ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

R24 REGULATIONS COURSE STRUCTURE

DEPARTMENT OF MECHANICAL ENGINEERING

Semester III (Second Year)

Sl. No.	Category	Course Code	Course Title	Hours per Week			Credits
				L	T	P	C
1	BS	24AMAT31T	Complex Variables and Partial Differential Equations	3	0	0	3
2	ESC	24AMEC31T	Basic Thermodynamics	3	0	0	3
3	PCC	24AMEC32T	Manufacturing processes	3	0	0	3
4	PCC	24AMEC33T	Mechanics of Solids	3	0	0	3
5	PCC	24AMEC34T	Material Science and Metallurgy	3	0	0	3
6	PCC (LAB)	24AMEC35L	Mechanics of Solids & Materials Science lab	0	0	3	1.5
7	PCC (LAB)	24AMEC32L	Manufacturing processes Lab	0	0	3	1.5
8	SEC	24AMEC36T	Computer-Aided Drafting and Design (with AutoCAD & CATIA)	1	0	2	2
9	MC	24AENS31T	Environmental Science	2	0	0	0
						Total Credits	**20**

Semester IV (Second Year)

Sl. No.	Category	Course Code	Course Title	Hours per Week			Credits
				L	T	P	C
1	HSMC	24AMEC41T	Industrial Management	3	0	0	3
2	BS	24AMAT41T	Probability & Statistics	3	0	0	3
3	HSMC	24AUHV41T	Universal Human Values–II	3	0	0	3
4	PCC	24AMEC42T	Fluid Mechanics & Hydraulic Machines	3	0	3	3
5	PCC	24AMEC43T	Theory of Machines	3	0	0	3
6	PCC	24AMEC44T	Thermal Energy Systems	3	0	0	3
7	PCC (LAB)	24AMEC42L	Fluid Mechanics & Hydraulic Machines Lab	0	0	3	1.5
8	PCC (LAB)	24AMEC43L	Theory of Machines Lab	0	0	3	1.5
9	SEC	24ACSE47L	Python for Data Science	1	0	2	2
						Total Credits	**23**
Mandatory Community Service Project Internship of 08 weeks duration during summer Vacation							

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

DEPARTMENT OF MECHANICAL ENGINEERING

Title of the Course: Industrial Management
Category: HSMC
Semester: IV Semester
Course Code: 24AMEC41T
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To introduce the scope and role of industrial engineering and the techniques for optimal design of layouts
2. To illustrate how work study is used to improve productivity and project management techniques
3. To explain TQM and quality control techniques.
4. To introduce financial and marketing management aspects.
5. To discuss human resource management and value analysis

Course Outcomes:

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

1. Describe the principles and functions of management & Plant layouts.
2. Apply work study methods and project management concepts at Industrial level.
3. Analyze data using control charts to monitor, improve quality and inventory control.
4. Describe various sources of finance, marketing and their implications.
5. Describe human resource management methods.

Unit 1 Introduction & Plant Layout 08

Introduction: Definition of industrial engineering (I.E), development, applications, role of an industrial engineer, differences between production management and industrial engineering, productivity measurement. concepts of management, importance, functions of management, scientific management, Taylor's principles, Fayol's principles of management.

PLANT LAYOUT: Factors governing plant location, types of production, types of layouts, advantages and disadvantages of process layout and product layout, Fixed position layout, applications.

Unit 2 Work Study & Project Management 07

Work Study: Importance, applications, work study, method study and time study(elementary treatment), work sampling, PMTS, micro-motion study, rating techniques, MTM, flow process charts, string diagrams and Therbligs.

Project Management: Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing (simple problems).

Unit 3 Statistical Quality Control & Total Quality Management 07

Statistical Quality Control: Quality control, and its importance, SQC, attribute sampling inspection with single and double sampling, Control charts X and R charts and their applications, simple numerical examples. Inventory, types of Inventories, Inventory control, EOQ, Inventory control techniques, ABC, VED, FSN, SOS, GOLF Analysis.

Total Quality Management: Elements of TQM – Continuous Improvement zero defect concept, quality circles, implementation, applications, ISO quality systems. Six Sigma–definition, basic concepts

Unit 4 Financial Management & Marketing 07

Financial Management: Scope and nature of financial management, Sources of finance, Ratio analysis, Management of working capital, Nature of Investment Decisions – Investment Evaluation criteria- NPV, IRR, PI, Payback Period, and ARR, numerical problems.

Marketing: Functions of Marketing, Marketing Mix, and Marketing Strategies based on Product Life Cycle, Channels of distribution.

Unit 5 Human Resource Management & Value Analysis 06

Human Resource Management: Concept of human resource management, personnel management and industrial relations, functions of personnel management, Job-evaluation, its importance and types, merit rating, quantitative methods, wage incentive plans, and types.

Value Analysis: Value engineering, implementation procedure, enterprise resource planning and supply chain management

Prescribed Textbooks:

1. O.P Khanna, Industrial Engineering and Management, Dhanpat Rai Publications (P) Ltd, 2018
2. Martand Telsang, Industrial Engineering and Production Management, S.Chand & Company Ltd. New Delhi, 2006

Reference Books:

1. M.Mahajan Industrial Engineering and Production Management, Dhanpat Rai & Co (P) Ltd, 2000
2. Bhattacharya DK, Industrial Management, S.Chand, publishers, 2010
3. J.G Monks, Operations Management, 3/e, McGraw Hill Publishers1987
4. T.R. Banga, S.C.Sharma, N. K. Agarwal, Industrial Engineering and Management Science, Khanna Publishers, 2008
5. Koontz O'Donnell, Principles of Management, 4/e, McGraw Hill Publishers, 1968
6. R.C.Gupta, Statistical Quality Control, Khanna Publishers, 1998

Web Resources:

1. https://www.youtube.com/watch?v=ckiMUG2imuM
2. https://youtu.be/4vq0FKWYud8
3. https://youtu.be/zdLWc9zs77Q
4. https://youtu.be/-TDh-5n90vk
5. https://youtu.be/BWbnKgFNcKg
6. https://youtu.be/_iWJzSp_foE

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC41T.1	2	2	2	2	-	-	-	-	-	-	-	2	2
24AMEC41T.2	3	2	2	2	-	-	-	-	-	-	-	1	1
24AMEC41T.3	2	2	2	2	-	-	-	-	-	-	-	1	1
24AMEC41T.4	3	2	2	2	-	-	-	-	-	-	-	2	2
24AMEC41T.5	2	2	2	2	-	-	-	-	-	-	-	2	2

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

DEPARTMENT OF MECHANICAL ENGINEERING

Title of the Course: Probability and Statistics
Category: BS
Semester: IV Semester
Course Code: 24AMAT41T
Branch/es: CE, ME, CSE, AIDS, AIML, CSE(AI), CSE(DS), CSE(AIML), CSE(IOT)

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To introduce the basic concepts and rules of probability.
2. To provide knowledge of common probability distributions and their applications.
3. To familiarize with statistical tools.
4. To conversant with estimation methods and perform hypothesis tests on large samples.
5. To gain knowledge on statistical methods for testing assumptions using small sample sizes.

Course Outcomes:

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

1. Apply the concepts of probability theorems in stochastic process
2. Apply the probability distribution in real life problems
3. Calculate the correlation between two variables
4. Evaluate the hypotheses of large samples
5. Evaluate the hypotheses of small samples

Unit 1 Probability **10**

Probability - axioms of probability – addition theorem of probability - conditional probability-multiplication theorem of probability (without proof) - Baye's theorem.
Random variables - discrete and continuous - Distribution functions - Mean and Variance.

Unit 2 Probability distributions **08**

Probability distributions – Binomial and Poisson distribution - fitting - normal distribution - their properties.

Unit 3 Introduction of statistics **08**

Introduction of Statistics – Mean - Median and Mode for ungrouped and grouped data.
Correlation - correlation coefficient: Karl Pearson's coefficient - Spearman's rank correlation.

Unit 4 Estimation and Testing of hypothesis for large samples **10**

Estimation - Point estimation - Interval estimation of one mean (small and large) - one Proportion (large). Test of Hypothesis: Types of errors, one and two tailed tests, level of significance, single mean -difference of means - single proportion - difference of proportions (large).

Unit 5 Testing of hypothesis for small samples **08**

Student t-distribution test for single mean - two means and paired t-test,
Testing of equality of variances (F-test) - χ^2 test for goodness of fit - χ^2 test for independence of attributes.

Prescribed Textbooks:

1. Miller and Freund, Probability and Statistics for Engineers,7/e, Pearson, 2008.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.

Reference Books:

1. S. Ross, a First Course in Probability, Pearson Education India, 2002.
2. W. Feller, an Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.
3. T. K.V. Iyengar, B. Krishna Gandhi, S. Ranganatham and M.V.S.S.N. Prasad, Probability and Statistics, 2nd edition, S. Chand, 2010.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering tool usage	The engineer and society	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning
24AMAT41T.1	3	2	1	2	-	-	-	-	-	-	-
24AMAT41T.2	3	2	1	2	-	-	-	-	-	-	-
24AMAT41T.3	3	2	1	2	-	-	-	-	-	-	-
24AMAT41T.4	3	3	1	2	-	-	-	-	-	-	-
24AMAT41T.5	3	3	1	2	-	-	-	-	-	-	-

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

DEPARTMENT OF MECHANICAL ENGINEERING

Title of the Course: Universal Human Values-II
Category: HSMC
Semester: IV Semester
Course Code: 24AUHV41T
Branch/es: ME, CSE, CSE(ICB)

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To recognize the vital interplay between values and skills, promoting sustained happiness and prosperity
2. To foster a holistic perspective on life and profession, encouraging value-based living through a clear understanding of human reality and existence
3. To emphasizes the ethical implications of such an understanding, fostering trustful behaviour, fulfilling human interactions, and a harmonious relationship with nature.

Course Outcomes:

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

1. Comprehend the terms like Natural Acceptance, Happiness and Prosperity.
2. Analyze one's self, and one's surroundings (family, society, nature).
3. Apply human values in enriching human relationships and human society.
4. Analyze the need for universal human values and harmonious existence.
5. Evaluate themselves as socially and ecologically responsible engineers.

Unit 1 Introduction to Value Education 12

Lecture1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)
Lecture2: Understanding Value Education
Tutorial 1: Practice Session1: Sharing about oneself
Lecture 3: Self-Exploration as the Process for Value Education
Lecture4: Continuous Happiness and Prosperity – The Basic Human Aspirations
Tutorial 2: Practice Session2: Exploring Human Consciousness
Lecture 5: Happiness and Prosperity – Current Scenario
Lecture 6: Method to Fulfill the Basic Human Aspirations
Tutorial 3: Practice Session3: Exploring Natural Acceptance

Unit 2 Harmony in the Human Being 08

Lecture 7: Understanding Human being as the co-existence of the self and the body.
Lecture 8: Distinguishing between the needs of the self and the body
Tutorial 4: Practice Session4: Exploring the difference of needs of self and body.
Lecture 9: The body as an instrument of the self
Lecture 10: Understanding harmony in the self
Tutorial 5: Practice Session5: Exploring sources of imagination in the self
Lecture 11: Harmony of the self with the body
Lecture 12: Programme to ensure self-regulation and health
Tutorial 6: Practice Session 6: Exploring harmony of self with the body

Unit 3 Harmony in the Family and Society 08

Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session7: Exploring the Feeling of Trust
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session 8: Exploring the Feeling of Respect
Lecture 16: Other Feelings, Justice in Human-to-Human Relationship
Lecture 17: Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session9: Exploring systems to fulfil human goal

Unit 4 Harmony in the Nature/Existence 10

Lecture 19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, Self-Regulation and Mutual Fulfilment among the Four Orders of Nature
Tutorial 10: Practice Session 10: Exploring the Four Orders of Nature
Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session11: Exploring Co-existence in Existence

Unit 5 Implications of the Holistic Understanding – A Look at Professional Ethics 10

Lecture 23: Natural Acceptance of Human Values
Lecture 24: Definitiveness of (Ethical) Human Conduct
Tutorial 12: Practice Session 12: Exploring Ethical Human Conduct
Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture 26: Competence in Professional Ethics
Tutorial 13: Practice Session13: Exploring Humanistic Models in Education
Lecture 27: Holistic Technologies, Production Systems and Management
Models-Typical Case Studies
Lecture 28: Strategies for Transition towards Value-based Life and Profession
Tutorial 14: Practice Session14: Exploring Steps of Transition towards Universal Human Order

Practice Sessions for UNIT I – Introduction to Value Education

PS1 Sharing about Oneself
PS2 Exploring Human Consciousness
PS3 Exploring Natural Acceptance

Practice Sessions for UNIT II – Harmony in the Human Being

PS4 Exploring the Difference of Needs of Self and Body
PS5 Exploring Sources of Imagination in the Self
PS6 Exploring Harmony of Self with the Body

Practice Sessions for UNIT III – Harmony in the Family and Society

PS7 Exploring the Feeling of Trust
PS8 Exploring the Feeling of Respect
PS9 Exploring Systems to fulfil Human Goal

Practice Sessions for UNIT IV – Harmony in the Nature (Existence)

PS10 Exploring the Four Orders of Nature
PS11 Exploring Co-existence in Existence

Practice Sessions for UNIT V – Implications of the Holistic Understanding – a Look at Professional Ethics

PS12 Exploring Ethical Human Conduct
PS13 Exploring Humanistic Models in Education
PS14 Exploring Steps of Transition towards Universal Human Order

Prescribed Textbooks:

1. The Textbook - R R Gaur, R Asthana, G P Bagaria. A Foundation Course in Human Values and Professional Ethics. 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1.

2. The Teacher's Manual - R R Gaur, R Asthana, G P Bagaria. Teachers' Manual for A Foundation Course in Human Values and Professional Ethics. 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books:

1. A. Nagaraj. *Jeevan Vidya: Ek Parichaya.* Jeevan Vidya Prakashan, Amarkantak, 1999.
2. A.N. Tripathi. *Human Values.* New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. Mohandas Karamchand Gandhi. *The Story of My Experiments with Truth*
5. E. F Schumacher. *Small is Beautiful*

Web Resources:

1. https://fdp-si.aicte-india.org/UHV- II%20Class%20Notes%20&%20 Handouts/UHV%20Handout%201Introduction%20to%20Value%20Education.pdf
2. https://fdp-si.aicte-india.org/UHV- II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf
3. https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3S2%20Respect%20July%2023.pdf
4. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf
5. https://fdp-si.aicte-india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%202325%20Ethics%20v1.pdf
6. https://www.studocu.com/in/document/kiet-group-of-institutions/universal-humanvalues/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385https://onlinecourses.swayam2.ac.in/aic22_ge23/preview
7. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf

CO-PO Mapping:

Course outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering tool usage	The engineer and the world	Ethics	Individual and collaborative teamwork	Communication	Project management and finance	Life-long learning
24AUHV41T.1	-	-	-	-	-	-	3	-	1	-	2
24AUHV41T.2	-	-	-	-	-	-	3	-	1	-	2
24AUHV41T.3	-	-	-	-	-	-	3	-	1	-	2
24AUHV41T.4	-	-	-	-	-	-	3	-	1	-	3
24AUHV41T.5	-	-	-	-	-	2	3	-	1	-	2

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

DEPARTMENT OF MECHANICAL ENGINEERING

Title of the Course: Fluid Mechanics and Hydraulic Machines
Category: PCC
Semester: IV Semester
Course Code: 24AMEC42T
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To impart the knowledge of fluid statics and kinematics.
2. To gain knowledge on fluid dynamics.
3. To understand the Hydro Electric power plant and importance of impact of jet on vanes.
4. To familiarize about different types of turbines and their performance characteristics.
5. To acquire knowledge on pumps and their performance characteristics.

Course Outcomes:

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

1. Solve the problems on properties of fluids under static and kinematic conditions.
2. Calculate the properties of fluids and losses in pipes under dynamic conditions.
3. Calculate the force exerted by the jet on vanes at different positions.
4. Solve the problems on performance parameters of different turbines.
5. Calculate the performance of the different types of Hydraulic Pumps.

Unit 1 Fluid Statics & Fluid Kinematics **10**

Dimensions and units: physical properties of fluids- specific gravity, viscosity, Newton's law of viscosity and surface tension vapour pressure - atmospheric gauge and vacuum pressure – measurement of pressure Piezometer, U-tube and differential manometers – Buoyancy (elementary treatment).

Fluid Kinematics: Stream line, path line, streak lines and stream tube, classification of flows-steady & unsteady, uniform & non uniform, laminar & turbulent, rotational & irrotational flows. Equation of continuity for one dimensional flow.

Unit 2 Fluid Dynamics & Closed Conduit Flow **08**

Surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, Applications of Bernoulli's equations- Measurement of flow: Pitot tube, Venturi meter and orifice meter. Momentum equation and its application on force on pipe bend. Vortex flow-Free and forced (Elementary Treatment).

Closed Conduit Flow: Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel.

Unit 3 Boundary Layer **08**

Introduction, momentum integral equation, displacement, momentum and energy thickness, separation of boundary layer.

Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

Unit 4 Hydraulic Turbines **10**

Classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design –draft tube theory- functions and efficiency.

Performance of Hydraulic Turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, water hammer.

Unit 5 Hydraulic Pumps **11**

Classification of pumps. Centrifugal pumps: Working, work done – manometric head, losses and efficiencies, specific speed, pumps in series and parallel. Performance - characteristic curves, NPSH.
Reciprocating Pumps: Working, Discharge, slip, ideal indicator diagram.

Prescribed Textbooks:

1. Fluid Mechanics and Hydraulic machines by Dr. R.K. Bansal latest edition November 2023
2. Hydraulics and Fluid Mechanics including Hydraulic Machines by Dr. P.N. Modi and Dr. S.M. Seth latest edition January 2019

Reference Books:

1. D.S. Kumar, Fluid Mechanics and Fluid Power Engineering. Kotaria & Sons – 2013 edition
2. D. Rama Durgaiah, Fluid Mechanics and Machinery. New Age International, 1st edition – 2002
3. Banga & Sharma, Hydraulic Machines. Khanna Publishers.
4. James W. Dally, William E. Riley, Instrumentation for Engineering Measurements. John Wiley & Sons Inc, 2nd edition – 2010

Web Resources:

1. https://www.youtube.com/watch?v=whCu4Xl3m98
2. https://www.youtube.com/watch?v=DW4rItB20h4
3. https://www.youtube.com/watch?v=GgVCTNCwfQk
4. https://www.youtube.com/watch?v=GQHCnWl2U6I
5. https://www.youtube.com/watch?v=LCzIk0VDVQc

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
24AMEC42T.1	3	2	2	2	-	-	-	-	-	-	-	2	2
24AMEC42T.2	3	2	2	2	-	-	-	-	-	-	-	1	2
24AMEC42T.3	3	2	2	2	-	-	-	-	-	-	-	2	2
24AMEC42T.4	3	2	3	2	-	-	-	-	-	-	1	2	2
24AMEC42T.5	3	2	3	2	-	-	-	-	-	-	1	2	2

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

DEPARTMENT OF MECHANICAL ENGINEERING

Title of the Course: Theory of Machines
Category: PCC
Semester: IV Semester
Course Code: 24AMEC43T
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To know the various basics related to simple mechanisms and their inversions.
2. To understand the velocity and acceleration in simple mechanisms and also effects of gyroscopic couple.
3. To familiarize the different gears and gear trains.
4. To apply the different balancing methods for rotating and reciprocating masses.
5. To understand the different vibrations and its natural frequencies for single degree of freedom system.

Course Outcomes:

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

1. Analyze different mechanisms, inversions of different kinematic chains and mobility of mechanisms
2. Analyze the velocity and acceleration diagrams of simple plane mechanisms by using relative velocity method and understand the effects of gyroscopic principle.
3. Analyze the phenomenon of interference in gears and velocity ratio of gear trains.
4. Estimate the balancing masses for rotating and reciprocating members in automotive applications.
5. Analyze the natural frequencies of mechanical systems based on governing equations.

Unit 1 Simple Mechanisms **09**

Kinematic Link-Types of Links-Types of constraint motions-Classification of Kinematic Pairs – Kinematic Chain-Degree of freedom – Grashof's Law-Inversions of four bar chain, single and double slider crank mechanisms- Description of straight-line mechanisms – Peacellier and Harts mechanism- Steering gear mechanism: Ackerman, Davis steering mechanisms.

Unit 2 Velocity and Acceleration analysis, Gyroscope **10**

Velocity and Acceleration analysis: Velocity analysis of simple mechanisms using relative velocity method-rubbing velocity– Acceleration analysis of simple mechanisms – four bar chain – single slider crank chain - Coriolis component of acceleration

Gyroscope: Principle of gyroscope-gyroscopic couple- gyroscopic effect in an aero plane, ship- simple Problems.

Unit 3 Gears & Gear trains **09**

Gears: Gear terminology-classification of toothed wheels -Involute and cycloidal gear profiles- law of gearing – interference in involute gears -Length of path of contact- arc of contact- contact ratio.

Gear Trains: Types of gear trains –epicyclic gear trains-simple problems.

Unit 4 Balancing of Rotating masses & Balancing of Reciprocating masses **10**

Balancing of Rotating masses: Need for balancing, balancing of single mass and several masses indifferent planes, using analytical and graphical methods.

Balancing of Reciprocating masses: Primary and Secondary balancing of reciprocating masses – graphical Method – balancing of locomotives – variation of tractive force, swaying couple, hammer blow.

Unit 5 Vibrations **09**

Introduction-Types of vibratory motion-Types of free vibrations-Natural frequency of free longitudinal vibrations-equilibrium method and energy method –Transverse vibrations –Dunkerly's method-Whirling speed of shafts- simple systems (Cantilever and Simply supported beams).

Torsional vibrations - Natural frequency of torsional vibration- Single rotor, and Two-rotor system.

Prescribed Textbooks:

1. P.L. Ballaney, Theory of Machines & Mechanisms, 25/e, Khanna Publishers.
2. S.S. Rattan, Theory of Machines, 4/e, Tata McGraw Hill.

Reference Books:

1. J.E. Shigley, Theory of Machines and Mechanisms, 4/e, Oxford.
2. R.S.Khurmi &J.K.Gupta, Theory of Machines, S. Chand Publications.
3. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, .
4. Jagadishlal, Theory of Mechanisms and Machines, Metropolitan Company Pvt Ltd.
5. R.K.Bansal, Theory of Machines, Lakshmi Publications.

Web Resources:

1. NPTEL :: Mechanical Engineering - Theory Of Mechanisms
2. Theory of Machine 02 | Simple Mechanism Part-2 - Question Practice Series | Abhyas | ME | GATE
3. Lecture 26: Analytical Velocity Analysis – III
4. Lecture 42 : Gears: Basic Concepts
5. Module 4 Lecture 1 Balancing of Single Slider Machines
6. NPTEL :: Mechanical Engineering - Mechanical Vibrations

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Engineering Tool usage	The Engineer and The World	Ethics	Individual and Collaborative team work	Communication	Project management and finance	Life-long learning	**PSO 1**	**PSO 2**
24AMEC43T.1	3	3	2	2	-	-	1	-	1	-	1	1	2
24AMEC43T.2	3	3	2	2	-	-	1	-	1	-	1	3	2
24AMEC43T.3	3	3	2	2	-	-	1	-	1	-	1	2	1
24AMEC43T.4	3	3	2	2	-	-	1	-	1	-	1	2	3
24AMEC43T.5	3	3	2	2	-	-	1	-	1	-	1	1	2

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

DEPARTMENT OF MECHANICAL ENGINEERING

Title of the Course: **Thermal Energy Systems**
Category: PCC
Semester: IV Semester
Course Code: 24AMEC44T
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
3	0	0	3

Course Objectives:

1. To familiarize about the Rankine cycle used for steam power plant & steam boilers.
2. To impart knowledge on the working of nozzles and condensers used in steam power plants.
3. To impart knowledge on the working of steam turbines.
4. To understand the principle and operation of various Refrigeration methods.
5. To acquire knowledge on different Psychometric Processes & Air conditioning systems.

Course Outcomes:

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

1. Calculate the efficiency of Rankine cycle and summarize the working of different boilers used in steam power plant.
2. Analyze the flow through Nozzles and condensers used in steam power plant.
3. Solve the performance parameters of Steam Turbines.
4. Explain various refrigeration methods for specific uses.
5. Analyze various heat load concepts using RSHF and GSHF using psychrometric processes for different air conditioning systems.

Unit 1 Introduction to steam power plant **10**

Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance – Regeneration – reheating.

Boilers: Classification based on Working principles - Fire tube and water tube boilers – High pressure Boilers.

Unit 2 Steam Nozzles & Condensers **10**

Steam Nozzles: Function of nozzle – applications - types, Flow through nozzles, thermodynamic analysis – assumptions -velocity of nozzle at exit- Ideal and actual expansion in nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio.

Condensers: Requirements of steam condensing plant, rare fraction – Classification of condensers – working principle of different types – vacuum efficiency and condenser efficiency – air leakage, sources and its effects.

Unit 3 Steam Turbines **10**

Classification of steam turbines -impulse turbine and reaction turbine -compounding of turbines - velocity diagrams for impulse and reaction turbines, efficiency, degree of reaction - governing of turbines.

Unit 4 Refrigeration **12**

Introduction: Refrigeration, Necessity and applications – Unit of refrigeration and C.O.P. – Different refrigeration methods.

Air Refrigeration: Bell Coleman Cycle-Simple air-cooling system- Refrigeration needs of Air craft.

Vapour Compression Refrigeration: Basic cycle - working principle and essential components of the plant –

COP – Expander vs. Throttling, effect of sub cooling and super heating – numerical Problems.
Vapour Absorption Refrigeration System: Description and working of NH_3- water system, Li Br –water (Two shell) System, Principle of operation of three Fluid absorption systems, properties of common refrigerants.

Unit 5 Air Conditioning **12**

Psychometric Properties & Processes – Need for Ventilation, Consideration of Infiltrated air – Heat Load concepts: RSHF, GSHF- Problems. Requirements of human comfort and concept of Effective Temperature-Comfort chart –Comfort Air Conditioning-Summer, winter & year-round air-conditioning systems (elementary treatment).

Prescribed Textbooks:

1. Thermal Engineering, R.K. Rajput, S.Chand & Co., 10th edition 2020, Laxmi publications, ISBN-9788131808047
2. Refrigeration and Air Conditioning by C P Arora, 4th Edition 2021. ISBN-13 : 978-9390385843

Reference Books:

1. Thermodynamics: An Engineering Approach, Cengel .Y.A and Boles M.A, 5/e, McGraw-Hill, 9th Ed 2019, ISBN-13: 978-9339221652
2. A Textbook of Thermal Engineering by R. S Khurmi & JS Gupta, S.Chand, 16th Ed.2020, ISBN 9788121925730
3. A Course In Refrigeration And Air-Conditioning By Domkundwar, Arora, Domkundwar, 2022. ISBN-13 : 978-1111644475
4. A text book of Refrigeration and Air Conditioning by R.K Rajput , S K Kataria & sons, 3rd Edition 2015. ISBN-13 : 978-93-5014-255-4

Web resources:

1. https://archive.nptel.ac.in/courses/112/107/112107291/
2. https://youtu.be/DuLFDzQVTU4
3. https://youtu.be/h1Yt4ibYXfA
4. https://archive.nptel.ac.in/courses/112/107/112107216/
5. https://archive.nptel.ac.in/courses/112/105/112105128/

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
24AMEC44T.1	3	3	2	3	-	-	-	-	-	-	1	2	1
24AMEC44T.2	3	2	2	2	-	-	-	-	-	-	1	2	1
24AMEC44T.3	3	3	2	3	-	-	-	-	-	-	1	2	1
24AMEC44T.4	3	2	2	1	-	-	-	-	-	-	2	2	2
24AMEC44T.5	3	3	2	3	-	-	-	-	-	-	2	2	3

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

DEPARTMENT OF MECHANICAL ENGINEERING

Title of the Course: Fluid Mechanics and Hydraulic Machines Lab
Category: PCC (LAB)
Semester: IV Semester
Course Code: 24AMEC42L
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:

1. To provide knowledge in verifying Bernoulli's Theorem.
2. To impart knowledge in fluid flow measuring devices like Venturimeter & Orifice meter.
3. To understand frictional losses in pipes with various diameters.
4. To understand impact of jet on vanes like flat vane & semicircular vane.
5. To acquire knowledge about various hydraulic machines like centrifugal pump, reciprocating pump, Pelton wheel, Francis turbine, Kaplan turbine etc.

Course Outcomes:

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

1. Apply the Bernoulli's Theorem for different flow channels.
2. Calculate the flow rate of fluids by the instruments like Venturimeter and Orificemeter.
3. Calculate the frictional losses in pipes.
4. Evaluate impact of jet on vanes like Flat vane & Semi-circular vane.
5. Evaluate different performance parameters of hydraulic machines like pumps and turbines.

List of Experiments:

1. Verification of Bernoulli's Theorem
2. Flow Through Venturimeter
3. Flow Through orifice meter
4. Determination of frictional losses in a given pile line.
5. Determination of loss of head due to sudden contraction in a pipeline.
6. Performance Test on Single Stage Centrifugal Pump
7. Performance Test on Multi Stage Centrifugal Pump.
8. Performance Test on Reciprocating Pump.
9. Impact of Jet on Vanes.
10. Performance Test on Pelton Wheel.
11. Performance Test on Francis Turbine.
12. Performance Test on Kaplan Turbine.
13. Turbine flow meter.

Note: Any 10 of the above 13 experiments are to be conducted.

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
24AMEC42L.1	3	2	2	2	-	-	-	1	-	-	-	2	1
24AMEC42L.2	3	2	2	2	-	-	-	1	-	-	-	2	1
24AMEC42L.3	3	2	2	2	-	-	-	1	-	-	-	2	1
24AMEC42L.4	3	3	2	3	-	-	-	1	-	-	1	2	2
24AMEC42L.5	3	3	2	3	-	-	1	1	-	-	1	2	2

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

DEPARTMENT OF MECHANICAL ENGINEERING

Title of the Course: Theory of Machines Lab
Category: PCC (LAB)
Semester: IV Semester
Course Code: 24AMEC43L
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
0	0	3	1.5

Course Objectives:

1. To understand the fundamentals of the theory of kinematics and dynamics of machines.
2. To understand techniques for studying motion of machines and their components.
3. To understand the vibrational behaviour of systems, principles of gyroscope and governors.

Course Outcomes:

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

1. Analyze the different inversions of mechanisms.
2. Apply the principles of gyroscopic effects and stabilization on various transport vehicles.
3. Analyze the characteristics of governors.
4. Analyze the vibration parameters of different systems.
5. Analyze Tribological behaviour of materials.

List of Experiments:

1. To study inversion of four Bar Mechanism, single slider crank chain mechanism and Double slider crank chain mechanism.
2. To find experimentally the Gyroscopic couple on Motorized Gyroscope and compare with applied couple.
3. Determination of characteristic curves of Watt Governor.
4. To study various types of Cam and Follower arrangement.
5. To determine critical speed or whirling speed of a rotating shaft and to verify the value theoretically.
6. Forced vibrations of a spring-mass system.
7. Determination of Torsional natural frequency of two rotor system.
8. Determination of damped natural frequency of Torsional vibrating system.
9. To perform the experiment of Balancing of rotating parts and find the unbalanced couple and forces.
10. To determine the Tribological properties (wear rate and coefficient of friction) of materials.
11. Determination of characteristic curves of Proell Governor

Note: Any 10 experiments need to be performed

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
24AMEC43L.1	3	3	2	3	-	-	1	-	-	-	-	3	3
24AMEC43L.2	3	3	2	3	-	-	-	-	-	-	-	3	3
24AMEC43L.3	3	3	2	3	-	-	-	-	-	-	-	2	2
24AMEC43L.4	3	3	2	3	-	-	-	-	-	-	-	3	3
24AMEC43L.5	3	3	2	3	-	-	-	-	-	-	-	2	2

ANNAMACHARYA UNIVERSITY

EXCELLENCE IN EDUCATION; SERVICE TO SOCIETY

(ESTD, UNDER AP PRIVATE UNIVERSITIES (ESTABLISHMENT AND REGULATION) ACT, 2016)

DEPARTMENT OF MECHANICAL ENGINEERING

Title of the Course: Python for Data Science
Category: SEC
Semester: IV Semester
Course Code: 24ACSE47L
Branch/es: Mechanical Engineering

Lecture Hours	Tutorial Hours	Practice Hours	Credits
1	0	2	2

Course Objectives:

1. To develop proficiency in Python programming and NumPy for numerical computing
2. To utilize Pandas for data analysis and Create insightful visualizations

Course Outcomes:

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

1. Write python programs using the core concepts like Lists, Dictionaries, sets, tuple, functions.
2. Demonstrate various mathematical operations on arrays using NumPy
3. Analyze and manipulate Data using Pandas
4. Create and customize fundamental 2D plots using Matplotlib
5. Plot customization 3D visualization.

Unit 1 Introduction to Python **09**

Data Types: Strings, Numbers, Booleans, Date and Time, Lists, Tuples, Dictionaries, Operators, Conditional Statements, Loops, Functions.

Unit 2 Introduction to NumPy **07**

The Basics of NumPy Arrays, Computation on NumPy Arrays: Universal Functions, Aggregations: Min, Max, and Everything in Between, Computation on Arrays: Broadcasting, Comparisons, Masks, and Boolean Logic, Fancy Indexing, Sorting Arrays.

Unit 3 Data Manipulation with Pandas **07**

Introducing Pandas Objects, Data Indexing and Selection, Operating on Data in Pandas, Handling Missing Data, Hierarchical Indexing, Combining Datasets: Concat and Append, Combining Datasets: Merge and Join, Aggregation and Grouping Planets Data.

Unit 4 Visualization with Matplotlib **07**

Two Interfaces for the Price of One, Simple Line Plots, Simple Scatter Plots, Visualizing Errors, Density and Contour Plots, Histograms, Binnings, and Density.

Unit 5 Advanced Customization and 3D Visualization **06**

Customizing Plot Legends, Customizing Colorbars, Multiple Subplots, Text and Annotation, Customizing Ticks, Customizing Matplotlib: Configurations and Stylesheets, Three-Dimensional plotting in Matplotlib.

Prescribed Textbooks:

1. Python Data Science Handbook: Essential Tools for Working with Data, JakeVanderPlas, O'reilly publications, 2016.

Reference Books:

1. Python® for Programmers -PaulDeitel, HarveyDeitel, Pearson Education, Inc,2019
2. Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data- David Dietrich, Barry Heller, Beibei Yang, Published by John Wiley & Sons, Inc, 2015

CO-PO Mapping:

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	**PSO1**	**PSO2**
24ACSE47L.1	3	3	2	3	1	-	-	-	-	-	-	2	2
24ACSE47L.2	3	3	2	3	2	-	-	-	-	-	-	1	2
24ACSE47L.3	3	3	2	3	2	-	-	-	-	-	-	2	2
24ACSE47L.4	3	3	2	3	2	-	-	-	-	-	-	2	2
24ACSE47L.5	3	3	2	3	2	-	-	-	-	-	-	1	2