity potential function.
Fluid Dynamics – Introduction, Euler's equation of motion, Bernoulli's equation and its Applications.

Unit III –Flow through pipes and Dimensional Analysis

Flow Through Pipes - Energy losses in pipes, Darcy Weisbach's equation, pipes in series and parallel, siphon, Moody's diagram.

Dimensional analysis – Need, methods, Buckingham's Pi theorem, Dimensionless numbers.

Unit IV- Internal and External Flows

Internal flow – Laminar flow through circular pipe, laminar flow between parallel plates.
External flow – Concept of boundary layer, flow over a flat plate, measure of boundary layer thickness, separation of boundary layer and methods of controlling it, Introduction CFD.

Unit V- Hydraulic Turbines

Pelton wheel – Introduction to impulse momentum principle and turbines, classification of water turbines, working principle heads and efficiencies, velocity triangle and analysis, specific speed and unit quantities.
Francis and Kaplan Turbine – Introduction, working principle, velocity triangles and analysis, comparison.
Draft tube – need and types, cavitations, governing mechanism, selection and performance characteristics.

Unit VI – Centrifugal Pump

Introduction, classification, working principle, heads and efficiencies, velocity triangle and analysis, Pumps in series and parallel, specific speed, minimum starting speed, selection, priming and cavitation, maximum suction lift and NPSH, performance curves.

List of Practical:

Practical consist of **any eight** experiments of the following –

1. Study and Demonstration of pressure measuring devices
2. Determination of viscosity of liquids by using Redwood's viscometer.
3. Verification of modified Bernoulli equation.
4. Determination of stability of floating body.
5. Determination of coefficient of discharge of V notch / Venturimeter.
6. Determination of major/minor losses in various pipes fittings.
7. Laminar and Turbulent flows by Reynolds' apparatus.
8. Verification of impulse momentum principle by using curve vane.
9. Determination of the performance characteristics of Pelton wheel/Francis Turbine.
10. Determination of the performance characteristics of Centrifugal pump.
11. Fly Wheel air flow measurement and analysis with computational tools.
12. Industrial visit to any hydropower plant / pumping station and report based on it.

Text Books:

1. Dr. R. K. Bansal , " Fluid mechanics & Hydraulic machines" , Laxmi Publication Pvt. Ltd. , New Delhi, ISBN : 13: 978-8131808153.
2. Dr. P. M. Modi& Dr. S. M. Seth, "Hydraulics & Fluid Mechanics", Standard Book House, ISBN: 978-81-89401-26-9.
3. Cengel&Cimbla, "Fluid Mechanics" Tata McGraw - Hill.
4. B. U. Pai, "Turbomachnies", Wiley India, ISBN 13: 9788126539550.

Reference Books:

1. V.P. Vasandani, Theory of Hydraulic Machinery Khanna Publishers, Delhi,*ISBN* 10: 0-07-0643419-X.
2. Dr. J. Lal, Hydraulic Machines, Metropolitan Book Co. Pvt. Ltd., Delhi, *ISBN* 10: 0-07-0643419-X.
3. Kundu, Cohen, Dowling, "Fluid Mechanics" Elsevier, India.
4. White, "Fluid Mechanics" Tata McGraw - Hill.

Course Coordinator: Mr. D. B. Nalawade

BoS Member: Dr. S. S.Kore

BoS Chairman: Dr .D N. Kamble

Strength of Materials (MEUA22204)

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: Engineering Mathematics, Engineering Mechanics.

Course Objectives:

1 To provide fundamental knowledge for determination of stress and strain for deformable body.
2 To apply the concept of principal stresses and theories of failure.
3 To draw shear force and bending moment diagram for different beams.
4 To determine bending and shear stress for different beam cross-sections.
5 To determine slope, deflection on beam and energy stored in members.
6 To provide fundamental knowledge to design shaft and column.

Course Outcomes:

Upon completion of the course, students will be able to

1. Analyze the structural members subjected to different stresses using the fundamental concepts.
2. Explain shear force and bending moment distribution across the beam.
3. Investigate the effect beam cross section on bending and shear stresses.
4. Evaluate the strains and deformation due to the elastic stresses developed within the materials.
5. Solve problems relating to torsional deformation of bars and other simple structures.
6. Ability to design and conduct experiments, as well as to analyze and interpret data.

Unit I: Simple Stress and strain

Deformation in solids, stress and strain- tension, compression and shear stress, Hook's law, elastic constants and their relations, volumetric, linear and shear strain, stresses and strains in determinate and indeterminate, homogeneous and composite bars under concentrated loads and self weight, thermal stress and strain.

Unit II: Principal Stresses and Theories of Failure

Normal and shear stresses on any oblique plane. Concept of principal planes, Mohr's circle, Maximum Principal stress theory, Maximum shear stress theory, Maximum Principal strain theory, Maximum strain energy theory.

Unit III: Shear Force and Bending Moment Diagram

Types of beams, shear forces and bending moment diagrams (Cantilever, Simply supported and Overhang beams) subjected to concentrated loads, uniformly distributed loads, uniformly varying loads and couples, Relationship between rate of loading, shear force and bending moment. Maximum bending moment and positions of points of contra-flexure.

Unit IV: Bending and Shear Stress

Bending stresses: Theory of simple bending, assumptions, flexural formula, moment of resistance, section modulus, bending stresses in symmetrical sections. Bending stress distribution diagram (rectangular, I,T).

Shear stresses: Concept, derivation of shear stress distribution formula, shear stress distribution diagram for common symmetrical sections, maximum and average shear stress.

Unit V: Slope and Deflection

Boundary condition, Computation of slopes and deflection in beams for standard cases, deflection of a beam using Macaulay's Method.
Strain Energy: Concept, strain energy stored in the member and stresses due to the gradually applied load, suddenly applied load, impact load.

Unit VI: Torsion and Buckling

Torsion: Theory of torsion and assumptions, stresses in a solid and hollow circular shaft, strength and rigidity criterion for the design of the shaft, power transmitted by a solid and hollow circular shaft, shafts in series and parallel.
Buckling of columns: Concept of buckling of columns, Euler's formula for buckling load for a different column, equivalent length, limitations of Euler's formula, Rankine's formula.

List of Practical: Lab Practice shall consist of the following *any 8* experiments

1. Determination of elongation, stress and strain of a bar using suitable software (Open-source/CAE software)
2. Shear test of ductile material on Universal Testing Machine
3. Principal stresses through the graphical and analytical method.
4. Experimental verification of flexural formula in bending for cantilever beam
5. Experimental verification of flexural formula in bending for simply supported beam
6. Experimental verification of torsion formula for a circular bar
7. Study of Shear force and bending moment diagrams with different end conditions using suitable software (programming language, open-source software etc)
8. Develop a program to determine slope and deflection in standard beams (using MATLAB/Python)
9. Experimental study of buckling of columns with different load conditions

Text Books:

1. S. Ramamurtham and R. Narayanan, "Strength of Materials", 18th Edition, Dhanpat Rai Publication, ISBN: 81-87433-54-X.
2. S.S. Rattan, "Strength of Material", 2nd Edition, Tata McGraw Hill Publication Co. Ltd., ISBN: 978-0-07-107256-4
3. R. K Bansal, "Strength of Materials", 6th Edition, Laxmi Publication, ISBN: 978-81-318-0814-6.
4. S.S. Bhavikatti, "Strength of Materials", Vikas Publishing, 4th Edition ISBN: 9789325971578.
5. Rajput R. K., "Strength of Materials", S. Chand Publication. ISBN-10 : 8188458104

Reference Books :

1. Ferdinand Beer, Jr., E. Russell Johnston, John DeWolf, David Mazurek, 6th Edition, "Mechanics of Materials", Tata McGraw Hill Publication Co. Ltd., ISBN-13: 978-0073380285
2. Timoshenko S. P. and Young D. N., "Strength of Materials", Affiliated East-West Press PVT. LTD. New Delhi, 2006, ISBN: 8176710199.
3. Singer and Pytel, "Strength of Materials", Addison Wesley Publishing Corporation, 1999, ISBN 0 321 04541 6.

Course Coordinator: Mr. N H Ambhore
BoS Member: Dr. P.P.Hujare
BoS Chairman: Dr .D N. Kamble

Manufacturing Technology (MEUA22205)

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

Prerequisite: Engineering Physics, Engineering Chemistry, Engineering Mathematics, Manufacturing Processes and Workshop Practice.

Course objectives: Manufacturing Technology covers the behavior of materials and the processes used to convert raw materials into finished products.
The course emphasizes process selection and sequencing, economics, quality and design for manufacture.

- Evaluate economics of machining processes understanding machining mechanics at different cutting conditions.
- To correlate the material type with the possible fabrication processes
- To describe the operations and tools for major manufacturing processes
- To interpret the knowledge about manufacturing processes, parameters and their effects on performance.

Course Outcomes:
Upon completion of the course, students will be able to-

1. Apply cutting mechanics to metal machining based on cutting force and power consumption.
2. Evaluate economics of machining processes understanding machining mechanics at different cutting conditions.
3. Derive various processes for thread and gear manufacturing.
4. Differentiate grinding and super-finishing processes.
5. Characterize (process parameters and response) of non-conventional machining processes for various applications.
6. Design Jigs and fixtures considering the Principles of locating and clamping devices.

Unit I: Theory of Metal cutting

Mechanics of chip formation, Types of chips, Merchant's circle of forces- Estimation of shear force, Normal shear force, Friction force, Normal friction force, Material Removal Rate (MRR), Cutting power estimation, Calculation of Total power and Specific energy. Mechanics of shearing (orthogonal and oblique), Shear plane angle, Shear stress, strain and Shear strain rate. Single point cutting tool nomenclature, cutting tool materials.
Machinability - Factors affecting machinability, Tool life, Types of tool wear and remedial actions, Cutting fluid and their types, Effect of process parameters on tool life, Taylor's tool life relation.

Unit II: Economics of Metal Cutting

Material removal rate and machining time: Turning, Drilling and Milling operations. Surface finish in machining, Economics of machining operations, Optimizing cutting parameters for minimum cost, Optimizing machining cost for maximum production and optimum cutting speed for maximum efficiency.

Unit III: Thread and Gear Manufacturing

Types of threads, elements and forms of screw threads. Thread cutting processes: by form tool,tapping, die heads, thread milling, thread rolling, thread grinding. Gear teeth forms and tooth terminology.
Gear Manufacturing: Casting, forming by form cutter, broaching, Gear generating Methods-Rack cutter, Pinion cutter, Gear shaping and hobbing processes.
Gear finishing: Gear shaving, Gear burnishing, Gear grinding, gear honing and gear lapping processes.

Unit IV: Grinding and Finishing Process

Introduction to abrasive machining and finishing operations, types of grinding machines, grinding wheel shapes and sizes ,standard marking system, selection of grinding wheel, glazing, dressing, balancing and mounting of grinding wheel, Surface finish in grinding.

Finishing operations: Lapping, Honing and super finishing processes, Polishing, buffing and burnishing processes.

Unit V: Non-Conventional Machining Processes

Introduction, classification of non-conventional machining processes, selection of process parameters and summary of process characteristics. Advantages, limitations and applications of abrasive jet machining (AJM), ultrasonic machining (USM), Electrochemical machining (ECM), electric discharge machining (EDM), electron beam machining (EBM), laser beam machining (LBM) and plasma arc machining (PAM). Comparison of advanced machining processes with conventional machining.

Unit VI: Jigs and fixtures

Definition and concept of Jig and Fixture, General guidelines to design Jigs and fixtures, advantages of jig and fixtures, concept of degrees of freedom,3-2-1 principle of location , Principles of clamping, locating devices. Types of clamps. Materials used for clamping and locating devices.

Types of Jigs: Channel jig, Template jig, Plate jig, Angle plate jig, Turn over jig, Box jig, and Latch jig.

Types of Fixtures: Turning fixture, Welding fixture, Milling fixture, Indexing fixtures. Concept of modular fixture. Pokayoke concept in jigs and fixtures.

Text Books:

1. Hajara Choudhari, Bose S.K. – Elements of workshop Technology Vol. II , Asian Publishing House, ISBN 0713136227
2. M.P Grover – Fundamentals of modern manufacturing: Materials and systems, John Wiley & Sons, Inc, New Jersey, 2010, ISBN 978-0470-467008.
3. R. K. Jain, Production Technology, Khanna Publishers, 16th Edition, 2003.
4. P. C. Sharma, Production Engineering, S. Chand Publication

Reference Books :

1. P. K Mishra, Non- conventional machining, Narosa Publishing House 10.
2. V. K Jain, Advanced machining processes , Allied Publisher, New Delhi 11.
3. Gary F. Benedict, Non – traditional manufacturing processes, Marcel Dekker Inc. 12.
4. M. H. A Kempster, An Introduction to Jig and Tool Design, ELBS 13.
5. P. H. Joshi, Jigs and fixtures , Tata McGraw Hill 14.
6. Black, and Kohser, Materials and Processes in Manufacturing, DeGarmo, John Wiley & Sons, Inc,New York, 2011.
7. Kalpakjian and Schmid - Manufacturing Engineering and Technology, Prentice Hall, New Jersey, 2013
8. Production technology –HMT, Tata McGraw Hill publication

Course Coordinator: Dr. B. S. Rathod

BoS Member: Dr.S .S. Chinchanikar

BoS Chairman: Dr .D N. Kamble

Metrology and Quality Control (MEUA22206)

Teaching Scheme	**Examination**					
Credits: 2 Lectures (L): 1hrs./week Tutorials (T):--- Practical (P): 2hrs./week	CIE	ISE	SCI	ESE	PR/OR/TW	Total
	--	--	--	--	50	50

Course Objectives:

- Select suitable instrument / gauge / method of inspection for determining geometrical and dimensional Measurements.
- Calibrate measuring instruments and design inspection gauges.
- Understand the advances in Metrology such as use of CMM, Laser for Metrology etc.
- Select and apply appropriate Quality Control Technique for given application

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

1. Design Limit gauges considering Allowance and Gauge makers tolerance.
2. Evaluate Dimensional and Geometric Errors using Comparators, Gear and hread.
3. Differentiate Cost of quality and value of quality with a view to Improve Product design using various quality tools.
4. Produce an Inference about Process capability by plotting Process control charts using suitable sampling Plans

Unit I: Standards and Gauges

Principles of Engineering metrology, Measurement standards, Types and sources of errors, Accuracy and Precision. Tolerances, Limits and Fits [IS 919-1993], Taylor's principle, Types of gauges, Wear allowance on gauges, Gauge design numerical.

UnitII: Measurement of Mechanical elements.

Comparators, Measurement of geometric form, Thread form (Major, Minor and Effective diameter, Thread angle and Pitch), Gear Metrology:(Gear form and tooth thickness),Numerical, Introduction to Advanced metrology :Coordinate Measuring Machine&Multi Gauging System.

Unit III: Introduction to Quality Tools

Concept of Quality: Various Definitions and Quality Statements, Cost of quality and value of quality, Deming's cycles & 14 Points, Juran Trilogy approach, Old New Seven Tools, Quality Circles. Importance of Quality deployment at Design and Manufacturing Engineering: Opportunities for improvement product design, Importance of initial planning for quality

Unit IV: Introduction to Statistical Quality Control

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

List of Practical's: - (any Eight)

1. Demonstration of linear and angular measuring instruments, slip gauges and their applications.
2. Error determination of linear / angular measuring instruments and determination of linear and angular dimensions of given part, (MSA: Gauge R & R).
3. Calibration of measuring instrument. Example – Dial gauge, Micrometer, Vernier (any one)
4. Verification of dimensions and geometry of given components using Mechanical /Pneumatic comparator. [An assignment with this experiment write-up as, Introduction to use of Standard CODE viz. ASME-Y14.5, ISO-1101].
5. Machine tool alignment testing on machine tool – Lathe / Drilling / Milling.
6. Demonstration of surfaces inspection using optical flat/interferometers. / Demonstration of surface roughness measurement using surface roughness tester.
7. Determination of geometry and dimensions of given composite object / single point tool, using profile projector and tool maker's microscope.
8. Measurement of spur gear parameters using Gear Tooth Vernier / Span Micrometer / Gear Rolling Tester.
9. Demonstration on Advance Measuring Instrument (CMM, Multi GuagingSystem)
10. Assignment on process capability and Control charts.

Textbooks:

1. Jain R.K., Engineering Metrology, Khanna Publication.
2. I. C. Gupta, Engineering Metrology, Dhanpath Rai.
3. Bewoor A. K. and Kulkarni V. A., Metrology and Measurements, Tata McGraw hill Publication.
4. Grant S.P., Statistical Quality Control, Tata McGraw hill Publication.
5. Mahajan M. Textbook of Metrology Dhanpath Rai. Publications.
6. Ragvendra N V, Engineering Metrology and Measurement, Oxford University Press

Reference Books:

1. Narayana K.L., Engineering Metrology.
2. Galyer J.F &Shotbolt C.R., Metrology for engineers
3. Gupta I.C., Engineering Metrology, Dhanpatrai Publications
4. Judge A.W., Engineering Precision Measurements, Chapman and Hall

Course Coordinator: Mr. A. A. Somatkar

BoS Member: Dr. A.P.Kulkarni

BoS Chairman: Dr .D N. Kamble

Data Analytics (MEUA22207)

Teaching Scheme	Examination Scheme					
Credits: 2 Lectures (L): 1 hr./week Tutorials (T): --hrs. Practical (P): 2 hrs/week	CIE	ISE	SCE	ESE	PR/OR/ TW	Total
	-	-	-	-	50	50

Prerequisites: Engineering Mathematics, Python programming

Course Objectives:

To introduce conceptual understanding using simple and practical examples and make you comfortable using analytics in your career. This course will make you know how to work with real data and choose the right methodology to correctly interpret the result.

Course Outcomes:

Upon completion of the course, students will be able to

1. Apply statistical concepts and probability theory to analyze data that can assist present and future business managers in making better decisions.
2. Develop both one-and two-tailed null and alternative hypotheses and that can be tested in a business setting by examining the rejection and non-rejection regions in light of Type I and Type II errors.
3. Calculate the coefficient of determination and confidence intervals to measure the fit for regression models.

Unit I: Introduction to Data Analytics and Probability Theory

Classification of data analytics, importance of data analytics, levels of data, types of variables, central tendency: mean, mode, percentile, and dispersion: skewness, kurtosis, range, variance, coefficient of variation, probability distributions: Binomial, Poisson, Hypergeometric, Exponential, Normal, and central limit theorem.

Unit II: Sampling Distributions and Hypothesis Testing

Sampling distributions: sample mean, sample proportion and sample variance, Hypothesis testing: p-value, critical value and confidence interval value, type-I and II errors, test for population mean, proportion and variance

Unit III: Regression Analysis

Simple and multiple linear regression: model assumptions, parameter estimation (least square method), test for significance (t and F test).

Practical:

1. Assignment of central tendency and dispersion.
2. Assignment on probability distributions.
3. Assignment on sampling distribution -I.
4. Assignment on sampling distribution - II
5. Assignment on testing of hypothesis for population mean
6. Assignment on testing of hypothesis for population proportion
7. Assignment on testing of hypothesis for population variance
8. Assignment on simple linear regression
9. Assignment on multiple linear regression

Textbooks:
1. Jay L. Devore, Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage Learning, 2010. 2. P.V. Sukhatme, Sampling Theory of Surveys with Applications, Indian Society for Agricultural Statistics, New Delhi. 3. Douglas C. Montgomery, George C. Runger, Applied Statistics and Probability for Engineers, Wiley, Year: 2018, ISBN: 1119409535 4. Ken Black, Business Statistics for Contemporary Decision Making, 6th Edition, Wiley
Reference Books:
1. Douglas C. Montgomery, Design and Analysis of Experiments, John Wiley, Year: 2001 2. Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, Introduction to Linear Regression Analysis, Wiley, 2012

Course Coordinator: Dr. S. C.Chinchanikar

BoS Member: Dr. S. C. Chinchanikar

BoS Chairman: Dr .D N. Kamble