Curriculum for B.E Degree Course in

MECHANICAL ENGINEERING

Regulation 2024

CHENNAI INSTITUTE OF TECHNOLOGY

Document Version

Version Number	Date	Author	Major Updates	Approved by
1	24.04.2024	Dr J Rajaparthiban	I, II and III Semester-Revised Mathematics Syllabus	
2.	30.04.2024	Dr J Rajaparthiban	Added: NCC and Design Thinking	

Section 1: General Course Structure

A. Definition of Credit:

1 Hour Lecture (L) per week	1 Credit
1 Hour Tutorial (T) per week	1 Credit
1 Hour Practical (P) per week	0.5 Credit

B. Structure of Program

S. No.	Category	Credits
1	Humanities & Social Science Courses (HSMC)	10
2	Basic Science Courses (BSC)	24
3	Engineering Science Courses (ESC)	24
4	Program Core Courses (PCC)	68
5	Professional Elective Courses (PEC)	18
6	Open Elective Courses (OEC)	6
7	Employability Enhancement Skills (EES)	19
8	Mandatory Course (MC)	0
	TOTAL	**169**

C. Course code and definition

Code	Definition
L	Lecture
T	Tutorial
P	Practical
C	Credits

- **Course level coding scheme:** Four-digit number used as suffix with the Course de for identifying the level of the course. Thousand's place denotes regulation number (we use "3" for 2022-23 Regulation) Digit at hundred's place signifies the semester in which course is offered. Last two digits represent the serial order of course within the semester. For example, 3101, 3102, … are courses offered during first semester.

D. Category-wise Courses

Humanities & Social Science Courses (HSMC)

S. No.	Course Title	Semester	L-T-P-C
1	HS4101 தமிழர் மரபு / Heritage of Tamils	1	1-0-0-1
2	HS4102-Communicative English – I	1	3-0-2-4
3	HS4201- தமிழரும் தொழில் நுட்பமும்/ Tamils and Technology	2	1-0-0-1
4	HS4202-Communicative English – II	2	3-0-2-4
	Total Credits		**10**

Basic Science Courses (BSC)

S. No.	Course Title	Semester	L-T-P-C
1	MA4101 Mathematics – I Calculus and Linear Algebra	1	3-1-0-4
2	PH4101-Engineering Physics	1	3-0-2-4
3	MA4201 Mathematics – II Probability and Statistics	2	3-1-0-4
4	PH4201-Material Science	2	3-0-2-4
5	MA4301 Mathematics – III Mathematical Methods for Engineering	3	3-1-0-4
6	MA4401 Mathematics-IV Numerical Methods	4	3-1-0-4
		Total Credits	**24**

Engineering Science Courses (ESC)

S. No.	Course Title	Semester	L-T-P-C
1	CS4111-Problem Solving Using C Programming	1	3-0-2-4
2	ME4102-Engineering Graphics	1	2-0-4-4
3	ME4101-Engineering Mechanics	1	3-1-0-4
4	CS4212-Problem Solving Using Python Programming	2	3-0-2-4
5	EE4211-Fundamentals of Electrical and Electronics Engineering	2	3-0-2-4
6	ME4307-Object Oriented Programming	3	3-0-2-4
		Total Credits	**24**

Program Core Courses (PCC)

S. No.	Course Title	Semester	L-T-P-C
1	ME4201-Manufacturing Technology-I	2	3-0-2-4
2	ME4301-Engineering Thermodynamics	3	3-0-0-3
3	ME4302-Fluid Mechanics and Machinery	3	3-0-2-4
4	ME4303-Manufacturing Technology-II	3	3-0-2-4
5	ME4304-Solid Mechanics	3	3-0-2-4
6	ME4305-Core Course Project – I	3	0-0-2-1
7	ME4401-Design of Machine Elements	4	3-0-0-3
8	ME4402-Engineering Metallurgy	4	3-0-0-3
9	ME4403-Mechanics of Machines	4	3-0-2-4
10	ME4404-Thermal Engineering	4	3-0-2-4
11	ME4405-Welding Technology	4	2-1-2-4
12	ME4406-Core Course Project – II	4	0-0-2-1
13	ME4501-Design of Transmission Systems	5	3-0-0-3
14	ME4502-Heat and Mass Transfer	5	3-0-0-3
15	ME4503-Product Life Cycle Management	5	3-0-2-4
16	ME4504-Core Course Project – III	5	0-0-2-1
17	ME4601-Mechatronics	6	3-0-0-3

18	ME4602-Finite Element Analysis	6	3-0-2-4
19	ME4603-Computer Aided Design and Manufacturing	6	3-0-2-4
20	ME4701-Process Planning and Cost Estimation	7	2-0-0-2
21	ME4702-Automobile Engineering	7	2-0-0-2
22	ME4703-Industrial Internet of Things	7	3-0-0-3
		Total Credits	**68**

Professional Elective courses

S. No.	Course Title	Semester	L-T-P-C
1	ME4VXX-Professional Elective – I	V	3-0-0-3
2	ME4VXX-Professional Elective – II	V	3-0-0-3
3	ME4VXX-Professional Elective – III	V	3-0-0-3
4	ME4VXX-Professional Elective – IV	VI	3-0-0-3
5	ME4VXX-Professional Elective – V	VI	3-0-0-3
6	ME4VXX-Professional Elective – VI	VII	3-0-0-3
		Total Credits	**18**

Open Elective Courses (OEC)

S. No.	Course Title	Semester	L-T-P-C
1	ME46OX-Open Elective – I	VI	3-0-0-3
2	ME47OX-Open Elective – II	VII	3-0-0-3
		Total Credits	**6**

Mandatory Course (MC)

S. No.	Course Title	Semester	L-T-P-C
1	MC43XX-Mandatory Course-I	III	2-0-0-0
2	MC44XX-Mandatory Course-II	IV	2-0-0-0
		Total Credits	**0**

Employability Enhancement Skills (EES)

S. No.	Course Title	Semester	L-T-P-C
1	ES4101-Employability Enhancement Skills – I	I	0-0-2-1
2	ES4202-Employability Enhancement Skills – II	II	0-0-2-1
3	ES4303-Employability Enhancement Skills – III	III	0-0-2-1
4	ES4404-Employability Enhancement Skills – IV	IV	0-0-2-1
5	ES4505-Employability Enhancement Skills – V	V	0-0-2-1
6	ME4604-Mini Project	VI	0-0-4-2
7	ME4704-Internship	VII	0-0-4-2
8	ME4705-Project Phase I	VII	0-0-10-5
8	ME4801-Project Phase II	VIII	0-0-10-5
		Total Credits	**19**

E. Induction Program

- ***Catapult*** is a dynamic week-long event designed for our incoming first-year students, offering an immersive introduction to the diverse array of clubs and activities across the college campus. In addition to familiarizing them with our labs and Centers of Excellence (COEs), Catapult aims to acclimate first-year students to college life, ensuring they feel at ease with the forthcoming experiences of their four-year journey.
- This initiative fosters meaningful connections between seniors and juniors, providing a platform for them to explore departmental projects and engage in collaborative activities, thereby enhancing camaraderie and knowledge sharing within the college community.

F. Evaluation Scheme

a. For Theory Courses:

The weightage of Internal assessment is 40% and for End Semester Exam is 60% The student has to obtain at least 50% marks individually both in internal assessment and end semester exams to pass

b. For Practical Courses:

The weightage of Internal assessment is 60% and for End Semester Exam is 40% For Theory cum Lab

The student has to obtain at least 50% marks individually both in internal assessment and end semester exams to pass.

c. For Theory Cum Practical Courses:

The weightage of Internal assessment is 50% and for End Semester Exam is 50% The student has to obtain at least 50% marks individually both in internal assessment and end semester exams to pass

Note: The internal assessment is based on the student's performance in 3 Internal Assessment (IA) exams, quizzes, assignments, class performance, attendance, etc.

d. For Project works:

Assessment of project works comprises three internal reviews and an end-of-semester evaluation. Internal reviews, worth 40 marks in total, encompass assessment criteria such as Project Synopsis/Proposal Evaluation, Methodology and Design of Existing System, Feasibility of Project Proposal, Planning of Project Work, and Team Work. At the conclusion of the semester, 20 marks are designated for assessing the quality of the report, while the remaining 40 marks are reserved for evaluating performance in viva-voce, demonstration of the work, and other relevant factors.

G. Learning Beyond Class Room

a. Students should be encouraged to visit Centers of Excellence (COEs) in the campus and learn additional technical skills

b. Students should be encouraged to participate in internal / external competitions, hackathons, etc. on a regular basis

Section 2: Semester wise Structure and Curriculum for B.E in Mechanical Engineering

Semester I							
S. No	**Theory / Practical/ T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	T	HS4101	தமிழர் மரபு /Heritage of Tamils	1	0	0	1
2	T	MA4101	Mathematics – I Calculus and Linear Algebra	3	1	0	4
3	T	ME4101	Engineering Mechanics	3	1	0	4
4	T/P	HS4102	Communicative English – I	3	0	2	4
5	T/P	PH4101	Engineering Physics	3	0	2	4
6	T/P	CS4111	Problem Solving Using C Programming	3	0	2	4
7	T/P	ME4102	Engineering Graphics	2	0	4	4
	P	ES4101	Employability Enhancement Skills – I	0	0	2	1
						Total	**26**

Semester II							
S. No	**Theory/ Practical/ T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	T	HS4201	தமிழரும் தொழில் நுட்பமும் /Tamils and Technology	1	0	0	1
2	T	MA4201	Mathematics – II Probability and Statistics	3	1	0	4
3	T&P	ME4201	Manufacturing Technology-I	3	0	2	4
4	T&P	CS4212	Problem Solving Using Python Programming	3	0	2	4
5	T&P	EE4211	Fundamentals of Electrical and Electronics Engineering	3	0	2	4
6	T&P	PH4201	Material Science	3	0	2	4
7	T&P	HS4202	Communicative English – II	3	0	2	4
8	P	ES4202	Employability Enhancement Skills – II	0	0	2	1
9			NCC Credit Course: Level 1 Army	2	0	0	2*
						Total	**26**

*NCC Credit Course is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

Semester III							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	T	MA4301	Mathematics – III Mathematical Methods for Engineering	3	1	0	4
2	T	ME4301	Engineering Thermodynamics	3	0	0	3
3	T	MC43XX	Mandatory Course-I	2	0	0	0
4	T&P	ME4302	Fluid Mechanics and Machinery	3	0	2	4
5	T&P	ME4303	Manufacturing Technology-II	3	0	2	4
6	T&P	ME4307	Object Oriented Programming	3	0	2	4
7	T&P	ME4304	Solid Mechanics	3	0	2	4
8	P	ME4305	Core Course Project – I	0	0	2	1
9	P	ES4303	Employability Enhancement Skills – III	0	0	2	1
						Total	**25**

Semester IV							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	T	MA4401	Mathematics – IV Numerical Methods	3	1	0	4
2	T	ME4401	Design of Machine Elements	3	0	0	3
3	T	ME4402	Engineering Metallurgy	3	0	0	3
4	T	MC44XX	Mandatory Course-II	2	0	0	0
5	T&P	ME4403	Mechanics of Machines	3	0	2	4
6	T&P	ME4404	Thermal Engineering	3	0	2	4
7	T&P	ME4405	Welding Technology	2	1	2	4
8	P	ME4406	Core Course Project – II	0	0	2	1
9	P	ES4404	Employability Enhancement Skills – IV	0	0	2	1
10			NCC Credit Course: Level 2 Navy	2	0	0	2*
						Total	**24**

*NCC Credit Course is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

Semester V							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	T	ME4501	Design of Transmission Systems	3	0	0	3
2	T	ME4502	Heat and Mass Transfer	3	0	0	3
3	T	ME4VXX	Professional Elective – I	3	0	0	3
4	T	ME4VXX	Professional Elective – II	3	0	0	3
5	T	ME4VXX	Professional Elective – III	3	0	0	3
6	T & P	ME4503	Product Life Cycle Management	3	0	2	4
7	P	ME4504	Core Course Project – III	0	0	2	1
8	P	ES4505	Employability Enhancement Skills – V	0	0	2	1
						Total	**21**

Semester VI							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	T	ME4601	Mechatronics	3	0	0	3
2	T	ME4VXX	Professional Elective – IV	3	0	0	3
3	T	ME4VXX	Professional Elective – V	3	0	0	3
4	T	ME46OX	Open Elective Course-I	3	0	0	3
5	T&P	ME4602	Finite Element Analysis	3	0	2	4
6	T&P	ME4603	Computer Aided Design and Manufacturing	3	0	2	4
7	P	ME4604	Mini Project	0	0	4	2
8			NCC Credit Course : Level 3 Air Force	2	0	0	2*
						Total	**22**

* NCC Credit Course is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

Semester VII							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	T	ME4701	Process Planning and Cost Estimation	2	0	0	2
2	T	ME4702	Automobile Engineering	2	0	0	2
3	T	ME4703	Industrial Internet of Things	3	0	0	3
4	T	ME4VXX	Professional Elective – VI	3	0	0	3
5	T	ME47OX	Open Elective - II	3	0	0	3
6	P	ME4704	Internship	0	0	4	2
7	P	ME4705	Project Phase I	0	0	10	5
						Total	**20**

Semester VIII							
S. No	**Theory/ Practical / T&P**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	P	ME4801	Project Phase II	0	0	10	5
						Total	**5**

Course Code	MATHEMATICS – I	L	T	P	C
MA4101	CALCULUS AND LINEAR ALGEBRA	3	1	0	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To familiarize the students with differential calculus.
- To acquire the knowledge of evaluating integrals and their applications.
- To introduce the concept of ordinary differential equations in engineering problems.
- To develop the use of matrix algebra techniques for practical applications.
- To acquire the knowledge of vector spaces and linear transformation in all engineering disciplines.

UNIT I: DIFFERENTIAL CALCULUS 12

Representation of a function - Limits - Continuity – Derivatives- Mean Value theorem - Rolle's theorem - Maclaurin series - Partial derivatives - Total derivatives - Taylors series - Maxima and minima.

UNIT II: INTEGRAL CALCULUS 12

Multiple Integration: Double and Triple integrals - Change of order of integration in double integrals - Change of variables (Cartesian to polar) -Volume of solids - Gradient - Curl - Divergence - Theorems of Green in a plane - Gauss and Stokes theorems (Excluding Proof).

UNIT III: DIFFERENTIAL EQUATIONS 12

First order linear and nonlinear differential equations - Higher order linear differential equations with constant coefficients - Method of Variation of Parameters - Cauchy's and Legendre's equations - Solution of partial differential equations.

UNIT IV: LINEAR ALGEBRA 12

Matrices: Determinants - rank of a matrix - System of linear equations (Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan) - Eigen Values - Eigen Vectors - Reduce the quadratic form into Canonical form - LU decomposition - Singular Value Decomposition

UNIT V: VECTOR SPACES AND LINEAR TRANSFORMATIONS 12

Vector Space – Subspace - linear dependence and independence - bases and dimensions - Linear transformations - Null space - range - Dimension theorem - Matrix representation of a linear transformations.

TOTAL: 60 HOURS

COURSE OUTCOMES:

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

CO1: Apply differential calculus tools in solving various applications in real situations.

CO2: Able to use the integral ideas in solving areas, volumes and other practical problems.

CO3: Apply various techniques in solving ordinary differential equations.

CO4: Recalling the matrix algebra methods for solving the practical problems.

CO5: Understand the concepts of vector spaces and applications of linear transformations.

TEXT BOOKS:

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi,43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
3. Friedberg. A.H., Insel. A.J, and Spence. L ., “Linear Algebra”, Prentice Hall of India, New Delhi, 4th Edition, 2004.

REFERENCES:

1. Weir, M.D and Joel Hass, "Thomas Calculus", Pearson India, 12thEdition, 2016.
2. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. O’Neil, P.V. “Advanced Engineering Mathematics”, Cengage Learning India Pvt., Ltd, New Delhi,2007.
4. Sastry, S.S, “Engineering Mathematics", Vol. I& II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., “Advanced Engineering Mathematics “Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.
6. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
7. Glyn James, “Advanced Modern Engineering Mathematics”, Pearson India, Eighth Edition, 2017.
8. Kumaresan. S., “Linear Algebra – A Geometric Approach”, Prentice – Hall of India, New Delhi, Reprint, 2010.

YOUTUBE RESOURCES:

1. **Khan Academy** - Linear Algebra: Khan Academy offers a comprehensive series of videos on linear algebra, including matrices, vectors, eigenvalues, and eigenvectors. The content is well-structured and suitable for beginners and intermediate learners.
2. **Patrick JMT** - Calculus: Patrick JMT's channel provides clear and concise explanations of calculus topics, including limits, derivatives, integrals, applications of derivatives, and differential equations.
3. **Professor Leonard** - **Calculus** 1: Professor Leonard's lectures cover calculus topics in-depth, including functions, limits, derivatives, integrals, and applications. The explanations are detailed and suitable for college-level calculus courses.
4. **Blue1Brown** - Essence of Linear Algebra: This series by 3Blue1Brown provides a visual and intuitive understanding of linear algebra concepts, including vectors, matrices, transformations, and eigenvalues. The animations and explanations are engaging and insightful

Course Code	ENGINEERING MECHANICS	L	T	P	C
ME4101		3	1	0	4

COURSE OBJECTIVES

- To Learn the use scalar and vector analytical techniques for analysing forces in statically determinate structures
- To introduce the equilibrium of rigid bodies, vector methods and free body diagram
- To study and understand the distributed forces, surface, loading on beam and intensity.
- To learn the principles of friction, forces and to determine the apply the concepts of frictional forecast the contact surfaces of various engineering systems.
- To develop basic dynamics concepts – force, momentum, work and energy.

COURSE DESCRIPTION

Engineering Mechanics is a foundational course that introduces students to the principles of mechanics and their application to engineering problems. The course covers topics such as statics, dynamics, kinematics, kinetics, and the behavior of particles and rigid bodies under various forces and constraints. Students will learn how to analyze and solve problems related to equilibrium, motion, and forces in engineering systems.

PREREQUISITES

- Basic knowledge of physics, mathematics (calculus, algebra), and engineering fundamentals is recommended for students enrolling in this course.
- Familiarity with vectors, forces, and basic kinematics concepts will be beneficial.

UNIT I STATICS OF PARTICLES 9

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of Force, Unit Vectors. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

UNIT II EQUILIBRIUM OF RIGID BODIES 9

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections. Trusses and frames; virtual work.

UNIT III DISTRIBUTED FORCES 9

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration, Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three- Dimensional Body, Centroid of a Volume, Composite Bodies, Determination of Centroids of Volumes by Integration. Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas, Moments of

Inertia of a Mass - Moments of Inertia of Thin Plates, Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.

UNIT IV FRICTION **9**

The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedge friction, Wheel Friction, Rolling Resistance, Ladder friction.

UNIT V DYNAMICS OF PARTICLES **9**

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion - Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact of bodies.

TOTAL (THEORY): 45 HOURS

COURSE OUTCOMES

At the end of the course the students would be able to
CO1: Illustrate the vector and scalar representation of forces and moments
CO2: Analyse the rigid body in equilibrium
CO3: Evaluate the properties of distributed forces
CO4: Determine the friction and the effects by the laws of friction
CO5: Calculate dynamic forces exerted in rigid body

TEXT BOOKS

1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 12thEdition, 2019.
2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

REFERENCES

1. Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
2. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.
3. Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4th Edition, Pearson Education Asia Pvt. Ltd., 2005.
4. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7thedition, Wiley student edition, 2013.
5. Timoshenko S, Young D H, Rao J V and Sukumar Pati, Engineering Mechanics, 5thEdition, McGraw Hill Higher Education, 2013.

YOUTUBE RESOURCES

1. **Structure free** - This channel offers comprehensive tutorials on Engineering Mechanics, covering topics such as statics, dynamics, equilibrium, and forces.
2. **Learn Engineering** - provides animated video lectures and tutorials on various engineering subjects, including Engineering Mechanics.
3. **Mechanical Engineering** - This channel features lectures and tutorials on Engineering Mechanics, mechanics of materials, and other mechanical engineering topics.
4. **Statics the Easy Way** - Statics the Easy Way offers explanations and examples related to statics, equilibrium, and force analysis in Engineering Mechanics.

Course Code	தமிழர்மரபு	L	T	P	C
HS4101		1	0	0	1

அலகு I மொழி மற்றும் இலக்கியம்: 3

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை: 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள்: 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL HOURS:15

Course Code	HERITAGE OF TAMILS	L	T	P	C
HS4101		1	0	0	1

COURSE DESCRIPTION

Explore the origins and development of ancient Tamil civilization, including the Sangam period, classical literature (Sangam literature), political systems, social structures, trade, and cultural exchanges. Discuss the significance of the Tamil language as one of the oldest classical languages in the world, and explore major works of Tamil literature, poets, playwrights, and literary movements.

PREREQUISITES

- A genuine interest in Tamil culture, history, language, literature, arts, and traditions is crucial for engaging with the subject matter and appreciating the depth and richness of Tamil heritage.
- Familiarity with general historical concepts, timelines, historical periods, and key events can provide a foundation for understanding the historical context of Tamil heritage and civilization.

UNIT I LANGUAGE AND LITERATURE 3

Language Families in India – Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature – Management Principles in Thirukural – Tamil Epics and Impact of Buddhism & Jainism in Tamil Land – Bakthi Literature Azhwars and Nayanmars – Forms of minor Poetry – Development of Modern literature in Tamil – Contribution of Bharathiyar and Bharathidhasan.

UNIT II HERITAGE – ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3

Hero stone to modern sculpture – Bronze icons – Tribes and their handicrafts – Art of temple car making – Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments – Mridhangam, Parai, Veenai, Yazh and Nadhaswaram – Role of Temples in Social and Economic Life of Tamils.

UNIT III FOLK AND MARTIAL ARTS 3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance – Sports and Games of Tamils.

UNIT IV THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature – Aram Concept of Tamils – Education and Literacy during Sangam Age – Ancient Cities and Ports of Sangam Age – Export and Import during Sangam Age – Overseas Conquest of Cholas.

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

Contribution of Tamils to Indian Freedom Struggle – The Cultural Influence of Tamils over the other parts of India – Self – Respect Movement – Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL (THEORY) : 15 HOURS

TEXT – CUM – REFERENCE BOOKS

1. Social Life of Tamils (Dr. K.K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils – The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr. S.V. Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi – Sangam City Civilization on the banks of river Vaigai (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL).

YOUTUBE RESOURCES:

1. **Tamil Heritage Foundation:** This channel focuses on Tamil heritage, history, culture, and arts, featuring documentaries, lectures, interviews, and discussions related to Tamil heritage and civilization.
2. **Madras Heritage and Carnatic Music:** This channel explores the heritage of Chennai (formerly Madras), including historical sites, architecture, cultural events, Carnatic music, and traditional arts of Tamil Nadu.
3. **Tamil Heritage Trust:** The Tamil Heritage Trust channel features videos on Tamil heritage, archaeological discoveries, heritage conservation, temple architecture, and cultural heritage initiatives.
4. **Vanam Tamil Arts & Culture:** This channel focuses on Tamil arts, culture, literature, folk traditions, dance forms, music, storytelling, and cultural events celebrating Tamil heritage.
5. **Chennai Heritage:** Chennai Heritage offers videos on the heritage of Chennai city, historical landmarks, monuments, heritage walks, cultural festivals, and stories of the city's past.

Course Code	COMMUNICATIVE ENGLISH –I	L	T	P	C
HS4102		3	0	2	4

COURSE OBJECTIVES

- To improve the communication competency.
- To learn basic grammatical structures in suitable contexts.
- To build students English language skills through LSRW.
- To enable the students to write in English precisely and effectively
- To develop language proficiency in expressing their opinions.

COURSE DESCRIPTION

This course aims to develop students' proficiency in English language skills, focusing on speaking, listening, reading, and writing. Emphasis is placed on real-life communication situations to enhance students' ability to interact effectively in various contexts.

PREREQUISITES

- Basic knowledge of English grammar
- Vocabulary is recommended for successful participation in this course.

INTRODUCTION TO EFFECTIVE COMMUNICATION **1**

What is effective communication? Why is communication critical for excellence during study, research, and work? What are the seven C's of effective communication?

UNIT I – INTEGRALS OF COMMUNICATION (GREETINGS &INTRODUCTION) **8**

Listening – Listening comprehensions, listening to News Speaking – Just A Minute, Introducing a friend Reading – Reading Newspaper / Articles/ Magazines, Reading comprehension Vocabulary – Synonyms& Antonyms, Acquaintance with Prefixes & suffixes from foreign languages in English to form derivatives and Word formation Grammar – Parts of Speech, Mixed Tenses, Active & Passive Voice Writing –Letter of Introduction, Developing the Hints

UNIT II – GIVING AND RECEIVING INSTRUCTIONS **9**

Listening – Listening to short stories, Narrations and Persuasive speech Speaking – Giving Instructions to use the Product/ Presenting or summarizing about a product Reading – Reading Advertisements / Biographies Vocabulary – Abbreviation, Acronyms, One – word Substitutes Grammar – WH Questions/Yes or No Questions, Imperatives Writing – Instructions, Paragraph Writing

UNIT III – DESCRIBING PEOPLE AND PLACES **9**

Listening – Listening to the description of a product Speaking –Picture Description, Narrating personal experiences and events Reading – Gadget Reviews, User Manuals Vocabulary – Homonyms, Homophones, Compound Words Grammar – Adjectives, Adverbs, Articles. Writing – Recommendations, Product/ Process Description.

UNIT IV –VISUALIZATION AND CLASSIFICATION **9**

Listening – TED talks Speaking – Interviewing a celebrity/Famous Personality Reading – Company profiles, Business Letters Vocabulary– Discourse Markers, Linking words and Phrases Collocation. Grammar – Pronouns, Conjunction, Preposition Writing – Interpretation of Charts and Graphs

UNIT V – EXPOSITION **9**

Listening – Watching Movies / Listening to Dialogues and Conversations Speaking – Role play, Panel Discussion, Debate Reading – Blogs, Novels, Short Stories Vocabulary – Phrasal Verbs

Grammar– Simple/Compound/Complex Sentences, Error Spotting, Punctuation. Writing – Descriptive Essay, Dialogue Writing

TOTAL (THEORY) : 45 HOURS

LIST OF EXERCISES:

1. Extempore (Oral)
2. Conversation on asking directions
3. Picture Description, about purchasing a product.
4. Summarizing a TED talk.
5. Role play.

PRACTICAL: 30 HOURS **TOTAL: 75 HOURS**

COURSE OUTCOMES

After the completion of the course, students will be able to

CO 1. Use appropriate words in a professional context
CO 2. Gain an understanding of basic grammatical structures and use them in the right context.
CO 3. Write definitions, descriptions, narrations and essays on various topics
CO 4. Speak fluently and accurately in formal and informal communicative contexts
CO 5. Express their opinions effectively in both oral and written medium of communication.

TEXT BOOKS

1. English for Engineers & Technologists Orient Black swan Private Ltd. Department of English, Anna University, (2020 edition)
2. English for Science & Technology Cambridge University Press, 2021.Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.
3. Professional English-II, V.K. Publications, Dr. S.N. Mahalakshmi.

REFERENCES

1. Technical Communication – Principles and Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. A Course Book On Technical English By Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.
3. Learning to Communicate–Dr.V. Chellammal. Allied Publishers, New Delhi,2003

YOUTUBE RESOURCES:

1. **BBC Learning English EngVid**: EngVid features lessons by experienced English teachers on various topics such as grammar, speaking skills, idioms, and pronunciation. The videos are engaging and suitable for learners at different levels.
2. **EngVid Learn English with Mister duncan:** This channel offers lessons in a fun and entertaining format, covering grammar, vocabulary, and common English phrases. Mister duncan's engaging style makes learning English enjoyable.
3. **Learn English with Mister duncan Rachel's English:** Rachel's English focuses on pronunciation and accent reduction. The channel provides clear explanations, practice exercises, and tips to improve spoken English clarity and fluency.
4. **Rachel's English TED-Ed**: Lessons Worth Sharing: TED-Ed features animated lessons on a wide range of topics, including language and communication. Students can explore TED-Ed's library for insightful talks and discussions related to effective communication skills.

Course Code	ENGINEERING PHYSICS	L	T	P	C
PH4101		3	0	2	4

COURSE OBJECTIVES

- To make the students effectively understand basics of mechanics and properties of matter.
- To provide an overview of sound and ultrasonic production, detection and applications.
- To introduce the basics of lasers.
- To enrich the basic knowledge of optical fiber
- To understand quantum mechanical phenomena and apply in computing fields.

COURSE DESCRIPTION

This course provides a comprehensive introduction to the fundamental principles of physics and their applications in engineering disciplines. It covers a range of topics including classical mechanics, electromagnetism, thermodynamics, optics, and modern physics concepts. Emphasis is placed on developing problem-solving skills, critical thinking, and the ability to apply physics principles to engineering problems and technologies.

PREREQUISITES

Basic knowledge of algebra, trigonometry, calculus, and physics principles (e.g., Newtonian mechanics, electromagnetism) is recommended for successful participation in this course

UNIT I MECHANICS AND PROPERTIES OF MATTER 9

Center of mass (CM) – motion of the CM – kinetic energy of system of particles – moment of inertia – theorems of M. I – moment of inertia of continuous bodies (Ring, Disc) – conservation of angular momentum – gyroscope. Elasticity – Hooke's law – stress –strain diagram – Factors affecting elasticity – bending of Beams – Young's modulus by uniform bending and non – uniform bending – Torsional Pendulum – I – shaped girders.

UNIT II ACOUSTICS AND ULTRASONICS 9

Acoustics: Classification and characteristics of sound – decibel – Weber – Fechner law – Factors affecting acoustics of buildings and their remedies – Methods of determination of Absorption Coefficient. -Doppler effect. Ultrasonic – Production of Ultrasonics by Magnetostriction and piezoelectric methods – acoustic grating – Non Destructive Testing – pulse echo system through transmission and reflection modes – A, B and C – scan displays.

UNIT III LASER 9

Laser: Characteristics – Spontaneous and stimulated emission – Pumping methods – Optical Resonator – Active medium and Active centre – Einstein's coefficient – population inversion – Types of laser – Nd – YAG laser, CO_2 laser, Semiconductor lasers: homojunction and heterojunction Industrial and medical application

UNIT IV FIBRE OPTICS **9**

Fiber optics – Principle, Numerical aperture and acceptance angle – types of optical fibers (material, refractive index, mode) – attenuation, dispersion – Fibre Optical Communication system(Block diagram) – Displacement sensors- Temperature/Pressure sensors – Wavelength division multiplexing

– Optical fibers in computers.

UNIT V QUANTUM MECHANICS **9**

Planck's quantum theory – Compton effect – Particle properties of wave: Matter waves, wave function – The Schrodinger equation (Time dependent and time independent forms) – Particle in a infinite potential well: 1D,2D and 3D Boxes – Scanning Tunneling microscope.

TOTAL HOURS (THEORY) : 45

PRACTICAL EXERCISES (FIVE ONLY)

1. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids.
2. Simple harmonic oscillations of cantilever.
3. Uniform bending – Determination of Young's modulus.
4. Laser – Determination of the wave length of the laser using grating.
5. Optical fibre – Determination of Numerical Aperture and acceptance angle.
6. Acoustic grating – Determination of velocity of ultrasonic waves in liquids.
7. Michelson Interferometer.

TOTAL HOURS (LAB):30

COURSE OUTCOMES

After the completion of the course, students will be able to

TOTAL HOURS (45+30):75

- **CO1.** Understand the importance of mechanics and express their knowledge in properties of matter
- **CO2.** Analyze the applications of acoustics and ultrasonic in engineering field.
- **CO3.** Acquire knowledge in laser and its applications
- **CO4.** Demonstrate a strong foundational knowledge in fiber optics
- **CO5.** Comprehend and apply quantum mechanical principles.

TEXT BOOKS

1. D. Kleppner and R. Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.

2. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw – Hill (Indian Edition), 2017.

3. Gaur R.K. and Gupta S.L. Engineering Physics. Dhanpat Rai publishers, 2009.

4. Kasap, Safa, Capper, " Handbook of Electronic and Photonic Materials"2nd edition, Springer, 2017.

5. Eleanor Rleffel and Wolfgang Polak, "Quantum computing a gentle introduction", 1st edition, The MIT press,2012.

REFERENCES

1. R. Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition),2009.
2. K. Thyagarajan and A. Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.
3. D. Halliday, R. Resnick and J. Walker. Principles of Physics, Wiley (Indian Edition), 2015.
4. Searls and Zemansky. University Physics, 2009.
5. David J. Griffiths, "Introduction to Quantum Mechanics", 2nd edition , Cambridge university press, 2017.
6. Chris Bernhardt, "Quantum computing for everyone" The MIT press, 2019.

YOUTUBE RESOURCES:

1. **MIT Open Courseware - Physics:** MIT offers a collection of physics courses covering various topics relevant to engineering physics, such as classical mechanics, electromagnetism, thermodynamics, and modern physics.
2. **Walter Lewin Lectures - MIT:** Walter Lewin's physics lectures from MIT cover classical mechanics, electromagnetism, waves, optics, and special relativity. His engaging teaching style makes complex concepts easier to understand.
3. **The Physics Classroom:** This channel provides tutorials, animations, and demonstrations covering a wide range of physics topics, including mechanics, waves, electricity, magnetism, and modern physics.
4. **Crash Course Physics:** Crash Course offers a series of engaging videos on physics topics, including classical mechanics, electricity, magnetism, waves, optics, and modern physics concepts.

Course Code	PROBLEM SOLVING USING C PROGRAMMING	L	T	P	C
CS4111		3	0	2	4

COURSE OBJECTIVES:

- To understand the basic programing constructs of C Language
- To develop C programming using arrays, strings and pointers
- To develop modular applications in C using functions
- To develop applications in C using struts and unions
- To do input/output and file handling in C

COURSE DESCRIPTION

Designing an algorithm involves breaking down the problem into smaller sub-problems and defining a step-by-step sequence of instructions to solve each sub-problem. Algorithms can be expressed using pseudo code or flowcharts before implementing them in C code. Choosing appropriate data structures such as arrays, linked lists, stacks, queues, trees, graphs, or hash tables based on the problem requirements is crucial for efficient problem-solving in C programming.

PREREQUISITES

- Proficiency in C programming language is essential, including knowledge of syntax, semantics, expressions, statements, arrays, strings, pointers, structures, and memory management concepts (dynamic memory allocation, pointers arithmetic).
- Familiarity with algorithm design principles, problem-solving techniques (brute force, divide and conquer, dynamic programming, greedy algorithms), algorithm analysis (time complexity, space complexity), and data structures (arrays, linked lists, stacks, queues) is necessary.

UNIT I BASICS OF C PROGRAMMING (Blooms Learning Levels: L3 – Apply) **15**

Introduction to programming paradigms – Structure of C program – Setting up the development environment (IDEs, compilers) and First C programs – Variables, Keywords, Data types, Constants, Operators, input / output statements – Decision making statements – Looping with while, do-while, and for loops – Nested loops and loop control statements

Coding Exercises:

1. Write a C program to find the sum of two integers entered by the user
2. Write a C program to check if a given number is even or odd
3. Write a C program to find the largest among three numbers using if-else statements

Problems-solving Assignments:

1. Write a C program to calculate the factorial of a given positive integer using a loop
2. Write a C program to check if a given number is a prime number
3. Write a C program to find the GCD (Greatest Common Divisor) of two numbers using a function

UNIT II ARRAYS, STRINGS, AND POINTERS (Blooms Learning Levels: L3 – Apply) **15**

Working with arrays: One dimensional array: declaration, initialization, and accessing elements – Two dimensional arrays: Declaration -Initialization – Accessing elements – Operations: Read – Print – Sum – Transpose, Strings in C: string functions and manipulation – Selection sort, linear and binary sort – Introduction to pointers and memory management – Pointer operators – Pointer arithmetic - Pointers and arrays

Coding Exercises:

1. Implement a program that finds the largest element in an array of integers
2. Write a C program to count the number of vowels and consonants in a given string
3. Write a program to reverse a string without using the standard string library functions

Problems-solving Assignments:

1. Write a C program to merge two sorted arrays into a single sorted array
2. Write a C program to find the second largest element in an array
3. Write a program that finds the intersection of two arrays and stores the result in a third array

UNIT III FUNCTIONS (Blooms Learning Levels: L3 – Apply) **15**

Modular programming – Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion, Binary Search using recursive functions – Parameter passing: Pass by value, Pass by reference

Coding Exercises:

1. Write a C program to exchange the values of variables
2. Implement a recursive function to calculate the factorial of a given number

Problems-solving Assignments:

1. Write a C program to sort an array of strings in alphabetical order
2. Create a program to implement a binary search algorithm to search for an element in a sorted array

UNIT IV STRUCTURE AND UNION (Blooms Learning Levels: L3 – Apply) **15**

Structure – Nested structures – Pointer and Structures – Array of structures – Self-referential structures – Dynamic memory allocation – Singly linked list (creation, insertion & deletion) – Typedef – Union – Storage classes and Visibility

Coding Exercises:

1. Write a C program to find the average and total marks of students using a struct

Problems-solving Assignments:

1. Write a C program to create a structure representing a book with title, author, and publication year. Implement functions to add, display, and search for books in a library
2. Implement a program to manage a student database using structs, including functions to add, delete, and display student records

UNIT V FILE PROCESSING (Blooms Learning Levels: L3 – Apply) **15**

Files – Types of file processing: Sequential access, Random access – Sequential access file – Random access file – Command line arguments – Code optimization and best practices

Coding Exercises:

1. Create a program that reads data from a file and calculates the average of a set of numbers
2. Write a program to copy the contents of one file into another file

Problems-solving Assignments:

1. Write a C program to read student records from a file and calculate their total and percentage
2. Develop a program to read employee details from a file, sort them based on salary, and write the sorted data back to the file

Final Project (sample) : Design a simple inventory management system for a small store using structs and file handling. The program should allow users to add, update, and delete items in the inventory and display the current stock

TOTAL HOURS (45+30) : 75

COURSE OUTCOMES:

CO1: Demonstrate knowledge on C Programming constructs
CO2: Design and implement applications using arrays, strings and pointers **CO3**: Develop and implement modular applications in C using functions **CO4**: Develop applications in C using structures and unions
CO5: Develop applications using sequential and random-access file processing

TEXT BOOKS:

1. Kernighan, B.W and Ritchie, D.M, "The C Programming language", Second Edition, Pearson Education, 2015.
2. Reema Thareja, "Programming In C", Second Edition, Oxford University Press India, 2016.

REFERENCES:

1. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
2. E Balagurusamy, "Programming in ANSI C", Eighth Edition, McGraw Hill Education, 2019.
3. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.
4. Peter van der Linden, "Expert C Programming", Pearson, 1994.

YOUTUBE RESOURCES:

1. **My code school:** This channel offers tutorials and lectures on programming concepts, data structures, algorithms, and problem-solving using C and C++ programming languages.
2. **Programming Knowledge:** Programming Knowledge provides tutorials on C programming basics, data structures, algorithms, problem-solving techniques, and coding exercises for beginners and intermediate learners.
3. **Saurabh Shukla Classes:** Saurabh Shukla Classes offer tutorials on C programming, data structures, algorithms, problem-solving strategies, and coding practice sessions for competitive programming and interviews.

4. **Geeks for Geeks:** Geeks for Geeks' YouTube channel provides tutorials, lectures, and coding examples on C programming, data structures, algorithms, problem-solving techniques, and interview preparation.

5. **Code With Harry:** Code With Harry offers tutorials on C programming basics, problem-solving exercises, programming projects, and tips for improving problem-solving skills using C language.

Course Code	ENGINEERING GRAPHICS	L	T	P	C
ME4102		2	0	4	4

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Drawing engineering curves.
- Drawing freehand sketch of simple objects.
- Drawing orthographic projection of solids and section of solids.
- Drawing development of solids
- Drawing isometric and perspective projections of simple solids.

COURSE DESCRIPTION

Engineering Graphics is a foundational course that focuses on the principles and techniques of graphical communication in engineering. The course covers topics such as technical drawing, computer-aided design (CAD), geometric construction, dimensioning, and visualization of engineering designs. Students will learn how to create, interpret, and communicate engineering drawings and models using industry-standard methods and software tools.

PREREQUISITES

- Basic knowledge of geometry, technical mathematics, and computer literacy is recommended for students enrolling in this course.
- Familiarity with drawing tools, CAD software, and engineering design concepts will be beneficial.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.

UNIT I PLANE CURVES 6+12

Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS AND FREEHAND SKETCHING 6+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles —Representation of Three Dimensional

objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects. Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6 +12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones. Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12

Principles of isometric projection — isometric scale - lsometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method. Practicing three dimensional modeling of isometric projection of simple objects by CAD Software (Not for examination)

TOTAL HOURS: (L=30; P=60) 90

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- **CO 1.** Use BIS conventions and specifications for engineering drawing.
- **CO 2.** Construct the conic curves, involutes and cycloid.
- **CO 3.** Solve practical problems involving projection of lines.
- **CO 4.** Draw the orthographic, isometric and perspective projections of simple solids.
- **CO 5.** Draw the development of simple solids.

TEXT BOOK:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53 Edition, 2019.
2. Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.
3. Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015

REFERENCES:

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill, 2nd Edition, 2019.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Publications, Bangalore, 27th Edition, 2017.
3. Luzzader, Warren.J. and Duff, John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
5. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 2nd Edition, 2009.
6. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.

YOUTUBE RESOURCES:

1. **SolidWorks Tutorials** - Tutorial Point: This playlist provides tutorials on using Solid Works, a popular CAD software, for engineering graphics and design.
2. **Engineering Graphics -** NPTEL: NPTEL (National Programme on Technology Enhanced Learning) offers video lectures on Engineering Graphics covering topics such as projections, isometric views, sections, and developments.
3. **Auto CAD Tutorials** - CAD in Black: CAD in Black provides tutorials on using Auto CAD, a widely used CAD software, for creating engineering drawings and graphics.
4. **Engineering Graphics – Edu Mation:** Edu Mation offers tutorials and lectures on Engineering Graphics covering topics such as projections, section views, dimensioning, and tolerancing.

Course Code	EMPLOYABILITY ENHANCEMENT SKILLS – I	L	T	P	C
ES4101		0	0	2	1

COURSE OBJECTIVES

- To categorize, apply and use thought process to understand the concepts of Quantitative methods to enhance problem solving skills.
- To prepare and explain the fundamentals related to various possibilities with numeric ability and probabilities related to quantitative aptitude.
- To critically evaluate numerous possibilities related to puzzles

COURSE DESCRIPTION

This course is designed to equip students with essential skills and competencies required for successful entry into the workforce and career advancement. It focuses on developing a range of professional skills, including communication, teamwork, problem-solving, critical thinking, leadership, and adaptability. The course also covers aspects such as resume writing, interview preparation, networking, personal branding, and career planning strategies.

PREREQUISITES

There are no specific prerequisites for this course. However, a willingness to learn, participate actively, and apply acquired skills is essential for maximizing the benefits of the course

UNIT I NUMBERS **6**

Introduction – Classification of numbers – Formation of Numbers (Small & Large) –Place Value – Face Value – Divisibility Rule – Prime, Composite Numbers – Prime Factorization – Number of factors – Number of factors (Odd & Even) – Sum of factors – Successors and Predecessors – Greatest Integer Value – Vedic Mathematics – Trailing Zeroes – Unit Digits–Remainder Theorem – Real Number – Rational Numbers: Integers, Fractions – Comparison of Numbers – Operations on fractions

– Scientific Notation

UNIT II PROBLEMS ON LETTERS, NUMBERS AND SYMBOLS **6**

Factors and Multiples, LCM and HCF – Relationship between LCM and HCF – Factorial – Simplification – VBODMAS – Square , Square Root – Cube, Cube Root – Exponents & Powers (Surds and Indices) – Sequence & Series: Arithmetic Progression – Geometric Progression – Special Progression, Letter Series, Number Series, Alpha – Numeric Series, Continuous Pattern Series

UNIT III VERBAL AND NON – VERBAL REASONING **6**

Verbal Reasoning – Analogy: Completing the Analogous pair, Direct Analogy, Choosing the Analogous pair, Double Analogy, Choosing a Similar Word, Detecting Analogies, Multiple word Analogy, Number Analogy, Alphabet Analogy – Classification: Odd Words and Numerals – Coding and Decoding: Letter, Number, Symbol, Matrix, Substitution, Deciphering Message Word, Number and Symbols. Non – Verbal Reasoning Figure Series – Missing figure, Incorrect figure – Analogy: Similarity Related Pair, Similarity Related figures, unrelated figures, Group of figures.

UNIT IV RATIO AND PROPORTION **6**

Introduction – Ratio – Proportion: Direct and Indirect – Unitary Method – Problems on Ages – Chain Rule – Partnership – Mixture or Allegation – Time and Work: Individual, Group, Efficiency, Wages – Pipes and Cistern: Inlet, Outlet, and Leakage

UNIT V PERCENTAGE **6**

Introduction – Percentages in real life – Profit and Loss – Discount – Simple Interest – Compound Interest – Relationship between Simple Interest and Compound Interest – Overhead Expenses and GST.

TOTAL (THEORY): 30 HOURS

COURSE OUTCOMES

After the completion of the course, students will be able to

CO 1. Develop the arithmetic ability and properties of numbers that we use in day to day life,
CO 2. Demonstrate the logic behind the formation of numbers, alphabets series.
CO 3. Apply the reasoning methods logically and evaluate complex relationships between the variables and numbers.
CO 4. Use the concept of ratios and proportion in ages and partnership problems.
CO 5. Apply the short cuts of the mathematical tricks to reduce the time duration in problem solving

TEXT BOOKS

1. "Quantitative Aptitude for Competitive Examinations" by R.S. Aggarwal – 2022"
2. "Teach Yourself Quantitative Aptitude" by Arun Sharma – 2017
3. "A modern approach verbal and non – verbal reasoning" by R.S. Aggarwal – 2017

REFERENCES

1. "Shortcuts in Mathematics" by Akhilesh Khare – 2016
2. "Vedic maths for competitive exams" by Ravi Shankar – 2016
3. "Quantitative Aptitude for Competitive Examination" by Abhijit Guha – 2017

YOUTUBE RESOURCES:

- **Career Vidz:** This channel offers videos on career advice, job search strategies, interview tips, resume writing, and personal development.
- **Work It Daily:** Work It Daily provides videos on career coaching, professional branding, networking, workplace skills, and job search tactics.
- **Linda Raynier:** Linda Raynier's channel covers topics such as resume writing, interview preparation, career growth strategies, and personal branding.
- **Andrew La Civita:** Andrew La Civita offers videos on career development, job interview techniques, communication skills, and leadership.

Course Code	MATHEMATICS – II	L	T	P	C
MA4201	PROBABILITY AND STATISTICS	3	1	0	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To introduce the basic concepts of probability and distributions.
- To learn the basic concepts of two -dimensional random variables.
- To acquire the knowledge in random processes, stationary, Markov and Poisson process.
- To acquire the knowledge of testing of hypothesis for small and large samples this plays an important role in real life problems.
- To summarise the design of experiments in the field of agriculture.

UNIT I: PROBABILITY AND RANDOM VARIABLES **12**

Probability: Axioms – Sample space – Events - Conditional Probability – Baye's Theorem - Discrete and continuous random variables - Moments - Moment generating functions - Standard distributions: Binomial - Poisson - Geometric - Uniform - Exponential and Normal distributions.

UNIT II: TWO DIMENSIONAL RANDOM VARIABLES **12**

Joint distributions - Marginal and conditional distributions - Covariance - Correlation - linear regression - Transformation of random variables - Central limit theorem (excluding proof).

UNIT III: RANDOM PROCESSES AND MARKOV CHAINS **12**

Random Processes: Introduction and Classification -Stationary Processes -Markov Processes - Poisson Processes -Discrete Parameter Markov Chains -Chapman-Kolmogorov Equations (Statement only) - Limiting Distributions.

UNIT IV: TESTING OF HYPOTHESIS **12**

Sampling distributions - Estimation of parameters **-**Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means - Tests based on t, F and Chi-square distributions for mean, variance **-** Contingency table (test for independent) - Goodness of fit.

UNIT V: DESIGN OF EXPERIMENTS **12**

One way and two-way classifications - Completely randomized design - Randomized block design - Latin square design.

TOTAL: 60 HOURS

COURSE OUTCOMES:

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

CO1: Understand the fundamental knowledge of the concepts of probability and have knowledge of Standard distributions which can describe real life phenomenon.

CO2: Recognize the basic concepts of two - dimensional random variables and apply in engineering applications.

CO3: Develop the basic concepts of random processes which are widely used in engineering fields.

CO4: Apply the concept of testing of hypothesis for small and large samples in real life problems.

CO5: Investigate of design of experiments in the field of agriculture.

TEXT BOOKS:

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.
3. Ibe, O.C.," Fundamentals of Applied Probability and Random Processes ", 1st Indian Reprint, Elsevier, 2007.

REFERENCES:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
2. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2010.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.

YOUTUBE RESOURCES:

1. **Evaluate Content:** Before relying on any YouTube resource, ensure that the content is accurate, reliable, and suitable for your level of understanding. Check the credentials of the creator or channel, read user reviews and comments, and preview the videos to gauge their quality and relevance to your studies.
2. **Review Playlists:** Look for playlists specifically curated for "Statistics and Numerical Methods" or related topics. These playlists often compile a series of videos that cover different aspects of the subject, making it easier to follow a structured learning path.
3. **Check University Channels:** Many universities upload lectures and course materials on their official YouTube channels. Search for universities or professors who specialize in statistics, mathematics, or engineering, as they often share valuable resources related to numerical methods and statistical analysis.
4. **Explore Educational Channels:** Look for reputable educational channels or channels affiliated with universities and educational institutions. Channels like Khan Academy, MIT Open Course Ware, Coursera, edX, and others often provide high-quality lectures and tutorials on various subjects, including statistics and numerical methods.

Course Code	MANUFACTURING TECHNOLOGY– I	L	T	P	C
ME4201		3	0	2	4

COURSE OBJECTIVE

To introduce the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and manufacture of plastic components.

Course Description

This course provides a comprehensive overview of various manufacturing processes, including metal casting, joining, forming, sheet metal processes, and the manufacture of plastic components. Students will learn the principles, techniques, equipment, and applications of each process, with a focus on practical industrial applications. The course covers the mechanics of chip formation, machining, thermal aspects, tool wear, tool life, surface finish, and machinability. Additionally, it explores turning machines, special and gear cutting machines, abrasive processes, broaching, and CNC machining, providing students with a solid foundation in modern manufacturing technologies.

Pre-requisites

Basic knowledge of materials science, manufacturing processes, and fundamental principles of physics and chemistry, especially related to heat and material properties.

UNIT I METAL CASTING PROCESSES 9

Sand Casting: Sand Mould – Type of patterns - Pattern Materials – Pattern allowances –Moulding sand Properties and testing – Cores –Types and applications – Moulding machines– Types and applications; Melting furnaces : Blast and Cupola Furnaces; Principle of special casting processes : Shell - investment – Ceramic mould – Pressure die casting - Centrifugal Casting - CO2 process – Stir casting; Defects in Sand casting

UNIT IIJOINING PROCESSES 9

Operating principle, basic equipment, merits and applications of: Fusion welding processes: Gas welding - Types – Flame characteristics; Manual metal arc welding – Gas Tungsten arc welding - Gas metal arc welding – Submerged arc welding – Electro slag welding; Operating principle and applications of: Resistance welding - Plasma arc welding – Thermit welding – Laser and Electron beam welding – Friction welding and Friction Stir Welding; Brazing and soldering; Weld defects: types, causes and cure.

UNIT III METAL FORMING PROCESSES 9

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – forging operations. Rolling of metals– Types of Rolling – Flat strip rolling – shape rolling operations – Defects in rolled parts. Principle of rod and wire drawing – Tube drawing – Principles of Extrusion – Types – Hot and Cold extrusion.

UNIT IV SHEET METAL PROCESSES 9

Sheet metal characteristics – shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Test methods –special forming processes- Working principle and applications – Hydro forming – Rubber pad forming – Metal spinning– Introduction to Explosive forming, magnetic pulse forming, peen forming, Super plastic forming – Micro forming

UNIT V MANUFACTURE OF PLASTIC COMPONENTS **9**

Types and characteristics of plastics – Moulding of thermoplastics – working principles and typical applications – injection moulding – Plunger and screw machines – Compression moulding, Transfer Moulding – Typical industrial applications – introduction to blow moulding –Rotational moulding – Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics.

TOTAL (THEORY): 45 HOURS

LAB EXERCISES

1. Prepare a green sand mould using single piece, split piece and loose piece patterns.
2. Prepare a shell mould using aluminium based pattern.
3. Welding of mild steel plates in flat, vertical and overhead position (SMAW)
4. Welding of mild steel pipes using TIG welding process
5. Friction factor evaluation using ring compression tests
6. Two high rolling of sheet metals
7. Manufacturing of simple sheet metal components using shearing and bending operations.
8. Manufacturing of sheet metal components using metal spinning on a lathe
9. Injection moulding of plastics
10. Preparation of polymer composites (Hand-lay method)

TOTAL (LAB): 30 HOURS

TOTAL (45 + 30): 75 HOURS

OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain different metal casting processes, associated defects, merits and demerits
CO2: Compare different metal joining processes
CO3: Summarize various hot working and cold working methods of metals
CO4: Explain various sheet metal making processes
CO5: Distinguish various methods of manufacturing plastic components and Prepare polymer composite by hand layer method

TEXT BOOKS

1. Hajra Chouldhary S.K and Hajra Choudhury. AK., Elements of workshop Technology, volume I and II, Media promoters and Publishers Private Limited, Mumbai, 2008
2. Kalpakjian. S, Manufacturing Engineering and Technology, Pearson Education India Edition, 2013

REFERENCE BOOKS

1. Gowri P. Hariharan, A.Suresh Babu, Manufacturing Technology I, Pearson Education, 2008
2. Paul Degarma E, Black J.T and Ronald A. Kosher, Materials and Processes, in Manufacturing Eight Edition, Prentice – Hall of India, 1997.
3. Rao, P.N. Manufacturing Technology Foundry, Forming and Welding, 4 th Edition, TMH- 2013
4. Roy. A. Lindberg, Processes and Materials of Manufacture, PHI / Pearson education, 2006

5. Sharma, P.C., A Text book of production Technology, S.Chand and Co. Ltd., 2014.

YOUTUBE RESOURCES

1. **Welding Tips and Tricks (Jody Collier):** This channel offers tutorials and tips on various welding techniques, including MIG, TIG, and stick welding, which will be helpful for the Joining Processes unit. The channel provides clear arc shots and straightforward instructions.
2. **Weld.com:** This channel provides a wide range of educational resources for welders, from fundamental concepts to advanced techniques in various welding processes, making it suitable for the Joining Processes unit.
3. **Keith Rucker - Vintage Machinery:** Keith Rucker's channel focuses on restoring vintage machinery and covers various metalworking processes, including casting and machining, which will be useful for both Metal Casting Processes and Metal Forming Processes units.
4. **MyfordBoy:** This channel specializes in model engineering and metal casting, showing detailed processes of sand casting and other foundry techniques, making it ideal for the Metal Casting Processes unit.
5. **Titans of CNC:** Academy: This channel offers comprehensive CNC machining tutorials and covers various manufacturing processes, including metal forming and sheet metal operations. It's a great resource for the Metal Forming Processes and Sheet Metal Processes units.

Course Code	தமிழரும் தொழில் நுட்பமும்	L	T	P	C
HS4201		1	0	0	1

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம்: 3

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

அலகு III <u>உற்பத்தித் தொழில் நுட்பம்</u>: 3

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV <u>வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்</u>: 3

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு V <u>அறிவியல் தமிழ் மற்றும் கணித்தமிழ்</u>: 3

அறிவியல் தமிழின் வளர்ச்சி –கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL : 15 HOURS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Code	TAMILS AND TECHNOLOGY	L	T	P	C
HS4201		1	0	0	1

COURSE DESCRIPTION

Provide an overview of Tamil culture, history, language, literature, arts, traditions, and contributions to civilization, highlighting the rich heritage of the Tamil people. Explore the historical and contemporary contributions of Tamils to technological advancements, innovation, scientific discoveries, engineering, and IT sectors globally.

PREREQUISITES

- Familiarity with Tamil culture, history, language, literature, arts, traditions, and societal values is essential for comprehending the course material and appreciating the role of Tamils in technological advancements.
- A fundamental understanding of technology concepts, digital literacy, computer usage, internet skills, software applications, and familiarity with digital media platforms is beneficial.

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY **3**

Designing and Structural construction House & Designs in household materials during Sangam Age – Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram – Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other worship places – Temples of Nayaka Period – Type study (Madurai Meenakshi Temple) – Thirumalai Nayakar Mahal – Chetti Nadu Houses, Indo – Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY **3**

Art of Ship Building – Metallurgical studies – Iron industry – Irons melting, steel – Copper and gold Coins as source of history – Minting of Coins – Beads making – industries Stone beads – Glass beads – Terracotta beads – Shell beads/ bone beats – Archeological evidences – Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY **3**

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry – Wells designed for cattle use – Agriculture and Agro Processing – Knowledge of Sea – Fisheries – Pearl – Conche diving – Ancient Knowledge of Ocean – Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING **3**

Development of Scientific Tamil – Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL (THEORY): 15 HOURS

TEXT – CUM – REFERENCE BOOKS

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi – 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

YOUTUBE RESOURCES:

1. **Tamil Heritage Foundation:** This channel focuses on Tamil heritage, history, culture, and arts, which may include discussions or lectures related to technology and its impact on Tamil culture.
2. **Tamils in Computing:** This channel aims to highlight the contributions of Tamils in the field of computing and technology, featuring interviews, discussions, and talks with Tamil professionals in tech.
3. **Cognitive Science and Tamil Culture:** While primarily focused on cognitive science and Tamil culture, this channel may cover topics related to technology's influence on language, cognition, and cultural aspects.
4. **Nallu Tamilar:** This channel explores various facets of Tamil culture, history, language, and traditions, occasionally touching upon modern developments and technology trends.
5. **Tamil Language Computing:** While focused on Tamil language computing, this channel may offer insights into the technological aspects of Tamil language processing, digital content creation, and software development in Tamil.

Course Code	PROBLEM SOLVING USING PYTHON PROGRAMMING	L	T	P	C
CS4212		3	0	2	4

COURSE OBJECTIVES:

- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To do input/output with files in Python

COURSE DESCRIPTION

This course is designed to introduce students to problem-solving techniques and programming skills using the Python programming language. It covers fundamental programming concepts, data structures, algorithm design, and their practical applications in solving computational problems.

PREREQUISITES

No prior programming knowledge is required, but familiarity with basic mathematical concepts and logical reasoning is beneficial for successful completion of this course.

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode, debugging; values and types: int, float, Boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if- if-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT V FILES, MODULES, PACKAGES **9**

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).

TOTAL (THEORY): 45 HOURS

LAB EXERCISES

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list &tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL (LAB): 30 HOURS **TOTAL (45+30) : 75 HOURS**

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1. Develop algorithmic solutions to simple computational problems.
CO 2. Develop and execute simple Python programs.
CO 3. Write simple Python programs using conditionals and looping for solving problems.
CO 4. Decompose a Python program into functions.
CO 5. Represent compound data using Python lists, tuples, dictionaries etc.
CO 6. Read and write data from/to files in Python programs.

CO 7. Implement programs in Python using conditionals and loops for solving problems
CO 8. Deploy functions to decompose a Python program.
CO 9. Process compound data using Python data structures
CO10. Utilize Python packages in developing software applications.

TEXT BOOKS:

1. Allen B. Downey, “Think Python: How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016.
2. Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving and programming”, 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCES:

1. Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition,2021.
2. G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.
3. John V Guttag, & Quot; Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data‘‘, Third Edition, MIT Press 2021
4. Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.
5. https://www.python.org/
6. Martin C. Brown, “Python: The Complete Reference”, 4th Edition, Mc-Graw Hill, 2018.

YOUTUBE RESOURCES:

1. **Programming with Mosh:** This channel offers comprehensive tutorials on Python programming, including problem-solving techniques, data structures, algorithms, and practical coding projects.
2. **Corey Schafer -** Python Tutorials: Corey Schafer's tutorials cover various aspects of Python programming, including problem-solving strategies, Python libraries, web development, data analysis, and machine learning.
3. **Sentdex -** Python Programming: sentdex provides tutorials on Python programming, data analysis, machine learning, and artificial intelligence, focusing on problem-solving techniques and coding projects.
4. **Free Code Camp.org -** Python Programming: free Code Camp.org offers tutorials on Python programming for beginners, covering basic syntax, data structures, algorithms, and problem-solving approaches.

Course Code	FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
EE4211		3	0	2	4

COURSE OBJECTIVES:

- To introduce the basics of electric circuits and analysis
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce Electronic devices and their characteristics.
- To educate on the fundamental concepts of digital electronics.
- To introduce the functional elements and working of measuring instruments.

COURSE DESCRIPTION

The Fundamentals of Electrical and Electronics Engineering course provides a foundational understanding of key principles, theories, and concepts in electrical and electronics engineering. It covers fundamental topics such as electric circuits, electromagnetism, electronic devices, digital systems, and electrical measurements. Students will learn about the applications of electrical and electronics engineering in various industries, including power systems, telecommunications, electronics, and computer engineering.

PREREQUISITES

• Basic knowledge of physics, mathematics (algebra, calculus), and engineering fundamentals is recommended for students enrolling in this course.
• Familiarity with circuit analysis, electronic components, and basic programming concepts may be beneficial

UNIT I ELECTRICAL CIRCUITS 9

DC Circuits: Circuit Elements, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws – Simple problems - Nodal Analysis, Mesh analysis with Independent sources only (Steady state), Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor.

UNIT II ELECTRICAL MACHINES 9

Construction and working principle of DC Separately and Self excited Generators- Construction, working principle, types and application of DC motors - Construction and working principle of Transformer - Construction, working principle, types and application of single and three phase induction motors.

UNIT III ELECTRONIC DEVICES 9

Semiconductor Devices: – Construction and operation of PN Junction Diodes, Zener Diode – Operation, characteristics and applications of BJT, FET-JFET, MOSFET, SCR ,IGBT.

UNIT IV DIGITAL ELECTRONICS 9

Review of number systems, binary, octal, hexa decimal codes, conversions, Boolean Algebra, Basic Logic Gates -SOP and POS forms, K-map representations, Combinational logic-Adder, Subtracter, Encoder, Decoder, Multiplexer and Demultiplexer.

UNIT V MEASUREMENTS AND INSTRUMENTATION **9**

Functional elements of an instrument, Standards and calibration, Operating Principle, types - Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter Instrument Transformers-CT and PT.

TOTAL (THEORY): 45 HOURS

LAB EXPERIMENTS

1. Experimental verification of electrical circuit problems using Kirchhoff's voltage and current laws.
2. Construct and verify house wiring using switches, fuse, indicator, energy meter and lamp
3. Stair case wiring
4. Electrical energy consumption in a circuit using single phase energy meter
5. O.C.C & Load characteristics of DC Shunt generator
6. Load test on DC Shunt motor.
7. Load test on single phase transformer
8. Load test on single phase Induction motor.
9. Load test on three phase Induction motor.
10. Experimental characteristics verification of PN junction diode.

TOTAL (LAB): 30 HOURS **TOTAL (45+30): 75 HOURS**

COURSE OUTCOMES:

After completing this course, the students will be able to

CO1. Compute the electric circuit parameters for simple problems
CO2. Explain the working principle and applications of electrical machines
CO3. Analyse the characteristics of electronic devices
CO4. Explain the basic concepts of digital electronics
CO5. Explain the operating principles of measuring instruments.

TEXT BOOKS:

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw Hill Education, 2020
2. S.K.Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, Second Edition, 2017.
3. Sedha R.S., "A textbook book of Applied Electronics", S. Chand & Co., 2008
4. James A .Svoboda, Richard C. Dorf, "Dorf's Introduction to Electric Circuits", Wiley, 2018.
5. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.

REFERENCES:

1. Kothari DP and I.J Nagrath, "Basic Electrical Engineering", Fourth Edition, McGraw Hill Education, 2019.
2. Thomas L. Floyd, 'Digital Fundamentals', 11th Edition, Pearson Education, 2017.
3. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th edition, 2017.
4. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 2002.
5. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010 **YouTube Resources:**

1. **NPTEL** - Electrical Engineering: NPTEL (National Programme on Technology Enhanced Learning) provides video lectures and courses on various subjects, including Electrical Engineering fundamentals.
2. **Learn Engineering:** Learn Engineering offers animated video lectures and tutorials on fundamental concepts in Electrical and Electronics Engineering, including circuits, transformers, machines, and more.
3. **Engineering Funda:** Engineering Funda provides video lectures on basic electrical engineering concepts, circuit analysis, electrical machines, transformers, and power systems.
4. **Electrical Engineering Basics:** This channel covers fundamental topics in Electrical Engineering such as electrical circuits, Ohm's Law, Kirchhoff's Laws, and basic electronics.

Course Code	MATERIALS SCIENCE	L	T	P	C
PH4201		3	0	2	4

COURSE OBJECTIVES

- To make the students to understand the basics of crystallography and its importance in studying materials properties.
- To inculcate the knowledge of phase relationship for the understanding of material properties.
- To understand the knowledge of mechanical properties of materials
- To enhance fundamental knowledge in transformation of heat in conducting materials.
- To instill knowledge of new engineering materials and its applications.

COURSE DESCRIPTION

The Materials Science course offers an interdisciplinary exploration of the structure, properties, processing, and applications of materials across various engineering and scientific disciplines. It covers fundamental principles, theories, and techniques related to the study of materials, including metals, ceramics, polymers, composites, and semiconductors. Students will learn about material properties, microstructure analysis, mechanical behavior, thermal properties, electrical properties, and material selection criteria.

PREREQUISITES

- Basic knowledge of physics, chemistry, and mathematics is recommended.
- Familiarity with engineering principles and scientific concepts will be beneficial for understanding advanced topics in materials science.

UNIT I CRYSTALLOGRAPHY **9**

Crystal structures: BCC, FCC and HCP – directions and planes – linear and planar densities – crystal imperfections – edge and screw dislocations – grain and twin boundaries – Burgers vector and elastic strain energy – , plastic deformation of materials – Millers indices – d spacing – crystal growth technique – Bridgmann and Czohralski method.

UNIT II PHASE DIAGRAM **9**

Solid solutions – Hume Rothery's rules – the phase rule – single component system – one – component system of iron – binary phase diagrams – Isomorphism systems – the tie – line rule – the lever rule – application to Isomorphism system – eutectic phase diagram – peritectic phase diagram – other invariant reactions – Iron – Iron carbide phase diagram – Temperature – Time – Transformation (TTT)Diagram

UNIT III MECHANICAL PROPERTIES **9**

Tensile test – plastic deformation mechanisms – slip and twinning – strengthening methods – strain hardening – refinement of the grain size – solid solution strengthening – precipitation hardening – creep resistance – creep curves – fracture – the Griffith criterion – fatigue failure – fatigue tests – methods of increasing fatigue life – hardness – Rockwell and Brinell hardness –Knoop and Vickers micro hardness(quantitative)

UNIT – IV HEAT TRANSFER **9**

Modes of heat transfer – thermal conductivity – heat capacity and diffusivity – rectilinear flow of heat – conduction through bodies in series and parallel – determination of thermal conductivity: good conductor: Forbe's method – bad conductor: Lee's disc method – applications of heat transfer – formation of ice in ponds – conductivity of earth's crust and age of earth– practical applications.

UNIT V NEW MATERIALS **9**

Ceramics – types and applications – composites: classification, role of matrix and reinforcement, processing of fiber reinforced plastics–metallic glasses: types, glass forming ability of alloys, melt spinning process, applications – shape memory alloys: phases, shape memory effect, pseudo elastic effect, NiTi alloy, applications– nanomaterials: preparation (bottom up and top down approaches), properties and applications–carbon nanotubes: types

TOTAL HOURS (THEORY): 45

PRACTICAL EXERCISES (FIVE ONLY)

1. Torsional pendulum – Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Testing of material Hardness – Brinell method
3. Testing of material Hardness – Rockwell method
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Non – uniform bending – Determination of Young's modulus
6. Determination of Band gap of a semiconductor.
7. Determination of specific resistance of a given coil of wire – Carey Foster's Bridge.
8. Determination of particle size using Laser and compact disc – width of the groove.

TOTAL HOURS (LAB): 30 **TOTAL HOURS (45+30): 75**

COURSE OUTCOMES

After the completion of the course, students will be able to

CO 1. Know the basics of crystallography and its importance for varied materials properties
CO 2. Understand the properties of materials through the study of phase relationships.
CO 3. Gain knowledge on mechanical properties of materials and their measurement
CO 4. Acquire knowledge on the concepts of thermal properties of materials and their applications.
CO 5. Appreciate the importance of ceramics, composites and nanomaterials

TEXT BOOKS

1. V. Raghavan. Materials Science and Engineering: A First Course, Prentice Hall India Learning Private Limited, 2015.
2. S.O. Kasap, Principles of Electronic Materials and Devices, Mc – Graw Hill, 2018.
3. Jasprit Singh, Semiconductor Devices: Basic Principles, Wiley (India), 2007.
4. Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, Mc – Graw Hill India (2019)
5. G.W. Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.

REFERENCES

1. R. Balasubramaniam, Callister's Materials Science and Engineering. Wiley (Indian Edition), 2014.
2. Wendelin Wright and Donald Askeland, Essentials of Materials Science and Engineering, CL Engineering, 2013.
3. Robert F.Pierret, Semiconductor Device Fundamentals, Pearson, 2006
4. Pallab Bhattacharya, Semiconductor Optoelectronic Devices, Pearson, 2017
5. Ben Rogers, Jesse Adams and Sumita Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2017.

YOUTUBE RESOURCES:

1. **MIT Open Course Ware** - Materials Science and Engineering: MIT's Open Course Ware program offers free access to lectures, course materials, and resources related to Materials Science and Engineering.
2. **Khan Academy -** Chemistry: Khan Academy covers various topics related to chemistry, including materials science concepts such as atomic structure, chemical bonding, and properties of materials.
3. **ASM International:** ASM International's channel provides videos on materials science, metallurgy, materials testing, and engineering materials.
4. **Materials Science and Engineering at Georgia Tech:** Georgia Tech's materials science and engineering department offers videos and lectures on various topics related to materials science.

Course Code	COMMUNICATIVE ENGLISH –II	L	T	P	C
HS4202		3	0	2	4

COURSE OBJECTIVES

- To engage learners in meaningful language activities to improve their LSRW skills
- To enhance learners awareness of general rules of writing for specific audiences
- To help learners understand the purpose, audience, contexts of different types of writing
- To develop analytical thinking skills for problem solving in communicative contexts
- To cultivate the learners to understand job applications and interviews for internship and placements.

COURSE DESCRIPTION

Communicative Higher English is an advanced-level course designed to enhance students' proficiency in the English language, focusing on advanced communication skills, critical analysis, and literary appreciation. The course emphasizes practical application of language skills in various contexts, including academic writing, public speaking, debates, and literary analysis. Students will engage with a wide range of texts, both literary and non-literary, to develop analytical thinking, language fluency, and communication strategies.

PREREQUISITES

- This course is suitable for students with an intermediate to advanced level of English proficiency.
- A strong foundation in grammar, vocabulary, reading comprehension, and basic writing skills is recommended.

UNIT I MAKING COMPARISONS 9

Listening – Evaluative Listening: Advertisements, Product Descriptions, – Audio/ video Speaking– Marketing a product, Persuasive Speech Techniques. Reading – Reading advertisements, user manuals, brochures Writing – Letter to the editor; Compare and Contrast Essay Grammar – Impersonal passive voice; Prepositional phrases Vocabulary –Contextual meaning of words

UNIT II EXPRESSING CASUAL RELATIONS IN SPEAKING AND WRITING 9

Listening – Listening to longer technical talks and completing–gap filling exercises. Listening technical information from podcasts Speaking –Describing and discussing the reasons of accidents or disasters based on news reports Reading – Reading longer technical texts/Novels Writing – Writing responses to complaints; Problem solution Essay Grammar –Subject – Verb Agreement, Infinitive and Gerunds Vocabulary – Adverbs.

UNIT III PROBLEM SOLVING 9

Listening–Watching movie scenes/documentaries depicting a technical problem and suggesting solutions. Speaking – Group Discussion (based on case studies), – techniques and Strategies. Reading – Case Studies, excerpts from literary texts, news reports etc. Writing – Checklists, Argumentative Essay Grammar –Error correction; If conditional sentences Vocabulary – Compound Words, Sentence Completion.

UNIT IV REPORTING OF EVENTS AND RESEARCH **9**

Listening – Listening Comprehension based on news reports and documentaries. Speaking – Interviewing, Presenting an oral report, Mini presentations on select topics Reading –Newspaper articles Writing – Industrial visit Report, Accident Report, Survey Report Grammar–Reported Speech, Modals Vocabulary– Conjunctions, use of prepositions.

UNIT V THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY **9**

Listening – Listening to TED Talks, Presentations, Formal job interviews Speaking – Mock Interview, Making presentations with visual aids Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals Writing –Job / Internship application – Cover letter with Resume Grammar – Numerical adjectives, Relative Clauses Vocabulary–Idioms.

TOTAL (THEORY): 45 HOURS

LIST OF EXERCISES:

1. Listening /Reading Comprehension
2. Introducing Oneself
3. Summary of a Podcast
4. Mini Presentation on General topic (ICT tools)
5. Autobiography of a famous Personality
6. Narrating an unforgettable event
7. Drafting an Email (printed format)
8. Developing a story using given Vocabulary
9. Group Discussion
10. Mock Interview

TOTAL (LAB): 30 HOURS **TOTAL (45+30): 75 HOURS**

COURSE OUTCOMES

After the completion of the course, students will be able to

CO 1. Compare and contrast products and ideas in technical texts.
CO 2. Identify cause and effects in events, industrial processes through technical texts
CO 3. Analyse problems in order to arrive at feasible solutions and communicate them orally and in the written format.
CO 4. Report events and the processes of technical and industrial nature.
CO 5. Present their opinions in a planned and logical manner, and draft effective resumes in context of job search.

TEXT BOOKS

1. English for Engineers & Technologists (2020edition) Orient Blacks wan Private Ltd. Department of English, Anna University.
2. English for Science & Technology Cambridge University Press 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.
3. Professional English-II, V.K.Publications, Dr.S.N. Mahalakshmi.

REFERENCES

1. Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. New Delhi.
2. Improve Your Writing. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.
3. Learning to Communicate–Dr.V. Chellammal. Allied Publishers, New Delhi,2003
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.

YOUTUBE RESOURCES:

1. **TED-Ed:** TED-Ed offers a wide range of videos on communication skills, public speaking, storytelling, and critical thinking, which are all relevant to higher English communication.
2. **BBC Learning English:** BBC Learning English provides videos and resources focused on improving English language skills, including speaking, listening, vocabulary, and pronunciation.
3. **Rachel's English:** Rachel's English is a channel dedicated to helping learners improve their American English pronunciation, intonation, and speaking skills.
4. **EnglishLessons4U -** Learn English with Ronnie! [engVid]: Ronnie from engVid offers lessons on English communication, grammar, vocabulary, idioms, and expressions to enhance language fluency.

Course Code	EMPLOYABILITY ENHANCEMENT SKILLS – II	L	T	P	C
ES4202		0	0	2	1

COURSE OBJECTIVES

- To categorize, apply and use thought process to understand the concepts of Quantitative methods to enhance problem solving skills.
- To prepare and explain the fundamentals related to various possibilities with numeric ability and probabilities related to quantitative aptitude.
- To critically evaluate numerous possibilities related to puzzles.

COURSE DESCRIPTION

This course discusses basic financial concepts, budgeting, and financial planning for personal and professional goals. It depicts entrepreneurial mindset, business basics, and exploring opportunities for entrepreneurship or freelancing. To understanding cultural differences, diversity, and inclusion in the workplace. Cross-cultural communication, sensitivity, and adapting to global work environments. Ethical decision-making, integrity in professional conduct, and upholding ethical standards. Professional ethics, workplace integrity, and maintaining a positive professional reputation

PREREQUISITES

• Basic knowledge of using digital tools and platforms for communication, research, and productivity (e.g., email, search engines, Microsoft Office suite). Familiarity with online collaboration tools (e.g., Google Drive, Zoom, Slack) if applicable

• Basic interpersonal skills such as active listening, empathy, and conflict resolution. Ability to work collaboratively in team environments and communicate effectively with peers and supervisors

UNIT I – TIME AND DISTANCE **6**

Introduction – Speed: Late / Early / Usual Time – Average Speed – Chasing – Problems on Train: Crossing Pole, Crossing Platform, Train moving in same and different direction – Boats and Streams: Upstream, Downstream – Clock – Calendar.

UNIT II – PROBABILITY AND STATISTICS **6**

Introduction – Algebra of Events – Addition theorem of Probability – Permutation and Combinations

– Problems based on choosing the objects – Statistics: Range – frequency, Arithmetic Mean – Median

– Mode – Variance – Standard Deviation – Measures of Dispersion – Coefficient of Variation.

UNIT III – ARITHMETIC AND LOGICAL REASONING **6**

Introduction – Mathematical Operations – Blood Relations: Direct, Indirect, coded – Problems on Cubes and Dices: Face identification – Folding and cutting Images – Counting technique of figures

– Distance & Direction

UNIT IV – APPLIED MATHEMATICS **6**

Mensuration (2D&3D): Square, Rectangle, Triangle, Circle, Parallelogram, Rhombus, Trapezoid, Quadrilateral, Cube, Cuboid, Cylinder, Cone, Sphere, Miscellaneous – Trigonometry: Ratio, Identities, Heights and Distances – Algebra – Logarithm – Geometry.

UNIT V – VERBAL AND LOGICAL REASONING **6**

Introduction – Venn diagram – Syllogism – Data Sufficiency – Decision Making – Puzzle: Number Puzzle, Letter Puzzle – Ranking Test – Data Arrangement: Linear, Circular, Miscellaneous – Critical Reasoning.

.TOTAL HOURS (THEORY): 30

COURSE OUTCOMES

After the completion of the course, students will be able to

- **CO 1.** Use their logical thinking and analytical abilities to solve Quantitative aptitude questions from company specific and other competitive tests.
- **CO 2.** Solve questions related to Time etc. from company specific and other competitive tests.
- **CO 3.** Illustrate and solve puzzle related questions from specific and other competitive tests

TEXT BOOKS:

1. "Quantitative Aptitude for Competitive Examinations" by R.S. Aggarwal – 2022"
2. "Teach Yourself Quantitative Aptitude" by Arun Sharma – 2017
3. "A modern approach verbal and non – verbal reasoning" by R.S. Aggarwal – 2017

REFERENCES:

1. "Shortcuts in Mathematics" by Akhilesh Khare – 2016
2. "Vedic maths for competitive exams" by Ravi Shankar – 2016
3. "Quantitative Aptitude for Competitive Examination" by Abhijit Guha – 2017

YOUTUBE RESOURCES:

1. **LinkedIn Learning**: LinkedIn Learning offers a wide range of videos and tutorials on employability skills such as communication, leadership, time management, and professional development.
2. **TED Talks:** TED Talks feature speakers from various fields sharing insights and strategies on personal development, leadership, creativity, and career growth.
3. **Skillsoft**: Skillsoft provides videos on leadership development, soft skills training, career planning, and professional growth strategies.
4. **Coursera:** Coursera's channel includes videos on a wide range of topics, including employability skills, personal branding, networking, and career advancement.
5. **MindTools Videos**: MindTools Videos offers videos on leadership, communication skills, time management, decision-making, and other essential employability skills.

Course Code	NCC Credit Course	L	T	P	C
		2	0	0	2

UNIT I NCC General **6**

Aims, Objectives & Organization of NCC (1) – Incentives (2) – Duties of NCC Cadet (1) – NCC Camps: Types & Conduct (2)

UNIT II National Integration and Awareness **4**

National Integration: Importance & Necessity (1) – Factors Affecting National Integration (1) – Unity in Diversity & Role of NCC in Nation Building (1) –Threats to National Security (1)

UNIT III Personality Development **7**

Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving (2) – Communication Skills (3) – Group Discussion: Stress & Emotions (2)

UNIT IV Leadership **5**

Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code (3) – Case Studies: Shivaji, Jhansi Ki Rani (2)

UNIT V Social Service and Community Development **8**

Basics, Rural Development Programmes, NGOs, Contribution of Youth (3) – Protection of Children and Women Safety (1) Road/ Rail Travel Safety (1) – New Initiatives (2) – Cyber and Mobile Security Awareness (1)

TOTAL: 30 HOURS

Levels:

Level	**Activities**
1 ARMY	II semester: The NCC cadets are fresh to NCC activities are provided with above curriculum / syllabus
2 NAVY	For the Higher semester cadets of IV semester the credits are awarded with the basic qualifying needs a) Minimum one Combined Annual training Camp (CATC) or Attachment Camp or Centrally Organised Camp has to be attended (camp certificate is required) b) Appeared for B Certificate Exam
3 AIR FORCE	For the Higher semester cadets of VI semester the credits are awarded with the basic qualifying needs a) Minimum one Combined Annual training Camp (CATC) or Attachment Camp or Centrally Organized Camp has to be attended (camp certificate is required) b) Appeared for C Certificate Exam

Course Code	MATHEMATICS – III	L	T	P	C
MA4301	MATHEMATICAL METHODS FOR ENGINEERING	3	1	0	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
- To apply the concept of Laplace transforms in engineering problems.
- To introduce the concepts of Z transforms.
- To learn the basic concepts of Fourier series and Fourier transforms.
- To use the numerical techniques of differentiation and integration in engineering and technology disciplines.

UNIT I: ANALYTIC FUNCTION & COMPLEX INTEGRATION **12**

Analytic functions - Cauchy-Riemann equations (statement only) - Complex integration - Cauchy's integral theorem - Cauchy's integral formula - Taylor's and Laurent's series - Zeros - Singular points - Residues - Cauchy's residue theorem (statement only) - Evaluation of contour integrals on simple closed curves.

UNIT II: LAPLACE TRANSFORMS **12**

Existence conditions - Transforms of elementary functions - Transform of unit step function and unit impulse function - Basic properties - Shifting theorem - Transforms of derivatives and integrals - Initial and final value theorem - Inverse transforms - Convolution theorem - Transform of periodic functions - Application - solution of linear second order ordinary differential equations with constant coefficients.

UNIT III: TRANSFORMS **12**

Elementary properties - Inverse Z-transform (using partial fraction and residues) - Initial and final value theorems - Convolution theorem - Formation of difference equations - Solution of difference equations using Z - transform.

UNIT IV: FOURIER SERIES **12**

Dirichlet's conditions – General Fourier series – Odd and even functions – Change of interval - Half range Sine series –Half range Cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis

UNIT V: FOURIER TRANSFORMS **12**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

TOTAL: 60 HOURS

COURSE OUTCOMES:

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

CO1: Evaluate real and complex integrals using the Cauchy's integral formula and residue theorem.

CO2: Apply Laplace transform and inverse transform of simple functions, properties, various related problems.

CO3: Understand the characteristics and properties of Z – transform.

CO4: Recognize the concepts of Fourier series and Fourier Transform and applying engineering problems.

CO5: Develop the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration in Engineering problems

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi,43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics", John WileyandSons,10th Edition, New Delhi, 2016.
3. Sankara Rao . K, "Numerical Methods for Scientists and Engineers", PHI Learning Pvt Ltd., New Delhi, 2007.

REFERENCES:

1. Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Bali N., Goyal M. and Watkins C., Advanced Engineering Mathematics||, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4. Jain R.K. and Iyengar S.R.K., Advanced Engineering Mathematics ||, Narosa Publications, New Delhi, 3rd Edition, 2007.
5. O'Neil, P.V. Advanced Engineering Mathematics||, Cengage Learning India Pvt., Ltd, New Delhi, 2007.
6. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
7. S. Ponnusamy, "Foundations of Complex Analysis" 2nd Edition, Narosa Publishing House, 2014.

YOUTUBE RESOURCES:

1. **MIT Open Course Ware (OCW):** MIT OCW offers lectures and course materials on various topics including Transforms and PDEs. You can find full course videos, lecture notes, and assignments.
2. **Khan Academy:** Khan Academy has videos on differential equations, including topics on Fourier series and Laplace transforms. These videos cover the basics and are great for building a foundation.
3. **The Math Sorcerer:** The Math Sorcerer channel provides tutorials on transforms, Fourier series, Laplace transforms, and solving differential equations. The videos are clear and well-explained.
4. **Dr. Chris Tisdell:** Dr. Chris Tisdell's channel covers various topics in mathematics, including videos on transforms, Fourier series, and solving PDEs. The explanations are detailed and easy to follow

Course Code	ENGINEERING THERMODYNAMICS	L	T	P	C
ME4301		3	0	0	3

COURSE OBJECTIVES:

- Impart knowledge on the basics and application of zeroth and first law of thermodynamics.
- Impart knowledge on the second law of thermodynamics in analysing the performance of thermal devices.
- Impart knowledge on availability and applications of second law of thermodynamics
- Teach the various properties of steam through steamtables and Mollier chart.
- Impart knowledge on the macroscopic properties of ideal and real gases.

COURSE DESCRIPTION

Engineering Thermodynamics is a fundamental course that introduces students to the principles and concepts governing energy transfer and thermodynamic systems in engineering applications. The course covers topics such as energy conservation, heat transfer, work interactions, properties of substances, and thermodynamic cycles. Students will learn how to apply thermodynamic principles to analyze and solve problems related to heat engines, refrigeration systems, power generation, and energy conversion processes.

PREREQUISITES

- Basic knowledge of physics, calculus, and introductory engineering principles is recommended.
- Familiarity with mathematical modeling, energy concepts, and material properties will be beneficial for understanding thermodynamic principles.

UNIT I BASICS, ZEROTH AND FIRST LAW 9

Review of Basics – Thermodynamic systems, Properties and processes Thermodynamic Equilibrium -Displacement work - P-V diagram. Thermal equilibrium - Zeroth law – Concept of temperature and Temperature Scales. First law – application to closed and open systems – steady and unsteady flow processes.

UNITII SECOND LAW AND ENTROPY 9

Heat Engine–Refrigerator-Heat pump. Statements of second law and their equivalence & corollaries. Carnot cycle - Reversed Carnot cycle - Performance - Clausius inequality. Concept of entropy - T-s diagram – T-ds Equations-Entropy change for a pure substance.

UNIT III AVAILABILITY AND APPLICATIONS OF II LAW 9

Ideal gases undergoing different processes - principle of increase in entropy. Applications of II Law. High- and low-grade energy. Availability and Irreversibility for open and closed system processes - I and II law Efficiency

UNIT IV PROPERTIES OF PURE SUBSTANCES 9

Steam- formation and its thermodynamic properties -p-V, p-T, T-, T-s, h-s diagrams. pVT surface. Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart.

UNIT V GAS MIXTURES AND THERMODYNAMIC RELATIONS 9

Properties of Ideal gas, real gas - comparison. Equations of state for ideal and real gases. Vander Waal's relation - Reduced properties - Compressibility factor - Principle of Corresponding states – Generalized Compressibility Chart. Maxwell relations- T-ds Equations- heat capacities relations- Energy equation, Joule-Thomson experiment-Clausius-Clapeyron equation.

TOTAL (THEORY): 45 HOURS

COURSE OUTCOMES:

At the end of the course the students would be able to

- **CO 1.** Apply the zeroth and first law of thermodynamics by formulating temperature scales and calculating the property changes in closed and open engineering systems.
- **CO 2.** Apply the second law of thermodynamics in analysing the performance of thermal devices through energy and entropy calculations.
- **CO 3.** Apply the second law of thermodynamics in evaluating the various properties of steam through steam tables and Mollier chart
- **CO 4.** Apply the properties of pure substance in computing the macroscopic properties of ideal and real gases using gas laws and appropriate thermodynamic relations.
- **CO 5.** Apply the properties of gas mixtures in calculating the properties of gas mixtures and applying various thermodynamic relations to calculate property changes.

TEXTBOOKS:

1. Nag.P.K.,"Engineering Thermodynamics",6thEdition,Tata Mc Graw Hill (2017), New Delhi.
2. Natarajan,E.,"Engineering Thermodynamics:Fundamentals and 2nd Edition(2014),Anuragam Publications,Chennai.

REFERENCES:

1. Cengel,Y and M.Boles, Thermodynamics-An Engineering Approach, Tata McGraw Hill, 9thEdition,2019.
2. Chattopadhyay,P, "Engineering Thermodynamics",2nd Edition Oxford University Press,2016
3. Rathakrishnan, E., "Fundamentals of Engineering Thermodynamics", 2nd Edition, Prentice Hall of IndiaPvt.Ltd,2006.
4. Claus Borgnakke and Richard E.Sonntag, "Fundamentals of Thermodynamics", 10th Edition, Wiley Eastern, 2019.
5. Venkatesh.A, "Basic Engineering Thermodynamics", Universities Press (India) Limited,2007

YOUTUBE RESOURCES:

1. **Learn ChemE** (University of Colorado Boulder): This channel offers a series of videos covering various topics in thermodynamics, including properties of substances, energy transfer, and thermodynamic cycles.
2. **The Organic Chemistry Tutor:** The channel provides tutorials on engineering thermodynamics concepts, laws, calculations, and problem-solving techniques.
3. **Engineering Academy:** Engineering Academy offers videos on thermodynamics topics, including the first law of thermodynamics, heat transfer, thermodynamic cycles, and more.
4. **Jeff Hanson -** Engineering Courses: The channel provides lectures and tutorials on engineering thermodynamics, covering fundamental concepts and applications.

Course Code	OBJECT ORIENTED PROGRAMMING	L	T	P	C
ME4307		3	0	2	4

COURSE OBJECTIVES:

The main objectives of this course are to:

- Understand Object Oriented Programming concepts and basics of Java programming language
- Know the principles of packages, inheritance and interfaces
- Define exceptions and use I/O streams
- Develop a java application with threads and generic classes
- Perform string manipulations

Course Description

Encapsulation of data and behaviour within classes to ensure data security and modularity. Abstraction through interfaces and abstract classes for hiding implementation details. OOAD methodologies like Unified Modelling Language (UML) for modelling of t ware systems. Use case diagrams, class diagrams, sequence diagrams, and other UML diagrams for visualizing system architecture.

Prerequisites

- Basic mathematical skills including arithmetic operations, logic, and Boolean algebra. Understanding of mathematical concepts used in programming, such as comparisons and logical operations. Proficiency in using command-line interfaces (CLI) for compiling and running programs.
- Familiarity with text editors or integrated development environments (IDEs) for writing and editing code. Understanding of basic data structures such as arrays, linked lists, stacks, queues, and trees. Knowledge of common algorithms such as searching, sorting, and recursion

UNIT I INTRODUCTION TO OOP AND JAVA FUNDAMENTALS 9

Object Oriented Programming– objects and classes - OOP in Java – Characteristics of Java – The Java Environment - Java Source File Structure – Compilation Fundamental Programming Structures in Java – Packages – Java Doc comments - Defining classes in Java -access specifiers - static members - Data Types, Variables, Operators, Control Flow – methods - constructors - Arrays.

UNIT II ABSTRACTION- ENCAPSULATION- INHERITANCE – POLYMORPHISM 9

Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the Object class – abstract classes and methods- final methods and classes – Interfaces – defining an interface, implementing interface, differences between classes and interfaces and extending interfaces - Object cloning -inner classes, Array Lists – Strings

UNIT III EXCEPTION H AND L IN G AND I/O 9

Exceptions-exception hierarchy-throwing and catching exceptions-built in exceptions, creating own exception-User defined Exceptions. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files

UNIT IV MULTI THREADING **9**

Differences between multi-threading and multitasking, thread lifecycle, creating threads, synchronizing threads, Inter thread communication, daemon threads, thread groups

UNIT V GENERIC PROGRAMMING **9**

Generic Programming – Generic classes – generic methods – Bounded Types – Restrictions and Limitations - Strings: Basic String class, methods, String Buffer Class & String Builder class

TOTAL: 45 HOURS

Course Format

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials

Assessments & Grading

Quizzes / Assignments, Project, 3 Internal Assessments, Final Examination

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Develop Java programs using OOP principles
CO2: Develop Java programs with the concepts inheritance and Polymorphism
CO3: Build Java applications using exceptions and I/O streams
CO4: Develop Java applications with threads and generics classes.
CO5: Develop interactive Java programs using strings

TEXT BOOKS:

1. Herbert Schildt, "Java: TheCompleteReference",11thEdition, Mc Graw Hill Education, New Delhi, 2019
2. Cay S. Horstmann, "Core Java Fundamentals", Volume1,11thEdition, Prentice Hall,2018.

REFERENCES:

1. Paul Deitel Harvey Deitel, Java How to Program, PrenticeHall;9th edition,2018.

YouTube Resources:

1. **MIT OpenCourseWare -** MIT OCW offers a wide range of lectures and courses on manufacturing systems and related topics, providing in-depth insights into advanced manufacturing concepts.
2. **Manufacturing Hub -** This channel covers various aspects of manufacturing, including lean manufacturing, agile manufacturing, and smart manufacturing techniques, offering practical tips and insights for students studying advanced manufacturing systems.
3. **The Engineer Guy -** While not specifically focused on advanced manufacturing, this channel provides insightful videos on engineering principles and processes, which can complement the understanding of manufacturing systems.
4. **Festo Learning -** Festo Learning offers videos on industrial automation, robotics, and smart manufacturing technologies, providing valuable insights into the latest advancements in manufacturing systems.

5. **The Lean Thinker-** This channel focuses on lean manufacturing principles and techniques, offering tutorials, case studies, and discussions to help viewers understand and implement lean practices in manufacturing processes.

30 HOURS

LIST OF EXPERIMENTS

1. Java program to demonstrate the concept of objects and classes.
2. Java program to demonstrate the fundamental programming structures.
3. Java class with private, protected, and public access specifiers.
4. Java program to demonstrate the concepts of inheritance and polymorphism.
6. Java program to demonstrate exception handling using try-catch blocks.
7. Java program to demonstrate basic input/output operations in Java using streams.
8. Java program to read and write data to/from files using file input/output streams.
9. Java program for multiple threads in a program to perform concurrent tasks.
10. Java program to demonstrate generic programming concepts of generic classes and methods.
11. Java program for String class, String Buffer class, and StringBuilder class to perform string manipulation operations.

TOTAL: 75 HOURS

Course Code	FLUID MECHANICS AND MACHINERY	L	T	P	C
ME4302		3	0	2	4

COURSE OBJECTIVES:

1. To understand the properties of the fluid
2. To analyze and appreciate the complexities involved in solving the fluid flow problems.
3. To study the mathematical techniques and apply them to the solutions of practical flow Problems
4. Learn to apply conservation laws flow through pipes.

COURSE DESCRIPTION

Fluid Mechanics and Machinery is a comprehensive course that introduces students to the fundamental principles of fluid mechanics and the operation of various fluid machinery used in engineering applications. The course covers topics such as fluid properties, fluid statics, fluid dynamics, flow measurements, hydraulic machinery, pumps, turbines, and their practical applications. The laboratory component provides hands-on experience with experimental setups, flow measurements, performance testing of pumps and turbines, and analysis of fluid behavior.

PREREQUISITES

1. Basic knowledge of physics, calculus, and engineering mechanics
2. Familiarity with fundamental concepts in fluid mechanics such as pressure, flow, and forces exerted by fluids

UNIT I BASIC CONCEPTS AND FLUID PROPERTIES 15

Density, specific weight, specific volume, specific gravity, viscosity, compressibility, capillary, surface tension and buoyancy - forces on submerged bodies, Measurement of Pressure: Pascal's law and Hydrostatic equation - concept of fluid static pressure, Measurement of Pressure using Manometers. Control-volume analysis of mass, momentum and energy; fluid acceleration

UNIT II FLUID DYNAMICS 15

Euler's equation - Bernoulli's equation and its applications. Laminar flow – Hagan Poiseuille equation - -basics of compressible flow, Turbulent flow – Darcy Weisbach formula - Viscous flow of incompressible fluids, Major and minor losses of flow in circular pipes. Pipes in series and in parallel. Bends and fittings, Boundary Layer - Boundary layer thickness, boundary layer separation

UNIT III DIMENSIONAL ANALYSIS 15

Dimension and Units – Buckingham π theorem – similitude – Dimensionless numbers - Model analysis. Centrifugal pumps, Reciprocating pump – working principles, Velocity triangles, Work done by impellor, Efficiencies, Cavitation in pumps. Classification of water turbines - Pelton wheel, Francis turbine and Kaplan turbines, working principles - Constructional details, Velocity triangles, Power and efficiency calculations - Specific speed.

TOTAL HOURS (THEORY): 45

LAB EXERCISES

1. Determination of coefficient of discharge of a venturimeter
2. Determination of friction factor for flow through pipes
3. Determination of metacentric height
4. Determination of forces due to impact of jet on a fixed plate
5. Characteristics of centrifugal pumps
6. Characteristics of reciprocating pump
7. Characteristics of Pelton wheel turbine

TOTAL HOURS (LAB): 30 **TOTAL HOURS: (45+30) - 75**

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to

CO1. Recognize the basic concepts of fluid properties.
CO2. Examine the fluid flow and its behaviour.
CO 3. Study the behaviour of boundary layer flows.
CO 4. Examine the dependent and independent dimensionless parameters.
CO 5. Analyze the performance of hydraulic machines.

TEXT BOOKS:

1. Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw-Hill Education, 2017.
2. Rajput, R.K., "Fluid Mechanics and Hydraulic Machines", S.Chand Publishers, 2016.
3. YunusCengel and John Cimbala, Fluid Mechanics Fundamentals and Application, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi 2010.

REFERENCE BOOKS:

1. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House (p) Ltd. New Delhi 2016
2. Bansal, R.K. "Fluid Mechanics and hydraulic Machines", Laxmi Publications (P) Ltd., New Delhi,2018
3. Introduction to Fluid Mechanics, Robert W. Fax, Philip J. Pritchard, Alan T. McDonald. Wiley India Edition. (Wiley Student Edition Seventh 2011).

YOUTUBE RESOURCES:

1. **Learn ChemE** (University of Colorado Boulder): This channel covers various topics in chemical engineering, including fluid mechanics and related experiments.
2. **NPTEL** - Mechanical Engineering: NPTEL offers lectures by professors from IITs and other institutions on fluid mechanics and machinery, including lab demonstrations.
3. **The Organic Chemistry Tutor:** This channel provides tutorials on fluid mechanics topics, equations, and problem-solving techniques.
4. **Engineering Academy:** Engineering Academy offers videos on fluid mechanics concepts, laboratory experiments, and machinery operation.
5. **Dr. Chirag Patel**: Dr. Chirag Patel's channel covers fluid mechanics lectures, demonstrations, and practical aspects of fluid machinery.

Course Code	MANUFACTURING TECHNOLOGY-II	L	T	P	C
ME4303		3	0	2	4

COURSE OBJECTIVES:

- To understand the concepts of metal cutting and measurements.
- To understand the working of standard machine tools, special purpose machines and allied machining processes.
- To study the advancements in manufacturing operations**.**

COURSE DESCRIPTION

Manufacturing Technology is a multidisciplinary course that introduces students to various manufacturing processes, techniques, and technologies used in industrial production. The course covers topics related to material properties, machining methods, casting, forming, welding, additive manufacturing, automation, and quality control in manufacturing. The laboratory component provides hands-on experience with manufacturing equipment, tools, processes, and quality assessment techniques.

PREREQUISITES

- Basic knowledge of materials science, engineering fundamentals, and manufacturing processes
- Familiarity with engineering drawings, measurement tools, and workshop practices

UNIT I THEORY OF METAL CUTTING 9

Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools– nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability

UNIT II TURNING MACHINES 9

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle.

UNIT III SPECIAL AND GEAR CUTTING MACHINES 9

Shaper, Planer, Slotter - Types of operations. Drilling, reaming, boring, tapping. Milling operations-types of milling cutters. Gear cutting – forming and generation - principle and construction of gear milling, hobbing and gear shaping processes –finishing of gears.

UNIT IV ABRASIVE PROCESS AND BROACHING 9

Abrasive processes: grinding wheel – specifications and selection, types of grinding process– cylindrical grinding, surface grinding, centre less grinding and internal grinding- Typical applications – concepts of surface integrity, broaching machines: broach construction – push, pull, surface and continuous broaching machines

UNIT IV CNC MACHINING 9

Numerical Control (NC) machine tools – CNC types, constructional details, special features, machining centre, part programming fundamentals CNC – manual part programming – micromachining – wafer machining

TOTAL (THEORY): 45 HOURS

LAB EXERCISES

1. Force measurement during turning operations
2. Tool angle grinding with Tool and Cutter Grinder
3. Eccentric turning and knurling
4. External thread cutting
5. Internal thread cutting
6. Taper turning by compound rest method
7. Making round to square using shaping machine.
8. Contour milling using vertical milling machine
9. Spur gear cutting in milling machine
10. Gear generation in hobbing machine
11. Plain Surface grinding
12. Cylindrical grinding
13. CNC Part Programming for turning
14. CNC Part Programming for milling

TOTAL (LAB): 30 HOURS
TOTAL (45+30): 75 HOURS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Develop relations for chip reduction coefficient, shear angle, shear strain, forces, power, specific energy and temperature in orthogonal cutting

CO2: Make use of turning machine tools to produce various features on a cylindrical components

CO3: Make use of shaper, planner, slotter and milling machine tools to produce flat surfaces and gears

CO4: Utilize different types of grinding machines to produce smooth flat and cylindrical surfaces and understand the basics of broaching machines

CO5: Apply the fundamentals concepts to CNC machining to prepare and simulate computer part programs

TEXT BOOKS

1. Hajra Choudhury, Elements of Workshop Technology, Vol.II., Media Promoters 2014
2. Rao. P.N, Manufacturing Technology - Metal Cutting and Machine Tools, 3 rd Edition, Tata McGraw-Hill, New Delhi, 2013.

REFERENCE BOOKS

1. Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J.White, Machine Tool Practices, Prentice Hall of India, 1998.
2. GefreyBothroyd, Fundamental of Metal Machining and Machine Tools, McGraw Hill, 1984.
3. HMT, Production Technology, Tata McGraw Hill, 1998.

Roy. A.Lindberg, Process and Materials of Manufacture, Fourth Edition, PHI/Pearson Education 2006.

YOUTUBE RESOURCES

1. **MIT OpenCourseWare**: Introduction to Manufacturing Systems
2. **NPTEL**: Manufacturing Processes I, Learn Engineering:
3. **The Engineering Mindset**: Manufacturing Engineering, NYU Tandon School of Engineering:
4. **NYU Tandon Online:** Fundamentals of Manufacturing for Engineers, SME (Society of Manufacturing Engineers):
5. **Smart Manufacturing:** These resources cover a broad range of topics within manufacturing technology, from basic concepts and processes to advanced systems and smart manufacturing techniques.

Course Code	SOLID MECHANICS	L	T	P	C
ME4304		3	0	2	4

COURSE OBJECTIVES:

- To learn the fundamental concepts of strength of materials
- To understand and analyze the stress induced in various structural members
- To evaluate the stability of columns and beams.
- To understand the two dimensional stresses.

COURSE DESCRIPTION

Solid Mechanics is a foundational course in engineering that focuses on the behavior of solid materials under various loading conditions. The course covers topics related to stress, strain, deformation, material properties, elasticity, plasticity, failure theories, and structural analysis. The laboratory component provides hands-on experience with experimental setups, testing procedures, data collection, and analysis of solid mechanics principles.

PREREQUISITES

- Basic knowledge of physics, mathematics (calculus, differential equations), and engineering fundamentals.
- Familiarity with mechanics of materials, statics, and dynamics.

UNIT I: SIMPLE STRESSES AND STRAIN 15

Introduction, Definition, Hooke's law, Stress-Strain diagrams, factor of safety, Elongation due to self-weight, Compound bars, Thermal stresses, Compound section subjected to thermal stresses. Elastic constants and their relationships. Principal stresses and principal planes- Mohr's circle. Strain Energy-Analysis of strain energy in uniaxial loading. Concept of Shear Center.

UNIT II: INTRODUCTION TO TYPES OF BEAMS 15

Supports and loadings. Definition of bending moment and shear force, Sign conventions, Shear force and bending moment diagrams for statically determinate beams subjected various kinds of loads. Stresses in Beams- bending equation, section modulus, flexural rigidity. Analysis of bending stress in the circular, rectangular, 'I' sections. Deflection of Beams - Double Integration method and Macaulay's method.

UNIT III: TORSION 15

Stresses and deformation in circular and hollow shafts, torsional rigidity and polar modulus, Power transmitted by a uniform shaft, Columns – Buckling load by Euler's and Rankine's equations. Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thin and thick cylinders subjected to internal pressure.

TOTAL HOURS (THEORY): 45

LAB EXERCISES

1. Double shear test on Mild steel and Aluminum rods
2. Torsion test on mild steel rod
3. Impact test on metal specimen
4. Hardness test on metals – Brinell and Rockwell Hardness Number
5. Deflection test on beams
6. Compression test on helical springs
7. Strain Measurement using Rosette strain gauge

TOTAL (LAB): 45 HOURS **TOTAL: (45+30) 75 HOURS**

COURSE OUTCOMES:

CO1 :Draw free-body diagrams; apply the equations of equilibrium to two- and three-dimensional solids; understand the concepts of strain and stress; solve simple boundary-value problems (tension, torsion, beam bending)

CO2: Apply the knowledge and principles of mechanics of materials in engineering design.

CO3: Demonstrate the ability to work and communicate effectively in engineering project using the principle of mechanics of material.

CO4: Analyze the behavior of the solid bodies subjected to various types of loading

CO5: Identify and display appropriate experimental techniques in mechanics of material through laboratory experiments

TEXT BOOKS:

1. Ferdinand P. Beer , E. Russell Johnston Jr, John T. DeWolf, David F. Mazurek, Sanjeev Sanghi, "Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd.,New Delhi, 8th Edition , 2020.
2. S.S. Rattan "Strength of Materials", McGraw Hill Education (India) Pvt. Ltd., 3rd Edition, 2017.

REFERENCE BOOKS:

1. Egor. Popov , "Mechanics of Materials" 2nd Edition, Pearson Education India, 2015
2. S. H. Crandall and N. C. Dahl, "Introduction to Mechanics of Solids", 3rd Edition, Tata Mc Graw Hill, India, 2013.
3. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2018.

YOUTUBE RESOURCES:

1. **Structure Free:** This channel provides in-depth tutorials and lectures on structural engineering topics, including solid mechanics.
2. **Mechanical Engineering by Engineering Funda:** The Engineering Funda channel covers various topics in mechanical engineering, including solid mechanics principles and applications.
3. **Mechanical work:** Another playlist from Structure Free focusing on structural analysis and mechanics of materials.
4. **NPTEL -** Mechanical Engineering (Solid Mechanics): NPTEL offers video lectures by professors from IITs and other institutions covering solid mechanics topics.

Course Code	EMPLOYABILITY ENHANCEMENT SKILLS – III:	L	T	P	C
ES4303	PROFESSIONAL COMMUNICATION AND TEAMWORK SKILLS	0	0	2	1

COURSE OBJECTIVES:

1. To familiarize students with various forms of communication.
2. To develop effective team communication skills.
3. To enhance stakeholder communication skills.
4. To cultivate ethical communication practices.
5. To explore digital communication tools and trends.

COURSE DESCRIPTION

This course is designed to equip students with essential skills and competencies required for successful entry into the workforce and career advancement. It focuses on developing a range of professional skills, including communication, teamwork, problem-solving, critical thinking, leadership, and adaptability. The course also covers aspects such as resume writing, interview preparation, networking, personal branding, and career planning strategies.

PREREQUISITES

There are no specific prerequisites for this course. However, a willingness to learn, participate actively, and apply acquired skills is essential for maximizing the benefits of the course

UNIT 1: Introduction to Communication - Verbal Communication Skills: - Written Communication Skills - Nonverbal Communication - Interpersonal Communication

UNIT 2: Characteristics of Effective Teams - Team Building and Group Cohesion - Conflict Resolution - Decision Making in Teams - Cross-Cultural Communication

UNIT 3: Stakeholder Communication - Presentation Skills - Effective Meetings - Feedback and Evaluation

UNIT 4: Professional Codes of Conduct - Integrity in Communication - Addressing Ethical Challenges - Analyzing real-world ethical communication dilemmas

UNIT 5: Digital Communication Tools - Social Media and Networking - Emerging Trends in Communication

COURSE OUTCOMES:

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

CO1: Demonstrate proficiency in various forms of communication.
CO2: Exhibit strong team communication skills.
CO3: Display competence in stakeholder communication.
CO4: Apply ethical communication principles.
CO5: Utilize digital communication tools effectively.

TEXTBOOKS:

1. Sharon J. Gerson and Steven M. Gerson. "Technical Communication: Process and Product", Pearson, 2014
2. Karl A. Smith. “Teamwork and Project Management”, McGraw-Hill Education, 2013
3. Charles E. Harris Jr., Michael S. Pritchard, and Michael J. Rabins. "Engineering Ethics: Concepts and Cases", Cengage Learning, 2012
4. Christoph Meinel and Harald Sack. "Digital Communication: Communication, Multimedia, Security", Springer, 2014

REFERENCES

1. Katherine L. Adams and Gloria J. Galanes. "Communicating in Groups: Applications and Skills", McGraw Hill Education, 2018
2. Lawrence Holpp. "Managing Teams: Strategies for Success", McGraw Hill, 1998.
3. Caroline Whitbeck (ed) "Ethics in Engineering Practice and Research", Cambridge University Press, 2011

YOUTUBE RESOURCES:

1. **Career Vidz:** This channel offers videos on career advice, job search strategies, interview tips, resume writing, and personal development.
2. **Work It Daily:** Work It Daily provides videos on career coaching, professional branding, networking, workplace skills, and job search tactics.
3. **Linda Raynier:** Linda Raynier's channel covers topics such as resume writing, interview preparation, career growth strategies, and personal branding.
4. **Andrew LaCivita:** Andrew LaCivita offers videos on career development, job interview techniques, communication skills, and leadership.

Course Code	MATHEMATICS – IV NUMERICAL METHODS	L	T	P	C
MA4401		3	1	0	4

COURSE OBJECTIVES:

- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations.
- To acquaint the student with understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT II INTERPOLATION AND APPROXIMATION 12

Interpolation with unequal intervals - Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines - Difference operators and relations - Interpolation with equal intervals - Newton's forward and backward difference formulae.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method - Two point and three-point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12

Single step methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge - Kutta method for solving first order equations - Multi step methods - Milne's and Adams - Bash forth predictor corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 12

Finite difference methods for solving second order two - point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular

domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

TOTAL : 60 HOURS

COURSE OUTCOMES:

CO1 Upon successful completion of the course, students should be able to:

CO2 Understand the basic concepts and techniques of solving algebraic and transcendental equations.

CO3 Appreciate the numerical techniques of interpolation and error approximations in various intervals in real life situations.

CO4 Apply the numerical techniques of differentiation and integration for engineering problems.

CO5 Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.

CO6 Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXTBOOKS:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
3. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.
4. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
5. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014 47.

REFERENCES:

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.
2. Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6 th Edition, New Delhi, 2006.
3. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall, 1992.
4. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3rd Edition, New Delhi, 2007.
5. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.

Course Code	DESIGN OF MACHINE ELEMENTS	L	T	P	C
ME4401		3	0	0	3

COURSE OBJECTIVES

- To learn the various steps involved in the Design Process.
- To Learn designing shafts and couplings for various applications.
- To Learn the design of temporary and permanent Joints.
- To Learn designing helical, leaf springs, flywheels, connecting rods and crank shafts for various applications.
- To Learn designing and select sliding and rolling contact bearings, seals and gaskets.(Use of PSG Design Data book is permitted)

COURSE DESCRIPTION

Design of Machine Elements is a fundamental course in mechanical engineering that focuses on the principles, methods, and techniques involved in designing machine components and systems. The course covers topics such as stress analysis, material selection, design factors, failure theories, and design considerations for various machine elements. Emphasis is placed on understanding the design process, applying engineering principles, and ensuring the functionality, reliability, and safety of machine elements.

PREREQUISITES

- Basic knowledge of mechanics, strength of materials, materials science, and engineering design fundamentals
- Familiarity with mathematics (calculus, differential equations) and computer-aided design (CAD) software is beneficial
- Understanding of manufacturing processes, machine components, and engineering drawing standards

UNIT I FUNDAMENTAL CONCEPTS IN DESIGN 9

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers- Direct, Bending and torsional loading- Modes of failure - Factor of safety – Combined loads – Principal stresses – Eccentric loading – curved beams – crane hook and 'C' frame- theories of failure – Design based on strength and stiffness – stress concentration – Fluctuating stresses – Endurance limit –Design for finite and infinite life under variable loading - Exposure to standards.

UNIT II DESIGN OF SHAFTS AND COUPLINGS 9

Shafts and Axles - Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys and splines – Rigid and flexible couplings.

UNIT III DESIGN OF TEMPORARY AND PERMANENT JOINTS 9

Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints – Welded joints- Butt, Fillet and parallel transverse fillet welds – welded joints subjected to bending, torsional and eccentric loads, riveted joints for structures - theory of bonded joints.

UNIT IV DESIGN OF ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 9

Types of springs, design of helical and concentric springs–surge in springs, Design of laminated springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines - Solid and Rimmed flywheels- connecting rods and crank shafts

UNIT V DESIGN OF BEARINGS AND MISCELLANEOUS ELEMENTS 9

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi& Boyd graphs, -- Selection of Rolling Contact bearings –Design of Seals and Gaskets.

TOTAL (THEORY): 45 HOURS

COURSE OUTCOMES:

At the end of the course the students would be able to

- **CO 1.** Explain the design machine members subjected to static and variable loads.
- **CO 2.** Apply the concepts design to shafts, key and couplings.
- **CO 3.** Apply the concepts of design to bolted, Knuckle, Cotter, riveted and welded joints.
- **CO 4.** Apply the concept of design helical, leaf springs, flywheels, connecting rods and crank shafts.
- **CO 5.** Apply the concepts of design and select sliding and rolling contact bearings, seals and gaskets.

TEXT BOOKS:

1. Bhandari V B, “Design of Machine Elements”, 4th Edition , Tata Mc Graw-Hill Book Co, 2016
2. Joseph Shigley, Richard G. Budynas and J. Keith Nisbett “Mechanical Engineering Design”, 10th Edition,Tata McGraw-Hill , 2015.

REFERENCES:

1. Ansel C Ugural, “Mechanical Design – An Integral Approach”, 1st Edition, Tata McGraw- Hill Book Co,2004.
2. Merhyle Franklin Spotts, Terry E. Shoup, and Lee Emrey Hornberger, “Design of Machine Elements”8th Edition, Printice Hall, 2004.
3. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine component Design”,6th Edition,Wiley, 2017.
4. Sundararajamoorthy T. V. and Shanmugam .N, “Machine Design”, Anuradha Publications, Chennai,2003.
5. Design of Machine Elements | SI Edition | Eighth Edition | By Pearson by M. F. Spotts, Terry E. Shoup,et al. | 25 March 2019

YOUTUBE RESOURCES:

1. **Design of Machine Elements by Learn Engineering:** This playlist offers a comprehensive overview of machine design principles, including stress analysis, material selection, and design considerations.
2. **Machine Design by NPTEL (National Programme on Technology Enhanced Learning):** NPTEL lectures on various aspects of machine design, covering topics such as design of fasteners, bearings, gears, shafts, and mechanical joints.
3. **Machine Design Tutorials by The Engineering Mindset**: This series includes tutorials on machine fundamentals, design calculations, stress analysis, and practical design examples.
4. **Design of Machine Elements by Mechanical Engineering Lectures:** Mechanical Engineering Lectures covers topics such as design of shafts, keys, couplings, springs, brakes, and clutches in machine elements design.
5. **Machine Design and Analysis by MIT Open Course Ware:** MIT Open Course Ware offers lectures on design and analysis, covering design methodologies, design optimization, and case studies.

Course Code	ENGINEERING METALLURGY	L	T	P	C
ME4402		3	0	0	3

COURSE OBJECTIVES

- To learn the constructing the phase diagram and using of iron-iron carbide phase diagram for microstructure formation.
- To learn selecting and applying various heat treatment processes and its microstructure formation.
- To illustrate the different types of ferrous and non-ferrous alloys and their uses in engineering field.
- To illustrate the different polymer, ceramics and composites and their uses in engineering field.
- To learn the various testing procedures and failure mechanism in engineering field.

COURSE DESCRIPTION

Engineering Metallurgy is a fundamental course that delves into the study of metallic materials, their properties, processing techniques, and applications in engineering. The course covers topics related to the structure of metals, phase transformations, mechanical properties, corrosion resistance, and heat treatment of metallic alloys. Students learn about different types of metals and alloys, their microstructures, mechanical behavior, material selection criteria, and manufacturing processes.

PREREQUISITES

- Basic knowledge of materials science, chemistry, physics, and engineering principles
- Familiarity with concepts such as atomic structure, chemical bonding, phase transformations, and mechanical behavior of materials

UNIT I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9

Stress and strain diagram for Engineering materials, Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – Iron carbide equilibrium diagram. Classification of steel and cast-Iron microstructure, properties and application.

UNIT II HEAT TREATMENT 9

Definition – Full annealing, stress relief, recrystallisation and spheroidising –normalizing, hardening and tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram – continuous cooling Transformation (CCT) diagram – Austempering, Martempering – Hardenability, Jominy end quench test -case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening – Thermo- mechanical treatments- elementary ideas on sintering.

UNIT III FERROUS AND NON-FERROUS METALS 9

Effect of alloying additions on steel (Mn, Si, Cr, Mo, Ni, V, Ti & W) – stainless and tool steels – HSLA - Maraging steels – Grey, white, malleable, spheroidal – alloy cast irons, Copper and its alloys – Brass, Bronze

and Cupronickel – Aluminium and its alloys; Al-Cu – precipitation strengthening treatment – Titanium alloys, Mg-alloys, Ni-based super alloys – shape memory alloys- Properties and Applications overview of materials standards.

UNIT IV NON-METALLIC MATERIALS 9

Polymers – types of polymers, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PAI, PPO, PPS, PEEK, PTFE, Thermoset polymers – Urea and Phenol formaldehydes –Nylon, Engineering Ceramics – Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON – inter metallics- Composites- Matrix and reinforcement Materials applications of Composites - Nano composites.

UNIT V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS 9

Mechanisms of plastic deformation, slip and twinning – Types of fracture – fracture mechanics- Griffith's theory- Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Micro and nano-hardness tests, Impact test lzod and charpy, fatigue and creep failure mechanisms.

TOTAL (THEORY): 45 HOURS

COURSE OUTCOMES

At the end of the course the students would be able to

- **CO 1.** Explain alloys and phase diagram, Iron-Iron carbon diagram and steel classification.
- **CO 2.** Explain isothermal transformation, continuous cooling diagrams and different heat treatment processes.
- **CO 3.** Clarify the effect of alloying elements on ferrous and non-ferrous metals.
- **CO 4.** Summarize the properties and applications of non-metallic materials.
- **CO 5.** Explain the testing of mechanical properties.

TEXT BOOKS:

1. Kenneth G.Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 9th edition ,2018
2. Sydney H.Avner, "Introduction to Physical Metallurgy", McGraw Hill Book Company, 1994

REFERENCES:

1. A. Alavudeen, N. Venkateshwaran, and J. T.Winowlin Jappes, A Textbook of Engineering Materials and Metallurgy, Laxmi Publications, 2006.
2. Amandeep Singh Wadhwa, and Harvinder Singh Dhaliwal, A Textbook of Engineering Material and Metallurgy, University Sciences Press, 2008.
3. G.S. Upadhyay and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt.Ltd, New Delhi, 2020.
4. Raghavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt.Ltd. 6th edition, 2019.
5. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, 2nd edition Re print 2019.

YOUTUBE RESOURCES

1. **University Channels:** Many universities and educational institutions upload lectures and tutorials related to Engineering Metallurgy. Look for channels from universities known for their materials science or metallurgical engineering programs.
2. **Educational Channels:** Explore educational channels that specialize in engineering, materials science, or metallurgy. These channels often have playlists or videos dedicated to topics within Engineering Metallurgy.
3. **Professional Organizations:** Check if professional organizations related to metallurgy or materials science have YouTube channels. They may share conference talks, seminars, or industry insights relevant to Engineering Metallurgy.
4. **Online Courses Platforms:** Platforms like Coursera, edX, or Khan Academy sometimes offer courses or video lectures on Engineering Metallurgy. You can search for specific courses or topics related to metallurgy on these platforms.

Course Code	MECHANICS OF MACHINES	L	T	P	C
ME4403		3	0	2	4

COURSE OBJECTIVES:

- To impart knowledge about forces acting on machine parts.
- To enable students to understand the fundamental concepts of machines
- To facilitate students to understand the functions of cams and gears.
- To make students to get an insight into balancing of rotating and reciprocating masses and the concepts of vibration.

COURSE DESCRIPTION

Mechanics of Machines is an essential course in mechanical engineering that focuses on the study of mechanisms, machine components, and their interactions. The course covers topics such as kinematics, dynamics, mechanisms, machine elements, and their applications in engineering systems. The accompanying laboratory sessions provide hands-on experience in analyzing, designing, and testing mechanical systems and components.

PREREQUISITES

- Basic knowledge of physics, mechanics, and engineering principles
- Familiarity with mathematics (calculus, differential equations, vectors) and computer-aided design (CAD) software is beneficial
- Understanding of materials science, strength of materials, and machine design fundamentals

UNIT I INTRODUCTION **15**

General concepts, Introduction of Simple mechanisms, Grublers rule, Grashof‟s Criterion for mobility. Velocity and accelerations in simple slider crank and four bar mechanisms by relative velocity method, Coriolis component of acceleration. Classification of cam and follower - displacement diagrams - Graphical layouts of cam profiles. Dynamic analysis of linkages, Flywheels and governors

UNIT II GEARS **15**

Fundamental law of gearing, spur gear contact ratio and interference/undercutting, Epicyclic gear trains – Analysis by tabular method. Basic features of vibratory systems – Single degree of freedom – Free vibration– Equations of motion – Natural frequency – Typesof Damping – Damped vibration– Torsional vibration of shaft – Critical speeds of shafts. Forced vibration

UNIT III BALANCING **15**

Static and dynamic balancing of revolving & reciprocating masses in single and multi-cylinder engines. Gyroscopes - Basic concepts - gyroscopic law, effect of gyroscopic couple on ships and aircrafts.

TOTAL (THEORY): 45 HOURS

LAB EXERCISES

1. Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.
2. Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum
3. Single degree of freedom Spring Mass System – Determination of natural Frequency
4. Multi degree freedom suspension system – Determination of influence coefficient.
5. Balancing of rotating & reciprocating masses.
6. Transverse vibration of Free-Free beam – with and without concentrated masses.
7. Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.
8. Determination of transmissibility ratio using vibrating table

TOTAL (LAB): 30 HOURS **TOTAL: (45+30) 75 HOURS**

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to

CO1. Understand the properties and behaviour in static conditions. Also, to understand the conservation laws applicable to fluids and its application through fluid kinematics and dynamics

CO2. Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel. Also, to understand the concept of boundary layer and its thickness on the flat solid surface.

CO3. Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies

CO4. Explain the working principles of various turbines and design the various types of turbines.

CO5. Explain the working principles of centrifugal, reciprocating and rotary pumps and design the centrifugal and reciprocating pumps

TEXTBOOKS:

1. F.B. Sayyad, “Kinematics of Machinery”, MacMillan Publishers Pvt Ltd., Tech-max Educational resources, 2020.
2. Rattan, S.S, “Theory of Machines”, 5th Edition, Tata McGraw-Hill, 2019.
3. Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”,4th Edition, Oxford University Press, 2014.
4. Cleghorn. W. L, “Mechanisms of Machines”, Oxford University Press, 2014
5. F. B. Sayyad, “Dynamics of Machinery”, McMillan Publishers India Ltd., Tech-Max Educational resources, 2020

REFERENCES:

1. Cleghorn. W. L, “Mechanisms of Machines”, Oxford University Press, 2014.
2. Ghosh. A and Mallick, A.K., “Theory of Mechanisms and Machines", 3rd Edition, Affiliated East-West Pvt. Ltd., New Delhi, 2020.
3. Khurmi, R.S.,” Theory of Machines”, 14th Edition, S Chand Publications, 2017.

YOUTUBE RESOURCES:

1. **NPTEL Mechanical Engineering -** Dynamics of Machines: This playlist covers topics related to Dynamics of Machines, including kinematics, dynamics, and mechanisms.
2. **Mechanical Engineering by Dr. D.K. Dwivedi:** Dr. D.K. Dwivedi's channel offers lectures on various topics in Mechanical Engineering, including Mechanics of Machines.
3. **Mechanics of Machines by Gate Lectures by Ravindra babu Ravula:** This series covers concepts of Mechanics of Machines, including kinematics, dynamics, and mechanisms, with a focus on GATE exam preparation.
4. **Mechanisms and Machines by Engineering Academy:** Engineering Academy's channel provides tutorials on mechanisms, machine design, and related topics.
5. **Mechanics of Machines by Learn Engineering:** Learn Engineering offers videos explaining concepts of Mechanics of Machines with animations and visualizations.

Course Code	THERMAL ENGINEERING	L	T	P	C
ME4404		3	0	2	4

COURSE OBJECTIVES:

1. To study the fuel properties and performance of I.C Engines.
2. To understand the performance of air-compressors and Gas Turbines
3. To apply the thermodynamics concepts into various thermal applications like Steam nozzles and Steam turbines.
4. To understand the different types of boilers and compute their performance.
5. To impart knowledge of the psychrometric processes and air conditioning systems.

COURSE DESCRIPTION

Thermal Engineering is a core course in mechanical engineering that focuses on the principles and applications of thermodynamics, heat transfer, and thermal systems. The course covers topics such as energy conversion, power cycles, refrigeration, air conditioning, heat exchangers, and thermal system design. The accompanying laboratory sessions provide hands-on experience in conducting experiments, analyzing thermal processes, and testing thermal equipment.

PREREQUISITES

- Basic knowledge of physics, mechanics, and engineering principles
- Familiarity with mathematics (calculus, differential equations) and thermodynamics fundamentals
- Understanding of heat transfer concepts (conduction, convection, radiation) and fluid mechanics is beneficial

UNITI: IC ENGINE ANALYSIS: 9

Air standard analysis - Carnot cycle - Otto cycle - Diesel cycle, Dual Cycle Classification- Principle and working of four stroke and two stroke petrol and diesel engines, Combustion process- Knocking, Detonation, Cetane and Octane numbers, Combustion in SI and CI engines.

UNITII: AIR COMPRESSORS: 9

Single stage reciprocating compressor- Working principle, Multistage reciprocating compressors: Working principle. Rotary compressor (Descriptive): Vane compressor, Screw compressor and lobe compressor. Gas turbine cycle analysis — open and closed cycle. Performance and its improvement - Regenerative, Intercooled, Reheated cycles and their combinations, Materials for Turbines

UNIT III: STEAM NOZZLES AND STEAM TURBINES 9

Steam Nozzle - Types and Shapes of nozzles, Flow of steam through nozzles, Critical pressure ratio, Variation of mass flow rate with pressure ratio. Effect of friction. Metastable flow. Steam Turbines -Types, Impulse and reaction principles, Velocity diagrams, Work done and efficiency - optimal operating conditions. Multi-staging, compounding and governing

UNIT IV: BOILERS **9**

Types and comparison, Mountings and Accessories, Fuels - Solid, Liquid and Gas, Performance calculations, Boiler trial

UNIT V: PSYCHROMETRY AND AIR CONDITIONING: **15**

Psychrometry and Psychrometric charts, Psychrometric process Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, Evaporative cooling, Introduction to HVAC (Descriptive) - Air handling and distribution system, Self-cleaning / Electro static precipitation in Air conditioning, Layout of Air conditioner in Automobiles.

TOTAL (THEORY): 45 HOURS

LAB EXERCISES

1. Experimental study on valve timing diagram in 4-stroke engine cut model and port timing diagram in 2-stroke engine cut model.
2. Performance and Heat balance test on a twin cylinder diesel engine with electrical dynamometer (Alternator).
3. Performance characteristics of a centrifugal blower test rig.
4. Air compressor test rig (Two stage).
5. Performance and combustion test on computerized Kirloskar TV1 engine with eddy current dynamometer. (In diesel mode).
6. Experiments on air-conditioning system.
7. Determination of flash and fire point by open cup apparatus.
8. Determination of viscosity using Redwood viscometer.

TOTAL (LAB): 30 HOURS

TOTAL: (45+30) 75 HOURS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1. Identify and describe air standard cycles for air standard efficiencies
CO 2. Identify basic components of Engines, differentiate and describe the working of different types of Engines.
CO 3. Compare, conduct performance test in Engines and calculate the performance of Engines.
CO 4. Compare and calculate the performance of reciprocating and rotary equipment.
CO 5. Classify, solve and calculate the psychrometry processes and air conditioning systems performance.
CO 6. Conduct test and calculate the properties of fuels and lubricants.

TEXT BOOKS:

1. Kothandaraman C.P, Domkundwar S, “A course in Thermal Engineering”, Dhanpat Rai & Co. pvt ltd, 2017.
2. Mahesh M, Rathore, “Thermal Engineering”, Mc Draw Hill Education private limited, Reprint 2016.

REFERENCE BOOKS:

1. Rudramoorthy R, "Thermal Engineering", Tata McGraw Hill Publishers Co. Ltd.,New Delhi, 2016.
2. Ganesan V, Internal Combustion Engine; Tata McGraw Hill Publishers Co. Ltd.,New Delhi, 2016.
3. Arora C.P, "Refrigeration and Air Conditioning", Tata McGraw Hill publishers Co. Ltd, 2017.

YOUTUBE RESOURCES:

1. **Thermal Engineering Lectures by Learn Engineering:** Learn Engineering offers a series of lectures covering various topics in thermal engineering, including thermodynamics, heat transfer, power cycles, and refrigeration.
2. **Thermodynamics and Heat Transfer by NPTEL**: NPTEL provides comprehensive lectures on thermodynamics and heat transfer, which are fundamental topics in thermal engineering.
3. **Thermal Engineering Basics by Learn Engineering Academy:** This series covers the basics of thermal engineering, including thermodynamics laws, heat transfer mechanisms, and applications in engineering.
4. **Heat Exchangers and Refrigeration by Chemical Engineering Guy:** Chemical Engineering Guy's channel offers videos on heat exchangers, refrigeration systems, and thermal processes in chemical engineering.
5. **Thermal Engineering Tutorials by MECH PROFESSOR:** MECH PROFESSOR provides tutorials on thermal engineering topics, including power cycles, heat exchangers, HVAC systems, and renewable energy.

Course Code	WELDING TECHNOLOGY	L	T	P	C
ME4405		2	1	2	4

COURSE OBJECTIVES

- To understand the basics of welding and to know about the various types of welding processes
- To elaborate various welding methods including advanced techniques, with emphasis on basic principles, limitations and application.
- To outline metallurgical aspects of welding and its defects

COURSE DESCRIPTION

Welding Technology is a comprehensive course that introduces students to the principles, processes, techniques, and applications of welding in various industries. The course covers topics such as welding methods, welding materials, welding procedures, safety protocols, quality control, and welding inspection. The accompanying laboratory sessions provide hands-on experience in welding operations, equipment handling, weld testing, and troubleshooting.

PREREQUISITES

- Basic knowledge of materials science, metallurgy, and mechanical engineering principles
- Familiarity with manufacturing processes, metal fabrication techniques, and workshop practices
- Understanding of safety regulations, hazard identification, and personal protective equipment (PPE) usage in industrial environments

UNIT I WELDING POWER SOURCES 9

Classification of welding power sources – basic features of the arc welding power sources- volt- ampere characteristics of a welding power source –volt ampere characteristics – constant current characteristics – constant voltage characteristics - Duty cycle of welding power source. Power sources for MIG/CO_2 welding.

UNIT II WELDING PROCESSES – 1 & WELDING METALLURGY –I 9

Welding Processes – 1: Classification of welding processes: heat sources, power sources, arc phenomena, arc Dynamics, manual metal arc welding, ingredients and function of flux coating, different types of electrodes and their applications, handling and storage of consumables; Gas tungsten arc welding (GTAW), electrode polarity, shielding gas, GTAW arc process & other recent developments in GTAW & applications Gas metal arc welding,

Welding Metallurgy –I: Introduction, Regions of a Fusion Weld, Fusion Zone, Unmixed Zone (UMZ), Partially Melted Zone (PMZ), Heat Affected Zone (HAZ),. Iron Carbon equilibrium diagram, Time Temperature diagram, CCT diagrams for carbon steels. Weldability of Stainless steels & Carbon Steels.

UNIT III RESISTANCE AND SOLID-STATE WELDING PROCESSES 9

General principle- heat generation in resistance welding- Electrical Characteristics of Resistance welding; Spot welding: Principle, variants of resistance spot welding- advantages, disadvantages, and applications of ultrasonic welding.

UNIT IV WELDING PROCESSES –II & WELDING METALLURGY-II 9

Welding Processes –II : Laser Beam Welding: Basics of Laser, types of Lasers, Principles of operation, effect of parameters on weld quality, advantages, and limitations, applications. Electron beam welding Advanced gas tungsten arc welding: Pulsed GTAW, Square-wave AC GTAW and plasma welding basics- Cold and hot-wire feed additions in GTAW Cold metal Transfer (CMT) – Process characteristics, advantages and applications of above techniques.

Welding Metallurgy-II: Classification of aluminum alloys Problems involved in aluminium welding – precaution and welding procedure requirements- Classification of copper alloys- influence of alloying elements in copper alloys various processes used for copper welding- problems involved in copper welding – precaution and welding procedure requirements.

UNIT V: WELDING DESIGN **9**

Types of weld joints, butt joint, lap joint, T-joint, cruci-form joint, corner joint and edge joint, fillet and groove welds., weld symbols, standard system of representation of welded joints. Design of Welded Joints, welding joint design to control distortion and shrinkage, residual stresses and cracking. Principles and methods and practical approach for crack resistance.

TOTAL (THEORY): 45 HOURS

LAB EXERCISES

Joining Of Metals

1. Simple exercises to make butt, lap, fillet joints using SMAW, GMAW, and GTAW processes.
2. Studying the effect of electrode polarity on weld bead formation
3. Studying the effect of heat input
4. Studying the effect of shielding gases on weld quality
5. Studying the effect of welding parameters of various processes such as SMAW, GMAW, FCAW, GTAW on bead geometry

Weldability Testing & Evaluation

1. Tensile properties evaluation of welded joints
2. Impact toughness properties evaluation of welded joints
3. Microhardness survey across the weld cross section
4. Bend Test (side and face) on welded joints
5. All weld metal properties evaluation
6. Macro and Micro structure analysis of weldments

TOTAL HOURS (LAB): 30 **TOTAL: (45+30) 75 HOURS**

COURSE OUTCOMES

Upon completion of this course, the students can able

CO 1. Understand the construction and working principles of gas and arc welding process.
CO 2. Understand the construction and working principles of resistance welding process.
CO 3. Understand the construction and working principles of various solid state welding process.
CO 4. Understand the construction and working principles of various special welding processes.
CO 5. Understand the concepts on weld joint design, weldability and testing of weldments.

TEXT BOOKS

1. Welding Handbook (Welding Processes), Volume II, 8th Edition, American Welding Society (AWS),1st June 1991.
2. John C. Lippold, Damian J. Kotecki, Welding metallurgy and weldability of stainless steels, 2005.
3. Resistance welding: Fundamentals and Applications, Hongyan Zhang and Jacek Senkara, Second Edition, CRC Press, 2011
4. John Norrish. "Advanced welding processes Technologies and process control" Wood head Publishing and Maney Publishing. Cambridge, England. 2006
5. Linnert G.E, Welding Metallurgy, Vol I & II, 4th edition, American Welding Society, 1994.
6. Gray T. G. E. "Rational Welding Design", Butterworth's, 1982

REFERENCE BOOKS

1. Parmer R. S., 'Welding Processes and Technology', Khanna Publishers
2. Little, R.L., Welding and Welding Technology, Tata McGraw Hill, New Delhi, 1996
3. Welding Engineering and Technology, R.S. Parmar, Khanna Publishers, 2013
4. O.P.Khanna, Welding Technology, Dhanpat Rai Publications, New Delhi, 2008
5. Saferian.D, The Metallurgy of Welding, Pergamon Press, 1985
6. Dieter G. "Mechanical Metallurgy", Tata McGraw Hill, 1988

YOUTUBE RESOURCES:

1. **Welding Technology Basics by Weld.com:** Weld.com provides a series of videos covering the basics of welding technology, including welding processes, equipment setup, techniques, and safety measures.
2. **Welding Techniques and Tips by The Fabrication Series:** The Fabrication Series offers tutorials on welding techniques, tips for improving weld quality, troubleshooting common welding problem6s, and advanced welding skills.
3. **Welding Processes Explained by Lincoln Electric:** Lincoln Electric's channel provides detailed explanations of various welding processes, such as MIG welding, TIG welding, stick welding, flux-cored welding, and more.
4. **Welding Safety and PPE by Miller Welders:** Miller Welders offers videos focusing on welding safety practices, personal protective equipment (PPE), hazard awareness, and safe welding techniques
5. **Welding Inspection and Quality Control by TWI Ltd:** TWI Ltd's channel covers topics related to welding inspection, quality control procedures, non-destructive testing (NDT), weld defects, and quality assurance in welding.

Course Code	EMPLOYABILITY ENHANCEMENT SKILLS – IV:	L	T	P	C
ES4404	LEADERSHIP AND PROJECT MANAGEMENT SKILLS	0	0	2	1

COURSE OBJECTIVES:

- To understand leadership within the context of project management.
- To differentiate between leadership and management roles.
- To learn project initiation processes and setting SMART objectives.
- To build high-performing teams through motivation, empowerment, and effective communication.
- To develop skills in project planning, estimation, resource allocation, risk management, and scheduling.

COURSE DESCRIPTION

This course is designed to equip students with essential skills and competencies required for successful entry into the workforce and career advancement. It focuses on developing a range of professional skills, including communication, teamwork, problem-solving, critical thinking, leadership, and adaptability. The course also covers aspects such as resume writing, interview preparation, networking, personal branding, and career planning strategies.

PREREQUISITES

There are no specific prerequisites for this course. However, a willingness to learn, participate actively, and apply acquired skills is essential for maximizing the benefits of the course

UNIT 1: Understanding Leadership - Introduction to Project Management - Leadership vs. Management - Project Initiation - Setting SMART Objectives

UNIT 2: Building High-Performing Teams - Motivation Theories - Empowering Team Members - Leadership Communication - Handling Team Conflicts

UNIT 3: Work Breakdown Structure (WBS) - Estimation Techniques - Gantt Charts and Network Diagrams - Resource Allocation - Risk Management

UNIT 4: Leading Project Teams - Monitoring and Controlling Progress - Change Management - Quality Management - Stakeholder Communication

UNIT 5: Project Closure Activities - Lessons Learned - Celebrating Success - Transition Planning

COURSE OUTCOMES:

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

CO1: Apply leadership principles to project management scenarios.
CO2: Distinguish between leadership and management functions in project environments.
CO3: Initiate projects effectively by setting SMART objectives.
CO4: Foster high-performing teams through motivation, empowerment, and conflict resolution.
CO5: Proficiently plan, schedule, and manage project activities, resources, risks, and stakeholder communications.

TEXTBOOKS

1. Peter G. Northouse. "Leadership: Theory and Practice", SAGE Publications, 2021
2. Patrick Lencioni. "The Five Dysfunctions of a Team: A Leadership Fable", Jossey-Bass, 2011
3. Robert K. Wysocki. "Effective Project Management: Traditional, Agile, Extreme", Wiley, 2019
4. Clifford F. Gray and Erik W. Larson. "Project Management: The Managerial Process", McGraw-Hill Education, 2017
5. Harold Kerzner. "Project Management Case Studies", Wiley, 2008

REFERENCES

1. Harold Kerzner. "Project Management: A Systems Approach to Planning, Scheduling, and Controlling", 10th edition, Wiley, 2009
2. Gregory P. Shea and Cassie A. Solomon. "Leading Successful Change: 8 Keys to Making Change Work", Gildan Media, LLC, 2013

YOUTUBE RESOURCES:

1. **Career Vidz:** This channel offers videos on career advice, job search strategies, interview tips, resume writing, and personal development.
2. **Work It Daily:** Work It Daily provides videos on career coaching, professional branding, networking, workplace skills, and job search tactics.
3. **Linda Raynier:** Linda Raynier's channel covers topics such as resume writing, interview preparation, career growth strategies, and personal branding.
4. **Andrew LaCivita:** Andrew LaCivita offers videos on career development, job interview techniques, communication skills, and leadership.

Course Code	NCC Credit Course	L	T	P	C
		2	0	0	2

UNIT I NCC General 6

Aims, Objectives & Organization of NCC (1) – Incentives (2) – Duties of NCC Cadet (1) – NCC Camps: Types & Conduct (2)

UNIT II National Integration and Awareness 4

National Integration: Importance & Necessity (1) – Factors Affecting National Integration (1) – Unity in Diversity & Role of NCC in Nation Building (1) –Threats to National Security (1)

UNIT III Personality Development 7

Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving (2) – Communication Skills (3) – Group Discussion: Stress & Emotions (2)

UNIT IV Leadership 5

Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code (3) – Case Studies: Shivaji, Jhansi Ki Rani (2)

UNIT V Social Service and Community Development 8

Basics, Rural Development Programmes, NGOs, Contribution of Youth (3) – Protection of Children and Women Safety (1) Road/ Rail Travel Safety (1) – New Initiatives (2) – Cyber and Mobile Security Awareness (1)

TOTAL: 30 HOURS

Levels:

Level	**Activities**
1 ARMY	II semester: The NCC cadets are fresh to NCC activities are provided with above curriculum / syllabus
2 NAVY	For the Higher semester cadets of IV semester the credits are awarded with the basic qualifying needs c) Minimum one Combined Annual training Camp (CATC) or Attachment Camp or Centrally Organised Camp has to be attended (camp certificate is required) d) Appeared for B Certificate Exam
3 AIR FORCE	For the Higher semester cadets of VI semester the credits are awarded with the basic qualifying needs c) Minimum one Combined Annual training Camp (CATC) or Attachment Camp or Centrally Organised Camp has to be attended (camp certificate is required) d) Appeared for C Certificate Exam

Course Code	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	C
ME4501		3	0	0	3

OBJECTIVES:

- To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
- To understand the standard procedure available for Design of Transmission of Mechanical elements
- To learn to use standard data and catalogues (Use of P S G Design Data Book permitted)

COURSE DESCRIPTION

The course covers topics such as power transmission, gear design, belt and chain drives, coupling design, and shaft design, emphasizing the selection of appropriate components based on application requirements. Students learn to analyze torque, speed, load, and other factors to design reliable, efficient, and durable transmission systems for different types of machinery and equipment.

PREREQUISITES

- Basic understanding of mechanics, materials science, and engineering design principles
- Familiarity with mathematics (calculus, trigonometry, and algebra) for calculations related to torque, speed, load, and gear ratios
- Knowledge of CAD software tools for 3D modeling, assembly design, and simulations (though this may be taught as part of the course)

UNIT I DESIGN OF FLEXIBLE ELEMENTS 9

Design of Flat belts and pulleys - Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys – Design of Transmission chains and Sprockets.

UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 9

Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects – Fatigue strength - Factor of safety - Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane- Equivalent number of teeth- forces for helical gears.

UNIT III BEVEL, WORM AND CROSS HELICAL GEARS 9

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits- terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears.

UNIT IV GEAR BOXES 9

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - Speed reducer unit. – Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications.

UNIT V CAMS, CLUTCHES AND BRAKES 9

Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses. Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches- Electromagnetic clutches. Band and Block brakes - external shoe brakes – Internal expanding shoe brake.

TOTAL (THEORY): 45 HOURS

COURSE OUTCOMES:

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

- **CO 1.** Apply the concepts of design to belts, chains and rope drives.
- **CO 2.** Apply the concepts of design to spur, helical gears.
- **CO 3.** Apply the concepts of design to worm and bevel gears.
- **CO 4.** Apply the concepts of design to gear boxes.
- **CO 5.** Apply the concepts of design to cams, brakes and clutches.

TEXT BOOKS:

1. Bhandari V, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008.

REFERENCES:

1. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements" 8th Edition, Printice Hall, 2003.
2. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
3. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000. th
4. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4Edition, Wiley, 2005
5. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

YOUTUBE RESOURCES:

1. **Design of Transmission Systems** - Gear Design by Learn Engineering: This video explains gear design principles, types of gears, gear terminology, and considerations for designing gears in transmission systems.
2. **Transmission System Design by MIT Open Course Ware:** MIT Open Course Ware offers lectures on transmission system design covering topics such as gear trains, belt drives, chain drives, and bearing selection.
3. **Belt Drives and Chain Drives by The Engineering Mindset:** This video discusses belt drives and chain drives, their advantages, limitations, design considerations, and calculations for designing transmission systems.

4. **Design of Shaft by NPTEL Mechanical Engineering:** NPTEL provides a lecture on the design of shafts, including shaft materials, sizing, keyways, stress analysis, and considerations for shaft design in transmission systems.
5. **Coupling Design Basics by Khan Academy:** Khan Academy's video covers the basics of coupling design, types of couplings, factors affecting coupling selection, and considerations for coupling design in transmission systems.

Course Code	HEAT AND MASS TRANSFER	L	T	P	C
ME4502		3	0	0	3

COURSE OBJECTIVES

- To learn the principal mechanism of heat transfer under steady state and transient conditions.
- To learn the fundamental concept and principles in convective heat transfer.
- To learn the theory of phase change heat transfer and design of heat exchangers.
- To study the fundamental concept and principles in radiation heat transfer.
- To develop the basic concept and diffusion, convective di mass transfer.

COURSE DESCRIPTION

Heat and Mass Transfer is a fundamental course in engineering that explores the principles and mechanisms governing the transfer of heat and mass in various systems. The course covers topics such as conduction, convection, radiation, diffusion, mass transfer, heat exchangers, and applications in engineering and thermodynamics. Emphasis is placed on understanding heat transfer mechanisms, analyzing heat/mass transfer problems, and applying principles to engineering design and analysis.

PREREQUISITES

- Basic knowledge of thermodynamics, fluid mechanics, and engineering mathematics (calculus, differential equations)
- Understanding of energy principles, heat transfer fundamentals, and properties of materials (thermal conductivity, heat capacity, density) is recommended
- Familiarity with engineering software tools for mathematical modeling, computational analysis, and data visualization

UNIT – I CONDUCTION 9

General Differential equation – Cartesian, Cylindrical and Spherical Coordinates – One Dimensional Steady State Heat Conduction –– plane and Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids – Use of Heisler's charts – Methods of enhanced thermal conduction

UNIT – II CONVECTION 9

Conservation Equations, Boundary Layer Concept – Forced Convection: External Flow – Flow over Plates, Cylinders Spheres and Bank of tubes. Internal Flow – Entrance effects. Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres. Mixed Convection.

UNIT – III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 9

Nusselt's theory of condensation- Regimes of Pool boiling and Flow boiling - Correlations in boiling and condensation. Heat Exchanger Types – TEMA Standards - Overall Heat Transfer Coefficient – Fouling Factors. LMTD and NTU methods. Fundamentals of Heat Pipes and its applications.

UNIT – IV RADIATION **9**

Introduction to Thermal Radiation - Radiation laws and Radiative properties - Black Body and Gray body Radiation - Radiosity - View Factor Relations. Electrical Analogy. Radiation Shields. Wien's displacement law, black and grey surfaces, Radiation network analysis, Heat transfer correlations for flow over flat plates. Effect of turbulence

UNIT – V MASS TRANSFER **9**

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state and Transient Diffusion - Stefan flow –Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

TOTAL (THEORY): 45 HOURS

COURSE OUTCOMES:

At the end of the course the students would be able to

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

TEXT BOOKS:

1. R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 2009

2. Yunus A. Cengel, "Heat Transfer A Practical Approach" – Tata McGraw Hill, 5thEdition – 2013

REFERENCES:

1. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley &Sons, 7th Edition, 2014.
2. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2010
3. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2012
4. Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.
5. S.P. Venkateshan, "Heat Transfer", Ane Books, New Delhi, 2014

YOUTUBE RESOURCES:

1. **Heat and Mass Transfer Lectures by Learn ChemE (University of Colorado Boulder):** Learn ChemE offers a comprehensive series of lectures covering fundamental concepts in heat and mass transfer, including conduction, convection, radiation, and diffusion.

2. **Heat Transfer Basics by Khan Academy**: Khan Academy provides introductory videos on heat transfer basics, including thermal conductivity, heat conduction, convection, and heat exchangers.
3. **Heat and Mass Transfer by NPTEL (National Programme on Technology Enhanced Learning):** NPTEL offers lectures on various topics in heat and mass transfer, such as heat conduction, convection, radiation, mass diffusion, and heat exchangers.
4. **Engineering Heat Transfer by The Organic Chemistry Tutor:** The Organic Chemistry Tutor provides tutorials on engineering heat transfer topics, including Fourier's law, Newton's law of cooling, heat exchangers, and thermal conductivity.
5. **Heat Transfer Lectures by Dr. Chandra Shekhar:** Dr. Chandra Shekhar's channel offers lectures on heat transfer principles, applications in engineering, heat exchangers, and heat transfer coefficients.

Course Code	PRODUCT LIFE CYCLE MANAGEMENT	L	T	P	C	
ME4503		3	0	2	4	

COURSE OBJECTIVES

- To study about the history, concepts and terminology in PLM
- To learn the functions and features of PLM/PDM
- To develop different modules offered in commercial PLM/PDM tools
- To demonstrate PLM/PDM approaches for industrial applications
- To use PLM/PDM with legacy data bases, Coax& ERP systems

COURSE DESCRIPTION

- Exploring emerging technologies and trends shaping the future of PLM, such as digital twins, IoT integration, and AI-driven analytics
- The impact of globalization, sustainability initiatives, and changing consumer preferences on PLM strategies
- Design considerations throughout the product life cycle, including design for manufacturability, sustainability, and cost-effectiveness.
- Engineering processes and methodologies to optimize product performance and quality

PREREQUISITES

- Understanding of project management principles, including project planning, scheduling, budgeting, and risk management.
- Familiarity with project management tools and techniques such as Gantt charts, critical path analysis, and resource allocation.

UNIT – I HISTORY, CONCEPTS AND TERMINOLOGY OF PLM 9

Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDm), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications

UNIT – II PLM/PDM FUNCTIONS AND FEATURES 9

User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration

UNIT – III DETAILS OF MODULES IN A PDM/PLM SOFTWARE 9

Case studies based on top few commercial PLM/PDM tools – Teamcenter, Windchill, ENOVIA, Aras PLM, SAP PLM, Arena, Oracle Agile PLM and Autodesk Vault.-Architecture of PLM software- selection criterion of software for particular application - Brand name to be removed

UNIT – IV ROLE OF PLM IN INDUSTRIES 9

Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organization, users, product or service, process performance- process compliance and process automation

UNIT – V BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE 9

PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP

TOTAL (THEORY): 45 HOURS

COURSE OUTCOMES:

At the end of the course the students would be able to

1. Summarize the history, concepts and terminology of PLM
2. Develop the functions and features of PLM/PDM
3. Discuss different modules offered in commercial PLM/PDM tools.
4. Interpret the implement PLM/PDM approaches for industrial applications.
5. Integrate PLM/PDM with legacy data bases, Coax& ERP systems

YOUTUBE RESOURCES:

1. **Siemens PLM Software:** Siemens PLM Software offers various videos and tutorials on PLM solutions, including product lifecycle management, digital twins, simulation, and more
2. **Product Lifecycle Management (PLM)**: PTC's PLM channel covers topics related to digital transformation, IoT, CAD/CAM, and product lifecycle management strategies Dassault Systems - PLM:
3. **Dassault Systems -** PLM: Dassault Systems' PLM videos showcase their solutions for digital manufacturing, 3D design, simulation, and collaboration across the product lifecycle
4. **Tech-Clarity:** Tech-Clarity's channel features videos on PLM best practices, industry trends, digital transformation, and technology adoption in manufacturing
5. **The PLM Doctor**: The PLM Doctor provides insights into product lifecycle management strategies, implementation tips, and interviews with industry experts

PLM LABORATORY

COURSE DESCRIPTION

The PLM Laboratory is designed to provide hands-on experience and practical skills in using Product Lifecycle Management software tools commonly used in industry. The course focuses on understanding the PLM process, managing product data, collaborating on design projects, and optimizing workflows for efficient product development. Students will learn how to use PLM software for CAD data management, BOM (Bill of Materials) management, change management, collaboration, and version control.

PREREQUISITES

- Basic knowledge of CAD software tools such as SolidWorks, AutoCAD, CATIA, or similar
- Understanding of engineering design principles, product development processes, and manufacturing concepts
- Familiarity with data management concepts, file organization, and document control practices in engineering environments

Introduction, Installation & maintenance of following software: DBMS, Java, PLM Server, CAD Software, MS Office, Application server, Software/ Hardware/ Network issues resolutions.

CAD: Modeling (at least 5 parts) and Assembly using any High End CAD Software. Assembly should include top down and bottom-up approaches, Drafting (at least 1 assembly).

CAD File/data exchange amongst the various CAD software and software for CMM, CAE, CNC, CAM

FEA: Analysis (structural, thermal and both) of at least two parts, Introduction to nonlinear analysis

PLM: Exhibiting use of following modules of any PLM software through at least six assignments

- Organization
- Workflow
- Product Structure
- Access Manager
- Query Builder
- Change Management
- Schedule Manager
- Manufacturing Process Planner

TEXT BOOKS:

1. Product Lifecycle Management for a Global Market, Springer; 2014 edition (29 September 2016), ISBN-10: 3662516330
2. Product Life Cycles and Product Management, Praeger Publishers Inc (27 March 1989) ISBN-10: 0899303196

REFERENCES:

1. AnttiSaaksvuori and AnselmiImmonen, “Product Lifecycle Management”, Springer Publisher, 2008 (3rd Edition)
2. IvicaCrnkovic, Ulf Asklund and Annita PerssonDahlqvist, “Implementing and Integrating Product Data Management and Software Configuration Management”, Artech House Publishers, 2003.
3. John Stark, “Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question”, Springer Publisher, 2007
4. John Stark, “Product Lifecycle Management: 21st Century Paradigm for Product Realisation”, Springer Publisher, 2011 (2nd Edition).
5. Michael Grieves, “Product Life Cycle Management”, Tata McGraw Hill, 2006.

TOTAL (LAB): 30 HOURS **TOTAL: (45+30) 75 HOURS**

YOUTUBE RESOURCES:

1. **University Lectures and Demonstrations:** Look for university lectures or demonstrations on PLM systems. Some universities may have recorded lectures or lab sessions related to PLM, which they share on their YouTube channels or learning platforms.
2. **Industry Webinars and Workshops:** Many PLM software vendors and industry organizations host webinars, workshops, and conferences where they discuss PLM best practices, case studies, and software demonstrations. Look for recordings of such events on YouTube or the respective websites.
3. **PLM Software Community Forums:** Explore PLM software community forums and discussion boards. Sometimes, users share their own tutorials, tips, and tricks on YouTube or other platforms.
4. **Online Learning Platforms:** Platforms like LinkedIn Learning, Coursera, Udemy, and Pluralsight may offer courses or tutorials on PLM concepts and software. While they may require a subscription or purchase, they can be valuable resources.

Course Code	EMPLOYABILITY ENHANCEMENT SKILLS – V:	L	T	P	C
ES4505	INNOVATION AND ENTREPRENEURSHIP	0	0	2	1

COURSE OBJECTIVES:

- To understand the fundamentals of entrepreneurship and innovation.
- To explore the components of an innovation ecosystem.
- To learn the principles of the Lean Startup methodology and its application.
- To develop skills in identifying entrepreneurial opportunities.
- To cultivate creativity and ideation techniques for innovation

COURSE DESCRIPTION

Employability Enhancement Skills is a comprehensive course designed to equip students with the essential skills, knowledge, and attitudes required for success in the modern workplace. The course focuses on developing professional competencies, interpersonal skills, career readiness, and adaptability to meet the demands of diverse industries and job roles. Through interactive learning experiences and practical exercises, students will enhance their employability, career prospects, and personal development.

PREREQUISITES

- There are no specific prerequisites for this course.
- However, students are encouraged to have a positive attitude, willingness to learn, and openness to self-improvement.

UNIT 1: Understanding Innovation - Entrepreneurship Fundamentals - Innovation Ecosystem - The Lean Startup Methodology - Identifying Opportunities

UNIT 2: Creativity and Ideation Techniques - Market Research and Validation - Customer Discovery - Prototype Development

UNIT 3: Business Model Canvas - Revenue Models - Customer Acquisition and Retention - Pricing Strategies - Scalability and Growth

UNIT 4: Financial Planning - Funding Options - Pitching Investors - Valuation Method - Financial Management

UNIT 5: Go-to-Market Strategy - Building a Team - Scaling Operations - Managing Growth - Exit Strategies

COURSE OUTCOMES:

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

CO1: Demonstrate an understanding of entrepreneurship fundamentals and innovation principles.
CO2: Analyze and navigate innovation ecosystems.
CO3: Apply Lean Startup methodology to validate and iterate business ideas.
CO4: Identify and evaluate entrepreneurial opportunities effectively.
CO5: Generate creative ideas, conduct market research, validate concepts, and develop prototypes for entrepreneurial ventures.

TEXTBOOKS

1. Eric Ries. "The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses", Random Housey, 2011
2. Alexander Osterwalder and Yves Pigneur. "Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers", Wiley, 2010
3. Karen Berman and Joe Knight. "Financial Intelligence for Entrepreneurs: What You Really Need to Know About the Numbers" Harvard Business Review Press, 2008

REFERENCES

1. Clayton M. Christensen. "The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail", Harvard Business Review Press, 2013
2. Steve Blank and Bob Dorf. "The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company" Wiley, 2020
3. Peter Thiel and Blake Masters. "Zero to One: Notes on Startups, or How to Build the Future" Virgin Digital, 2014

YOUTUBE RESOURCES:

1. **Explore Career Development Channels:** Look for YouTube channels dedicated to career development, professional skills, and personal growth. Channels like TEDx Talks, Brian Tracy, CareerVidz, and CareerBuilder offer valuable insights and tips.
2. **University and Institution Channels**: Many universities and educational institutions upload videos related to employability skills, career workshops, interview preparation sessions, and soft skills training. Explore channels from universities known for their career services.
3. **Career Coaches and Experts**: Search for videos from career coaches, HR professionals, industry experts, and motivational speakers who share tips, strategies, and advice on enhancing skills.
4. **Online Learning Platforms:** Platforms like Coursera, LinkedIn Learning, Udemy, and Skill share often have free or paid courses on employability skills. Some of them also share introductory videos or excerpts from their courses on YouTube.

Course Code	MECHATRONICS	L	T	P	C
ME4601		3	0	0	3

COURSE OBJECTIVE:

To impart knowledge about the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation.

COURSE DESCRIPTION

Mechatronics is an interdisciplinary field integrating mechanical engineering, electrical engineering, computer science, and control engineering to design and create intelligent systems. This course provides a comprehensive introduction to the fundamental principles and applications of mechatronics

PREREQUISITES

Students may have extensive prior knowledge in all of these areas (Mathematics, Physics, Electronics, Mechanical Engineering), a strong foundation in mathematics and physics is particularly important for success in a mechatronics course. Students with limited background in certain areas may benefit from additional review or preparatory coursework before enrolling in the course

UNIT I INTRODUCTION 9

Introduction to Mechatronics – Systems – Concepts of Mechatronics approach – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensors – Light sensors

UNIT II MICROPROCESSOR AND MICROCONTROLLER 9

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set, Timing diagram of 8085 – Concepts of 8051 microcontroller – Block diagram,.

UNIT III PROGRAMMABLE PERIPHERAL INTERFACE 9

Introduction – Architecture of 8255, Keyboard interfacing, LED display –interfacing, ADC and DAC interface, Temperature Control – Stepper Motor Control – Traffic Control interface.

UNIT IV PROGRAMMABLE LOGIC CONTROLLER 9

Introduction – Basic structure – Input and output processing – Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC.

UNIT V ACTUATORS AND MECHATRONIC SYSTEM DESIGN 9

Types of Stepper and Servo motors – Construction – Working Principle – Advantages and Disadvantages. Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Engine Management system – Automatic car park barrier.

TOTAL: 45 HOURS

OUTCOMES:

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

CO1 Discuss the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical, Electronic Systems and sensor technology.

CO2 Discuss the architecture of Microprocessor and Microcontroller, Pin Diagram, Addressing Modes of Microprocessor and Microcontroller.

CO3 Discuss Programmable Peripheral Interface, Architecture of 8255 PPI, and various device interfacing

CO4 Explain the architecture, programming and application of programmable logic controllers to problems and challenges in the areas of Mechatronic engineering.

CO5 Discuss various Actuators and Mechatronics system using the knowledge and skills acquired through the course and also from the given case studies

TEXT BOOKS:

1. Bolton, “Mechatronics”, Prentice Hall, 2008
2. Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, 5th Edition, Prentice Hall, 2008.

REFERENCES:

1. Bradley D.A, Dawson D, Buru N.C and Loader A.J, “Mechatronics”, Chapman and Hall, 1993.
2. Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print, 2013
3. Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, PWS publishing company, 2007.
4. Krishna Kant, “Microprocessors & Microcontrollers”, Prentice Hall of India, 2007.
5. Michael B.Histand and Davis G.Alciatore, “Introduction to Mechatronics and Measurement systems”, McGraw Hill International edition, 2007.

Course Code	FINITE ELEMENT ANALYSIS	L	T	P	C
ME4602		3	0	2	4

COURSE OBJECTIVES:

1. To introduce the concepts of Mathematical Modeling of Engineering Problems.
2. To appreciate the use of FEM to a range of Engineering Problems.

COURSE DESCRIPTION

Provide an overview of FEA as a numerical simulation technique used in engineering to analyze complex structures, components, and systems under various loading conditions. Cover fundamental concepts such as discretization, element types (e.g., beam, truss, shell, solid), mesh generation, boundary conditions, material properties, and loading conditions. Introduce students to industry- standard FEA software tools such as ANSYS, Abaqus, SolidWorks Simulation, or similar, and provide hands-on training in using these tools for analysis and simulation tasks.

PREREQUISITES

• A solid understanding of engineering mechanics is essential, including topics such as statics, dynamics, mechanics of materials, and structural analysis. Knowledge of forces, moments, equilibrium, stress, and strain is fundamental for FEA.
• Proficiency in mathematics is crucial, particularly in calculus (including differential equations), linear algebra, numerical methods, and vector calculus. These mathematical concepts are extensively used in FEA formulations and analyses.

UNIT I BASICS OF FEA AND ONE-DIMENSIONAL PROBLEMS 15

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method. One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices - Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation – Transverse deflections and Natural frequencies of beams.

UNIT II TWO DIMENSIONAL SCALAR AND VECTOR VARIABLE PROBLEMS 15

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements. Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements.

UNIT III ISOPARAMETRIC FORMULATION 15

Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress

problems - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.

TOTAL (THEORY): 45 HOURS

LAB EXERCISES

1. MATLAB basics, Dealing with matrices, Graphing-Functions of one variable and two variables
2. Use of Matlab to solve simple problems in vibration
3. Mechanism Simulation using Multibody Dynamic software

B. ANALYSIS

1. Force and Stress analysis using link elements in Trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axi – symmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Model analysis of Beams.
9. Harmonic, transient and spectrum analysis of simple systems.

TOTAL HOURS (LAB): 45 **TOTAL: (45+30) =75 HOURS**

COURSE OUTCOMES

CO1. Summarize the basics of finite element formulation.
CO2. Apply finite element formulations to solve one dimensional Problems.
CO3. Apply finite element formulations to solve two dimensional scalar Problems. Apply finite element method to solve two dimensional Vector problems.
CO4. Apply finite element method to solve problems on iso parametric element and dynamic Problems.
CO5. Simulate the working principle of air conditioning system, hydraulic and pneumatic cylinder and cam follower
CO6. Mechanisms using MATLAB.
CO7. Analyze the stresses and strains induced in plates, brackets and beams and heat transfer problems.
CO 8. Calculate the natural frequency and mode shape analysis of 2D components and beams.

TEXT BOOKS:

1. Reddy. J.N., “An Introduction to the Finite Element Method”, 3rd Edition, Tata McGraw- Hill, 2005
2. Seshu, P, “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

REFERENCES:

1. Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2005 (Indian Reprint 2013)*
2. Chandrupatla & Belagundu, “Introduction to Finite Elements in Engineering”, 3rd Edition, Prentice Hall College Div, 1990

3. Logan, D.L., “A first course in Finite Element Method”, Thomson Asia Pvt. Ltd., 2002
4. Rao, S.S., “The Finite Element Method in Engineering”, 3rd Edition, Butterworth Heinemann, 2004
5. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, “Concepts and Applications of Finite Element Analysis”, 4th Edition, Wiley Student Edition, 2002.

YOUTUBE RESOURCES:

1. **Solid Professor:** Solid Professor offers tutorials and training videos on various engineering software tools, including FEA software such as SolidWorks Simulation, ANSYS, and more.
2. **ANSYS** How To Videos: ANSYS' official YouTube channel provides tutorials, webinars, and demonstrations for ANSYS software, covering topics related to FEA, structural analysis, thermal analysis, and more.
3. **Abaqus Tutorial**: Abaqus Tutorial offers tutorials, tips, and guides for using Abaqus FEA software, covering various analysis types, modeling techniques, and simulation procedures.
4. **Sim Scale:** Sim Scale's channel provides tutorials and simulations using cloud-based FEA software, covering structural mechanics, fluid dynamics, thermal analysis, and multi physics simulations.
5. **FEA Solutions:** FEA Solutions offers tutorials, case studies, and educational content on FEA software tools, finite element modeling techniques, and simulation methodologies.

Course Code	COMPUTER AIDED DESIGN AND MANUFACTURING	L	T	P	C
ME4603		2	0	2	3

COURSE OBJECTIVES:

- To provide an overview of how computers are being used in mechanical component design
- To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

COURSE DESCRIPTION

Provide an introduction to Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM), highlighting their roles in modern engineering and manufacturing processes. Introduce students to industry-standard CAD software tools such as AutoCAD, SolidWorks, CATIA, or similar, and cover fundamental concepts of 2D drafting, 3D modeling, assemblies, and parametric design. Explore CAM software tools used for CNC machining, toolpath generation, manufacturing simulations, and post-processing operations. Discuss integration with CAD models and CAM workflows.

PREREQUISITES

• Proficiency in using computers, operating systems (e.g., Windows, macOS), and basic software applications (e.g., Microsoft Office suite) is necessary for working with CAD/CAM software tools and lab equipment.
• Familiarity with technical drawing conventions, engineering graphics, orthographic projections, isometric views, and dimensioning practices is important for interpreting and creating engineering drawings.

UNIT I INTRODUCTION TO GEOMETRIC MODELING AND CAD STANDARDS 10

Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations- homogeneous coordinates - Line drawing -Clipping- viewing transformation-Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – CAD/CAM concepts ––Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves-Techniques for surface modeling – surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG andB-rep. Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. - communication standard.

UNIT IV FUNDAMENTAL OF CNC AND PART PROGRAMING 10

Introduction to NC systems and CNC - Machine axis and Co-ordinate system- CNC machine tools- Principle of operation CNC- Construction features including structure- Drives and CNC controllers- 2D and 3D machining on CNC- Introduction of Part Programming, types - Detailed Manual part programming on Lathe & Milling machines using G codes and M codes- Cutting Cycles, Loops, Sub program and Macros- Introduction of CAM package.

UNIT V CELLULAR MANUFACTURING AND FLEXIBLE MANUFACTURING SYSTEM (FMS) 10

Group Technology(GT),Part Families–Parts Classification and coding–Simple Problems in Opitz Part Coding system–Production flow Analysis–Cellular Manufacturing–Composite part concept–Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control–Quantitative analysis in FMS

TOTAL : 30 HOURS

LAB EXERCISES

1. Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed drawing.
2. Bearings - Bush bearing, Plummer block
3. Valves – Safety and non-return valve
4. Couplings – Flange, Universal, Oldham's, Muff, Gear couplings
5. Joints – Knuckle, Gib & cotter, strap, sleeve & cotter joints
6. Engine parts – Piston, connecting rod, cross-head (vertical and horizontal), stuffing box, multi- plate clutch
7. Miscellaneous machine components – Screw jack, machine vice, tail stock, chuck, vane and gear pump

TOTAL (LAB): 30 HOURS **TOTAL: (30+30) =60 HOURS**

COURSE OUTCOMES

- **CO 1.** Explain the 2D and 3D transformations, clipping algorithm, Manufacturing models and Metrics
- **CO 2.** Explain the fundamentals of parametric curves, surfaces and Solids
- **CO 3.** Summarize the different types of Standard systems used in CAD
- **CO 4.** Apply NC & CNC programming concepts to develop part programme for Lathe & Milling Machines
- **CO 5.** Summarize the different types of techniques used in Cellular Manufacturing and FMS
- **CO 6.** Follow the drawing standards, Fits and Tolerances
- **CO 7.** Re-create part drawings, sectional views and assembly drawings as per standards

TEXT BOOKS:

1. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill PublishingCo.2007
2. Mikell. P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
3. Radhakrishnan P, Subramanyan S. And Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi,2000.
4. Gopalakrishna K.R., "Machine Drawing", 22nd Edition, Subhas Stores Books Corner, Bangalore, 2013.

REFERENCES:

1. Chris McMahon and Jimmie Browne "CAD/CAM Principles", "Practice and Manufacturing management " Second Edition, Pearson Education, 1999.
2. Donald Hearn and M. Pauline Baker "Computer Graphics"'. Prentice Hall, Inc,1992.

3. Foley, Wan Dam, Feiner and Hughes - "Computer graphics principles & practice" Pearson Education -2003
4. William M Neumann and Robert F.Sproul “Principles of Computer Graphics”, McGraw Hill Book Co. Singapore, 1989.
5. N. D. Bhatt and V.M. Panchal, “Machine Drawing”, 48th Edition, Charotar Publishers,2013
6. Junnarkar, N.D., “Machine Drawing”, 1st Edition, Pearson Education, 2004
7. N. Siddeshwar, P. Kanniah, V.V.S. Sastri, ”Machine Drawing” , published by Tata Mc GrawHill,2006

YOUTUBE RESOURCES:

1. **SolidWorks:** SolidWorks' official YouTube channel offers tutorials, tips, and demonstrations for using SolidWorks CAD software, covering topics such as 3D modeling, assemblies, simulations, and CAM integration.

2. **Autodesk Fusion 360:** Autodesk Fusion 360's channel provides tutorials, webinars, and design projects using Fusion 360 CAD/CAM software, including 3D modeling, generative design, machining strategies, and collaborative workflows.

3. **CATIA:** CATIA's official channel offers tutorials and showcases for CATIA software, covering CAD modeling, surface design, assembly design, kinematics, and advanced design features.

4. **Siemens NX:** Siemens NX's YouTube channel provides tutorials, tips, and training sessions for NX CAD/CAM/CAE software, including 3D modeling, simulation, toolpath generation, and manufacturing processes.

5. **Mastercam:** Mastercam's channel offers tutorials, webinars, and machining demonstrations for Mastercam CAD/CAM software, covering topics such as toolpath creation, CNC programming, and machining operations

Course Code	NCC Credit Course	L	T	P	C
		2	0	0	2

UNIT I NCC General 6

Aims, Objectives & Organization of NCC (1) – Incentives (2) – Duties of NCC Cadet (1) – NCC Camps: Types & Conduct (2)

UNIT II National Integration and Awareness 4

National Integration: Importance & Necessity (1) – Factors Affecting National Integration (1) – Unity in Diversity & Role of NCC in Nation Building (1) –Threats to National Security (1)

UNIT III Personality Development 7

Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving (2) – Communication Skills (3) – Group Discussion: Stress & Emotions (2)

UNIT IV Leadership 5

Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code (3) – Case Studies: Shivaji, Jhansi Ki Rani (2)

UNIT V Social Service and Community Development 8

Basics, Rural Development Programmes, NGOs, Contribution of Youth (3) – Protection of Children and Women Safety (1) Road/ Rail Travel Safety (1) – New Initiatives (2) – Cyber and Mobile Security Awareness (1)

TOTAL: 30 HOURS

Levels:

Level	**Activities**
1 ARMY	II semester: The NCC cadets are fresh to NCC activities are provided with above curriculum / syllabus
2 NAVY	For the Higher semester cadets of IV semester the credits are awarded with the basic qualifying needs e) Minimum one Combined Annual training Camp (CATC) or Attachment Camp or Centrally Organised Camp has to be attended (camp certificate is required) f) Appeared for B Certificate Exam
3 AIR FORCE	For the Higher semester cadets of VI semester the credits are awarded with the basic qualifying needs e) Minimum one Combined Annual training Camp (CATC) or Attachment Camp or Centrally Organised Camp has to be attended (camp certificate is required) f) Appeared for C Certificate Exam

Course Code	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
ME4701		2	0	0	2

COURSE OBJECTIVES:

1. To introduce the process planning concepts to make cost estimation for various products after process planning

COURSE DESCRIPTION

Covers the process of selecting appropriate manufacturing processes based on product requirements, materials, tolerances, and production volumes. Discuss design for manufacturability (DFM) principles and considerations. Explores methods for analyzing and optimizing process flows, including process mapping, value stream mapping (VSM), time studies, and efficiency improvements. Discusses strategies for material selection, procurement, inventory management, and resource allocation to ensure smooth production operations and minimize waste.

PREREQUISITES

- Familiarity with technical drawing, blueprint reading, and computer-aided design (CAD) software is beneficial for understanding engineering drawings, layouts, and process flow diagrams commonly used in process planning.
- Knowledge of various manufacturing processes, such as machining, casting, forming, welding, and assembly, is important for understanding process capabilities, limitations, and cost implications.

UNIT I INTRODUCTION TO PROCESS PLANNING 6

Introduction- methods of process planning-Drawing interpretation-Material evaluation – steps in process selection-.Production equipment and tooling selection

UNIT II PROCESS PLANNING ACTIVITIES 6

Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies

UNIT III INTRODUCTION TO COST ESTIMATION 6

Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of over head charges- Calculation of depreciation cost

UNIT IV PRODUCTION COST ESTIMATION 6

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

UNIT V MACHINING TIME CALCULATION 6

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.

TOTAL: 30 HOURS

COURSE OUTCOMES:

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

- **CO1.** Select the process, equipment and tools for various industrial products.
- **CO2.** Prepare process planning activity chart.
- **CO3.** Explain the concept of cost estimation.
- **CO4.** Compute the job order cost for different type of shop floor.
- **CO5.** Calculate the machining time for various machining operations.

TEXT BOOKS:

1. Peter scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, Dec 2002.
2. Sinha B.P, "Mechanical Estimating and Costing", Tata-McGraw Hill publishing co, 1995.

REFERENCES:

1. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.
2. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9th Edition, John Wiley,1998.
3. Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2003.
4. Mikell P. Groover, "Automation, Production, Systems and Computer Integrated Manufacturing", Pearson Education 2001.
5. K.C. Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management", Khanna Publishers 1990.

YOUTUBE RESOURCES:

1. **MIT Open Course Ware:** MIT Open Course Ware offers lectures and course materials from MIT's Mechanical Engineering department, including topics on manufacturing processes, process planning, and related engineering concepts.
2. **Learn Engineering -** Manufacturing: Learn Engineering provides educational videos on various topics, including manufacturing processes, automation, and quality control, which are relevant to process planning and cost estimation.
3. **Engineering Explained -** Manufacturing: Engineering Explained covers engineering concepts, technologies, and processes, including topics related to manufacturing, production planning, and cost analysis.
4. **The Engineering Mindset:** Manufacturing Engineering: The Engineering Mindset channel offers videos on engineering fundamentals, industrial processes, and automation, with content that touches on process planning and cost estimation aspects.
5. **GATE Lectures by Ravindrababu Ravula:** Industrial Engineering: This channel provides lectures and tutorials on topics relevant to industrial engineering, including process planning, production management, and cost estimation techniques.

Course Code	AUTOMOBILE ENGINEERING	L	T	P	C
ME4702		3	0	0	3

COURSE OBJECTIVES

- To study the construction and working principle of various parts of an automobile.
- To study the practice for assembling and dismantling of engine parts and transmission system
- To study various transmission systems of automobile.
- To study about steering, brakes and suspension systems
- To study alternative energy sources

COURSE DESCRIPTION

Explore the various types of powertrains used in automobiles, including internal combustion engines (gasoline, diesel), electric powertrains (battery-electric, hybrid, plug-in hybrid), and alternative fuel systems (e.g., hydrogen fuel cells). Discuss the principles of automotive design, including aerodynamics, ergonomics, safety considerations, and materials selection. Cover manufacturing processes such as casting, machining, welding, and assembly.

PREREQUISITES

- A strong foundation in mathematics, including calculus, algebra, geometry, and differential equations, is essential for understanding and analyzing engineering principles and calculations in automotive engineering.
- Proficiency in CAD software tools (e.g., AutoCAD, SolidWorks, CATIA) for 2D and 3D modeling is valuable for designing and analyzing automotive components and assemblies.

UNIT –I VEHICLE STRUCTURE AND ENGINES 9

Types of automobiles vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines – components-functions and materials, variable valve timing (VVT).

UNIT–II ENGINE AUXILIARY SYSTEMS 9

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

UNIT – III TRANSMISSION SYSTEMS 9

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Overdrive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

UNIT – IV STEERING, BRAKES AND SUSPENSION SYSTEMS 9

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS),electronic brake force distribution (EBD) and Traction Control.

UNIT – V ALTERNATIVE ENERGY SOURCES 9

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required–Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

TOTAL (THEORY): 45 HOURS

COURSE OUTCOMES:

At the end of the course the students would be able to

1. Recognize the various parts of the automobile and their functions and materials.
2. Discuss the engine auxiliary systems and engine emission control.
3. Distinguish the working of different types of transmission systems.
4. Explain the Steering, Brakes and Suspension Systems.
5. Predict possible alternate sources of energy for IC Engines.

TEXT BOOKS:

1. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.
2. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 13th Edition 2014.

REFERENCES:

1. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2012.
2. Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
3. Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999.
4. Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Good heart – Will Cox Company Inc, USA ,1978.
5. Newton, Steeds and Garet, "Motor Vehicles", Butterworth Publishers,1989.

YOUTUBE RESOURCES:

1. **Engineering Explained:** This channel covers a wide range of engineering topics, including automotive engineering, vehicle dynamics, engines, drivetrains, and automotive technology explanations.
2. **Learn Engineering:** Learn Engineering provides educational videos on engineering concepts, mechanisms, and technologies, including automotive engineering principles and components.
3. **SAE International:** SAE International's channel features technical content, webinars, and industry insights related to automotive engineering, vehicle technology, mobility solutions, and standards development.
4. **Engineering Explained -** Motorsports: This spin-off channel from Engineering Explained focuses specifically on motorsports engineering, covering topics such as race car design, aerodynamics, suspensions, and performance tuning.

5. **Real Engineering:** Real Engineering explores engineering concepts across various disciplines, including automotive engineering-related topics such as vehicle design, engineering innovations, and future mobility solutions.

Course Code	INDUSTRIAL INTERNET OF THINGS	L	T	P	C
ME4703		3	0	0	3

COURSE OBJECTIVES

1. To understand Smart Objects and loT Architectures
2. To learn about various IOT-related protocols
3. To build simple loT Systems using Arduino and Raspberry Pi.
4. To understand data analytics and cloud in the context of loT
5. To develop loT infrastructure for popular applications.

COURSE DESCRIPTION

Cover the foundational technologies that underpin IIoT, such as sensors, actuators, communication protocols (e.g., MQTT, CoAP), edge computing, cloud computing, and data analytics. Discuss the different types of connectivity options (e.g., wired, wireless, cellular) and networking architectures (e.g., star, mesh, edge-to-cloud) commonly employed in IIoT environments.

PREREQUISITES

- Familiarity with industrial automation principles, control systems (e.g., PLCs, SCADA), and manufacturing processes provides a foundational understanding of the industrial environment where IIoT technologies are deployed.
- Experience or knowledge in systems integration methodologies, protocols (e.g., RESTful APIs, MQTT), and interoperability standards is valuable for integrating IIoT devices and systems with existing industrial infrastructures.

UNIT I FUNDAMENTALS OF loT **9**

Evolution of Internet of Things - Enabling Technologies - loT Architectures: oneM2M, loT World Forum (loT WF) and Alternative loT models - Simplified loT Architecture and Core loT Functional Stack - Fog, Edge and Cloud in loT - Functional blocks of an loT ecosystem - Sensors, Actuators, Smart Objects and Connecting Smart Objects

UNIT II loT PROTOCOLS **9**

loT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11 ah and LoRaWAN - Network Layer: IP versions, Constrained Nodes and Constrained Networks - Optimizing IP for loT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks - Application Transport Methods: Supervisory Control and Data Acquisition - Application Layer Protocols: CoAP and MQTT

UNIT III DESIGN AND DEVELOPMENT **9**

Design Methodology - Embedded computing logic - Microcontroller, System on Chips - loT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming

UNIT IV DATA ANALYTICS AND SUPPORTING SERVICES 9

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest - Role of Machine Learning - No SQL Databases - Hadoop Ecosystem - Apache Kafka, Apache Spark - Edge Streaming Analytics and Network Analytics - Xively Cloud for loT, Python Web Application Framework - Django -AWS for

loT - System Management with NETGONF-YANG

UNIT V CASE STUDIES/INDUSTRIAL APPLICATIONS 9

Cisco loT system - IBM Watson loT platform - Manufacturing - Converged Plantwide Ethernet Model (CPwE) - Power Utility Industry – Grid Blocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control

TOTAL (THEORY): 45 HOURS

COURSE OUTCOMES:

Upon completion of the course, the student should be able to:

- **CO 1.** Explain the concept of loT.
- **CO 2.** Analyze various protocols for loT.
- **CO 3.** Design a Poe of an +o'T system using Rasperry Pi/Arduino
- **CO 4.** Apply data analytics and use cloud offerings related to loT

TEXT BOOKS

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete. Rob Barton and Jerome Henry, "loT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017
2. Arshdeep Bahga, Vijay Madisetti, —Internet of Things – A hands-on approach||, Universities Press, 2015
3. Olivier Hersent, David Boswarthick, Omar Elloumi, —The Internet of Things – Key applications and Protocols||, Wiley, 2012

REFERENCES:

1. Jan Ho¨ ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), —Architecting the Internet of Things||, Springer, 2011.
3. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance your projects, 2nd Edition, O'Reilly_Media,_2011.

YOUTUBE RESOURCES:

1. **IBM Internet of Things**: IBM's official IoT channel covers various topics related to IoT and IIoT, including industry-specific applications, case studies, and technology demonstrations.
2. **Siemens'** YouTube channel includes videos on industrial automation, digitalization, and IoT solutions, offering insights into how IIoT is transforming manufacturing and other industries.
3. **Cisco's IoT channel** features videos on IoT architectures, cybersecurity, edge computing, and smart city solutions, providing a comprehensive view of IoT technologies and trends.

4. **Microsoft Azure's IoT playlist** covers tutorials, webinars, and case studies related to IoT development, data analytics, and cloud integration using Azure IoT services.
5. **Bosch's YouTube channel** features videos on IoT innovations, smart manufacturing, connected devices, and IoT solutions for automotive, industrial, and smart city applications.

APPENDIX B: OPEN ELECTIVES I

S.No	COURSE CODE	COURSE TITLE
1.	ME46O1	Lean Concepts, Tools and Practices
2.	ME46O2	Reverse Engineering
3.	ME46O3	Fire Safety Engineering
4.	ME46O4	Fundamentals of Aeronautical Engineering
5.	ME46O5	Nano Technology
6.	ME46O6	Functional Materials
7.	ME46O7	Basics of Plastics Processing
8.	ME46O8	Solar Energy Conversion Systems
9.	ME46O9	Machine Learning for Smart Manufacturing
10.	CY46O1	Engineering Chemistry

OPEN ELECTIVES – II

SL.NO.	COURSE CODE	COURSE TITLE
1.	ME47O1	Technical Writing
2.	ME47O2	Production and Operations Management for Entrepreneurs
3.	ME47O3	Nanomaterials and Applications
4.	ME47O4	Concepts in Mobile Robotics
5.	ME47O5	Renewable Energy Technologies
6.	ME47O6	Energy Technology
7.	ME47O7	Plastic Materials for Engineers
8.	ME47O8	Properties and Testing of Plastics
9.	ME47O9	Professional Ethics in Engineering

Course Code	LEAN CONCEPTS, TOOLS AND PRACTICES	L	T	P	C
ME4601		3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge about the basics of lean principles, tools and techniques, and implementation in the construction industry.

UNIT I Introduction **9**

Introduction and overview of the construction project management - Review of Project Management & Productivity Measurement Systems - Productivity in Construction - Daily Progress Report-The state of the industry with respect to its management practices -construction project phases - The problems with current construction management techniques.

UNIT II Lean Management **9**

Introduction to lean management - Toyota's management principle-Evolution of lean in construction industry - Production theories in construction –Lean construction value - Value in construction - Target value design - Lean project delivery system- Forms of waste in construction industry - Waste Elimination.

UNIT III Core Concepts in Lean **9**

Concepts in lean thinking – Principles of lean construction – Variability and its impact – Traditional construction and lean construction – Traditional project delivery - Lean construction and workflow reliability – Work structuring – Production control.

UNIT IV Lean Tools and Techniques **9**

Value Stream Mapping – Work sampling – Last planner system – Flow and pull based production – Last Planner System – Look ahead schedule – constraint analysis – weekly planning meeting- Daily Huddles – Root cause analysis – Continuous improvement – Just in time.

UNIT V Lean Implementation in Construction Industry **9**

Lean construction implementation- Enabling lean through information technology - Lean in design - Design Structure - BIM (Building Information Modelling) - IPD (Integrated Project Delivery) – Sustainability through lean construction approach.

TOTAL: 45 HOURS

COURSE OUTCOMES:

CO1: Explains the contemporary management techniques and the issues in present scenario.
CO2: Apply the basics of lean management principles and their evolution from manufacturing industry to construction industry.
CO3: Develops a better understanding of core concepts of lean construction tools and techniques and their importance in achieving better productivity.
CO4: Apply lean techniques to achieve sustainability in construction projects.
CO5: Apply lean construction techniques in design and modeling.

REFERENCES:

1. Corfe, C. and Clip, B., Implementing lean in construction: Lean and the sustainability agenda, CIRIA, 2013..
2. Shang Gao and Sui Pheng Low, Lean Construction Management: The Toyota Way, Springer, 2014.
3. Dave, B., Koskela, L., Kiviniemi, A., Owen, R., and Tzortzopoulos, P., Implementing lean in construction: Lean construction and BIM, CIRIA, 2013.
4. Ballard, G., Tommelein, I., Koskela, L. and Howell, G., Lean construction tools and techniques, 2002.
5. Salem, O., Solomon, J., Genaidy, A. and Luegring, M., Site implementation and Assessment of Lean Construction Techniques, Lean Construction Journal, 2005.

Course Code	REVERSE ENGINEERING	L	T	P	C
ME46O2		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- Applying the fundamental concepts and principles of reverse engineering in product design and development.
- Applying the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
- Applying the concept and principles of material identification and process verification in reverse engineering of product design and development.
- Analysing the various legal aspect and applications of reverse engineering in product design and development.
- Understand about 3D scanning hardware & software operations and procedure to generate 3D model

UNIT I Introduction & Geometric Form **9**

Definition – Uses – The Generic Process – Phases – Computer Aided Reverse Engineering - Surface and Solid Model Reconstruction – Dimensional Measurement – Prototyping.

UNIT II Material Characteristics And Process Identification **9**

Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness –Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure Material Specification - Composition Determination - Microstructure Analysis - Manufacturing Process Verification.

UNIT III Data Processing **9**

Statistical Analysis – Data Analysis – Reliability and the Theory of Interference – Weibull Analysis – Data Conformity and Acceptance – Data Report – Performance Criteria – Methodology of Performance Evaluation – System Compatibility.

UNIT IV 3d Scanning and Modelling **9**

Introduction, working principle and operations of 3D scanners: Laser, White Light, Blue Light - Applications- Software for scanning and modelling: Types- Applications- Preparation techniques for Scanning objects- Scanning and Measuring strategies - Calibration of 3D Scanner- Step by step procedure: 3D scanning - Geometric modelling – 3D inspection- Case studies.

UNIT V Industrial Applications **9**

Reverse Engineering in the Automotive Industry; Aerospace Industry; Medical Device Industry. Case studies and Solving Industrial projects in Reverse Engineering. Legality: Patent – Copyrights –Trade Secret – Third-Party Materials.

TOTAL: 45 HOURS

COURSE OUTCOMES:

- Apply the fundamental concepts and principles of reverse engineering in product design and development.
- Apply the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
- Apply the concept and principles of material identification and process verification in reverse engineering of product design and development.
- Apply the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.
- Analyze the various legal aspect
- Applications of reverse engineering in product design and development.

TEXT BOOKS:

1. Robert W. Messler, Reverse Engineering: Mechanisms, Structures, Systems & Materials, 1st Edition, McGraw-Hill Education, 2014
2. Wego Wang, Reverse Engineering Technology of Reinvention, CRC Press, 2011

REFERENCES:

1. Scott J. Lawrence , Principles of Reverse Engineering, Kindle Edition, 2022
2. Kevin Otto and Kristin Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Prentice Hall, 2001
3. Kathryn, A. Ingle, "Reverse Engineering", McGraw-Hill, 1994.
4. Linda Wills, "Reverse Engineering", Kluver Academic Publishers, 1996
5. Vinesh Raj and Kiran Fernandes, "Reverse Engineering: An Industrial Perspective", SpringerVerlag London Limited 2008.

Course Code	FIRE SAFETY ENGINEERING	L	T	P	C
ME4603		3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To enable the students to acquire knowledge of Fire and Safety Studies
- To learn about the effect of fire on materials used for construction, the method of test for non combustibility & fire resistance
- To learn about fire area, fire stopped areas and different types of fire-resistant doors
- To learn about the method of fire protection of structural members and their repair due to fire damage.
- To develop safety professionals for both technical and management through systematic and
- quality-based study programmes

UNIT I Inherent Safety Concepts 9

Compartment fire-factors controlling fire severity, ventilation controlled and fuel controlled fires; Spread of fire in rooms, within building and between buildings. Effect of temperature on the properties of structural materials- concrete, steel, masonry and wood; Behavior of non-structural materials on fire-plastics, glass, textile fibres and other house hold materials.

UNIT II Plant Locations 9

Compartment temperature-time response at pre-flashover and post flashover periods; Equivalence of fire severity of compartment fire and furnace fire; Fire resistance test on structural elements standard heating condition, Indian standard test method, performance criteria.

UNIT III Working Conditions 9

Fire separation between building- principle of calculation of safe distance. Design principles of fire resistant walls and ceilings; Fire resistant screens- solid screens and water curtains; Local barriers; Fire stopped areas-in roof, in fire areas and in connecting structures; Fire doors- Low combustible, Non-combustible and Spark-proof doors; method of suspension of fire doors; Air-tight sealing of doors;

UNIT IV Fire Severity And Repair Techniques 9

Fabricated fire proof boards-calcium silicate, Gypsum, Vermiculite, and Perlite boards; Fire protection of structural elements - Wooden, Steel and RCC.. Reparability of fire damaged structures Assessment of damage to concrete, steel, masonry and timber structures, Repair techniques- repair methods to reinforced concrete Columns, beams and slabs, Repair to steel structural members, Repair to masonry structures.

UNIT V Working At Heights 9

Safe Access - Requirement for Safe Work Platforms- Stairways - Gangways and Ramps-Fall Prevention & Fall Protection - Safety Belts - Safety nets - Fall Arrestors- Working on Fragile Roofs - Work Permit Systems-Accident Case Studies.

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO1: Understand the effect of fire on materials used for construction

CO2: Understand the method of test for non-combustibility and fire resistance; and will be able to select different structural elements and their dimensions for a particular fire resistance rating of a building.

CO3: To understand the design concept of fire walls, fire screens, local barriers and fire doors and able to select them appropriately to prevent fire spread.

CO4: To decide the method of fire protection to RCC, steel, and wooden structural elements and their repair methods if damaged due to fire.

CO5: Describe the safety techniques and improve the analytical and intelligence to take the right decision at right time.

TEXT BOOKS:

1. Roytman, M. Y," Principles of fire safety standards for building construction". Amerind Publishing Co. Pvt. Ltd., New Delhi,1975
2. John A. Purkiss," Fire safety engineering design of structures" (2nd edn.), Butterworth Heinemann, Oxford, UK,2009

REFERENCES:

1. Smith, E.E. and Harmathy, T.Z. (Editors),"Design of buildings for fire safety". ASTM Special Publication 685, American Society for Testing and Materials, Boston, U.S.A,1979.
2. Butcher, E. G. and Parnell, A. C, "Designing of fire safety". JohnWiley and Sons Ltd., New York, U.S.A.1983.
3. Jain, V.K,"Fire safety in buildings" (2nd edn.). New Age International(P) Ltd., New Delhi,2010.
4. Hazop&Hazan,"Identifying and Assessing Process Industry Hazards", Fourth Edition ,1999
5. Frank R. Spellman, Nancy E. Whiting," The Handbook of Safety Engineering: Principles and Applications", 2009

Course Code	FUNDAMENTALS OF AERONAUTICAL ENGINEERING	L	T	P	C
ME4604		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To acquire the knowledge on the Historical evaluation of Airplanes
- To learn the different component systems and functions
- To know the concepts of basic properties and principles behind the flight
- To learn the basics of different structures & construction
- To learn the various types of power plants used in aircrafts

UNIT I History of Flight **9**

Balloon flight-ornithopter-Early Airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.

UNIT II Aircraft Configurations and Its Controls **9**

Different types of flight vehicles, classifications-Components of an airplane and their functions Conventional control, powered control- Basic instruments for flying-Typical systems for control actuation.

UNIT III Basics of Aerodynamics **9**

Physical Properties and structures of the Atmosphere, Temperature, pressure and altitude relationships, Newton's Law of Motions applied to Aeronautics-Evolution of lift, drag and moment. Aerofoils, Mach number, Maneuvers.

UNIT IV Basics of Aircraft Structures **9**

Odometric position estimation, belief representation, probabilistic mapping, Markov localization, Bayesian localization, Kalman localization, positioning beacon systems

UNIT V Basics of Propulsion **9**

Basic ideas about piston, turboprop and jet engines – use of propeller and jets for thrust production Comparative merits, Principle of operation of rocket, types of rocket and typical applications, Exploration into space.

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

- Illustrate the history of aircraft & developments over the year
- Ability to identify the types & classifications of components and control systems
- Explain the basic concepts of flight & Physical properties of Atmosphere
- Identify the types of fuselage and constructions.

- Distinguish the types of Engines and explain the principles of Rocket.

TEXT BOOKS

1. Anderson, J.D., Introduction to Flight, McGraw Hill; 8th edition , 2015
2. E Rathakrishnan, “Introduction to Aerospace Engineering: Basic Principles of Flight”, John Wiley, NJ, 2021
3. Stephen.A. Brandt, Introduction to aeronautics: A design perspective, 2nd edition, AIAA Education Series, 2004.

REFERENCES

1. Sadhu Singh, “Internal Combustion Engines and Gas Turbine”-, SS Kataraia & Sons, 2015
2. Kermode , “Flight without Formulae”, -, Pitman; 4th revised edition 1989

Course Code	NANO TECHNOLOGY	L	T	P	C
ME4605		3	0	0	3

COURSE OBJECTIVES:

- The course emphasis on the molecular safe assembly and materials for polymer electronics

UNIT I Introduction **9**

Historical Perspectives, Lessons from the Nature, Engineering the Functions, Tuning the functions, Multiscale Modeling and Computation, Classification of Functional Materials, Functional Diversity of Materials, Hybrid Materials, Technological Relevance, Societal Impact

UNIT II Synthesis Of Nanomaterials **9**

Bottom up and Top-down approach for obtaining nano materials - Precipitation methods – sol gel technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods – laser ablation, sputtering.

UNIT III Nano Composites **9**

Definition- importance of nanocomposites- nano composite materials-classification of composites metal/metal oxides, metal-polymer- thermoplastic based, thermoset based and elastomer based influence of size, shape and role of interface in composites applications.

UNIT IV Nano Structures and Characterization Techniques **9**

Classifications of nanomaterials - Zero dimensional, one-dimensional and two-dimensional nanostructures- Kinetics in nanostructured materials- multilayer thin films and superlattice- clusters of metals, semiconductors and nanocomposites. Spectroscopic techniques, Diffraction methods, thermal analysis method, BET analysis method.

UNIT V Applications of Nano Materials **9**

Overview of nanomaterials properties and their applications, nano painting, nano coating, nanomaterials for renewable energy, Molecular Electronics and Nanoelectronics – Nanobots Biological Applications. Emerging technologies for environmental applications- Practice of nanoparticles for environmental remediation and water treatment.

TOTAL: 45 HOURS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications

CO2: Able to acquire knowledge about the different types of nano material synthesis

CO3: Describes about the shape, size, structure of composite nano materials and their interference.

CO4: Understand the different characterization techniques for nanomaterials

CO5: Develop a deeper knowledge in the application of nanomaterials in different fields.

TEXT BOOKS:

1. Mick Wilson, Kamali Kannangara,Geoff Smith, Michelle Simmom, Burkhard Raguse, " Nano Technology: Basic Science & Engineering Technology", 2005, Overseas Press
2. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties &Applications" Imperial College Press, 2004
3. William A Goddard "Handbook of Nanoscience, Engineering and Technology", 3rd Edition, CRC Taylor and Francis group 2012.

REFERENCES:

1. R.H.J. Hannink & A.J. Hill, Nanostructure Control, Wood Head Publishing Ltd., Cambridge, 2006.
2. C.N.R. Rao, A. Muller, A.K. Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications Vol. I & II, 2nd edition, 2005, Wiley VCH Verlag Gibtl & Co
3. Ivor Brodie and Julius J. Muray,' The physics of Micro/Nano – Fabrication', Springer International Edition,2010

Course Code	FUNCTIONAL MATERIALS	L	T	P	C
ME46O6		3	0	0	3

COURSE OBJECTIVES:

- Gain a thorough understanding of the various types of functional materials, including their classifications and characteristics.
- Understand the physical, chemical, and mechanical properties that define functional materials.
- Explore the relationship between the structure of materials at the atomic, molecular, and macroscopic levels and their properties.
- Analyze how modifications in structure can influence the functional properties of materials.
- Learn about different synthesis methods and fabrication techniques used to create functional materials.

UNIT I Introduction **9**

Historical Perspectives, Lessons from the Nature, Engineering the Functions, Tuning the functions, Multiscale Modeling and Computation, Classification of Functional Materials, Functional Diversity of Materials, Hybrid Materials, Technological Relevance, Societal Impact

UNIT II Molecular Self Assembly **9**

Molecular Organization, Self-Assembly in Biology, Energetics of Self-Organization, A Few Case Studies, Synthetic Protocols and Challenges, Solvent-assisted Self-Assembly, Directed Assembly Langmuir-Blodgett and Langmuir-Schaefer techniques, Technological Applications of SAMs.

UNIT III Bio-Inspired Materials **9**

Bio-inspired materials, Classification, Biomimicry, Spider Silk, Lotus Leaf, Gecko feet, Synovial fluid, 'Bionics'-Bio-inspired Information Technologies, Artificial Sensory Organs, Biomineralization- En route to Nanotechnology.

UNIT IV Smart Or Intelligent Materials **9**

Criteria for Smartness, Significance of Smart Materials, Representative Examples like Smart Gels and Polymers, Electro/Magneto Rheological Fluids, Smart Electro ceramics, Technical Limitations and Challenges, Functional Nanocomposites, Polymer-carbon nanotube composites

UNIT V Materials For Polymer Electronics **9**

Polymers for Electronics, Organic Light Emitting Diodes, Working Principle of OLEDs, Illustrated Examples, Organic Field-Effect Transistors Operating Principle, Design Considerations, Polymer FETs vs Inorganic FETs, Liquid Crystal Displays, Engineering Aspects of Flat Panel Displays, Intelligent Polymers for Data Storage, Polymer-based Data Storage-Principle, Magnetic Vs. Polymer-based Data Storage.

TOTAL: 45 HOURS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- Students will be able to differentiate among various functional properties and select appropriate material for certain functional applications, analyze the nature and potential of functional material.

TEXT BOOKS:

1. Vijayamohanan K. Pillai and Meera Parthasarathy, "Functional Materials: A chemist's perspective", Universities Press Hyderabad (2012).

REFERENCES:

1. Stephen Manne "Biomimetic Materials Chemistry" Wiley-VCH New York, 1966

Course Code	BASICS OF PLASTICS PROCESSING	L	T	P	C
ME46O7		3	0	0	3

COURSE OBJECTIVES:

- Understand the fundamentals of plastics processing, such as the relationships between material structural properties and required processing parameters, and so on
- To gain practical knowledge on the polymer selection and its processing
- Understanding the major plastic material processing techniques (Extrusion, Injection molding,
- Compression and Transfer molding, Blow molding, Thermoforming and casting)
- To understand suitable additives for plastics compounding
- To Propose troubleshooting mechanisms for defects found in plastics products manufactured by various processing techniques

UNIT I INTRODUCTION TO PLASTICS PROCESSING 9

Introduction to plastic processing – Principles of plastic processing: processing of plastics vs. metals and ceramics. Factors influencing the efficiency of plastics processing: molecular weight, viscosity and rheology. Difference in approach for thermoplastic and thermoset processing - Additives for plastics compounding and processing: antioxidants, light stabilizers, UV stabilizers, lubricants, impact modifiers, flame retardants, antistatic agents, stabilizers and plasticizers. Compounding: plastic compounding techniques, plasticization, pelletization

UNIT II EXTRUSION 9

Extrusion – Principles of extrusion. Features of extruder: barrel, screw, types of screws, drive mechanism, specifications, heating & cooling systems, types of extruders. Flow mechanism: process variables, die entry effects and exit instabilities. Die swell, Defects: melt fracture, shark skin, bambooing - Factors determining efficiency of an extruder. Extrusion of films: blown and cast films. Tube/pipe extrusion. Extrusion coating: wire & cable. Twin screw extruder and its applications - Applications of extrusion and new developments

UNIT III INJECTION MOLDING 9

Injection molding – Principles and processing outline, machinery, accessories and functions, specifications, process variables, mould cycle - Types of clamping: hydraulic and toggle mechanisms. Start-up and shut down procedures-Cylinder nozzles- Press capacity projected area -Shot weight Basic theoretical concepts and their relationship to processing - Interaction of moulding process aspect effects in quoted variables. Basic mould types - Reciprocating vs. plunger type injection moulding - Thermoplastic vs. thermosetting injection moulding - Injection moulding vs. other plastic processing techniques - State-of-the art injection moulding techniques - Introduction to trouble shooting

UNIT IV COMPRESSION AND TRANSFER MOLDING 9

Compression moulding – Basic principles of compression and transfer moulding-Meaning of terms-Bulk factor and flow properties, moulding materials, process variables and process cycle, Inter relation between flow properties-Curing time-Mould temperature and Pressure requirements. Preforms and preheating Techniques of preheating. Machines used-Types of compression mould- positive, semi-positive and flash. Common moulding faults and their correction- Finishing of mouldings. Transfer moulding: working principle, equipment, Press capacity-Integral moulds and auxiliary ram moulds, moulding cycle, moulding tolerances, pot transfer, plunger transfer and screw transfer moulding techniques, advantages over compression moulding

UNIT V BLOW MOLDING, THERMOFORMING AND CASTING 9

Blow moulding: principles and terminologies. Injection blow moulding. Extrusion blow moulding. Design guidelines for optimum product performance and appearance. Thermoforming: principle, vacuum forming, pressure forming mechanical forming. Casting: working principle, types and applications.

TOTAL: 45 HOURS

OUTCOMES:

On successful completion of this course, the student will be able to

CO1. Ability to find out the correlation between various processing techniques with product properties

CO2. Understand the major plastics processing techniques used in moulding (injection, blow, compression, and transfer), extrusion, thermoforming, and casting.

CO3. Acquire knowledge on additives for plastic compounding and methods employed for CO3the same

CO4. Familiarize with the machinery and ancillary equipment associated with various plastic processing techniques.

CO5. Select an appropriate processing technique for the production of a plastic product

REFERENCES:

1. S. S. Schwart, S. H. Goodman, Plastics Materials and Processes, Van Nostrad Reinhold Company Inc. (1982).
2. F. Hensen (Ed.), Plastic Extrusion Technology, Hanser Gardner (1997).
3. W. S. Allen and P. N. Baker, Hand Book of Plastic Technology, Volume-1, Plastic Processing Operations [Injection, Compression, Transfer, Blow Molding], CBS Publishers and Distributors (2004).
4. M. Chanda, S. K. Roy, Plastic Technology handbook, 4th Edn., CRC Press (2007).
5. I. Rubin, Injection Molding Theory & Practice, Society of Plastic Engineers, Wiley (1973).
6. D.V. Rosato, M. G. Rosato, Injection Molding Hand Book, Springer (2012).
7. M. L. Berins (Ed.), SPI Plastic Engineering Hand Book of Society of Plastic Industry Inc., Springer (2012).
8. B. Strong, Plastics: Material & Processing, A, Pearson Prentice hall (2005).
9. D.V Rosato, Blow Molding Hand Book, Carl Hanser Verlag GmbH & Co (2003).

Course Code	SOLAR ENERGY CONVERSION SYSTEMS	L	T	P	C
ME4608		3	0	0	3

COURSE OBJECTIVES:

- To provide a comprehensive understanding of Solar Energy Conversion Systems (SECS).
- To explore the engineering principles, economic analysis, and meteorological data that influence the design and optimization of SECS

UNIT I INTRODUCTION TO SOLAR ENERGY CONVERSION SYSTEMS 9

Solar Radiation- Astronomical Parameters- Interaction of Solar Radiation with the Atmosphere.

UNIT II SOLAR ENERGY RADIATIVE FLUX DEPLETION 9

Optical Depth for a Vertical Path- Atmospheric Mass- Integral Transmission Factor of the Atmosphere- Attenuation of Solar Radiation by Clouds

UNIT III CORRELATION WITH METEOROLOGICAL CONDITIONS 9

Depletion "Constant" of the Atmosphere- Quantitative Aspects of Cloud Presence- Solmet - Meteorological Data- Model Input Data.

UNIT IV APPENDICES AND ADDITIONAL RESOURCES 9

Definitions and Units of Measure for Irradiance- Radiation Laws Applied to Computation of Solar Energy Fluxes- Computation of Precipitable Water and Equivalent Height of the Atmosphere- Insolation Climatology Data on SOLMET Format- W.M.O. Cloud Definition and Classification- Analogic Records of Surface Weather Observation.

UNIT V ADVANCED TOPICS IN SOLAR ENERGY 9

Solar Cell Technologies- Concentrated Solar Power Systems- Solar Thermal Collectors- Photovoltaic System Design- Energy Storage for Solar Applications.

TOTAL: 45 HOURS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- Students will be able to differentiate among various functional properties and select appropriate material for certain functional applications, analyze the nature and potential of functional material.

REFERENCES:

1. G. Russo, "Analytical Models and Numerical Simulation Codes for Solar Energy Systems' Engineers (I)," Fourth Course on Solar Energy Conversion, International Center for Theoretical Physics, Italy, 1977.
2. G. Russo, "Passive and Active Systems Radiation Dynamics," Act of the Congress SAIE 77, Italy, 1977.

3. Russo and G. Russo, "Analytical Models and Numerical Simulation Codes for Solar Energy Systems Engineering (II)," Fourth Course on Solar Energy Conversion, International Center for Theoretical Physics, Italy, 1977.
4. G. Russo, "Design of Solar Energy Conditioning Systems," Technical Report, Polytechnic of Torino, School of Engineering, Torino, Italy, 1975.
5. G. Russo, "Solar Collectors: Testing Loop Design," FIAT C.R.F. Technical Report No. 528/75/lmr, 1975

Course Code	MACHINE LEARNING FOR SMART MANUFACTURING	L	T	P	C
ME46O9		3	0	0	3

COURSE OBJECTIVES:

Impart knowledge of smart manufacturing for industry 4.0 for making student innovative.

UNIT I INDUSTRY 4.0 9

Concept, Globalization and emerging issues, The Fourth Revolution, LEAN manufacturing, Smart and connected business perspectives, Smart factories

UNIT II AUTOMATION 9

Programable Logic Controller (PLC) and its Programming software, Communication of different devices with PLC, Sensor, Smart Sensor, HMI design, Cyber Physical System – key components, ISA-95 architecture, CPS-5C architecture, Concept of Digit Twin.

UNIT III COMMUNICATION 9

Protocols – MQTT, OPC UA, Ether Net/IP, Profinet, Ether CAT, etc; MQTT – History, MQTT broker, Message types, Quality of Service (QoS), Application; OPC UA – History, Specification, Client, Server, Programming with – Free and open-source software, Propriety software; Augmented Reality.

UNIT IV IOT PLATFORM 9

Data Modelling, IoT platforms – Thing, basic functionalities, Abstract definition of Thing, Networks, etc; IoT Gateway, Machine interfaces – Cloud-based Mosquitto brokers, Programming with – Free and open-source software, Propriety software.

UNIT V MACHINE LEARNING FOUNDATION 9

Learning algorithms – Supervised, Unsupervised, Self-learning, Feature learning, etc. Models – Artificial Neural Networks, Decision trees, Regression analysis, Genetic algorithms, etc.; Programming with – Free and open-source software, Propriety software

TOTAL: 45 HOURS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- Introduce concept of Industry 4.0 for Smart Manufacturing.
- Understand use various hardware used in Smart Manufacturing.
- Understand need of various communication protocols. hardware and software, IoT Layers and their relative importance.
- Understand could-computing IoT platform for Smart Manufacturing.
- Understand machine learning to make smart factories.
- Understand application of hardware, communication protocol, IOT platform, machine learning etc. to implement IoT for smart manufacturing for the need of Industry 4.0.

REFERENCES:

1. Christoph Jan Bartodziej, “The Concept Industry 4.0 – An Empirical Analysis of Technologies and Application in Production Logistics”, Spinger Gabler, 2015 2.
2. Alasdair Gilchrist, “Industry 4.0 – The Industrial Internet of Thigs”, Springer Link, 2016 3.
3. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978-1-118-47347-4, Willy Publications. 4.
4. Michahelles, “Architecting the Internet of Things”, ISBN 978-3- 642-19156-5 e-ISBN 978- 3-642-19157-2, Springer. 5.
5. Hakima Chaouchi, “The Internet of Things Connecting Objects to the Web” ISBN : 978-1- 84821-140-7, Willy Publications. 6.
6. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things: Key Applications and Protocols”, ISBN: 978-1-119-99435-0, 2nd Edition, Willy Publications 7.
7. W. Botton, “Programmable Logic Controllers”, Fourth Edition, Elsevier, 2006
8. P. Juahs, K. Molnar, “Key Components of the Architecture of Cyber-physical manufacturing systems”, International Scientific Journal “Industry 4.0”, 2017, issue 5, 205- 207
9. Jen-Ruey Jiang, “An improved cyber-physical systems architecture for Industry 4.0 smart factories”, Advances in Mechanical Engineering, 2018, Vol. 10(6) 1-15

Course Code	ENGINEERING CHEMISTRY	L	T	P	C
CY4601		3	0	0	3

COURSE OBJECTIVES

- To inculcate sound understanding of water quality and water treatment techniques.
- To impart knowledge on the preparatory methods of nano-material's. To introduce the properties and applications of composites
- To facilitate the understanding of fuel classification, preparation, combustion, and environmental impact.
- To conversant with the principle electro-chemistry, cell reactions, and corrosion protection techniques.
- To acquire a deep understanding of renewable energy sources along with energy storage technologies and innovation in sustainable energy systems.

COURSE DESCRIPTION

- This course provides a foundational understanding of chemistry principles and their applications in engineering disciplines.
- It covers key topics such as atomic structure, chemical bonding, thermodynamics, kinetics, electro-chemistry, materials science, and environmental chemistry.
- Emphasis is placed on linking fundamental chemical concepts to engineering applications and technological advancements.

PREREQUISITES

- Basic knowledge of chemistry concepts, including atomic structure, chemical bonding, stoichiometry, and thermodynamics, is recommended for successful participation in this course.
- Proficiency in algebra and basic calculus is also beneficial.

UNIT I WATER AND ITS TREATMENT 9

Water: Sources and impurities, hardness, alkalinity. Treatments – sterilization – break point chlorination, UV, Ozonation, Desalination of brackish water: Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming & foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment Ion exchange demineralization and zeolite process.

UNIT II NANO MATERIALS & COMPOSITE 9

Basics: Distinction between molecules, nanomaterials and bulk materials; Types of nanomaterials: Definition, properties and uses of nano particles and nanotube. Preparation of nano materials: laser ablation, and electro spinning. An application of nano materials in medicine, agriculture, energy, electronics and catalysis

Composite: Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. FRP – Hybrid composites – definition and examples

UNIT III FUELS AND COMBUSTION 9

Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel:

Manufacture of synthetic petrol (Bergius process), Knocking – octane number, diesel oil – cetane number; Power alcohol and biodiesel.

Combustion of fuels: Introduction: Calorific value – higher and lower calorific values, Theoretical calculation of calorific value; Flue gas analysis – ORSAT Method. CO_2 emission and carbon foot print.

UNIT IV ELECTRO CHEMISTRY AND CORROSION CONTROL 9

Electrochemistry – Introduction, Electrochemical cells – electrolytic cell – reversible and irreversible cells. Electrode potential – Oxidation and reduction Potentials – emf, Nernst equation and applications - Reference electrodes – Calomel electrode – Electrochemical series – its applications

Corrosion protection – cathodic protection – sacrificial anodic and impressed current protection methods; advanced protective coatings: electroplating and electroless plating.

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Solar energy conversion: Principle, working and applications of solar cells; recent developments in solar cell materials. Wind energy; Geothermal energy. Hydrogen as fuel: Sources of hydrogen – Hydrogen production methods – electrolysis, limitations and applications.

Storage Devices: Batteries – Types of batteries, Primary battery – dry cell, Secondary battery – lead acid battery and lithium – ion – battery; Electric vehicles – working principles; Fuel cells: $H_2 – O_2$ fuel cell.

TOTAL HOURS (THEORY): 45

COURSE OUTCOMES

After the completion of the course, students will be able to

- To infer the quality of water and propose suitable treatment methodologies for hard water.
- To identify and apply basic concepts of nanomaterial's preparation for engineering applications. To gain knowledge of fuel properties, manufacturing processes, combustion characteristics, and environmental considerations.
- To attain expertise in electrochemical principles, cell reactions and corrosion protection techniques.
- To attain proficiency in different forms of energy resources and fuel cell utilization, fostering the lead advancements in renewable energy and energy storage solutions.

TEXT BOOKS

1. Dara S.S, Umare S.S, "Engineering Chemistry", First revised Edition by S. Chand & Company Ltd., New Delhi 2015.
2. Jain P. C. & Monica Jain., "Engineering Chemistry", 16th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
3. K. Klabunde, G. Sergeev, Nano chemistry, 2nd Edition, Springer Publisher, 2013.
4. S.A. Sherif, D. Yogi Goswami, E.K. (Lee) Stefanakos, Aldo Steinfeld "Handbook of Hydrogen Energy", 1st Edition, CRC Press, 2014.

REFERENCE BOOKS

1. Shikha Agarwal., "Engineering Chemistry and Applications", Cambridge University press, 2016.
2. Kazunari Sasaki, Hai – Wen Li, Akari Hayashi, Junichiro Yamabe, Teppei Ogura, Stephen M. Lyth, Hydrogen Energy Engineering A Japanese Perspective, Springer, 2016.
3. Introduction to Nano: basics to Nanoscience and Nanotechnology, by Sengupta, Amretashis, Sarkar, Chandan Kumar, Springer Publisher, 2015.
4. Lefrou.,Christine., Fabry., Pierre., Poignet., Jean – claude., "Electrochemistry – The Basics, with examples" Springer. 2012.

5. Zaki Ahmad, Digby Macdonald, “Principles of Corrosion Engineering and Corrosion Control”, Elsevier Science, 2nd Edition, 2012.

YOUTUBE RESOURCES:

2. **Chemical Engineering Guy:** This channel covers various topics in chemical engineering, including engineering chemistry concepts such as chemical kinetics, thermodynamics, and materials science.
3. **Learn ChemE -** Chemical Engineering: Learn Chem E offers a series of video tutorials and lectures on chemical engineering topics, including chemistry fundamentals, process design, and materials engineering.
4. **MIT Open Course Ware** - Chemistry: MIT's Open Courseware provides lectures and course materials on chemistry topics relevant to engineering, such as organic chemistry, physical chemistry, and chemical kinetics. Khan Academy - Chemistry: Khan Academy's chemistry videos cover fundamental concepts in chemistry, including atomic structure, chemical bonding, thermodynamics, kinetics, and electro-chemistry.

OPEN ELECTIVES – II

Course Code	TECHNICAL WRITING	L	T	P	C
ME47O1		3	0	0	3

COURSE OBJECTIVES:

- To understand the present complex information in a clear and easily understandable way to the target audience, which involves breaking down intricate concepts into simpler terms and providing clear explanations

UNIT I INTRODUCTION TO TECHNICAL WRITING 9

Characteristics of Technical Writing - Rhetorical awareness - Ethics - Steps in the technical writing process- Prewriting for technical documents-Understanding audience and purpose, Primary and secondary research - Surveys and interviews - Research methods

UNIT II COMPONENTS OF TECHNICAL DOCUMENTS 9

Introductions – Abstracts – Definitions – Titles and headings - Effective visual design – Summaries – Technical descriptions – conclusions

UNIT III TYPES OF TECHNICAL REPORT 9

Formal Technical Reports - Progress and research reports - Incidence reports - Feasibility reports - Evaluation reports – Analytical and informational reports - Executive summaries.

UNIT IV LANGUAGE 9

Style – Accuracy – Brevity – Clarity – Tone – Vocabulary – Formal and impersonal language – Structure of the report - Plagiarism

UNIT V WRITING PROPOSALS 9

Nature and significance –Types of proposals - Persuasive elements - Request for proposals – Structure and parts of a proposal

TOTAL: 45 HOURS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Acquire a working knowledge of writing strategies, formats and templates of professional writing.
CO2: Analyse communication-related problems of technical documents from number of genres.
CO3: Use visuals to communicate a large amount of information quickly and efficiently
CO4: Enhance writing skills to produce effective reports confidently

TEXT BOOKS:

1. Daniel G. Riordan, Steven E. Pauley, Biztantra: Technical Report Writing Today, 8th Edition (2004).
2. Rizvi M Ashraf, (2005). Effective Technical Communication. McGraw Hill Education (India) Pvt. Ltd. New Delhi.
3. Alred, G. (2011). Handbook of Technical Writing (10th ed.). New York: St Martin's. (OPTIONAL)

REFERENCES:

1. M. Frank. Writing as thinking: A guided process approach, Englewood Cliffs, Prentice Hall Reagents.
2. R. Quirk, S. Greenbaum, G. Leech and J. Svartik: A comprehensive grammar of the English language, Longman, London.
3. Daniel G. Riordan & Steven A. Panley: “Technical Report Writing Today” - Biztaantra.

Course Code	PRODUCTION AND OPERATIONS MANAGEMENT FOR	L	T	P	C
ME47O2	ENTREPRENEURS	3	0	0	3

COURSE OBJECTIVES:

The students should be made:

- To know the basic concept and function of Production and Operation Management for entrepreneurship.
- To understand the Production process and planning.
- To understand the Production and Operations Management Control for business owners

UNIT I INTRODUCTION TO PRODUCTION AND OPERATIONS MANAGEMENT 9

Functions of Production Management - Relationship between production and other functions – Production management and operations management, Characteristics of modern production and operation management, organisation of production function, recent trends in production /operations management - production as an organisational function, decision making in production Operations research

UNIT II PRODUCTION & OPERATION SYSTEMS 9

Production Systems- principles – Models - CAD and CAM- Automation in Production - Functions and significance- Capacity and Facility Planning: Importance of capacity planning- Capacity measurement – Capacity Requirement Planning (CRP) process for manufacturing and service industry

UNIT III PRODUCTION & OPERATIONS PLANNING 9

Facility Planning – Location of facilities – Location flexibility – Facility design process and techniques – Location break even analysis-Production Process Planning: Characteristic of production process systems – Steps for production process- Production Planning Control Functions – Planning phase- Action phase- Control phase - Aggregate production planning

UNIT IV PRODUCTION & OPERATIONS MANAGEMENT PROCESS 9

Process selection with PLC phases- Process simulation tools- Work Study – Significance – Methods, evolution of normal/ standard time – Job design and rating - Value Analysis - Plant Layout: meaning – characters –- Plant location techniques - Types- MRP and Layout Design - Optimisation and Theory of Constraints (TOC)– Critical Chain Project Management (CCPM)- REL (Relationship) Chart – Assembly line balancing- – Plant design optimisation -Forecasting methods.

UNIT V CONTROLLING PRODUCTION & OPERATIONS MANAGEMENT 9

Material requirement planning (MRP)- Concept- Process and control - Inventory control systems and techniques – JIT and Lean manufacturing - Network techniques - Quality Management: Preventive Vs Breakdown maintenance for Quality – Techniques for measuring quality - Control Chart (X , R , p , np and C chart) - Cost of Quality, Continuous improvement (Kaizen) - Quality awards - Supply Chain Management - Total Quality Management - 6 Sigma approach and Zero Defect Manufacturing.

45 HOURS

COURSE OUTCOMES:

- **CO1:** To understand the basics and functions of Production and Operation Management for business owners.
- **CO2:** To learn about the Production & Operation Systems.
- **CO3:** To acquaint on the Production & Operations Planning Techniques followed by entrepreneurs in Industries.
- **CO4:** To known about the Production & Operations Management Processes in organisations.
- **CO5:** To comprehend the techniques of controlling, Production and Operations in industries.

REFERENCES:

1. Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, Pearson, 2007.
2. Amitabh Raturi, Production and Inventory Management, , 2008.
3. Adam Jr. Ebert, Production and Operations Management, PHI Publication, 1992.
4. Muhlemann, Okland and Lockyer, Production and Operation Management, Macmillan India,1992.
5. Chary S.N, Production and Operations Management, TMH Publications, 2010.
6. Terry Hill ,Operation Management. Pal Grave McMillan (Case Study).2005.

Course Code	NANOMATERIALS AND APPLICATIONS	L	T	P	C
ME47O3		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications.
- Gaining knowledge on dimensionality effects on different properties of nanomaterials
- Getting acquainted with the different processing techniques employed for fabricating nanomaterials
- Having knowledge on the different characterization techniques employed to characterize the nanomaterials
- Acquiring knowledge on different applications of nanomaterials in different disciplines of engineering.

UNIT I NANOMATERIALS 9

Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials

UNIT II THERMODYNAMICS & KINETICS OF NANOSTRUCTURED MATERIALS 9

Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials.

UNIT III PROCESSING 9

Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique

UNIT IV STRUCTURAL CHARACTERISTICS 9

Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nano indentation, Grain size, phase formation, texture, stress analysis .

UNIT V APPLICATIONS 9

Applications of nanoparticles, quantum dots, nanotubes, nanowires, nanocoatings; applications in electronic, electrical and medical industries

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO1: Evaluate nanomaterials and understand the different types of nanomaterials
CO2: Explain working of basic instruments used in characterization of nanoparticles.
CO3: Discuss the application of nanotechnology to mechanical and civil domains

CO4: Classify the nanomaterials based on the dimensions.

CO5: Assess the suitability of nanomaterials for various device applications

TEXT BOOKS:

1. Bhusan, Bharat (Ed), "Springer Handbook of Nanotechnology", 2nd edition, 2007.
2. Carl C. Koch (ed.), NANOSTRUCTURED MATERIALS, Processing, Properties and Potential Applications, NOYES PUBLICATIONS, Norwich, New York, U.S.A.

REFERENCES:

1. Poole C.P, and Owens F.J., Introduction to Nanotechnology, John Wiley 2003
3. Nalwa H.S., Encyclopedia of Nanoscience and Nanotechnology, American Scientific Publishers 2004
4. Zehetbauer M.J. and Zhu Y.T., Bulk Nanostructured Materials, Wiley 2008
5. Wang Z.L., Characterization of Nanophase Materials, Wiley 2000
6. Gutkin Y., Ovid'ko I.A. and Gutkin M., Plastic Deformation in Nanocrystalline Materials, Springer 2004.

Course Code	CONCEPTS IN MOBILE ROBOTICS	L	T	P	C
ME4704		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To introduce mobile robotic technology and its types in detail.
- To learn the kinematics of wheeled and legged robot.
- To familiarize the intelligence into the mobile robots using various sensors.
- To acquaint the localization strategies and mapping technique for mobile robot.
- To aware the collaborative mobile robotics in task planning, navigation and intelligence.

UNIT I INTRODUCTION TO MOBILE ROBOTS 9

Introduction – Locomotion of the Robots – Key Issues on Locomotion – Legged Mobile Roots – Configurations and Stability – Wheeled Mobile Robots – Design Space and Mobility Issues – Unmanned Aerial and Underwater Vehicles

UNIT II KINEMATICS 9

Kinematic Models – Representation of Robot – Forward Kinematics – Wheel and Robot Constraints – Degree of Mobility and Steerability – Maneuverability – Workspace – Degrees of Freedom – Path and Trajectory Considerations – Motion Controls - Holonomic Robots

UNIT III PERCEPTION 9

Sensors for Mobile Robots – Classification and Performance Characterization – Wheel/Motor Sensors – Heading Sensors - Ground-Based Beacons - Active Ranging - Motion/Speed Sensors – Camera - Visual Appearance based Feature Extraction

UNIT IV LOCALIZATION 9

Localization Based Navigation Versus Programmed Solutions - Map Representation - Continuous Representations - Decomposition Strategies - Probabilistic Map-Based Localization - Landmark-Based Navigation - Globally Unique Localization - Positioning Beacon Systems - Route-Based Localization - Autonomous Map Building - Simultaneous Localization and Mapping (SLAM).

UNIT V PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS 9

Introduction - Competences for Navigation: Planning and Reacting - Path Planning - Obstacle Avoidance - Navigation Architectures - Control Localization - Techniques for Decomposition - Case Studies – Collaborative Robots – Swarm Robots.

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: Evaluate the appropriate mobile robots for the desired application.

CO2: Create the kinematics for given wheeled and legged robot.

CO3: Analyse the sensors for the intelligence of mobile robotics.

CO4: Create the localization strategies and mapping technique for mobile robot.

CO5: Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications

TEXT BOOKS

1. Roland Siegwart and Illah Nour bakish, "Introduction to Autonomous Mobile Robots" MIT Press, Cambridge, 2004.

REFERENCES

1. Dragomir N. Nenchev, Atsushi Konno, Teppei Tsujita, "Humanoid Robots: Modelling and Control", Butterworth-Heinemann, 2018
2. Mohanta Jagadish Chandra, "Introduction to Mobile Robots Navigation", LAP Lambert Academic Publishing, 2015.
3. Peter Corke, "Robotics, Vision and Control", Springer, 2017.
4. Ulrich Nehmzow, "Mobile Robotics: A Practical Introduction", Springer, 2003.
5. Xiao Qi Chen, Y.Q. Chen and J.G. Chase, "Mobile Robots - State of the Art in Land, Sea, Air, and Collaborative Missions", Intec Press, 2009.
6. Alonzo Kelly, Mobile Robotics: Mathematics, Models, and Methods, Cambridge University Press, 2013, ISBN: 978-1107031159.

Course Code	RENEWABLE ENERGY TECHNOLOGIES	L	T	P	C
ME4705		3	0	0	3

COURSE OBJECTIVES:

- To know the Indian and global energy scenario
- To learn the various solar energy technologies and its applications.
- To educate the various wind energy technologies.
- To explore the various bio-energy technologies.
- To study the ocean and geothermal technologies.

UNIT I ENERGY SCENARIO 9

Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status. Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans.

UNIT II SOLAR ENERGY 9

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications

UNIT III WIND ENERGY 9

Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics - Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues – Applications.

UNIT IV BIO-ENERGY 9

BIO resources – Biomass direct combustion – thermochemical conversion - biochemical conversion mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration –- Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production – Applications

UNIT V OCEAN AND GEOTHERMAL ENERGY 9

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact

TOTAL: 45 HOURS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Discuss the Indian and global energy scenario.
CO2: Describe the various solar energy technologies and its applications.
CO3: Explain the various wind energy technologies.
CO4: Explore the various bio-energy technologies.
CO5: Discuss the ocean and geothermal technologies.

TEXT BOOKS:

1. Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, McGraw Hill; First edition (10 December 2020), ISBN-10 : 9390385636
2. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10: 812034470

REFERENCES:

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.
2. Rai.G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2014.
3. Sukhatme. S.P., "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
4. Tiwari G.N., "Solar Energy – Fundamentals Design, Modelling and applications", Alpha Science Intl Ltd, 2015.
5. Twidell, J.W. & Weir A., "Renewable Energy Resources", EFNSpon Ltd., UK, 2015

Course Code	ENERGY TECHNOLOGY	L	T	P	C
ME4706		3	0	0	3

Course Objectives

- Explore diverse energy sources and conversion processes.
- Analyze energy storage systems and efficiency strategies.
- Investigate renewable energy technologies and smart grid concepts.
- Examine environmental impacts, policy frameworks, and emerging innovations.

UNIT I INTRODUCTION 9

Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources

UNIT II CONVENTIONAL ENERGY 9

Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT III NON-CONVENTIONAL ENERGY 9

Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV BIOMASS ENERGY 9

Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.

UNIT V ENERGY CONSERVATION 9

Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation

TOTAL: 45 HOURS

COURSE OUTCOMES:

On completion of this course, the student will be able to

- **CO1:** Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.
- **CO2:** Students will excel as professionals in the various fields of energy engineering
- **CO3:** Compare different renewable energy technologies and choose the most appropriate based on local conditions.
- **CO4:** Explain the technological basis for harnessing renewable energy sources.
- **CO5:** Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level.

TEXT BOOKS:

1. Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.
2 Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984.
3. Bansal, N.K., Kleeman, M. and Meliss, M., Renewable Energy Sources and Conversion Technology, Tata McGraw Hill, 1990.
4. Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.

REFERENCES:

1. Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York.
2. El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.
3. Sukhatme. S.P., Solar Enery - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981

Course Code	PLASTIC MATERIALS FOR ENGINEERS	L	T	P	C
ME47O7		3	0	0	3

COURSE OBJECTIVES:

- Understand the advantages, disadvantages and general classification of plastic materials
- To know the manufacturing, sources, and applications of engineering thermoplastics
- Understand the basics as well as the advanced applications of various plastic materials in the industry
- To understand the preparation methods of thermosetting materials
- Select suitable specialty plastics for different end applications

UNIT I INTRODUCTION TO PLASTIC MATERIALS 9

Introduction to Plastics – Brief history of plastics, advantages and disadvantages, thermoplastic and thermosetting behavior, amorphous polymers, crystalline polymers and cross-linked structures. General purpose thermoplastics/ Commodity plastics: manufacture, structure, properties and applications of polyethylene (PE), cross-linked PE, chlorinated PE, polypropylene, polyvinyl chloride-compounding, formulation, polypropylene (PP)

UNIT II ENGINEERING THERMOPLASTICS AND APPLICATIONS 9

Engineering thermoplastics – Aliphatic polyamides: structure, properties, manufacture and applications of Nylon 6, Nylon 66. Polyesters: manufacture, structure, properties and uses of PET, PBT. Manufacture, structure, properties and uses of Polycarbonates, acetal resins, polyimides, PMMA, polyphenylene oxide, thermoplastic polyurethane (PU)

UNIT III THERMOSETTING PLASTICS 9

Thermosetting Plastics – Manufacture, curing, moulding powder, laminates, properties and uses of phenol formaldehyde resins, urea formaldehyde, melamine formaldehyde, unsaturated polyester resin, epoxy resin, silicone resins, polyurethane resins.

UNIT IV MISCELLANEOUS PLASTICS FOR END APPLICATIONS 9

Miscellaneous plastics- Manufacture, properties and uses of polystyrene, HIPS, ABS, SAN, poly(tetrafluoroethylene) (PTFE), TFE and copolymers, PVDF, PVA, poly (vinyl acetate), poly (vinyl carbazole), cellulose acetate, PEEK, High energy absorbing polymers, super absorbent polymers- their synthesis, properties and applications

UNIT V PLASTICS MATERIALS FOR BIOMEDICAL APPLICATIONS 9

Sources, raw materials, methods of manufacturing, properties and applications of bio-based polymers- poly lactic acid (PLA), poly hydroxy alkanoates (PHA), PBAT, bioplastics- bio-PE, bio-PP, bio-PET, polymers for biomedical applications

TOTAL: 45 HOURS

COURSE OUTCOMES:

On completion of this course, the student will be able to

- **CO1:** To study the importance, advantages and classification of plastic materials
- **CO2:** Summarize the raw materials, sources, production, properties and applications of various engineering thermoplastics
- **CO3:** To understand the application of polyamides, polyesters and other engineering thermoplastics, thermosetting resins
- **CO4:** Know the manufacture, properties and uses of thermosetting resins based onpolyester, epoxy, silicone and PU
- **CO5:** To understand the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers

REFERENCES:

1. Marianne Gilbert (Ed.), Brydson's Plastics Materials, 8 th Edn., Elsevier (2017).
2. J.A.Brydson, Plastics Materials, 7 th Edn., Butterworth Heinemann (1999).
3. Manas Chanda, Salil K. Roy, Plastics Technology Handbook, 4 th Edn., CRC press (2006).
4. A. Brent Strong, Plastics: Materials and Processing, 3 rd Edn., Pearson Prentice Hall (2006).
5. Olagoke Olabisi, Kolapo Adewale (Eds.), Handbook of Thermoplastics 2 nd Edn., CRC press(2016).
6. Charles A. Harper, Modern Plastics Handbook, McGraw-Hill, New York, 1999.
7. H. Dominighaus, Plastics for Engineers, Hanser Publishers, Munich, 1988.

Course Code	PROPERTIES AND TESTING OF PLASTICS	L	T	P	C
ME4708		3	0	0	3

COURSE OBJECTIVES:

- To understand the relevance of standards and specifications as well as the specimen preparation for polymer testing.
- To study the mechanical properties and testing of polymer materials and their structural property relationships.
- To understand the thermal properties of polymers and their testing methods.
- To gain knowledge on the electrical and optical properties of polymers and their testing methods.
- To study about the environmental effects and prevent polymer degradation.

UNIT I INTRODUCTION TO CHARACTERIZATION AND TESTING OF POLYMERS 9

Introduction- Standard organizations: BIS, ASTM, ISO, BS, DIN etc. Standards and specifications. Importance of standards in the quality control of polymers and polymer products. Preparation of test pieces, conditioning and test atmospheres. Tests on elastomers: processability parameters of rubbers – plasticity, Mooney viscosity, scorch time, cure time, cure rate index, Processability tests carried out on thermoplastics and thermosets: MFI, cup flow index, gel time, bulk density, bulk factor.

UNIT II MECHANICAL PROPERTIES 9

Mechanical properties: Tensile, compression, flexural, shear, tear strength, hardness, impact strength, resilience, abrasion resistance, creep and stress relaxation, compression set, dynamic fatigue, ageing properties, Basic concepts of stress and strain, short term tests: Viscoelastic behavior (simple models: Kelvin model for creep and stress relaxation, Maxwell-Voigt model, strain recovery and dynamic response), Effect of structure and composition on mechanical properties, Behavior of reinforced polymers.

UNIT III THERMAL RHEOLOGICAL PROPERTIES 9

Thermal properties: Transition temperatures, specific heat, thermal conductivity, co-efficient of thermal expansion, heat deflection temperature, Vicat softening point, shrinkage, brittleness temperature, thermal stability and flammability. Product testing: Plastic films, sheeting, pipes, laminates, foams, containers, cables and tubes.

UNIT IV ELECTRICAL & OPTICAL PROPERTIES 9

Electrical properties: volume and surface resistivity, dielectric strength, dielectric constant and power factor, arc resistance, tracking resistance, dielectric behavior of polymers (dielectric co-efficient, dielectric polarization), dissipation factor and its importance. Optical properties: transparency, refractive index, haze, gloss, clarity, birefringence.

UNIT V ENVIRONMENTAL AND CHEMICAL RESISTANCE 9

Environmental stress crack resistance (ESCR), water absorption, weathering, aging, ozone resistance, permeability and adhesion. Tests for chemical resistance. Acids, alkalies, Flammability tests- oxygen index test.

TOTAL: 45 HOURS

COURSE OUTCOMES:

On completion of this course, the student will be able to

CO1: Understand the relevance of standards and specifications.
CO2: Summarize the various test methods for evaluating the mechanical properties of the polymers.
CO3: To know the thermal, electrical & optical properties of polymers.
CO4: Identify various techniques used for characterizing polymers.
CO5: Distinguish the processability tests used for thermoplastics, thermosets and elastomers.

REFERENCES:

1. F.Majewska, H.Zowall, Handbook of analysis of synthetic polymers and plastics, Ellis Horwood Limited Publisher 1977.
2. J.F.Rabek, Experimental Methods in Polymer Chemistry, John Wiley and Sons 1980.
3. R.P.Brown, Plastic test methods, 2nd Edn., Harlond, Longman Scientific, 1981.
4. A. B. Mathur, I. S. Bharadwaj, Testing and Evaluation of Plastcis, Allied Publishers Pvt. Ltd., New Delhi, 2003.
5. Vishu Shah, Handbook of Plastic Testing Technology, 3rd Edn., John Wiley & Sons 2007.
6. S. K. Nayak, S. N. Yadav, S. Mohanty, Fundamentals of Plastic Testing, Springer, 2010.

Course Code	PROFESSIONAL ETHICS IN ENGINEERING	L	T	P	C
ME47O9		3	0	0	3

COURSE OBJECTIVES:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to install moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES 9

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation –Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management

UNIT II ENGINEERING ETHICS 9

Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics –A Balanced Outlook on Law

UNIT IV SAFETY, RESPONSIBILITY AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk -Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

UNIT V GLOBAL ISSUES 9

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors –Moral Leadership –Code of Conduct – Corporate Social Responsibility

TOTAL: 45 HOURS

COURSE OUTCOMES:

Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society

TEXTBOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, NewDelhi, 2004.

REFERENCES:

1. Charles B. Fledder mann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001
5. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Mc Graw Hill education, India Pvt. Ltd., New Delhi 2013.
6. World Community Service Centre, „ Value Education‟, Vethathiri publications, Erode, 2011

APPENDIX C: MANDATORY COURSES – I

SL.NO.	COURSE CODE	COURSE TITLE
1.	MC4301	Introduction to Women and Gender Studies
2.	MC4302	Elements of Literature
3.	MC4303	Film Appreciation
4.	MC4304	Disaster Risk Reduction and Management
5.	MC4305	Design Thinking

MANDATORY COURSES – II

SL. NO.	COURSE CODE	COURSE TITLE
1.	MC4401	Environmental Science and Sustainability
2.	MC4402	Well Being with traditional practices -Yoga, Ayurveda and Siddha
3.	MC4403	History of Science and Technology in India
4.	MC4404	Political and Economic Thought for a Human Society
5.	MC4405	State, Nation Building and Politics in India
6.	MC4406	Industrial Safety

Course Code	INTRODUCTION TO WOMEN AND GENDER STUDIES	L	T	P	C
MC4301		2	0	0	0

COURSE OBJECTIVES:

1. Understand the difference between sex and gender, including masculinity and femininity, shaped by societal norms.
2. Critique patriarchal systems and hierarchies, advocating for the deconstruction of binary views and recognition of gender diversity.
3. Engage with various feminist frameworks to analyze and address gender inequality.
4. Trace the development and impact of feminist movements globally, nationally, and locally.
5. Analyze language, media, and narratives to understand and challenge gender norms and stereotypes.

UNIT I CONCEPTS 2

Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.

UNIT II FEMINIST THEORY 2

Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

UNIT III WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL 2

Rise of Feminism in Europe and America, Women's Movement in India.

UNIT IV GENDER AND LANGUAGE 2

Linguistic Forms and Gender, Gender and narratives.

UNIT V GENDER AND REPRESENTATION 2

Advertising and popular visual media, Gender and Representation in Alternative Media, Gender and social media.

TOTAL:10 PERIODS

Course Outcomes:

Upon Successful Completion of the course the students will be able to

CO1: Mastery of key gender studies concepts, including sex vs. gender, patriarchy, and power dynamics.

CO2: Ability to critically evaluate societal norms and gender roles, recognizing and deconstructing stereotypes.

CO3: Application of diverse feminist theories to address gender inequality on local, national, and global scales.

CO4: Understanding of the historical progression and impact of feminist movements on social attitudes and policies.

CO5: Development of effective communication skills to advocate for gender equality, challenging norms in language, media, and society architecture and how different ARM processors work.

Text Books & References:

To be decided by the teacher and student, on the basis of individual student so as to enable him or her to write the term paper

Course Code	ELEMENTS OF LITERATURE	L	T	P	C
MC4302		2	0	0	0

COURSE OBJECTIVES:

- To make the students aware about the finer sensibilities of human existence through an art form. The students will learn to appreciate different forms of literature as suitable modes of expressing human experience

UNIT I RELEVANCE OF LITERATURE 2

Enhances Reading, thinking, discussing and writing skills, Develops finer sensibility for better human relationship, Increases understanding of the problem of humanity without bias, Providing space to reconcile and get a cathartic effect.

UNIT II ELEMENTS OF FICTION 2

Fiction, fact and literary truth, Fictional modes and patterns, Plot character and perspective.

UNIT III ELEMENTS OF POETRY 2

Emotions and imaginations, Figurative language, Simile, metaphor, conceit, symbol, pun and irony, Personification and animation, Rhetoric and trend.

UNIT IV ELEMENTS OF DRAMA 2

Drama as representational art, Content mode and elements, Theatrical performance, Drama as narration, mediation and persuasion, Features of tragedy, comedy and satire.

UNIT V TUTORIALS 2

The students will write a term paper to show their understanding of a particular piece of literature

TOTAL:10 PERIODS

Course Outcomes:

Upon Successful Completion of the course the students will be able to

Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities

Text Books:

1. An Introduction to the Study of English Literature, W.H. Hudson, Atlantic, 2007.
2. An Introduction to Literary Studies, Mario Klarer, Routledge, 2013.

References:

1. The Experience of Poetry, Graham Mode, Open college of Arts with Open Unv Press,1991.
2. The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuff, 2114.

Course Code	FILM APPRECIATION	L	T	P	C
MC4303		2	0	0	0

COURSE OBJECTIVES:

- Understand filmmaking components, including equipment and storytelling.
- Trace film language evolution, focusing on significant milestones.
- Explore film theories (realist, auteurist, psychoanalytic, feminist).
- Analyze representative films from diverse cultural contexts.
- Examine Indian cinema's development, from early era to regional diversity..

UNIT I THE COMPONENT OF FILMS 2

The material and equipment, The story, screenplay and script, The actors, crew members, and the director, The process of film making, Structure of a film

UNIT II EVOLUTION OF FILM LANGUAGE 2

Film language, form, movement etc, Early cinema, Silent film (Particularly French), The emergence of feature films: Birth of a Nation, Talkies

UNIT III FILM THEORIES AND CRITICISM/APPRECIATION 2

Realist theory: Auteurists, Psychoanalytic, Ideological, Feminists, How to read films? Film Criticism / Appreciation

UNIT IV DEVELOPMENT OF FILMS 2

Representative Soviet films, Representative Japanese films, Representative Italian films, Representative Hollywood film and the studio system.

UNIT V INDIAN FILMS 2

The early era, The important films made by the directors, The regional films, The documentaries in India

TOTAL:10 PERIODS

Course Outcomes:

Upon Successful Completion of the course the students will be able to

CO1: Gain a comprehensive understanding of filmmaking components and techniques

CO2: Explore the historical evolution of film language and major milestones.

CO3: Develop critical analysis skills through the study of various film theories.

CO4: Broaden cultural awareness by analyzing representative films from diverse contexts.

CO5: Appreciate the development and diversity of Indian cinema

Text Books:

A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these

Course Code	DISASTER RISK REDUCTION AND MANAGEMENT	L	T	P	C
MC4304		2	0	0	0

COURSE OBJECTIVES:

- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster
- management
- To acquaint with the skills for planning and organizing disaster response

UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS 2

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, Inter relations between Disasters and Sustainable development Goals

UNIT II DISASTER RISK REDUCTION (DRR) 2

Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources

UNIT III DISASTER MANAGEMENT 2

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)

UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT 2

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management

UNIT V DISASTER MANAGEMENT: CASE STUDIES 2

Discussion on selected case studies to analyze the potential impacts and actions in the contest of disasters- Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work- Mock drill -

TOTAL:10 PERIODS

Course Outcomes:

Upon Successful Completion of the course the students will be able to

CO1: To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR)

CO2: To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction

CO3: To develop disaster response skills by adopting relevant tools and technology

CO4: Enhance awareness of institutional processes for Disaster response in the country

CO5: Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity

Text Books:

1.Taimpo (2016), Disaster Management and Preparedness, CRC Publications

2. Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications

References:

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2. Government of India, National Disaster Management Policy, 2009.

Course Code	Design Thinking	L	T	P	C
MC4305		2	0	0	0

COURSE OBJECTIVES:

The main objectives of this course are to:

- Introduce students to the fundamental concepts and principles of design thinking.
- Develop students' ability to empathize with users and identify their needs.
- Equip students with skills for problem-solving and generating innovative solutions.
- Foster collaboration and interdisciplinary teamwork among students.
- Apply design thinking methodologies to real-world engineering challenges.

COURSE DESCRIPTION

This course offers an exploration of the principles and methodologies behind design thinking, emphasizing on a human-centered approach to innovation and problem-solving. Through a blend of lectures, hands-on exercises, and interactive workshops, participants learn to empathize with users, define problems, generate creative solutions, and iterate on prototypes.

UNIT I INTRODUCTION TO DESIGN THINKING 2

Definition and principles of design thinking – Importance and applications in engineering – Case studies of successful design thinking projects

UNIT II EMPATHIZE AND DEFINE 2

Understanding user needs and motivations – Techniques for empathetic research (interviews, observations, etc.) – Defining problem statements based on user insights

UNIT III IDEATE AND PROTOTYPE 2

Techniques for generating ideas (brainstorming, mind mapping, etc.) – Prototyping methods and tools – Iterative design process and feedback loops

UNIT IV TEST AND ITERATE 2

User testing and feedback collection – Analyzing and interpreting feedback – Iterating on prototypes based on feedback

UNIT V APPLICATION AND WORKSHOP 2

Applying design thinking to engineering challenges – Workshop sessions for hands-on practice – Presentation (Posters / PPT / Demonstration) of final projects and reflection on the design process

WORKSHOP IDEAS:

1. Design Sprints: Conduct short, intensive workshops where students work collaboratively to solve a specific problem within a constrained timeframe.
2. Design Challenges: Pose open-ended design challenges to students and facilitate group work sessions where they brainstorm and prototype solutions.

3. User Persona Creation: Have students create user personas based on research findings and use them to guide the design process.
4. Prototyping Sessions: Provide materials and tools for students to create rapid prototypes of their ideas, encouraging experimentation and creativity.
5. Design Critiques: Organize sessions where students present their prototypes to peers for feedback and constructive criticism, fostering a culture of iteration and improvement.

COURSE FORMAT

Lectures and discussions, Workshops, Group discussions and presentations,

COURSE OUTCOMES:

OUTCOMES: Upon completion of the course, the students will be able to:

CO1: Understand the principles and process of design thinking.
CO2: Identify user needs through empathetic research.
CO3: Generate creative ideas and solutions through brainstorming and prototyping.
CO4: Apply design thinking methodologies to solve engineering problems effectively.
CO5: Work collaboratively in multidisciplinary teams to address complex challenges.

TEXT BOOKS:

1. Tim Brown, "Change by Design", Revised and Updated, Harper, 2019.
2. Christian Müller-Roterberg, “Handbook of Design Thinking: Tips & Tools for How to Design Thinking”, Independently Published, 2018.
3. Jeanne Liedtka, and Tim Ogilvie, “Designing for Growth: A Design Thinking Tool Kit for Managers”, Columbia University Press, 2011.

REFERENCES:

1. Don Norman, “The Design of Everyday Things”, Basic Books, 2015.
2. Hasso Plattner, Christoph Meinel, and Larry Leife (editors), “Design Thinking: Understand – Improve – Apply”, Springer-Verlag, 2013.
3. Richard Banfield, C. Todd Lombardo and Trace Wax, “Design Sprint: A Practical Guidebook for Building Great Digital Products”, O'Reilly Media, 2015.

TOTAL: 10 PERIODS

MANDATORY COURSES II

Course Code	ENVIRONMENTAL SCIENCE AND SUSTAINABILITY	L	T	P	C
MC4401		2	0	0	0

COURSE OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

UNIT I ENVIRONMENT AND BIODIVERSITY **2**

Definition, scope and importance of environment – need for public awareness. Ecosystem and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION **2**

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

UNIT III RENEWABLE SOURCES OF ENERGY **2**

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT **2**

Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILITY PRACTICES **2**

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

TOTAL : 10 PERIODS

Course Outcomes:

Upon Completion of the course the students will be able to

CO1: To recognize and understand the functions of the environment, ecosystems and biodiversity and their conservation.

CO2: To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.

CO3: To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.

CO4: To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.

CO5: To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

Text Books:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

References:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 . edition 2010
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai,2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition,2015.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

Course Code	WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA AND SIDDHA	L	T	P	C
MC4402		2	0	0	0

COURSE OBJECTIVES:

- To enjoy life happily with fun filled new style activities that help to maintain health also
- To adapt a few lifestyle changes that will prevent many health disorders
- To be cool and handbill every emotion very smoothly in every walk of life
- To learn to eat cost effective but healthy foods that are rich in essential nutrients
- To develop immunity naturally that will improve resistance against many health disorders

UNIT I HEALTH AND ITS IMPORTANCE 2

Health: Definition - Importance of maintaining health - More importance on prevention than treatment Ten types of health one has to maintain - Physical health - Mental health - Social health – Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health – Environmental health - Occupational/Professional heath.

Present health status - The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities.

Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes – Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues. Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) – Maintaining BMI-Importance and actions to be taken

UNIT II DISASTER RISK REDUCTION (DRR) 2

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.

Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water. Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions

UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 2

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy. Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.

Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory – Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (Tri-Dosha Theory) - Udal Thathukkal Prevention of illness with our traditional system of medicine

Primary Prevention - To decrease the number of new cases of a disorder or illness – Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention – To decrease the amount of disability associated with an existing disorder

UNIT IV MENTAL WELLNESS **2**

Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions. Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement. Sleep - Sleep and its importance for mental wellness - Sleep and digestion. Immunity - Types and importance - Ways to develop immunity

UNIT V YOGA 2

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.

TOTAL:10 PERIODS

Course Outcomes:

Upon Successful Completion of the course the students will be able to

CO1:Embrace enjoyable, health-promoting activities to foster happiness and well-being.
CO2: Adopt lifestyle changes aimed at preventing various health issues.
CO3: Cultivate emotional resilience to navigate life's challenges with ease.
CO4: Learn to incorporate cost-effective, nutrient-rich foods into daily dietary habits.
CO5: Enhance natural immunity to bolster resistance against a range of health disorders

Text Books:

1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California

References:

1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts
2. A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001.

Course Code	HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA	L	T	P	C
MC4403		2	0	0	0

COURSE OBJECTIVES:

- Understand key historical concepts and perspectives relevant to the study of science and technology in India.
- Explore the historiography of Indian science and technology through the works of influential historians.
- Trace the development of science and technology in ancient and medieval India, including interactions with other civilizations.
- Analyze the impact of colonialism on Indian science and technology, including responses to Western influence.
- Examine the growth of techno-scientific institutions in colonial India

UNIT I CONCEPTS AND PERSPECTIVES 2

Meaning of History Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism. Science and Technology- Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

UNIT II HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA 2

Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.

UNIT III SCIENCE AND TECHNOLOGY IN ANCIENT INDIA 2

Technology in pre-historic period Beginning of agriculture and its impact on technology Science and Technology during Vedic and Later Vedic times Science and technology from 1st century AD to C-1200.

UNIT IV SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA 2

Legacy of technology in Medieval India, Interactions with Arabs Development in medical knowledge, interaction between Unani and Ayurveda and alchemy Astronomy and Mathematics: interaction with Arabic Sciences Science and Technology on the eve of British conquest

UNIT V SCIENCE AND TECHNOLOGY IN COLONIAL INDIA 2

Science and the Empire Indian response to Western Science Growth of techno-scientific institutions

TOTAL:10 PERIODS

Course Outcomes:

Upon Successful Completion of the course the students will be able to

CO1: Understand historical concepts in the context of Indian science and technology.

CO2: Explore diverse historiography of Indian science and technology.

CO3: Trace the development of science and technology in ancient and medieval India

CO4: Analyze the impact of colonialism on Indian science and technology

CO5: Develop critical thinking skills to assess the relationship between science, technology, and society in India's history

Text Books:

1.A Social History of Indian Science" by Dhruv Raina

2. Science and Society in Early India" by D.P. Chattopadhyaya

References:

1. History of Science and Technology in India: Vol 1-5" by Debiprasad Chattopadhyaya

2. Science, Technology, Imperialism, and War" by Debiprasad Chattopadhyaya

Course Code	POLITICAL AND ECONOMIC THOUGHT FOR A HUMAN SOCIETY	L	T	P	C
MC4404		2	0	0	0

COURSE OBJECTIVES:

- This course will begin with a short overview of human needs and desires and how different political-economic systems try to fullfill them. In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions

UNIT I CAPITALISM 2

Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies imperialism. Liberal democracy

UNIT II COMMUNISM 2

Fascism and totalitarianism. World war I and II. Cold war. Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models.

UNIT III WELFARE STATE 2

Welfare state. Relation with human desires. Empowered human beings, satisfaction. (3 lectures) Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one's lives. Relationship with nature

UNIT IV ESSENTIAL ELEMENTS OF INDIAN CIVILIZATION 2

Technology as driver of society, Role of education in shaping of society. Future directions. (Refs: Nandkishore Acharya, David Dixon, Levis Mumford)

UNIT V SCIENCE AND TECHNOLOGY IN COLONIAL INDIA 2

Science and the Empire Indian response to Western Science Growth of techno-scientific institutions

TOTAL:10 PERIODS

Course Outcomes:

Upon Successful Completion of the course the students will be able to:

The students will get an understanding of how societies are shaped by philosophy, political and economic system, how they relate to fulfilling human goals & desires with some case studies of how different attempts have been made in the past and how they have fared.

Text Books:

1. Adam Smith, J.S.MILL

References:

1. A Nagaraj, M K Gandhi, JC Kumarappa

Course Code	STATE, NATION BUILDING AND POLITICS IN INDIA	L	T	P	C
MC4405		2	0	0	0

COURSE OBJECTIVES:

The objective of the course is to provide an understanding of the state, how it works through its main organs, primacy of politics and political process, the concept of sovereignty and its changing contours in a globalized world. In the light of this, an attempt will be made to acquaint the students with the main development and legacies of national movement and constitutional development in India, reasons for adopting a Parliamentary-federal system, the broad philosophy of the Constitution of India and the changing nature of Indian Political System. Challenges/ problems and issues concerning national integration and nation-building will also be discussed in the contemporary context with the aim of developing a future vision for a better India.

UNIT I CONCEPTS AND PERSPECTIVES 2

Understanding the need and role of State and politics. Development of Nation-State, sovereignty, sovereignty in a globalized world.

UNIT II ORGANS OF STATE 2

Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government unitary-federal, Presidential-Parliamentary, The idea of India.

UNIT III NATIONAL AWAKENING 2

1857 and the national awakening. 1885 Indian National Congress and development of national movement – its legacies.

UNIT IV CONSTITUTION 2

Constitution making and the Constitution of India. Goals, objective and philosophy. Need for a Federal system

UNIT V NATIONAL INTEGRATION AND NATION-BUILDING 2

Challenges of nation-building – State against democracy (Kothari) New social movements. The changing nature of Indian Political System, the future scenario.

TOTAL:10 PERIODS

Course Outcomes:

Upon Successful Completion of the course the students will be able to:

It is expected that this course will make students aware of the theoretical aspect of the state, its organs, its operationalization aspect, the background and philosophy behind the founding of the present political system, broad streams and challenges of national integration and nation-building in India. It will equip the students with the real understanding of our political system/ process in correct perspective and make them sit up and think for devising ways for better participation in the system with a view to making the governance and delivery system better for the common man who is often left unheard and unattended in our democratic setup besides generating a lot of dissatisfaction and difficulties for the system.

Text Books:

1.Sunil Khilnani, The Idea of India. Penguin India Ltd., New Delhi.

2.Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012.

References:

1.Brij Kishore Sharma, Introduction to the Indian Constitution, PHI, New Delhi, latest edition.

2.Sumantra Bose, Transforming India: Challenges to the World's Largest Democracy, Picador India, 2013.

Course Code	INDUSTRIAL SAFETY	L	T	P	C
MC4406		2	0	0	0

COURSE OBJECTIVES:

1. To Understand the Introduction and basic Terminologies safety.
2. To enable the students to learn about the Important Statutory Regulations and standards.
3. To enable students to Conduct and participate the various Safety activities in the Industry.
4. To have knowledge about Workplace Exposures and Hazards.
5. To assess the various Hazards and consequences through various Risk Assessment Techniques.

UNIT I SAFETY TERMINOLOGIES 2

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold LimitValue (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT II STANDARDS AND REGULATIONS 2

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006

UNIT III SAFETY ACTIVITIES 2

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan-Safety poster and Display- Human Error Assessment

UNIT IV WORKPLACE HEALTH AND SAFETY 2

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety- Toxic gas Release

UNIT V HAZARD IDENTIFICATION TECHNIQUES 2

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability-Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis-Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment

TOTAL:10 PERIODS

Course Outcomes:

Upon Successful Completion of the course the students will be able to

CO1:Understand the basic concept of safety.
CO2:Obtain knowledge of Statutory Regulations and standards.
CO3:Know about the safety Activities of the Working Place.
CO4:Analyze on the impact of Occupational Exposures and their Remedies
CO5:Obtain knowledge of Risk Assessment Techniques

Text Books:

1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education

References:

1. Frank Lees (2012) 'Lees' Loss Prevention in Process Industries. Butterworth-Heinemann publications, UK, 4th Edition.
2. John Ridley & John Channing (2008)Safety at Work: Routledge, 7th Edition.
3. Dan Petersen (2003) Techniques of Safety Management: A System Approach
4. Alan Waring.(1996).Safety management system: Chapman &Hall, England
5. Society of Safety Engineers, USA

APPENDIX A: PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE COURSE

VERTICAL 1	VERTICAL 2	VERTICAL 3	VERTICAL 4	VERTICAL 5	VERTICAL 6	VERTICAL 7
DESIGN	**MANUFACTURING**	**THERMAL**	**PRODUCT AND PROCESS DEVELOPMENT**	**COMPUTATIONALENGINEERING**	**ROBOTICS AND AUTOMATION**	**QUALITY ENGINEERING**
Design of Jigs, Fixtures and Press Tools	Non-traditional Manufacturing	Advanced Internal Combustion Engines	Value Engineering	Computational Solid Mechanics	Sensors and Instrumentation	Quality Control
Design Concepts in Engineering	Digital Manufacturing and IoT	Alternative Fuels	Green Supply Chain Management	Computational Fluid Dynamics and Heat transfer	Electrical Drives and Control	Total Quality Management
Modern Robotics	Lean Manufacturing	Power Plant Engineering	Materials Science and Engineering	Theory on Computation and Visualization	Embedded Systems and Programming	Principles of Management
Tool Design	Green Manufacturing Design and Practices	Gas Dynamics and Jet Propulsion	Design For X	Artificial Intelligence and Machine Learning-1	Hydraulics and Pneumatics	Entrepreneurship Development
Geometric Dimensioning & Tolerancing	Environment Sustainability and Impact Assessment	Thermal Power Engineering	Ergonomics in Design	Advanced Statistics and Data Analytics	Smart Mobility and Intelligent Vehicles	Logistics in Manufacturing, Supply Chain and Distribution
Advanced Gear Engineering and Precision Component Design	Additive Manufacturing	Pressure Vessels	New Product Development	CAD and CAE	Mechatronics and IOT	Sustainable Management
Design for Manufacturing	Precision Manufacturing	Turbo Machines	Product Life Cycle Management	Machine Learning for Intelligent Systems	Drone Technologies	Metrology & Measurements
Composite Materials and Mechanics	Casting and Welding Processes	Refrigeration and Air Conditioning	Sustainability in Design & Manufacturing	Advanced Finite Element Analysis	Automation in Manufacturing	Material Handling Equipment, Repair and Maintenance

Course Code	DESIGN OF JIGS, FIXTURES AND PRESS TOOLS	L	T	P	C
ME4V11		3	0	0	3

COURSE OBJECTIVES:

- To understand the functions and design principles of Jigs, fixtures and press tools
- To gain proficiency in the development of required views of the final design.

UNIT I LOCATING AND CLAMPING PRINCIPLES: 9

Basic elements principles of location -Locating methods and devices -Redundant Location

Principles of clamping - Mechanical actuation pneumatic and hydraulic actuation –

Standard parts Drill bushes and Jig buttons -Tolerances and materials used.

UNIT II JIGS AND FIXTURES 9

Press Working Terminologies – operations- Types of presses - press accessories Computation of press capacity- Strip layout- Material Utilization- Shearing action Clearances -Press Work Materials - Center of pressure- Design of various elements of dies Die Block Punch holder, Die set, guide plates- Stops Strippers Pilots -Selection of Standard parts -Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.

UNIT III PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES 9

Press Working Terminologies – operations- Types of presses - press accessories -Computation of press -capacity Strip layout- Material Utilization -Shearing action -Clearances Press -Work Materials - Center of pressure- Design of various elements of dies Die Block -Punch holder, Die set, guide plates Stops- Strippers- Pilots Selection of -Standard parts- Design and preparation of four standard views of simple blanking, piercing, -compound and progressive dies

UNIT IV BENDING AND DRAWING DIES 9

Difference between bending and drawing Blank development for above operations –Types of Bending dies-Press capacity-Spring back-knockouts-direct and indirect- pressure pads- Ejectors-Variables affecting Metal flow in drawing operations-draw die inserts-draw beads- ironing-Design and development of bending, forming, drawing, reverse redrawing and combination dies-Blank development for axisymmetric, rectangular and elliptic parts- Single and double action dies

UNIT V FORMING TECHNIQUES AND EVALUATION 9

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies recent trends in tool design- computer Aids for sheet metal forming Analysis basic introduction - tooling for numerically controlled machines- setup reduction for work holding Single minute exchange of dies Poka Yoke.

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO1 Summarize the different methods of Locating Jigs and Fixtures and Clamping principles

CO2 Design and develop jigs and fixtures for given component

CO3 Discuss the press working terminologies and elements of cutting dies

CO4 Distinguish between Bending and Drawing dies.

CO5 Discuss the different types of forming techniques

TEXT BOOKS:

1. Joshi, P.H. Jigs and Fixtures , Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2010.
2. Joshi P.H Press tools - Design and Construction , wheels publishing, 1996

REFERENCES:

1. ASTME Fundamentals of Tool Design Prentice Hall of India.
2. Design Data Hand Book, PSG College of Technology, Coimbatore.
3. Donaldson, Lecain and Goold Tool Design , 5th Edition, Tata McGraw Hill, 2017.
4. Hoffman Jigs and Fixture Design , Thomson Delmar Learning, Singapore, 2004.
5. Kempster, Jigs and Fixture Design , Third Edition, Hoddes and Stoughton, 1974.
6. Venkataraman. K., Design of Jigs Fixtures & Press Tools , Tata McGraw Hill, New Delhi, 2005.

Course Code	DESIGN CONCEPTS IN ENGINEERING	L	T	P	C
ME4V12		3	0	0	3

COURSE OBJECTIVES:

- Introduce students to the fundamental principles and elements of design in engineering.
- Equip students with the skills to utilize modern design tools and software effectively.
- Encourage the application of design thinking to solve complex engineering problems.
- Foster innovation and creativity through structured design projects.
- Teach the importance and methods of incorporating sustainability into engineering design.

UNIT I PRINCIPLES AND ELEMENTS OF DESIGN 9

Introduction to engineering design: Definitions, significance, and application areas- Fundamental principles of design: Aesthetics, functionality, usability- Basic elements of design: Line, shape, form, texture, color, and space-Overview of the design process: Stages from conceptualization to implementation.

UNIT II DESIGN TOOLS AND TECHNIQUES 9

Computer-Aided Design (CAD) tools: Features, benefits, and application in engineering-Simulation tools and techniques: Use in predicting performance and reducing prototyping costs-Modern prototyping techniques: 3D printing, CNC machining, and rapid prototyping..

UNIT III DESIGN THINKING AND INNOVATION 9

Ideation and creativity in design: Techniques for brainstorming and idea generation-Applying design thinking in problem-solving: Steps, tools, and methodologies-Case studies in innovative design: Examination of successful design innovations.

UNIT IV CREATIVITY AND INNOVATION IN DESIGN 9

Techniques to enhance creativity: SCAMPER, mind mapping, and other tools-Role of innovation in design: Importance of innovation for competitive advantage-Analyzing and learning from global design innovations.

UNIT V SUSTAINABLE DESIGN PRACTICES 9

Principles of sustainable design: Environmental considerations in design-.Eco-design strategies: Methods for minimizing environmental impact-Case studies in sustainable design: Successful examples of sustainable engineering solutions.

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO 1 Understand and apply the fundamental principles and elements of design in engineering projects.

CO 2 Utilize advanced tools and software for designing and prototyping.

CO 3 Implement design thinking to enhance innovation and solve complex problems.

CO 4 Foster creativity in designing processes and projects.

CO 5 Integrate sustainability into the design process to create eco-friendly and socially responsible products.

TEXT BOOKS:

1. Dym, C. L., & Little, P. (2014). Engineering Design: A Project-Based Introduction (4th ed.). John Wiley & Sons.
2. Ulrich, K. T., & Eppinger, S. D. (2016). Product Design and Development (6th ed.). McGraw-Hill Education.

REFERENCES:

1. Lockwood, T. (Date). Design Thinking: Integrating Innovation, Customer Experience, and Brand Value. Allworth Press.

2. Kelley, T. (Date). The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm. Currency.

Course Code	MODERN ROBOTICS	L	T	P	C
ME4V13		2	0	2	3

COURSE OBJECTIVES:

- To introduce definition, history of robotics and robot anatomy.
- To learn the simulation of robot kinematics
- To study the grasping and manipulation of robots.
- To study about mobile robot and manipulation.
- To study the applications of industrial, service, domestic robots

UNIT I INTRODUCTION **6**

Robot: Definition, History of Robotics, Robot Anatomy, Co-ordinate systems, types and classification, Configuration space and degrees of freedom of rigid bodies and robots, Configuration space topology and representation; configuration and velocity constraints; task space and workspace, Rigid-body motions, rotation matrices, angular velocities, and exponential coordinates of rotation, Homogeneous transformation matrices.

UNIT II SIMULATION OF ROBOT KINEMATICS **6**

Robot kinematics, Forward and inverse kinematics (two three four degrees of freedom), Forward and inverse kinematics of velocity, Homogeneous transformation matrices, translation and rotation matrices Dennavit and Hartenberg (D-H) transformation, Dynamics of Open Chains, Trajectory Generation, motion planning, robot control: First- and second-order linear error dynamics, stability of a feedback control system

UNIT III GRASPING AND MANIPULATION OF ROBOTS **6**

Kinematics of contact, contact types (rolling, sliding, and breaking), graphical methods for representing kinematic constraints in the plane, and form-closure grasping, Coulomb friction, friction cones, graphical methods for representing forces and torques in the plane, End effectors, grippers, types of gripper, gripper force analysis, and examples of manipulation and grasping.

UNIT IV MOBILE ROBOTS **6**

Mobile robot, Wheeled Mobile Robots: Kinematic models of omni-directional and non-holonomic wheeled mobile robots, Controllability, motion planning, feedback control of non-holonomic wheeled mobile robots; odometry for wheeled mobile robots; and mobile manipulation. Reference Trajectory generation, feed forward control.

UNIT VAPPLICATIONS OF ROBOTS **6**

Application of robotic: industrial robots, Service robots, domestic and house hold robots, Medical robots, military robots, agricultural robots, space robots, Aerial robotics Role of robots in inspection, assembly, material handling, underwater, space and healthcare

TOTAL: 30 HOURS

MODERN ROBOTICS LABORATORY

Experiments

1. 30 modelling and motion simulation of rotational joint assembly
2. 30 modelling and motion simulation of prismatic joint assembly
3. 30 modelling and motion simulation of Cartesian robot
4. 30 modelling and motion simulation of articulated robot
5. 30 modelling and motion simulation of spherical robot
6. 30 modelling and motion simulation of cylindrical robot

COURSE OUTCOMES:

At the end of the course the students would be able to

1. Discuss the definition, history of robotics and robot anatomy.
2. Develop the simulation of robot kinematics
3. Describe the grasping and manipulation of robots.
4. Explain about mobile robot and manipulation.
5. Discuss the applications of industrial, service, domestic robots.

TEXT BOOKS:

1. Modern Robotics: Mechanics, Planning, and Control, by Kevin M. Lynch , Frank C. Park , Cambridge University Press; 1st edition (25 May 2017), ISBN-10 : 110715
2. Modern Robotics: Mechanics, Systems and Control, by Julian Evans, Larsen and Keller Education (27 June 2019), ISBN-10 : 1641720751

REFERENCES:

1. Modern Robotics: Designs, Systems and Control, by Jared Kroft, Willford Press (18 June 2019) ISBN-10 : 1682856763
2. Advanced Technologies in Modern Robotic Applications, by Chenguang Yang , Hongbin Ma , Mengyin Fu, Springer; Softcover reprint of the original 1st ed. 2016 edition (30 May 2018), ISBN 10 : 981109263X
3. Modern Robotics: Building Versatile Machines, by Harry Henderson, Facts On File Inc; Illustrated edition (1 August 2006), ISBN-10 : 0816057451
4. Artificial Intelligence for Robotics, by Francis X. Govers, Packt Publishing Limited; Standard Edition (30 August 2018), ISBN-10 : 1788835441
5. Modern Robotics Hardcover by Lauren Barrett (Editor), Murphy & Moore Publishing (1 March 2022), ISBN-10 : 1639873732

Course Code	TOOL DESIGN	L	T	P	C
ME4V14		3	0	0	3

COURSE OBJECTIVES:

- Selecting the different machine tool mechanisms.
- Designing the Multi speed Gear Box and feed drives.
- Designing the machine tool structures.
- Designing the guide ways and power screws.
- Designing the spindles and bearing

UNIT I INTRODUCTION TO MACHINE TOOL DESIGN **9**

Introduction to Machine Tool Drives and Mechanisms, Auxiliary Motions in Machine Tools, Kinematics of Machine Tools, Motion Transmission

UNIT II REGULATION OF SPEEDS AND FEEDS **9**

Aim of Speed and Feed Regulation, Stepped Regulation of Speeds, Multiple Speed Motors, Ray Diagrams and Design Considerations, Design of Speed Gear Boxes, Feed Drives, Feed Box Design.

UNIT III DESIGN OF MACHINE TOOL STRUCTURES **9**

Functions of Machine Tool Structures and their Requirements, Design for Strength, Design for Rigidity, Materials for Machine Tool Structures, Machine Tool Constructional Features, Beds and Housings, Columns and Tables, Saddles and Carriage.

UNIT IV DESIGN OF GUIDEWAYS AND POWER SCREWS **9**

Functions and Types of Guide ways, Design of Guide ways, Design of Aerostatic Slide ways, Design of Anti-Friction Guide ways, Combination Guide ways, Design of Power Screws.

UNIT V DESIGN OF SPINDLES AND SPINDLE SUPPORT **9**

Functions of Spindles and Requirements, Effect of Machine Tool Compliance on Machining Accuracy, Design of Spindles, Antifriction Bearings. Dynamics of Machine Tools: Machine Tool Elastic System, Static and Dynamic Stiffness

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO1: Select the different machine tool mechanisms.

CO2: Design the Multi speed Gear Box and feed drives.

CO3: Design the machine tool structures.

CO4: Design the guide ways and power screws.

CO5: Design the spindles and bearings

TEXT BOOKS:

1. James G. Bralla, “Design for Manufacturability Handbook”, McGraw Hill Professional, 1998.
2. O. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 1998.

REFERENCES:

1. N.K. Mehta, Machine Tool Design and Numerical Control, TMH, New Delhi, 3rd edition 2012
2. G.C. Sen and A. Bhattacharya, Principles of Machine Tools, New Central Book Agency, 2015
3. K Pal, S. K. Basu, “Design of Machine Tools”, 6th Edition. Oxford IBH, 2014
4. N. S. Acherkhan, “Machine Tool Design”, Volume 2 University Press of the Pacific, 2000
5. F. Koenigsberger, Design Principles of Metal-Cutting Machine Tools, Pergamon Press, 1964
6. F. Koenigsberger, Machine Tool Structures, Pergamon Press,1970.

Course Code	GEOMETRIC DIMENSIONING & TOLERANCING	L	T	P	C
ME4V15		3	0	0	3

COURSE OBJECTIVES:

- To make the students to understand the concepts of Environmental Sustainability & Impact Assessment
- To familiarize the students in environmental decision-making procedure.
- Make the students to identify, predict and evaluate the economic, environmental, and social impact of development activities.
- To provide information on the environmental consequences for decision making
- To promote environmentally sound and sustainable development through the identification of appropriate alternatives and mitigation measures

UNIT I ENVIRONMENTAL IMPACT ASSESMENT **9**

Environmental impact assessment objectives – rationale and historical development of EIA - Conceptual frameworks for EIA Legislative development – European community directive – Hungarian directive

UNIT II ENVIRONMENTAL DECISION MAKING **9**

Strategic environmental assessment and sustainability appraisal – Mitigation, monitoring and management of environmental impacts- Socio economic impact assessment

UNIT III ENVIRONMENTAL POLICY, PLANNING AND LEGISLATION **9**

Regional spatial planning and policy – Cumulative effects assessment – Planning for climate change, uncertainty and risk

UNIT IV LIFE CYCLE ASSESSMENT **9**

Life cycle assessment; Triple bottom line approach; Industrial Ecology. Ecological foot printing, Design for Environment, Future role of LCA, Product stewardship, design, durability and justifiability, measurement techniques and reporting

UNIT V SUSTAINABLE URBAN ECONOMIC DEVELOPMENT **9**

Spatial economics – Knowledge economy and urban regions

TOTAL: 45 HOURS

OUTCOMES: On successful completion of this course, the student will be able to

CO1: Explain the concepts of Environment Sustainability and trained to make decision related to Environment.

CO2: Make decision that has an effect on our environment

CO3: Evaluate the basics of environmental policy, planning and various legislation Get

valuable information for exploring decisions in each life stage of materials, buildings, services and infrastructure

CO4: Explain the Life cycle assessment of Environmental sustainability

CO5: Explain sustainable urban economic development.

TEXT BOOKS:

1. The Application of Science in Environmental Impact Assessment, by Aaron J. MacKinnon, Peter N. Duinker , Tony R. Walker , Routledge; 1st edition (14 May 2019), ISBN-10 : 0367340194
2. Routledge Handbook of Environmental Impact Assessment, by Kevin Hanna, Routledge; 1st edition (11 April 2022), ISBN-10 : 0367244470

REFERENCES:

1. Clive George, C. Collin, H. Kirkpolarice – Impact Assessment and sustainable development Edward Elgar Publishing, 2007.
2. Robort B Gibsan, Sustainability Assessment, Earth Scan publishers, 2005
3. Simon Dresner, The principle of sustainability – Earth Scan publishers, 2008
4. Canter, R.L., "Environmental Impact Assessment", McGraw Hill Inc., New Delhi, 1996.
5. Shukla, S.K. And Srivastava, P.R., "Concepts In Environmental Impact Analysis", Common Wealth Publishers, New Delhi, 1992.
6. John G. Rau And David C Hooten "Environmental Impact Analysis Handbook", McGraw Hill Book Company, 1990.

Course Code	ADVANCED GEAR ENGINEERING AND PRECISION COMPONENT DESIGN	L	T	P	C
ME4V16		2	0	2	3

Course Objective:

- This course aims to provide students with a comprehensive understanding of advanced gear engineering and the design of related precision components.
- Students will learn fundamental principles, advanced dynamics, and precision techniques essential for designing efficient and reliable gear systems.
- The course will cover topics such as gear geometry, manufacturing processes, lubrication, reliability analysis, and performance evaluation.
- By the end of the course, students will be equipped with the knowledge and skills necessary to design and analyze precision gear systems to meet diverse industrial requirements.

COURSE OUTCOMES:

CO 1: Understand fundamental gear principles, including geometry, manufacturing, and dynamics.

CO2: Apply advanced techniques for gear design, lubrication, and reliability analysis.

CO3: Select appropriate components such as seals, bolts, and cutting tools for precision systems.

CO4: Analyze machine duty, load spectrum, and NVH characteristics in gear systems.

CO5: Utilize quality methods for design optimization and performance evaluation.

CO6: Interpret and apply relevant industry standards for gear design and component selection.

UNIT 1: FUNDAMENTALS AND STANDARDS **6**

Introduction to Gears, Gear Nomenclature and Geometry, Gear Ratios and Gear Trains, Gear Manufacturing Processes, Basic Formulas and Equations, Standards and Specifications, Introduction to major gear standards: (ISO, AGMA, DIN), AGMA Load Capacity Equations, Design Considerations.

UNIT 2: ADVANCED GEAR DYNAMICS **6**

Geometry of involute Gears, load carrying capacity of involute gears - Surface Durability & Bending Strength, Profile, Lead modifications in gears, Lubrication and additives- Gearbox lubrication, Machinery lubrication, Amount of lubrication requirement, Bearings- Types, Uses of each type, Misalignment, Preloading, System level stiffness.

UNIT 3: ENGINEERING PRECISION **6**

Reliability calculation and probabilistic approach for damage, Design of Transmission systems, Sealing technology O-rings, Oil seals - Design Criteria, Selection, Materials, failures, Selection of Bolt and Calculation of Bolt strength, Gear cutting tools.

UNIT 4: PRECISION COMPONENTS AND PERFORMANCE METRICS **6**

Spline, Keyways - types, standards available, calculation, Circlips - Types, Selection, Calculation, Machine duty, Load Spectrum of Industrial machines or gearboxes, QFD, DFMEA, Power rating, Efficiency, IP Protection of Electric motors.

UNIT 5: ENGINEERING EXCELLENCE **6**

NVH (Noise, Vibration and Harshness), Testing standards ASTM D5182, ASTM D4998, ASTM D5182 etc., DIN743-Shaft torsional strength calculation, ISO 281 - Bearing Life Calculation, DIN 3960 - Gear Geometry Parameters, ISO 6336 - Gear strength calculation, VDI 2230 - Bolt Strength calculation, Palmgren-Miner rules, Wohler Curves, Gear tribology

(TOTAL: 30 HOURS)

LIST OF EXPERIMENTS

1. KISSsoft

   KISSsoft general settings and buttons, Gear, shaft, and bearing modules, Navigation of the software, Gear, shaft and bearing design and optimization techniques

2. SIMCENTER 3D

   Gear contact geometry, Gear contact force- Standard gear contact force – Analytical gear contact forces – Advanced gear contact forces – Damping gear contact forces – Friction gear contact forces - Total gear force evaluation.

3. AMESIM

   Thermodynamics: Steel ball in water bath, Mechanics and vibrations: Free response of a system with one Degree of Freedom, Mechanics and vibrations: Response of a system with one Degree of Freedom (DoF) excited by a sinusoidal force, Hydraulics: Pressure transducer

   Mechanics: Vertical throw, Performing a batch run with Simcenter Amesim, Using the experiment view in Simcenter Amesim, Creating a super component of P.I.D. controller with Simcenter Amesim

4. Friction Testing machine (Brake, Clutch and fluid evaluations).
3. Hydraulic Pulsator for gear tooth bending test.
4. Mechanical Resonance Pulsator.
5. FZG Drag Torque Test Rig.
6. Rolling Element Bearings Power Loss Test Rig.

PRACTICAL EXERCISES (TOTAL: 30 HOURS)

TOTAL (30+30): 60 HOURS

TEXTBOOKS:

1. "Gear Design Simplified" by Franklin D. Jones, Henry H. Ryffel, and Edgar J. McEvoy, Industrial Press Inc., 1984. ISBN 0831111593, 9780831111595.
2. "Handbook of Gear Design" by Gitin M. Maitra. Mc. Graw Hill, New Delhi. 1994.
3. "Gear Materials, Properties, and Manufacture" by J.R. Davis. ASM International, ISBN: 978-1-62708-345-4. 2005

4. Radzevich, S.P. (Ed.). (2021). Dudley's Handbook of Practical Gear Design and Manufacture (4th ed.). CRC Press. https://doi.org/10.1201/9781003126881

REFERENCES

1. "Lubrication Fundamentals" by J. George Wills. CRC Press. (2001)ISBN-10: 0824705220, ISBN-13: 978-0824705223

2. "Reliability Engineering" by Kailash C. Kapur and Michael Pecht. Publisher: Wiley-IEEE Press, (2011). ISBN-10: 0470638829

3. "Seals and Sealing Handbook" by Robert K. Flitney. Elsevier Science. 2013. ISBN-13: 978-0080982625

4. "Bearing Design in Machinery: Engineering Tribology and Lubrication" by Avraham Harnoy. CRC Press. 2002, ISBN-13: 978-0824707036

5. "Machine Design" by Robert L. Norton. Pearson Publication (2010) ISBN-13: 978-0136123705

6. "Electric Machinery and Transformers" by Bhag S. Guru and Huseyin R. Hiziroglu. Publisher: Oxford University Press. 2000, ISBN-13: 978-0195138900

7. "Noise, Vibration, and Harshness (NVH) Testing and Measurement Techniques" by Geoffrey N. Finlay. Publisher: Wiley. 2013. ISBN-13: 978-1119963539

8. Relevant standards and technical papers from organizations such as ASTM, ISO, AGMA, and DIN.

Course Code	DESIGN FOR MANUFACTURING	L	T	P	C
ME4V17		3	0	0	3

COURSE OBJECTIVES:

- To introduce economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.
- To learn design consideration principles of forming in the design of extruded, stamped, and forged products.
- To learn design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.
- To learn design consideration principles of welding in the design of welded products.
- To learn design consideration principles of assembly in the design of assembled products

UNIT I INTRODUCTION AND CASTING **9**

Introduction - Economics of process selection - General design principles for manufacturability; Design considerations for: Sand cast – Die cast – Permanent mold cast parts.

UNIT II FORMING **9**

Design considerations for: Metal extruded parts – Impact/Cold extruded parts – Stamped parts –Forged parts

UNIT III MACHINING9

Design considerations for: Turned parts – Drilled parts – Milled, planed, shaped and slotted parts– Ground parts

UNIT IV WELDING **9**

Arc welding – Design considerations for: Cost reduction – Minimizing distortion – Weld strength – Weldment & heat treatment. Resistance welding – Design considerations for: Spot – Seam – Projection – Flash & Upset weldment

UNIT V ASSEMBLY **9**

Design for assembly – General assembly recommendations – Minimizing the no. of parts – Design considerations for: Rivets – Screw fasteners – Gasket & Seals – Press fits – Snap fits – Automatic assembly.

TOTAL: 45 HOURS

OUTCOMES: On successful completion of this course, the student will be able to

Discuss the economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.

CO 1 Explain design consideration principles of forming in the design of extruded, stamped, and forged products.

CO 2 Explain design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.

CO 3 Explain design consideration principles of welding in the design of welded products.

CO 4 Explain design consideration principles of assembly in the design of assembled products.

TEXT BOOKS:

1. James G. Bralla, "Handbook of Product Design for Manufacture", McGraw Hill, 1986.
2. O. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 1998

REFERENCES:

1. Corrado Poli, Design for Manufacturing: A Structured Approach, Elsevier, 2001.
2. David M. Anderson, Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production, CIM Press, 2004.
3. Erik Tempel man, Hugh Shercliff, Bruno Ninaber van Eyben, Manufacturing and Design: Understanding the Principles of How Things Are Made, Elsevier, 2014.
4. Henry Peck, "Designing for Manufacture", Sir Isaac Pitman & Sons Ltd., 1973.
5. Matousek, "Engineering Design", Blackie & Sons, 1956.

Course Code	COMPOSITE MATERIALS AND MECHANICS	L	T	P	C
ME4V18		3	0	0	3

COURSE OBJECTIVES:

The objective of this course is to enable the student:

1. To study the fundamentals of composite material strength and its mechanical behaviour
2. To study the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.
3. To study Thermo-mechanical behaviour and study of residual stresses in Laminates during processing.
4. To Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips.
5. To study the fundamentals of composite material strength and its mechanical

UNIT I INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS & MANUFACTURING 9

Definition -Need - General Characteristics, Applications. Fibers - Glass, Carbon, Ceramic and Aramid fibers. Matrices - Polymer, Graphite, Ceramic and Metal Matrices - Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions - Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina - Isotropic limit case, Orthotropic Stiffness matrix (Qij), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina -Transformation Matrix, Transformed Stiffness. Manufacturing: Bag Moulding Compression Moulding - Pultrusion - Filament Winding Other Manufacturing Processes

UNIT II FLAT PLATE LAMINATE CONSTITUTE EQUATIONS 9

Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations - Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

UNIT III LAMINA STRENGTH ANALYSIS 9

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure

UNIT IV THERMAL ANALYSIS 9

Assumption of Constant C.T. E's. Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T. E's. C.T. E's for special Laminate Configurations -Unidirectional, Off- axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates

UNIT V ANALYSIS OF LAMINATED FLAT PLATES **9**

Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations - Natural Frequencies

TOTAL: **45 HOURS**

COURSE OUTCOMES:

OUTCOMES: At the end of the course the students would be able to

1. Summarize the various types of Fibers, Equations and manufacturing methods for
2. Derive Flat plate Laminate equations
3. Analyze Lamina strength
4. Analyze the thermal behavior of Composite laminates
5. Analyze Laminate flat plates

TEXT BOOKS:

1. Gibson, R.F., "Principles of Composite Material Mechanics", Second Edition, McGraw-Hill, CRC press in progress, 1994, -.
2. Hyer, M.W., "Stress Analysis of Fiber- Reinforced Composite Materials", McGraw Hill, 1998

REFERENCES:

1. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990.
2. Halpin, J.C., "Primer on Composite Materials, Analysis", Technomic Publishing Co., 1984.
3. Issac M. Daniel and Ori lshai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition - 2007
4. Mallick, P.K., Fiber," Reinforced Composites: Materials, Manufacturing and Design", Maneel Dekker Inc, 1993.
5. Mallick, P.K. and Newman, S., (edition), "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 1990.

Course Code	NON-TRADITIONAL MANUFACTURING	L	T	P	C
ME4V21		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student:

- To classify non-traditional machining processes and describe mechanical energy
- based non- traditional machining processes.
- To differentiate chemical and electro chemical energy-based processes.
- To describe thermo-electric energy-based processes
- To explain nano finishing processes.
- To introduce hybrid non-traditional machining processes and differentiate hybrid non-traditional machining processes

UNIT I INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES 9

Introduction - Need for non-traditional machining processes - Classification of non-traditional machining processes - Applications, advantages and limitations of non-traditional machining processes - Abrasive jet machining, Abrasive water jet machining, Ultrasonic machining their principles, equipment, effect of process parameters, applications, advantages and limitations.

UNIT II CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED PROCESSES 9

Principles, equipments, effect of process parameters, applications, advantages and limitations of Chemical machining, Electro-chemical machining, Electro-chemical honing, Electro-chemical grinding, Electro chemical deburring.

UNIT III THERMO-ELECTRIC ENERGY BASED PROCESSES 9

Principles, equipments, effect of process parameters, applications, advantages and limitations of Electric discharge machining, Wire electric discharge machining, Laser beam machining, Plasma arc machining, Electron beam machining, Ion beam machining.

UNIT IV NANO FINISHING PROCESSES 9

Odometric position estimation, belief representation, probabilistic mapping, Markov localization, Bayesian localization, Kalman localization, positioning beacon systems

UNIT V HYBRID NON-TRADITIONAL MACHINING PROCESSES 9

Introduction - Various hybrid non-traditional machining processes, their working principles, equipments, effect of process parameters, applications, advantages and limitations. Selection and comparison of different non traditional machining processes

TOTAL: 45 HOURS

COURSE OUTCOMES: Upon successful completion of the course, students will be able to

1. Formulate different types of non-traditional machining processes and evaluate mechanical energy based non-traditional machining processes.
2. Illustrate chemical and electro chemical energy based processes.
3. Evaluate thermo-electric energy-based processes.
4. Interpret nano finishing processes.
5. Analyze hybrid non-traditional machining processes and differentiate non- traditional machining processes.

TEXT BOOKS

1. Adithan. M., "Unconventional Machining Processes", Atlantic, New Delhi, India, 2009. ISBN 13: 9788126910458
2. Anand Pandey, "Modern Machining Processes", Ane Books Pvt. Ltd., New Delhi, India, 2019.

REFERENCES

1. Benedict, G.F., "Non-traditional Manufacturing Processes", Marcel Dekker Inc., New York 1987. ISBN-13: 978-0824773526.
2. Carl Sommer, "Non-Traditional Machining Handbook", Advance Publishing., United States, 2000, ISBN-13: 978-1575373256.
3. Golam Kibria, Bhattacharyya B. and Paulo Davim J., "Non-traditional Micromachining Processes:
4. Fundamentals and Applications", Springer International Publishing., Switzerland, 2017, ISBN:978-3-319-52008-7.
5. Jagadeesha T., "Non-Traditional Machining Processes", I.K. International Publishing House Pvt. Ltd., New Delhi, India, 2017, ISBN-13: 978-9385909122.
6. Kapil Gupta, Neelesh K. Jain and Laubscher R.F., "Hybrid Machining Processes: Perspectives on Machining and Finishing", 1st edition, Springer International Publishing., Switzerland, 2016, ISBN-13: 978-3319259208.

Course Code	DIGITAL MANUFACTURING AND IoT	L	T	P	C
ME4V22		3	0	0	3

COURSE OBJECTIVES:

- To study the various aspects of digital manufacturing.
- To inculcate the importance of OM in Product Lifecycle Management and Supply chain Management.
- To formulate of smart manufacturing systems in the digital work environment.
- To interpret IoT to support the digital manufacturing.

UNIT I INTRODUCTION **6**

Introduction - Need - Overview of Digital Manufacturing and the Past - Aspects of Digital Manufacturing: Product life cycle, Smart factory, and value chain management - Practical Benefits of Digital Manufacturing - The Future of Digital Manufacturing

UNIT II DIGITAL LIFE CYCLE & SUPPLY CHAIN MANAGEMENT **6**

Collaborative Product Development, Mapping Requirements to specifications - Part Numbering, Engineering Vaulting, and Product reuse - Engineering Change Management, Bill of Material and Process Consistency - Digital Mock up and Prototype development - Virtual testing and collateral. Overview of Digital Supply Chain - Scope& Challenges in Digital SC - Effective Digital Transformation - Future Practices in SCM.

UNIT III SMART FACTORY **6**

Smart Factory - Levels of Smart Factories - Benefits - Technologies used in Smart Factory Smart Factory in IoT- Key Principles of a Smart Factory - Creating a Smart Factory - Smart Factories and Cyber security

UNIT IV INDUSTRY 4.0 **6**

Introduction - Industry 4.0 -Internet of Things - Industrial Internet of Things - Framework: Connectivity devices and services - Intelligent networks of manufacturing - Cloud computing - Data analytics -Cyber physical systems -Machine to Machine communication - Case Studies.

UNIT V STUDY OF DIGITAL TWIN **6**

Basic Concepts - Features and Implementation - Digital Twin: Digital Thread and Digital Shadow- Building Blocks - Types - Characteristics of a Good Digital Twin Platform - Benefits, Impact & Challenges - Future of Digital Twins.

TOTAL: 30 HOURS

DIGITAL MANUFACTURING AND loT LABORATORY

Experiments

1. Measure the Distance Using Ultrasonic Sensor and Make Led Blink Using Arduino

2. Detect the Vibration of an Object Using Arduino

3. Sense a Finger When it is Placed on Board Using Arduino

4. Temperature Notification Using Arduino

5. Switch Light On and Off Based on the Input of User Using Raspberry Pi

6. Connect with the Available Wi-Fi Using Arduino

TOTAL: 30 HOURS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1. Impart knowledge to use various elements in the digital manufacturing.

CO2. Differentiate the concepts involved in digital product development life cycle process and supply chain management in digital environment.

CO3. Select the proper procedure of validating practical work through digital validation in Factories.

CO4. Implementation the concepts of loT and its role in digital manufacturing

CO5. Analyze and optimize various practical manufacturing process through digital twin

TEXT BOOKS

1. Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited, 2012.

2. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", A press, 2016.

REFERENCES

1. Lihui Wang and Andrew YehChing Nee, Collaborative Design and Planning for Digital Manufacturing, Springer-Verlag London Limited, 2009.
2. Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, "Digital Twin Driven Smart Manufacturing", Elsevier Science., United States, 2019.
3. Alp Ustundag and Emre Cevikcan, "Industry 4.0: Managing The Digital Transformation", Springer Series in Advanced Manufacturing., Switzerland, 2017
4. Ronald R. Yager and Jordan Pascual Espada, "New Advances in the Internet of Things",Springer., Switzerland, 2018.

Course Code	LEAN MANUFACTURING	L	T	P	C
ME4V23		3	0	0	3

COURSE OBJECTIVES:

- To introduce the basics of 6 SIGMA
- To learning about the lean manufacturing tools.
- To study about the deeper understanding methodologies of Lean manufacturing.
- To study the lean concepts and its elements.

UNIT I BASICS OF 6 SIGMA **9**

Introduction to 6 Sigma, basic tools of six sigma like problem solving approach, standard deviation, normal distribution, various sigma levels with some examples, value for the enterprise, Variation, and sources of variation, Mean and moving the mean, Various quality costs, cost of poor quality.

UNIT II INTRODUCTION TO LEAN MANUFACTURING TOOLS **9**

Process Capability Indices, Cause and Effect diagram, Control Charts, Introduction to FMEA, APQP, PPAP. 3 foundational 6 Sigma methodologies: DMAIC, DMEDI, and Process Management DMEDI for process creation, DMAIC for process improvement and POCA for sustaining improvements

UNIT III DEEPER UNDERSTADING METHODOLOGIES **9**

What is a process, Why Process management, Keys to process management, Difference between process management and 6 Sigma, Introduction to Deming cycle, POCA, DMAIC and continuous improvement, DMEDI for creation process, DMAIC Vs DMEDI with examples, Introduction to Toyota Production System, Six Sigma and Production System integration

UNIT IV LEAN ELEMENTS **9**

Introduction to Lean Concepts like In-Built Quality, Concept of Right Part at the Right Time, Lead Time reduction, Optimum utilization of Capital, Optimum utilization of People. Understanding the Zero-defect concept and Metrics, Focus on Human Resources, Quality, Delivery, Cost. Building Zero defect capabilities, Cultural and Organizational aspects

UNIT V IMPLEMENTATION AND CHALLENGES **9**

Implementing Checks and Balances in the process, Robust Information Systems, Dashboard, follow up and robust corrective and preventive mechanism. Concept of Audits, and continuous improvement from gap analysis, risk assessments etc.

TOTAL: 45 HOURS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Discuss the basics of 6 SIGMA

CO2: Elaborate the lean manufacturing tools.

CO3: Illustrate about the deeper understanding methodologies of Lean manufacturing.

CO4: Discuss lean concepts and its elements.

CO5: Describe the implementation and challenges of lean manufacturing

TEXT BOOKS

1. Quality Planning and Analysis- JM Juran & amp; FM Gryna. Tata Mc Graw Hill
2. Lean Manufacturing: Principles to Practice by Akhilesh N. Singh, Bibliophile South Asia The Toyota Way: 14 Management Principles

3 Gemba Kaizen: A Commonsense Approach to a Continuous Improvement Strategy, Masaki Imai.

REFERENCES

1. Quality Council of India https://qcin.org/ & its library. https://qcin.org/nbqp/knowledge bank/
2. International Society of Six Sigma Professionals: https://isssp.org/about-us/
3. NPTEL / SWAYAM: https://nptel.ac.in/courses/110105123: Six Sigma, Prof. Jitesh J Thakkar, IIT
4. Kharagpur, Certification course. (Self- Learning). Older/ Previous editions of AIAG manuals on APQP, FMEA and PPAP. These are great sources of information on Quality Planning and has basics of Project Management and required skills.
5. Quality Management for Organizations Using Lean Six Sigma Techniques- Erick C Jones

Course Code	GREEN MANUFACTURING DESIGN AND PRACTICES	L	T	P	C
ME4V24		3	0	0	3

COURSE OBJECTIVES

1. To introduce the concept of environmental design and industrial ecology.
2. To impart knowledge about air pollution and its effects on the environment.
3. To enlighten the students with knowledge about noise and its effects on the environment.
4. To enlighten the students with knowledge about water pollution and its effects on the environment.
5. To introduce the concept of green co-rating and its need

UNIT I DESIGN FOR ENVIRONMENT AND LIFE CYCLE ASSESSMENT 9

Environmental effects of design -selection of natural friendly material - Eco design - Environmental damage Material flow and cycles - Material recycling - Emission less manufacturing- Industrial Ecology- Pollution prevention - Reduction of toxic emission - design for recycle.

UNIT II AIR POLLUTION SAMPLING AND MEASUREMENT 9

Primary and Secondary Pollutants, Automobile Pollutants, Industrial Pollution, Ambient air quality Standards, Metrological aspects of air Pollution, Temperature lapse Rates and Stability-wind velocity and turbulence-Pump behavior dispersion of air Pollutants-solution to the atmosphere dispersion equation- the Gaussian Plume Model, Air pollution sampling-collection of gaseous air pollutants-collection of particulate pollutants-stock sampling, analysis of air pollutants-sulfur dioxide-nitrogen dixide, carbon monoxide, oxidants and ozone

UNIT III NOISE POLLUTION AND CONTROL 9

Frequency and Sound Levels, Units of Noise based power radio, contours of Loudness. Effect of human, Environment and properties, Natural and Anthrogenic Noise Sources, Measuring Instruments for frequency and Noise levels, Masking of sound, Types, Kinetics, Selection of different reactors used for waste treatment, Treatment of noise at source, Path and Reception, Sources of noise, Effects of noise- Occupational Health hazards, thermal Comforts, Heat Island Effects, Radiation Effects

UNIT IV WATER DEMAND AND WATER QUALITY 9

Factors affecting consumption, Variation, Contaminants in water, Nitrates, Fluorides, Detergents, taste and odour, Radio activity in water, Criteria, for different impurities in water for portable and non-portable use, Point and non-point Source of pollution, Major pollutants of Water, Water Quality Requirement for different uses, Global water crisis issues.

UNIT V GREEN CO-RATING 9

Ecological Footprint - Need For Green Co-Rating - Green Co-Rating System - Intent- System Approach- Weightage- Assessment Process - Types Of Rating - Green Co-Benefits - Case Studies Of Green Co- Rating

TOTAL: 45 HOURS

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1: Explain the environmental design and selection of eco-friendly materials.

CO2: Analyse manufacturing processes towards minimization or prevention of air pollution.

CO3: Analyse manufacturing processes towards minimization or prevention of noise pollution.

CO4: Analyse manufacturing processes towards minimization or prevention of water pollution.

CO5: Evaluate green co-rating and its benefits.

TEXT BOOKS

1. Gradel.T.E. and B.R. Allenby - Industrial Ecology - Prentice Hall - 2010
2. Rao M.N. and Dutta A.K. "Wastewater treatment", Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006

REFERENCES

1. Gradel.T.E. and B.R. Allenby - Industrial Ecology - Prentice Hall - 2010
2. Frances Cairncross- Costing the Earth: The Challenge for Governments, the Opportunities for Business - Harvard Business School Press - 1993.
3. World Commission on Environment and Development (WCED), Our Common Future, Oxford University Press 2005.
4. Rao M.N. and Dutta A.K. "Wastewater treatment", Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006
5. Rao CS Environmental Pollution Control Engineering-, Wiley Eastern Ltd., New Delhi, 2006.
6. Lewis H Bell and Douglas H Bell, Industrial noise control, Fundamentals and applications, Marcel Decker, 1994.

Course Code	ENVIRONMENT SUSTAINABILITY AND IMPACT ASSESSMENT	L	T	P	C
ME4V25		3	0	0	3

COURSE OBJECTIVES:

- To make the students to understand the concepts of Environmental Sustainability & Impact Assessment
- To familiarize the students in environmental decision making procedure.
- Make the students to identify, predict and evaluate the economic, environmental, and social impact of development activities
- To provide information on the environmental consequences for decision making
- To promote environmentally sound and sustainable development through the identification of appropriate alternatives and mitigation measures.

UNIT I ENVIRONMENTAL IMPACT ASSESMENT **9**

Environmental impact assessment objectives – rationale and historical development of EIA - Conceptual frameworks for EIA Legislative development – European community directive – Hungarian directive.

UNIT II ENVIRONMENTAL DECISION MAKING **9**

Strategic environmental assessment and sustainability appraisal – Mitigation, monitoring and management of environmental impacts- Socio economic impact assessment.

UNIT III ENVIRONMENTAL POLICY, PLANNING AND LEGISLATION **9**

Regional spatial planning and policy – Cumulative effects assessment – Planning for climate change, uncertainty and risk.

UNIT IV LIFE CYCLE ASSESSMENT **9**

Life cycle assessment; Triple bottom line approach; Industrial Ecology. Ecological foot printing, Design for Environment, Future role of LCA, Product stewardship, design, durability and justifiability, measurement techniques and reporting.

UNIT V SUSTAINABLE URBAN ECONOMIC DEVELOPMENT **9**

Spatial economics – Knowledge economy and urban regions

TOTAL: 45 HOURS

OUTCOMES: On successful completion of this course, the student will be able to

CO 1 Explain the concepts of Environment Sustainability and trained to make decision related to Environment.

CO 2 Make decision that has an effect on our environment

CO 3 Evaluate the basics of environmental policy, planning and various legislation Get valuable information for exploring decisions in each life stage of materials, buildings, services and infrastructure.

CO 4 Explain the Life cycle assessment of Environmental sustainability.

CO 5 Explain sustainable urban economic development

TEXT BOOKS

1. The Application of Science in Environmental Impact Assessment, by Aaron J. MacKinnon, Peter N. Duinker , Tony R. Walker , Routledge; 1st edition (14 May 2019), ISBN-10 : 0367340194.
2. Routledge Handbook of Environmental Impact Assessment, by Kevin Hanna, Routledge; 1st edition (11 April 2022), ISBN-10 : 0367244470

REFERENCES

1. Clive George, C. Collin, H. Kirkpolarice – Impact Assessment and sustainable development –Edward Elgar Publishing, 2007
2. Robort B Gibsan, Sustainability Assessment, Earth Scan publishers, 2005
3. Simon Dresner, The principle of sustainability – Earth Scan publishers, 2008
4. Canter, R.L., "Environmental Impact Assessment", McGraw Hill Inc., New Delhi, 1996.
5. Shukla, S.K. And Srivastava, P.R., "Concepts In Environmental Impact Analysis", Common Wealth Publishers, New Delhi, 1992
6. John G. Rau And David C Hooten "Environmental Impact Analysis Handbook", McGraw Hill Book Company, 1990

Course Code	ADDITIVE MANUFACTURING	L	T	P	C
ME4V26		2	0	2	3

COURSE OBJECTIVES

The objective of this course is to enable the student,

- To familiarize various software tools, processes and techniques to create physical objects that satisfy product development / prototyping requirements, using AM.
- To be acquainted with vat polymerization and direct energy deposition processes
- To be familiar with powder bed fusion and material extrusion processes.
- To gain knowledge on applications of binder jetting, material jetting and sheet lamination processes

UNIT I INTRODUCTION **6**

Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping- Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain- ASTM/ISO 52900 Classification - Benefits. Applications: Building Printing - Bio Printing - Food Printing- Electronics Printing. Business Opportunities and Future Directions - Case studies: Automobile, Aerospace, Healthcare.

UNIT II DESIGN FOR ADDITIVE MANUFACTURING (DFAM) **6**

Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Material Extrusion: Fused Deposition Modeling (FDM)- Process-Materials -Applications and Limitations

UNIT III VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSITION **6**

Photo polymerization: Stereolithography Apparatus (SLA)- Materials Process - top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (OLP) - Process - Advantages - Applications. Continuous Liquid Interface Production (CLIP)Technology. Directed Energy Deposition: Laser Engineered Net Shaping (LENS)- Process - Material Delivery - Materials -Benefits -Applications

UNIT IV POWDER BED FUSION AND MATERIAL EXTRUSION **6**

Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Material Extrusion: Fused Deposition Modeling (FDM)- Process-Materials -Applications and Limitations.

UNIT V OTHER ADDITIVE MANUFACTURING PROCESSES **6**

Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits- Limitations - Applications. Material Jetting: Multi-Jet Modeling- Materials - Process - Benefits - Applications. Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding- Materials-Application and Limitation.

TOTAL: 30 HOURS

ADDITIVE MANUFACTURING LABORATORY

EXPERIMENTS

1. Modelling and converting CAD models into STL file.
2. Manipulation and error fixing of STL file.
3. Design and fabrication of parts by varying part orientation and support structures.
4. Fabrication of parts with material extrusion AM process.
5. Fabrication of parts with vat polymerization AM process.
6. Design and fabrication of topology optimized parts

TOTAL: 30 HOURS

EQUIPMENT REQUIRED – LAB

1. Extrusion based AM machine
2. Resin based AM machine
3. Mechanical design software
4. Open-source AM software for STL editing, manipulation and slicing.

COURSE OUTCOMES:

At the end of this course students shall be able to:

C01: Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.

CO2: Acquire knowledge on process of transforming a concept into the final product in AM technology.

CO3: Elaborate the vat polymerization and direct energy deposition processes and its applications.

CO4: Acquire knowledge on process and applications of powder bed fusion and material extrusion.

CO5: Evaluate the advantages, limitations, applications of binder jetting, material jetting and sheet lamination processes.

TEXT BOOKS:

1. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani "Additive manufacturing technologies". 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0

2. Andreas Gebhardt and Jan-Steffen Hotter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1.

REFERENCES:

1. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Proto typing,

Rapid Manufacturing", Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.

2. Milan Brandt,"Laser Additive Manufacturing: Materials, Design, Technologies, and

Applications", Woodhead Publishing., United Kingdom, 2016, ISBN:9780081004333.

3. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.

4. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer., United States,2006, ISBN: 978-1-4614-9842-1.

5. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press., United States, 2011, ISBN: 9780849334092.

Course Code	PRECISION MANUFACTURING	L	T	P	C
ME4V27		3	0	0	3

COURSE OBJECTIVES:

The objective of this course is to enable the student to

- Gain comprehensive knowledge of the fundamental principles and concepts of precision engineering, including dimensional accuracy, surface finish, and geometric tolerances.
- Acquire practical skills in advanced manufacturing techniques such as micro-machining, nano-fabrication, and ultra-precision machining processes used in the production of high-precision components.
- Learn to apply metrology and quality control methods to ensure the accuracy and reliability of precision-manufactured products. This includes the use of coordinate measuring machines (CMM), laser interferometry, and other high-precision measurement tools.
- Explore various applications of precision manufacturing in industries such as aerospace, automotive, electronics, and medical devices. Understand how precision manufacturing techniques contribute to the development of high-performance and reliable products.

UNIT I PRECISION ENGINEERING 9

Introduction to Precision Engineering, Need for precision manufacturing, Taniguchi diagram, Four Classes of Achievable Machining Accuracy - Normal, Precision, High-precision, Ultra-precision Processes and Nanotechnology

UNIT II PRECISION MACHINING 9

Overview of Micro- and Nano-machining, Conventional micro machining techniques - micro-turning, micro-milling, micro-grinding, Ultra-precision diamond turning, non-conventional micromachining techniques abrasive jet and water jet micromachining, Ultrasonic micromachining, micro electrical discharge machining, photochemical machining, electro chemical micromachining, laser beam micromachining, Electron beam micromachining, Focused Ion Beam micromachining, etc

UNIT III MACHINE DESIGN FOR PRECISION MANUFACTURING 9

Philosophy of precision machine design, Ultra-Precision Machine Elements: Guide- ways, Drive Systems, Friction Drive, Linear Motor Drive, Spindle Drive. Bearings: Principle, construction and application of Rolling. Hydrodynamic and Hydrostatic Bearings, Aerostatic Bearings, Magnetic bearings.

UNIT IV MECHANICAL AND THERMAL ERRORS **9**

Sources of error, Principles of measurement, Errors due to machine elements, bearings, spindles, Kinematic design, Structural compliance. Vibration, Thermal errors - background, thermal effects, Environmental control of precision machinery. Error mapping and error budgets.

UNIT V MEASUREMENT AND CHARACTERISATION **9**

Optical dimensional metrology of precision features - Machine vision, Multi-sensor coordinate metrology, Laser Tracking Systems, Laser scanners, White-Light Interference 30 Microscopes, Focus-Based Optica Metrology- Fringe projection method, Measurement of Typical Nano features. Surface metrology - 30 surface topography - Need, Measurement - Chromatic confocal Microscopy, Interferometry, Non-optical Scanning Microscopy - Scanning electron Microscopes, scanning probe microscopes, Parameters for characterizing 30 surface topography

TOTAL: 45 HOURS

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Explain the need, significance and progress of precision manufacturing and the different levels of manufacturing.

CO2: Explain the principle and working of different methods of precision machining.

CO3: Explain the special construction requirements of precision machine tools.

CO4: Explain the errors involved in precision machine tools and calculate the error budgets for a given situation.

CO5: Select a suitable measurement solution to measure and characterize precision machined features.

TEXT BOOKS:

1. Jain, V.K., Introduction to micromachining, Narosa publishers, 2018

2. Venktesh V.C., Sudinlzman, Precision Engineering, Tata Mc.Graw Hill Publishing Company, New Delhi 2007

REFERENCES:

1. David Dornfeld, Dae-Eun Lee, Precision Manufacturing, Springer, 2008. Jain, V.K., Micro manufacturing Processes, CRC Press, 2012.
2. Joseph McGeough, Micromachining of Engineered Materials, Marcel Dekker Inc., 2002.
3. Kevin Harding, "Handbook of Optical Dimensional Metrology, Series: Series in Optics and optoelectronics", Taylor & Francis, 2013.
4. Murty, R.L., Precision Engineering in Manufacturing, New Age publishers, 2005.

Course Code	CASTING AND WELDING PROCESSES	L	T	P	C
ME4V28		3	0	0	3

COURSE OBJECTIVES:

The objective of this course is to enable the student,

- To study the ferrous casting metallurgy and its applications.
- To study the nonferrous casting metallurgy and its applications.
- To study the ferrous welding metallurgy and its applications.
- To study the welding metallurgy of alloy steels and nonferrous metals and its applications.
- To Identifying the causes and remedies of various welding defects; applying welding standards and codes.

UNIT I FERROUS CAST ALLOYS **9**

Solidification of pure metals and alloys and eutectics -Nucleation - Growth Process, Critical nucleus size. Super cooling- Niyama Criterion -G/R ratio- Cell- Dendritic - Random dendritic structure-Segregation and Coring- Eutectics-Compositions and alloys in Cast Irons, FG-CGI- SG structures, Metallic Glass- Mold dilation, Mold metal reactions- Structure and Section sensitivity Cast irons- family & microstructures-Alloying effects-Malleable Iron, ADI, Charge calculations- Effect of normal elements and alloying elements in steels. Compositional aspects and properties of alloy steels- melting procedure and composition control for carbon steels- low alloy steels - stainless steels- composition control- slag-metal reactions-desulphurization dephosphorization, specifications for carbon steels- low alloy steels and stainless steels.

UNIT II NON-FERROUS CAST ALLOYS **9**

Copper- Aluminium- Magnesium- zinc - Nickel base alloys- melting practices - Al alloys, Mg alloys, Nickel alloys, Zinc alloys and copper alloys-modification and grain refinement of Al alloys- problems in composition control- degassing techniques -Heat Treatment of Aluminium alloys – Basics of Solution and Precipitation process. - Applications of Aluminium Alloy castings in various fields. Residual Stresses- defects in castings.

UNIT III PHYSICAL METALLURGY OF WELDING **9**

Welding of ferrous materials: Iron- Iron carbide diagram, TTT and CCT diagrams, effects of steel composition, formation of different microstructural zones in welded plain-carbon steels. Welding of C-Mn and low-alloy

steels, phase transformations in weld and heat - affected zones, cold cracking, role of hydrogen and carbon equivalent, formation of acicular ferrite and effect on weld metal toughness.

UNIT IV WELDING OF ALLOY STEELS AND NON-FERROUS METALS 9

Welding of stainless steels, types of stainless steels, overview of joining ferritic and martensitic types, welding of austenitic stainless steels, Sensitization, hot cracking, sigma phase and chromium carbide formation, ways of overcoming these difficulties, welding of cast iron. Welding of non-ferrous materials: Joining of aluminium, copper, nickel and titanium alloys, problems encountered and solutions

UNIT V DEFECTS, WELDABILITY AND STANDARDS 9

Defects in welded joints: Defects such as arc strike, porosity, undercut, slag entrapment and hot cracking, causes and remedies in each case. Joining of dissimilar materials, weldability and testing of weldments. Introduction to International Standards and Codes

TOTAL: 45 HOURS

COURSE OUTCOMES: At the end of the course the students would be able to

CO1: Explain the ferrous casting metallurgy and its applications.

CO2: Explain the non ferrous casting metallurgy and its applications.

CO3: Explain the ferrous welding metallurgy and its applications.

CO4: Explain the welding metallurgy of alloy steels and non ferrous metals and its applications.

CO5: Identify the causes and remedies of various welding defects; apply welding standards and codes.

TEXT BOOKS:

1. Heine R W, Loper C R and Rosenthal P C, "Principles of Metal Castings", Tata McGraw Hill, 2017.

2. A.K.Chakrabarthi, 'Casting Technology and Cast Alloys,Prentice Hall, 2005.

REFERENCES:

1. ASM International. Handbook Committee, ASM Handbook: Casting. Volume 15, ASM International, 2008.

2. Baldev Raj, Shankar V, Bhaduri A K, "Welding Technology for Engineers", Narosa Publications, 2009.

3. Beeley P, "Foundry Technology" Butterworth-Heinemann, 2001.

4. R.S.Parmar, "Welding Engineering and Technology", Khanna Publishers, 2010

5. John Campbell, "Casting", Butterworth-Heinemann, 2003

Course Code	ADVANCED INTERNAL COMBUSTION ENGINES	L	T	P	C
ME4V31		3	0	0	3

COURSE OBJECTIVES:

The objective of this course is to enable the student,

- To study the working of Gasoline fuel injection systems and SI combustion.
- To study the working of Diesel fuel injection systems and CI combustion.
- To Identifying the source and measure it; explain the mechanism of emission formation and control methods.
- To study the Selecting alternative fuel resources and its utilization techniques in IC engines.
- To study the advanced combustion modes and future power train systems.

UNIT I SPARK IGNITION ENGINES 9

Mixture requirements – Fuel injection systems – Mono-point, Multipoint & Direct injection -Stages of combustion – Normal and Abnormal combustion, Spark Knock, Factors affecting knock, Combustion chambers

UNIT II COMPRESSION IGNITION ENGINES 9

Diesel Fuel Injection Systems – Mechanical and Common Rail Direct Injection Systems - Stages of combustion – Knocking – Factors affecting knock –Direct and Indirect injection systems –Fuel Spray behavior – Spray structure and spray penetration – Air motion - Combustion chambers – Turbo charging – Waste Gate, Variable Geometry turbochargers

UNIT III EMISSION FORMATION AND CONTROL 9

Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling emissions – In-cylinder treatments – After treatment systems – Three Way Catalytic converter, Selective Catalytic Reduction, De-NOx Catalyst, Diesel Oxidation Catalyst and Particulate Traps – Methods of emission measurement – Emission norms and Driving cycles.

UNIT IV ALTERNATIVE FUELS 9

Alcohol Fuels, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel -Properties, Suitability, Merits and Demerits – Utilization Methods - Engine Modifications

UNIT V ALTERNATE COMBUSTION AND POWER TRAIN SYSTEM 9

Low Temperature Combustion - Homogeneous charge compression ignition (HCCI) – Reactivity Controlled Compression Ignition (RCCI) – Gasoline Compression Ignition – Spark Assisted HCCI - Hybrid Electric and Electric Vehicles –- Fuel Cells

TOTAL: 45 HOURS

COURSE OUTCOMES: At the end of the course the students would be able to

CO1. Explain the working of Gasoline fuel injection systems and SI combustion.

CO2. Explain the working of Diesel fuel injection systems and CI combustion

CO3. Identify the source and measure it; explain the mechanism of emission formation and control methods

CO4. Select alternative fuel resources and its utilization techniques in IC engines.

CO5. Explain advanced combustion modes and future power train systems.

TEXT BOOKS:

1. V. Ganesan, “Internal Combustion Engines”, V Edition, Tata McGraw Hill, 2012.
2. John B. Heywood, “Internal Combustion Engines Fundamentals”, McGraw-Hill, 1988.

REFERENCES:

1. B.P. Pundir, “IC Engines Combustion & Emission”, Narosa Publishing House, 2014.
2. Duffy Smith, “Auto Fuel Systems”, The Good Heart Wilcox Company, Inc., 2003.
3. EranSher, Handbook of Air Pollution from Internal Combustion Engines: Pollutant Formation and Control, Academic Press, 1998.
4. K.K. Ramalingam, “Internal Combustion Engine Fundamentals”, SciTech Publications, 2011.
5. R.B. Mathur and R.P. Sharma, “Internal Combustion Engines”, Dhanpat Rai& Sons, 2007

Course Code	ALTERNATIVE FUELS	L	T	P	C
ME4V32		3	0	0	3

COURSE OBJECTIVES:

The objective of this course is to enable the student,

- To expose potential alternate fuels and their characteristics
- To use appropriate synthetic fuels and fuel additives for better combustion characteristics
- To utilise alcohol fuels effectively for lower emissions
- To elaborate on the utilisation of Bio-Diesel and its types as a suitable fuel in CI engines
- To utilise different gaseous fuels and predict their performance and combustion characteristics.

UNIT I INTRODUCTION **9**

Availability, Suitability, Properties, Merits and Demerits of Potential Alternative Fuels – Alcohols, Biodiesel, Hydrogen, Liquefied Petroleum Gas, Natural Gas, Biogas, Fuel standards – ASTM & EN.

UNIT II SPECIAL AND SYNTHETIC FUELS **9**

Different synthetic fuels, Merits, and demerits, Dual, Bi-fuel and Pilot injected fuel systems, Fuel

additives – types and their effect on performance and emission characteristics of engines, Flexifuel systems, Ethers - as fuel and fuel additives, properties and characteristics.

UNIT III ALCOHOL FUELS **9**

Alcohols – Properties, Production methods and usage in engines. Blending, dual fuel operation,

surface ignition, spark ignition and oxygenated additives. Performance, combustion and emission Characteristics in engines - Issues & limitation in alcohols

UNIT IV BIO-DIESEL FUELS **9**

Vegetable oils and their important properties. Fuel properties characterization - Methods of using vegetable oils – Blending, preheating, Transesterification and emulsification – Performance, combustion and emission characteristics in diesel engines - Third generation biofuels, Ternary and Quaternary fuels, Issues & limitation of using vegetable oils in IC engines

UNIT V GASEOUS FUELS **9**

Biogas, Natural gas, LPG, Hydrogen – Properties, problems, storage and safety aspects - Methods of utilisation in engines - Performance, combustion and emission characteristics in engines - Issues & limitation in Gaseous fuels.

TOTAL: 45 HOURS

COURSE OUTCOMES: At the end of the course the students would be able to

The students will be able to

CO 1 Expose potential alternate fuels and their characteristics

CO 2 Use appropriate synthetic fuels and fuel additives for better combustion characteristics

CO 3 Utilise alcohol fuels effectively for lower emissions

CO 4 Elaborate on the utilisation of Bio-Diesel and its types as a suitable fuel in CI engines

CO 5 Utilise different gaseous fuels and predict their performance and combustion characteristics

REFERENCES:

1. Keith Owen and Trevor Eoley, Automotive Fuels Handbook, SAE Publications, 1990.
2. Pundir B.P, I.C. Engines Combustion and Emission, 2010, Narosa Publishing House.
3. Pundir B.P , Engine Combustion and Emission, 2011, Narosa Publishing House Keith
4. Richard L. Bechtold, Automotive Fuels Guide Book, SAE Publications, 1997

Course Code	POWER PLANT ENGINEERING	L	T	P	C
ME4V33		3	0	0	3

COURSE OBJECTIVES:

The objective of this course is to enable the student,

- To study the coal based thermal power plants.
- To study the diesel, gas turbine and combined cycle power plants.
- To learn the basic of nuclear engineering and power plants.
- To learn the power from renewable energy
- To study energy, economic and environmental issues of power plants

UNIT I COAL BASED THERMAL POWER PLANTS 9

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants - Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 9

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT III NUCLEAR POWER PLANT 9

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANADA Deuterium-Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants

UNIT IV POWER FROM RENEWABLE ENERGY 9

Hydro Electric Power Plants - Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biagas and Fuel Cell power systems

UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 9

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants

TOTAL: 45 HOURS

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Explain the layout, construction and working of the components inside a thermal power plant.

CO2: Explain the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants

CO3: Explain the layout, construction and working of the components inside nuclear power plants

CO4: Explain the layout, construction and working of the components inside Renewable energy power plants

CO5: Explain the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production

TEXT BOOKS:

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw- Hill Publishing Company Ltd., 2008.
2. A Textbook of Power Plant Engineering by R.K. Rajput 1 January 2016

REFERENCES:

1. EI-Wakil. M.M., "Power Plant Technology", Tata McGraw - Hill Publishing Company Ltd., 2010.
2. Thomas C. Elliott, Kao Chen and Robert C. Swane kamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw - Hill, 1998.
3. Power Plant Engineering by B. Vijaya Ramnath C. Elanchezhian, L. Saravanakumar November 2019.
4. Power Plant Engineering, As per AICTE: Theory and Practice by Dipak Kumar Mandal, Somnath Chakrabarti, et al. 11 January 201

Course Code	GAS DYNAMICS AND JET PROPULSION	L	T	P	C
ME4V34		3	0	0	3

COURSE OBJECTIVES:

The objective of this course is to enable the student to:

1. To study the fundamentals of compressible flow concepts and the use of gas tables.
2. To learn the compressible flow behaviour in constant area ducts.
3. To study the development of shock waves and its effects.
4. To study the types of jet engines and their performance parameters.
5. To learn the types of rocket engines and their performance parameters

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 9

Energy and momentum equations of compressible fluid flows, Concepts of compressible flow - Mach waves and Mach cone. Flow regimes, effect of Mach number on compressibility. Stagnation, static, critical properties and their interrelationship. isentropic flow and its relations. isentropic flow through variable area ducts nozzles and diffusers. Use of Gas tables

UNIT II COMPRESSIBLE FLOW THROUGH DUCTS 9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) - variation of flow properties. Choking - Isothermal flow with friction - Use of Gas tables

UNIT III NORMAL AND OBLIQUE SHOCKS 9

Governing equations – Rankine - Hugoniot Relation - Variation of flow parameters across the normal and oblique shocks - Prandtl - Meyer expansion and relation - Use of Gas tables

UNIT IV JET PROPULSION 9

Theory of jet propulsion -thrust equation - Performance parameters - thrust, power and efficiency. Operation, cycle analysis and performance of ram jet, turbojet, turbofan, turbo prop and pulse jet engines

UNIT V SPACE PROPULSION 9

Types of rocket engines and propellants - Characteristic velocity - thrust equation. Theory of single and multistage rocket propulsion - Liquid fuel feeding systems - Solid propellant geometries - Orbital and escape velocity - Rocket performance calculations

TOTAL: 45 HOURS

COURSE OUTCOMES: On successful completion of this course, the student will be able to

CO1: Apply the fundamentals of compressible flow concepts and the use of gas tables.

CO2: Analyze the compressible flow behaviour in constant area ducts

CO3: Analyze the development of shock waves and its effects.

CO4: Explain the types of jet engines and their performance parameters

CO5: Explain the types of rocket engines and their performance parameters

TEXT BOOKS:

1. Anderson, J.D., "Modern Compressible flow", Third Edition, McGraw Hill, 2003.
2. S.M. Yahya, "Fundamentals of Compressible Flow with Aircraft and Rocket propulsion", New Age International (P) Limited, 4th Edition, 2012.

REFERENCES:

1. David Dornfeld, Dae-Eun Lee, Precision Manufacturing, Springer, 2008. Jain, V.K., Micro manufacturing Processes, CRC Press, 2012.
2. Joseph McGeough, Micromachining of Engineered Materials, Marcel Dekker Inc., 2002.
3. Harding, "Handbookof Optical Dimensional Metrology, Series: Series in Optics and optoelectronics", Taylor & Francis, 2013.
4. Murty, R.L., Precision Engineering in Manufacturing, New Age publishers, 2005.

Course Code	THERMAL POWER ENGINEERING	L	T	P	C
ME4V35		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To classify non-traditional machining processes and describe mechanical energy based non-traditional machining processes.
- To differentiate chemical and electro chemical energy-based processes.
- To describe thermo-electric energy-based processes
- To explain nano finishing processes.
- To introduce hybrid non-traditional machining processes and differentiate hybrid non-traditional machining processes

UNIT I FUELS AND COMBUSTION **9**

Fuels - Types and Characteristics of Fuels - Determination of Properties of Fuels - Fuels Analysis – Proximate and Ultimate Analysis - Moisture Determination - Calorific Value -Gross & Net Calorific Values

UNIT II BOILER **9**

Types and comparison, Mountings and Accessories. Performance calculations, Boiler trial.

UNIT III AIR COMPRESSORS **9**

Classification and comparison, working principle, work of compression - with and without clearance, Volumetric efficiency, Isothermal efficiency and lsentropic efficiency. Multistage air compressor with intercooling. Working principle and comparison of Rotary compressors with reciprocating air compressors.

UNIT IV REFRIGERATION SYSTEMS **9**

Vapour compression refrigeration cycle, Effect of Superheat and Sub-cooling, Performance calculations, Working principle of air cycle, vapour absorption system, and Thermoelectric refrigeration

UNIT V PSYCHROMETRY AND AIR-CONDITIONING **9**

Psychrometric properties - Property calculations using Psychrometric chart and expressions - Psychrometric processes - adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing Air conditioning systems, concept of RSHF, GSHF and ESHF, Cooling load calculations. Cooling towers - concept and types

TOTAL: 45 HOURS

COURSE OUTCOMES: Upon successful completion of the course, students will be able to

At the end of the course the students would be able to

1. Evaluate the fuel properties and arrive at proximate and ultimate analysis of fuels.
2. Analyze different types of boilers and compute their performance parameters.
3. Evaluate the performance parameters of an air compressor.
4. Apply the working principles of various refrigeration systems and perform cop calculations.
5. Analyze the psychrometric properties and how they are utilized in arriving at calculations to determine heating loads

TEXT BOOKS

1. Mahesh. M. Rathore, "Thermal Engineering", 1st Edition, Tata McGraw Hill, 2010.
2. Ballaney. P, "Thermal Engineering", 25th Edition, Khanna Publishers, 2017

REFERENCES

1. Anantha narayanan P.N," Basic Refrigeration and Air-Conditioning", 4th Edition, Tata McGraw Hill, 2013.
2. Arora," Refrigeration and Air-Conditioning", 2nd Edition, Prentice Hall of India, 2010.
3. Mathur M.L and Mehta F.S., ''Thermal Science and Engineering", 3rd Edition, Jain Brothers Pvt. Ltd, 2017.
4. Nag P.K, "Basic and Applied Thermodynamics", 2nd Edition, Tata McGraw Hill, 2010
5. Soman. K, "Thermal Engineering", 2nd Edition, Prentice Hall of India, 20111.

Course Code	PRESSURE VESSELS	L	T	P	C
ME4V36		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To introduce the Mathematical knowledge to design pressure vessels and piping
- To learn the ability to carry of stress analysis in pressure vessels and piping
- To study the design of vessels and theory of reinforcement.
- To study buckling and fracture analysis in vessels.
- To learn piping layout and flow diagram.

UNIT I INTRODUCTION **9**

Methods for determining stresses - Terminology and Ligament Efficiency-Applications

UNIT II STRESSES IN PRESSURE VESSELS **9**

Introduction - Stresses in a circular ring, cylinder -Dilation of pressure vessels, Membrane stress Analysis of Vessel - Cylindrical, spherical and, conical heads - Thermal Stresses - Discontinuity stresses in pressure vessels

UNIT III DESIGN OF VESSELS **9**

Design of Tall cylindrical self-supporting process columns - Supports for short vertical vessels - Stress concentration at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement - Pressure Vessel Design

UNIT IV BUCKLING AND FRACTURE ANALYSIS IN VESSELS **9**

Buckling phenomenon - Elastic Buckling of circular ring and cylinders under external pressure - collapse of thick-walled cylinders or tubes under external pressure - Effect of supports on Elastic Buckling of Cylinders - Buckling under combined External pressure and axial loading

UNIT V PIPING **9**

Introduction - Flow diagram - piping layout and piping stress Analysis.

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course the students would be able to

1. Explain Methods for determining stresses Terminology and Ligament Efficiency, Applications
2. Analyse stress in pressure vessels
3. Design and analysis of pressure vessels.
4. Analysis of buckling and fracture analysis in vessels

5. Design and analysis piping layout and piping

TEXT BOOKS

1. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors,1987.
2. Theory And Design Of Pressure Vessels (Pb 2001) by HARVEY J.F. 11 January 2001

REFERENCES

1. Henry H. Bedner, "Pressure Vessels, Design Hand Book", CBS publishers and Distributors,1987.
2. Stanley, M. Wales, "Chemical process equipment, selection and Design". Buterworths series in Chemical Engineering, 1988.
3. William. J., Bees, "Approximate Methods in the Design and Analysis of Pressure Vessels and Piping", Pre ASME Pressure Vessels and Piping Conference, 1997.
4. Sam Kannapan, "Introduction to Pipe Stress Analysis". John Wiley and Sons, 1985.
5. Theory and design of Pressure Vessels (Pb 2001)by HARVEY J.F. 11 January 2001

Course Code	TURBO MACHINES	L	T	P	C
ME4V37		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student,

- To study the energy transfer in rotor and stator parts of the turbo machines.
- To study the function of various elements of centrifugal fans and blowers.
- To evaluating the working and performance of centrifugal compressor
- To analyzing flow behavior and flow losses in axial flow compressor.
- To study the types and working of axial and radial flow turbines

UNIT I WORKING PRINCIPLES **9**

Classification of Turbomachines - Energy transfer between fluid and rotor - Euler equation and its interpretation. Velocity triangles. Efficiencies in Compressor and Turbine stages. Degree of reaction. Dimensionless parameters for Turbomachines

UNIT II CENTRIFUGAL FANS AND BLOWERS **9**

Types - components - working. Flow analysis in impeller blades-volute and diffusers. Velocity triangles - h-s diagram. Stage parameters in fans and blowers - Performance characteristic curves - various losses. Fan bearings, drives and noise

UNIT III CENTRIFUGAL COMPRESSOR **9**

Components - blade types. Velocity triangles - h-s diagram, stage work. Slip factor and Degree of Reaction. Performance characteristics and various losses - Geometry and performance calculation

UNIT IV AXIAL FLOW COMPRESSOR **9**

Construction details. Work done factor. Velocity triangles - h-s diagram, stage work. Work done factor. Performance characteristics, efficiency and stage losses - Stalling and Surging - Free and Forced vortex flow

UNIT V AXIAL AND RADIAL FLOW TURBINES **9**

Axial flow turbines - Types - Elements - Stage velocity diagrams - h-s diagram, stage work - impulse and reaction stages. Compounding of turbines. Performance coefficients and losses. Radial flow turbines: Types Elements - Stage velocity diagrams - h-s diagram, stage work Performance coefficients and losses.

TOTAL: 45 HOURS

COURSE OUTCOMES:

At the end of the course the students would be able to

1. Explain the energy transfer in rotor and stator parts of the turbo machines.

2. Explain the function of various elements of centrifugal fans and blowers
3. Evaluate the working and performance of centrifugal compressor.
4. Analyse flow behaviour and flow losses in axial flow compressor.
5. Explain the types and working of axial and radial flow turbines

TEXT BOOKS

1.Ganesan, V., "Gas Turbines", 3rd Edition, Tata McGraw Hill, 2011. .
2.Yahya, S.M., "Turbines, Compressor and Fans", 4th Edition, Tata McGraw Hill, 2011

REFERENCES

1. Dixon, S.L., "Fluid Mechanics and Thermodynamics of Turbomachinery", 7th Edition, Butterworth-Heinemann, 2014.
2. Gopalakrishnan. G and Prithvi Raj. D," A Treatise on Turbomachines", Scitech Publications (India) Pvt. Ltd., 2nd Edition, 2008.
3. Lewis, R.I., "Turbomachinery Performance Analysis" 1st Edition, Arnold Publisher, 1996. Saravanamutto, Rogers,
4. Cohen, Straznicky., "Gas Turbine Theory" 6th Edition, Pearson Education Ltd, 2009.
5. Venkanna, B.K., "Fundamentals of Turbomachinery", PHI Learning Pvt. Ltd., 2009.

Course Code	REFRIGERATION AND AIR CONDITIONING	L	T	P	C
ME4V38		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Understand the basic principles and concepts underlying refrigeration and air conditioning systems, including thermodynamics, heat transfer, and fluid mechanics.
- Learn about the refrigeration cycle, refrigerants, and the laws governing the performance of refrigeration systems.
- Develop the ability to design and analyze various types of refrigeration systems, including vapor compression and absorption systems.
- Evaluate the performance of these systems through calculations of coefficients of performance (COP), energy efficiency ratios (EER), and other relevant metrics.

UNIT I INTRODUCTION **9**

Introduction to Refrigeration - Unit of Refrigeration and COP, Ideal cycles - Refrigerants Desirable properties Classification - Nomenclature - ODP & GWP

UNIT II CENTRIFUGAL FANS AND BLOWERS **9**

Types - components - working. Flow analysis in impeller blades-volute and diffusers. Velocity triangles - h-s diagram. Stage parameters in fans and blowers - Performance characteristic curves - various losses. Fan bearings, drives and noise

UNIT III OTHER REFRIGERATION SYSTEMS **9**

Working principles of Vapour absorption systems and adsorption cooling systems refrigeration- Ejector refrigeration systems- Thermo electric refrigeration- Air refrigeration c- Vortex and Pulse tube refrigeration systems.

UNIT IV PSYCHROMETRIC PROPERTIES AND PROCESSES **9**

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.

UNIT V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION **9**

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air

distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO1 Explain the basic concepts of Refrigeration

CO2 Explain the Vapor compression Refrigeration systems and to solveproblems

CO3 Discuss the various types of Refrigeration systems

CO4 Calculate the Psychrometric properties and its use in psychrometric processes

CO5 Explain the concepts of Air conditioning and to solve problems

TEXT BOOKS

Arora, C.P., "Refrigeration and Air Conditioning", edition, McGraw Hill, New Delhi, 2010.

REFERENCES

1. ASHRAE Hand book, Fundamentals, 2010
2. Jones W.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann, 2007
3. Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009.
4. Stoecker, W.F. and Jones J. W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 86.

Course Code	VALUE ENGINEERIG	L	T	P	C
ME4V41		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Study the value engineering process and understand its functions within the process.
- Determine the appropriate value engineering methodology for a given project and propose suitable training for both centralized and decentralized modes.
- Learn various decision-making processes and cost evaluation models and apply them in the product development lifecycle.
- Explore an in-depth understanding of various value engineering applications in human resources, manufacturing, and marketing.
- Demonstrate the implementation of value engineering solutions and propose improvements.

UNIT I VALUE ENGINEERING BASICS **9**

Origin, definition, and meaning of value engineering and value analysis-Differences between value analysis, value engineering, and traditional cost reduction techniques-Discussion on types of value functions (Basic and Secondary). Concepts of cost and worth, creativity in Value Engineering-Uses, applications, advantages, and limitations of Value Analysis.

UNIT II VALU ENGINEERING JOB PLAN AND PROCESS **9**

Introduction to the seven phases of the job plan- Introduction to the seven phases of the job plan- Use of FAST (Function Analysis System Technique) Diagramming as a Value Engineering tool- Behavioral and organizational aspects of Value Engineering. Ten principles of Value Analysis-Benefits of Value Engineering.

UNIT III VALUE ENGINEERING TECHNIQUES **9**

Techniques such as brainstorming, Gordon technique, Morphological Analysis, and ABC Analysis-Decision-making frameworks like Make or Buy Decisions-Function Cost Worth- Analysis (FCWA). Break Even Analysis and Life Cycle Cost (LCC)

UNIT IV WORKSHEETS AND GUIDELINES **9**

Preparation and use of worksheets in the general and information phases-Function classification, relationship, and summary - Cost analysis, idea listing, comparison, feasibility ranking. Guidelines for writing value engineering proposals, financial aspects, and life cycle cost analysis. Case studies and discussions

UNIT V VERSATILITY OF VALUE ENGINEERING **9**

Application of value engineering in maintenance, repair activities, and non-hardware projects-Initiating a value engineering program, including introduction, training plans, and career development for value engineering specialties.

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO1: Ability to estimate product costs based on value engineering principles in terms of value, functions, and worth.

CO2: Capability to articulate product details through various phases of value engineering.

CO3: Proficiency in selecting and applying appropriate methods and standards on value engineering projects and proposing suitable training.

CO4: Ability to apply querying theory and FAST to perfect a value engineering project implementation.

CO5: Development of various case studies related to value engineering project implementation.

TEXT BOOKS

1. Iyer. S.S., "Value Engineering", New Age International (P) Limited, 9th Edition, 2009.
2. Anil Kumar, and Mukhopadhyaya, "Value Engineering: Concepts, Techniques, and Applications", SAGE Publications, 1st Edition, 2003.

REFERENCES

1. Del L. Younker., "Value Engineering: analysis and methodology", CRC Press, 2003.
2. Richard Park., "Value Engineering A Plan for Invention", CRC Press, 1998.
3. Arthur E. Mudge., "Value Engineering :A systematic approach", McGraw Hill, 1989.
4. Alphonse Dell'lsola., "Value Engineering: Practical Applications for Design, Construction, Maintenance and Operations", R.S. Means Company, 1997.
5. Lawrence D. Miles., "Techniques of Value Analysis and Engineering", Lawrence D. Miles Value Foundation, 3rd Edition, 2015

Course Code	GREEN SUPPLY CHAIN MANAGEMENT	L	T	P	C
ME4V42		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To familiar the various standards and legislation of modern electronic manufacturing.
- To know the conventional electronic processing and lead-free electronic manufacturing techniques.
- To recognize the steps involved in assembly process and understand the need of recycle the electronics
- To implement reliability and product life cycle estimation tools in green electronic manufacturing.
- To demonstrate the green electronic manufacturing procedure in applications

UNIT I INTRODUCTION TO GREEN SUPPLY CHAIN 9

Environmental concerns of the modern society- Overview of electronics industry and their relevant regulations in China, European Union and other key countries- global and regional strategy and policy on green electronics industry. Restriction of Hazardous substances (RoHS) - Waste Electrical and electronic equipment (WEEE - Energy using Product (EuP) and Registration - Evaluation, Authorization and Restriction of Chemical substances (REACH)

UNIT II SUSTAINABLE PROCUREMENT AND GREEN SOURCING 9

Basics of IC manufacturing and its process - Electronics with Lead (Pb) -free solder pastes, conductive adhesives, Introduction to green electronic materials and products - halogen-free substrates and components. Substitution of non-recyclable thermosetting polymer-based composites with recyclable materials X-Ray Fluorescence (XRF) for identifying hazardous substances in electronic products.

UNIT III ENVIRONMENTAL IMPACT IN LOGISTICS 9

Various processes in assembling electronics components - the life-cycle environmental impacts of the materials used in the processes - substrate interconnects. Components and process equipments- Technology and management on e-waste recycle system construction, global collaboration, and product disassembles technology.

UNIT IV CORPORATE SOCIAL RESPONSIBILITY AND ENVIONMENTAL REGULATIONS 9

Stages of product development process in green design: Materials- Manufacturing - Packaging and use - End of Life and disposal - Design for recycling - Life Cycle Assessment (LCA), and Eco-design tools - Environmental management systems, and International standards - Eco-design in electronics industry.

UNIT V GREEN INFORMATION TECHNOLOGY AND SYSTEMS 9

Reliability of green electronics systems, Reuse and recycle of End-of-Life(EOL) electrical and electronic equipment for effective waste management - Introduction of Green Supply Chain, and Modeling green products from Supply Chain point of view - A life-cycle assessment for eco-design of Cathode Ray Tube Recycling

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO1: Get concise awareness of standards and legislation of modern electronic manufacturing for green environment.

CO2: Explain the conventional electronic processing and lead free electronic manufacturing techniques.

CO3: Realize the assembly process and the need of recycle of electronics

CO4: Use reliability and product life cycle estimation tools for electronic manufacturing.

CO5: Validate the green electronic manufacturing procedures in applications.

TEXT BOOKS

1. Green Supply Chain Management, by Charisios Achillas, Dionysis D. Bochtis, Dimitrios Aidonis, Routledge; 1st edition (16 November 2018), ISBN-10 1138644617
2. Sammy G. Shina, Green Electronics Design and Manufacturing, McGraw Hill., 2008.

REFERENCES

1. David Austen, Green Electronic Morning, lngleby Gallery, 2006.
2. John Hu. Mohammed Ismail, CMOS High Efficiency on - Chip Power Management, Springer Publications 4th edition, 2011.
3. Yuhang yang and Maode Ma, Green Communications and Networks, Springer Publication., 2014.
4. Sanka Ganesan, Michael Pecht, Lead free Electronics, John Wiley & Sons, 2006.
5. Charles A. Harper, Electronic Materials and Processes Hand book, McGraw-Hill, 2010.
6. Sammy G. Shina, Green Electronics Design and Manufacturing, McGraw Hill., 2008

Course Code	MATERIALS SCIENCE AND ENGINEERING	L	T	P	C
ME4V43		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Equip students with a thorough understanding of the various physical, chemical, and mechanical properties of materials.
- Teach students to analyze and interpret the microstructures of different materials and their impact on properties.
- Educate students on reading and applying phase diagrams and understanding phase transformations.
- Instruct students on various material processing techniques and their influence on the properties and performance of materials.
- Introduce students to advanced materials like nanomaterials and biomaterials, highlighting their applications and potential in new technologies.

UNIT I INTRODUCTION AND ATOMIC STRUCTURE 9

Overview of Material Science and its significance - Classification of materials based on different criteria-atomic models and atomic bonding types - Crystal structures and atomic arrangements in solids

UNIT II MATERIAL PROPERTIES AND THEIR MEASUREMENTS 9

Mechanical properties: Strength, hardness, ductility, and toughness-Testing methods: Tensile, compression, hardness, and impact tests-.Thermal properties: Heat capacity, thermal expansion-Electrical and magnetic properties of materials.

UNIT III IMPERFECTIONS AND PHASE DIAGRAMS 9

Types of imperfections in solids: Point, line, and surface defects-Significance of imperfections in materials-Introduction to phase diagrams and their interpretation-Phase transformations: Nucleation and growth mechanisms.

UNIT IV MATERIALS PROCESSING AND MANUFACTURING 9

Common manufacturing processes: Casting, forming, and joining-Material-specific processing techniques-Surface treatment and heat treatment of metals-Challenges in materials processing and the role of process selection

UNIT V ADVANCED MATERIALS AND FUTURE TRENDS **9**

Introduction to nanomaterials, biomaterials, and composite materials-Smart materials: Piezoelectrics, shape memory alloys-Recent advancements in material science- Future trends and applications in material science.

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO 1 Master the identification and description of material properties for application-specific selections.

CO 2 acquire skills in micro-structural analysis to understand material behaviors under varied conditions.

CO 3 proficiently use phase diagrams to predict and manipulate material phase transformations.

CO 4 learn diverse material processing techniques to enhance properties and performance.

CO 5 explore advanced materials, preparing them for innovations in nanotechnology and biomaterials.

TEXT BOOKS

1. Allister, W.D., Jr., and Rethwisch, D.G., "Materials Science and Engineering: An Introduction," 9th Edition, John Wiley & Sons.

2. Askeland, D.R., Fulay, P.P., and Wright, W.J., "The Science and Engineering of Materials," 7th Edition, Cengage Learning.

REFERENCES

1. Smith, W.F., and Hashemi, J., "Foundations of Materials Science and Engineering," 6th Edition, McGraw-Hill Education.

Course Code	DESIGN FOR X	L	T	P	C
ME4V44		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Introduce the economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications.
- Learn the design consideration principles of forming in the design of extruded, stamped, and forged products
- Learn design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.
- Learn design consideration principles of welding in the design of welded products.
- Learn design consideration principles in additive manufacturing

UNIT I INTRODUCTION 9

General design principles for manufacturability- strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric Tolerances Assembly limits -Datum features - Tolerance stacks. Design to minimize material usage - Design for disassembly - Design for recyclability - Design for manufacture - Design for energy efficiency - Design to regulations and standards.

UNIT II FACTORS INFLUENCING FORM DESIGN 9

Working principle, Material, Manufacture, Design- Possible solutions - Materials choice - Influence of materials on form design - form design of welded members, forgings and castings.

UNIT III COMPONENT DESIGN - MACHINING CONSIDERATION 9

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clamp ability - Design for accessibility – Design for assembly - Product design for manual assembly - Product design for automatic assembly – Robotic Assembly

UNIT IV COMPONENT DESIGN - CASTING CONSIDERATION 9

Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA

UNIT V DESIGN FOR ADDITIVE MANUFACTURING **9**

Introduction to AM, DFMA concepts and objectives, AM unique capabilities, exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers.

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO1: Elaborate the design principles for manufacturability

CO2: Discuss the factors influencing in form design

CO3.: Apply the component design features of various machine.

CO4.: Discuss the design consideration principles of welding in the design of welded products.

CO5.: Discuss the design consideration principles of additive manufacturing.

TEXT BOOKS

1. James G. Bralla, "Design for Manufacturability Handbook", McGraw Hill Professional, 1998.

2. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts,

3. Architectures and Implementation, Springer, 1998.Design and Manufacturing, McGraw Hill., 2008.

REFERENCES

1. Corrado Poli, Design for Manufacturing: A Structured Approach, Elsevier, 2001.

2. David M. Anderson, Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production, CIM Press, 2004.

3. Erik Tempelman, Hugh Shercliff, Bruno Ninaber van Eyben, Manufacturing and Design: Understanding the Principles of How Things Are Made, Elsevier, 2014.

4. Graedel T. Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall. Reason Pub., 1996.

5. Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994

Course Code	ERGONOMICS IN DESIGN	L	T	P	C
ME4V45		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Introduce to industrial design based on ergonomics.
- Consider ergonomics concept in manufacturing
- Apply ergonomics in design of controls and display.
- Apply environmental factors in ergonomics design.
- Develop aesthetics applicable to manufacturing and product

UNIT I INTRODUCTION **9**

An approach to industrial design, Elements of design structure for industrial design in engineering application in modern manufacturing systems- Ergonomics and Industrial Design: Introduction to Ergonomics, Communication system, general approach to the man-machine relationship, Human component of work system, Machine component of work system, Local environment-light, Heat, Sound.

UNIT II ERGONOMICS AND PRODUCTION **9**

Introduction, Anthropometric data and its applications in ergonomic, working postures, Body Movements, Work Station Design, Chair Design - Visual Effects of Line and Form: The mechanics of seeing, Psychology of seeing, Figure on ground effect, Gestalt's perceptions - Simplicity, Regularity, Proximity, Wholeness. Optical illusions, Influences of line and form

UNIT III DESIGN PRINCIPLES FOR DISPLAY AND CONTROLS **9**

Displays: Design Principles of visual Displays, Classification, Quantitative displays, Qualitative displays, check readings, Situational awareness, Representative displays, Design of pointers, Signal and warning lights, colour coding of displays, Design of multiple displays Controls: Design considerations, Controls with little efforts - Push button, Switches, rotating Knobs. Controls with muscular effort - Hand wheel, Crank, Heavy lever, Pedals. Design of controls in automobiles, Machine Tools

UNIT IV ENVIRONMENTAL FACTORS **9**

Colour: Colour and light, Colour and objects, Colour and the eye - after Image, Colour blindness, Colour constancy, Colour terms - Colour circles, Munsel colour notation, reactions to colour and colour combination - colour on engineering equipments, Colour coding, Psychological effects, colour and machine form, colour and style

UNIT V AESTHETIC CONCEPTS **9**

Concept of unity, Concept of order with variety, Concept of purpose, Style and environment, Aesthetic expressions - Symmetry, Balance, Contrast, Continuity, Proportion. Style - The components of style,

House style, Style in capital good. Introduction to Ergonomic and plant layout software's, total layout design.

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO 1 Appreciate ergonomics need in the industrial design.

CO 2 Apply ergonomics in creation of manufacturing system

CO 3 Discuss on design of controls and display.

CO 4 Consider environmental factors in ergonomics design.

CO 5 Report on importance of aesthetics to manufacturing system and product

TEXT BOOKS

1. Ergonomics in Design: Methods and Techniques (Human Factors and Ergonomics) by Marcelo M. Soares, Francisco Rebelo
2. Ergonomics in Product Design by Send points Publishing Co. Ltd

REFERENCES

1. Benjamin W. Niebel, Motion and Time Study, Richard, D. Irwin Inc., 7th Edition, 2002
2. Brain Shakel," Applied Ergonomics Hand Book", Butterworth Scientific London 1988.
3. Bridger, RC., Introduction to Ergonomics, 2ndEdition, 2003, McGraw Hill Publications.
4. Martin Helander, A Guide to human factors and Ergonomics, Taylor and Francis, 2006
5. Mayall W.H. "Industrial design for Engineers", London Hiffee books Ltd., 1988.

Course Code	NEW PRODUCT DEVELOPMENT	L	T	P	C
ME4V46		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Introduce the fundamental concepts of the new product development
- Develop material specifications, analysis and process.
- Learn the Feasibility Studies & reporting of new product development.
- Study the New product qualification and Market Survey on similar products of new product development
- Learn Reverse Engineering. Cloud points generation, converting cloud data to 3D model

UNIT I FUNDAMENTALS OF NPD **9**

Introduction - Reading of Drawing - Grid reading, Revisions, ECN (Engg. Change Note), Component material grade, Specifications, customer specific requirements - Basics of monitoring of NPD applying Gantt chart, Critical path analysis - Fundamentals of BOM (Bill of Materials), Engg. BOM & Manufacturing BOM - Basics of MIS software and their application in industries like SAP, MS Dynamics, Oracle ERP Cloud-QFD.

UNIT II MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS **9**

Material specification standards - ISO, DIN, JIS, ASTM, EN, etc. - Awareness on various manufacturing process like Metal castings & Forming, Machining (Conventional, 3 Axis, 4 Axis, 5 Axis,), Fabrications, Welding process. Qualifications of parts mechanical, physical & Chemical properties and their test report preparation and submission. Fundamentals of DFMEA & PFMEA, Fundamentals of FEA, Bend Analysis, Hot Distortion, Metal and Material Flow, Fill and Solidification analysis.

UNIT III ESSENTIALS OF NPD **9**

RFQ (Request of Quotation) Processing - Feasibility Studies & reporting - CFT (Cross Function Team) discussion on new product and reporting - Concept design, Machine selection for tool making, Machining -Manufacturing Process selection, Machining Planning, cutting tool selection - Various Inspection methods - Manual measuring, CMM - GOM (Geometric Optical Measuring), Lay out marking and Cut section analysis. Tool Design and Detail drawings preparation, release of details to machine shop and CAM programming - Tool assembly and shop floor trials. Initial sample submission with PPAP documents

UNIT IV CRITERIONS OF NPD **9**

New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for

testing frequencies - Market Survey on similar products, Risk analysis, validating samples with simulation results, Lesson Learned & Horizontal deployment in NPD

UNIT V REPORTING & FORWARD-THINKING OF NPD **9**

Detailed study on PPAP with 18 elements reporting, APQP and its 5 Sections, APQP vs PPAP, Importance of SOP (Standard Operating Procedure) - Purpose & documents, deployment in shop floor - Prototyping & RPT - Concepts, Application and its advantages, 3D Printing - resin models, Sand cores for foundries; Reverse Engineering. Cloud points generation, converting cloud data to 3D model - Advantages & Limitation of RE, CE (Concurrent Engineering)- Basics, Application and its advantages in NPD (to reduce development lead time, time to Market, Improve productivity and product cost.)

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

1. Discuss fundamental concepts and customer specific requirements of the New Product development
2. Discuss the Material specification standards, analysis and fabrication, manufacturing process.
3. Develop Feasibility Studies & reporting of New Product development
4. Analyzing the New product qualification and Market Survey on similar products of new product development
5. Develop Reverse Engineering. Cloud points generation, converting cloud data to 3D model

TEXT BOOKS

1. Product Development - Sten Jonsson
2. Product Design & Development - Karl T. Ulrich, Maria C. Young, Steven D. Eppinger

REFERENCES

1. Revolutionizing Product Development - Steven C Wheelwright & Kim B. Clark
2. Change by Design
3. Toyota Product Development System - James Morgan & Jeffrey K. Liker
4. Winning at New Products - Robert Brands 3rd Edition
5. Product Design & Value Engineering - Dr. M.A. Bulsara &Dr. H.R. Thakkar

Course Code	PRODUCT MANAGEMENT	L	T	P	C
ME4V47		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Provide students with a comprehensive understanding of the role of a product manager.
- Equip students with tools and methodologies used in product planning and development.
- Enhance students' skills in market analysis and competitive strategy formulation.
- Develop abilities to manage a product through its lifecycle.
- Foster decision-making skills based on data analysis and market feedback.

UNIT I INTRODUCTION TO PRODUCT MANAGEMENT **9**

Role and responsibilities of a Product Manager - Overview of the product lifecycle

Key concepts in product management: market fit, user experience, and business models.

UNIT II PRODUCT PLANNING AND STRATEGY **9**

Market research and customer needs analysis-Ideation and concept validation-

Product strategy development: Vision, goals, and roadmaps.

UNIT III PRODUCT DEVELOPMENT PROCESS **9**

Agile and lean methodologies for product development-Prioritization techniques: KANO model, MOSCOW method, etc.- Prototyping and MVP (Minimum Viable Product) development.

UNIT IV GO-TO-MARKET STRATEGIES AND MARKETING **9**

Product positioning and branding-Marketing mix and product launch strategies-Sales enablement and distribution channels.

UNIT V PRODUCT LIFECYCLE MANAGEMENT **9**

Metrics and KPIs for product success-User feedback and continuous improvement-Scaling products and managing product portfolios

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

1. understand the fundamental role and functions of a product manager across different stages of the product lifecycle.
2. skilled in conducting market research, developing product strategies, and creating actionable roadmaps

3. learn to apply Agile and Lean methodologies effectively, prioritize product features, and prototype efficiently.
4. Master the development and execution of go-to-market strategies, including marketing, branding, and distribution.
5. adept at using key performance indicators to measure product success and integrate user feedback for ongoing product improvement.

TEXT BOOKS

1. Cagan, Marty. "Inspired: How to Create Products Customers Love." 2nd Edition.
2. Perri, Melissa. "Escaping the Build Trap: How Effective Product Management Creates Real Value."

REFERENCES

1. Olsen, Dan. "The Lean Product Playbook: How to Innovate with Minimum Viable Products and Rapid Customer Feedback."

Course Code	SUSTAINABILITY IN DESIGN & MANUFACTURING	L	T	P	C
ME4V48		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Equip students with a broad understanding of environmental issues and sustainability.
- Foster knowledge of biodiversity and ecosystem importance.
- Analyze impacts and management of various pollution types.
- Explore renewable energy sources and conservation strategies.
- Promote understanding of sustainable practices and management in various contexts.

UNIT I ENVIRONMENT AND BIODIVERSITY 9

Focus on the importance of the environment and biodiversity, discussing ecosystem diversity, biodiversity threats, and conservation strategies.

UNIT II ENVIRONMENTAL POLLUTION 9

Analyzes various pollution types including water, air, soil, and noise, alongside waste management practices and environmental protection laws

UNIT III RENEWABLE SOURCES OF ENERGY 9

Explores energy management, conservation strategies, and new energy sources like hydrogen and tidal energy.

UNIT IV SUSTAINBILITY AND MANAGEMENT 9

Discusses sustainable development goals, economic and social sustainability, climate change, and environmental management in industries

UNIT V SUSTAINABILITY PRACTICES 9

Covers zero waste concepts, circular economy, sustainable habitat approaches like green buildings and materials, and energy efficiency.

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

1. Recognize the importance of biodiversity, identify ecosystem threats, and learn conservation strategies.
2. Identify and understand various pollution types, learn waste management practices, and comprehend environmental laws.

3. Assess various renewable energy sources and understand energy conservation and management.
4. Learn about sustainable development goals and practices, focusing on economic and social sustainability.
5. Explore sustainable building practices and understand the principles of zero waste and the circular economy.

TEXT BOOKS

1. Botkin, D.B. & Keller, E.A., Environmental Science: Earth as a Living Planet. Wiley; 10th edition (2019) - Offers comprehensive coverage of environmental science with a focus on solutions

2. Gaston, K.J. & Spicer, J.I., Biodiversity: An Introduction. Wiley-Blackwell; 2nd edition (2004) - Provides a fundamental understanding of biodiversity and conservation

3. Kothari, D.P. & Singal, K.C., Renewable Energy Sources and Emerging Technologies. PHI Learning; 2nd edition (2011) - Discusses renewable energy sources and technological advancements

REFERENCES

1. Robertson, M., Sustainability Principles and Practice. Routledge; 3rd edition (2021), Details sustainability principles and their applications

2. Peirce, J.J., Vesilind, P.A., & Weiner, R., Environmental Pollution and Control. Butterworth-Heinemann; 4th edition (1997), Explores various aspects of environmental pollution and management

3. Kruger, A. & Seville, C., Green Building: Principles and Practices in Residential Construction. Delmar Cengage Learning; 1st edition (2012), A guide to sustainable building techniques and materials

Course Code	COMPUTATIONAL SOLID MECHANICS	L	T	P	C
ME4V51		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To study the definition and basics on theory of elasticity
- To learn finite element method and procedure for static linear elasticity
- To study the Non-Linear and History depend problems
- To study time dependent and dynamic problems of Small and large strain visco plasticity
- To study Structural Elements & Interfaces and contact using penalty method

UNIT I BASIC ON THEORY OF ELASTICITY 9

Definitions- notations and sign conventions for stress and strain, Equations of equilibrium - Strain - displacement relations, Stress - strain relations, Lame's constant - cubical dilation, Compressibility of material, bulk modulus, Shear modulus, Compatibility equations for stresses and strains, Principal stresses and principal strains, Mohr's circle, Saint Venant's principle

UNIT II FINITE ELEMENT METHOD FOR STATIC LINEAR ELASTICITY 9

Derivation and implementation of a basic 2D FE code with triangular constant strain elements - Generalization of finite element procedures for linear elasticity: interpolation and numerical integration in 1 D, 2D and 3D. Deriving finite element equations - constructing variational forms; mixed methods - Accuracy and convergence; the Patch test

UNIT III NON-LINEAR AND HISTORY DEPEND PROBLEMS 9

Small strain hypo-elastic materials - Small strain visco-plasticity - Large strain elasticity -Large strain visco-plasticity.

UNIT IV TIME DEPENDENT AND DYNAMIC PROBLEMS 9

First-order systems - the diffusion equation - Explicit time integration - the Newmark method – Implicit time integration - Modal analysis and modal time integration

UNIT V STRUCTURAL ELEMENTS & INTERFACES AND CONTACT 9

Continuum Beams - Shells - Cohesive Zones - Enforcing constraints using penalty methods and Lagrange Multipliers - Contact elements (in two dimensions)

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO 1 Discuss the definition and basics on theory of elasticity
CO 2 Derive the finite element method for static linear elasticity, solve problems.

CO 3 Discuss the Non Linear and History depend problems, Solve problems.
CO 4 Discuss time dependent and dynamic problems, solve problems.
CO 5 Discuss Structural Elements & Interfaces and contact, solve problems.

TEXT BOOKS

1. L.S.Srinath, Advanced Mechanics Of Solids, 3rd Edition 2008.(0070139881 ·9780070139886).
2. J.N.Reddy, Introduction To Finite Element Method, 4th Edition 2020. (939038527X9789390385270).
3. RD.Cook, Concepts and Applications of Finite Element Analysis, 4th Edition 2001 (978-0-471-35605-9).
4. S.Timoshenko, Theory of Elasticity, McGraw-Hill Education (India) Pvt Limited, 2010.(9780070701229-0070701229)
5. G. Ramamurty, Applied Finite Element Analysis, 1.K. International Publishing House Pvt.Limited,2013. (9789380578453- 9380578458)

REFERENCES

1. The Mechanics of Solids and Structures - Hierarchical Modeling and the Finite Element Solution (Computational Fluid and Solid Mechanics) by Miguel Luiz Bucalem and KlausJurgen Bathe I 25 February 2013
2. The Finite Element Analysis of Shells - Fundamentals (Computational Fluid and Solid Mechanics) by Dominique Chapelle and Klaus-Jurgen Bathe 127 January 2013
3. Inelastic Analysis of Solids and Structures (Computational Fluid and Solid Mechanics) by M.Kojic and Klaus-Jurgen Bathe I 22 October 2010
4. High-Resolution Methods for Incompressible and Low-Speed Flows (Computational Fluid and Solid Mechanics) by D. Drikakis and W. Rider 122 October 2010
5. Discontinuous Finite Elements in Fluid Dynamics and Heat Transfer (Computational Fluid and Solid Mechanics) by Ben Q. Li 122 October 2010.

Course Code	COMPUTATIONAL FLUID DYNAMICS AND HEAT TRANSFER	L	T	P	C
ME4V52		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To study the fluid flow simulation techniques and its mathematical behaviour
- To learn the Discretise 1 D and 2D systems using finite difference and finite volume techniques
- To Formulate diffusion -convection problems using finite volume method
- To study the flow field for different types of grids
- To learn the need for turbulence models and its types

UNIT I INTRODUCTION **9**

Basics of Computational Fluid Dynamics - Governing equations- Continuity, Momentum and Energy equations - Boundary conditions & Types- Time-averaged equations for Turbulent Flow - Classification and Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations, comparison between Analytical, Experimental and Numerical techniques, Techniques of Discretization and Numerical errors

UNIT II FINITE ELEMENT METHOD FOR STATIC LINEAR ELASTICITY **9**

Derivation and implementation of a basic 2D FE code with triangular constant strain elements - Generalization of finite element procedures for linear elasticity: interpolation and numerical integration in 1 D, 2D and 3D. Deriving finite element equations - constructing variational forms; mixed methods - Accuracy and convergence; the Patch test

UNIT III NON-LINEAR AND HISTORY DEPEND PROBLEMS **9**

Steady one-dimensional convection and diffusion - Central, upwind differencing schemes, properties of discretization schemes, Hybrid, Power-law, QUICK Schemes, Computation of Boundary layer flow, von Neumann stability analysis

UNIT IV TIME DEPENDENT AND DYNAMIC PROBLEMS **9**

Stream function and vorticity, Representation of the pressure gradient term, Staggered grid – Momentum equations, Pressure and Velocity corrections - Pressure Correction equation, SIMPLE algorithm and its variants - PISO Algorithms, Computation of internal and external thermal boundary layer.

UNIT V STRUCTURAL ELEMENTS & INTERFACES AND CONTACT **9**

Turbulence model requirement and types, mixing length model, Two equation (k-€) models - High and low Reynolds number models, LES, DNS, Mesh Generation and refinement Techniques-software tools, Stability of solver, Courant Fredrick Levy number, relaxation factor, and grid independence test

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO 1 Apply the fundamentals of CFD, and develop case specific governing equations.

CO 2 Discuss finite difference and finite volume-based analysis for steady and transient diffusion problems.

CO 3 Implement various mathematical schemes under finite volume method for convention diffusion.

CO 4 Solve complex problems in the field of fluid flow and heat transfer with the support of high speed computers.

CO 5 Apply the various discretization methods, solution procedure and the concept of turbulence modelling.

TEXT BOOKS

1. Versteeg, H.K., and Malalasekera, W.,"An Introduction to Computational Fluid Dynamics": The finite volume Method, Pearson Education, 2014.
2. Ghoshdastidar, P.S., "Computational Fluid Dynamics and Heat Transfer", Cengage Learning, 2017.

REFERENCES

1. John. F. Wendt, "Computational Fluid Dynamics - An Introduction", Springer, 2013.
2. K. Muralidhar & T.Sundararajan, Computational Fluid Flow and Heat Transfer, Narora Publishing House, 1994.
3. Suhas V, Patankar, "Numerical Heat transfer and Fluid flow", Taylor & Francis, 2009.
4. Uriel Frisch, Turbulence, Cambridge University Press, 1999.
5. Yogesh Jaluria & Kenneth E. Torrance, "Computational Heat Transfer'', CRC press, 2002.

Course Code	THEORY ON COMPUTATION AND VISUALIZATION	L	T	P	C
ME4V53		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Develop skills in designing efficient algorithms and rigorously analyzing their time and space complexity.
- Understand various algorithmic paradigms such as divide-and-conquer, dynamic programming, and greedy algorithms.
- Implement these data structures in practical scenarios and understand their impact on performance.
- Utilize software tools and libraries to create visual representations that aid in understanding and communicating computational processes.
- Apply theoretical concepts to solve real-world problems, particularly in areas requiring complex computations and data analysis.

UNIT I REVIEW OF MATHEMATICAL THEORY **9**

Sets, Functions, Logical statements, Proofs, Relations, Languages, Principal of Mathematical Induction, Strong Principle, Recursive Definitions, Structural Induction

UNIT II REGULAR LANGUAGES AND FINITE AUTOMATA **9**

Regular Expressions, Regular Languages, Application of Finite Automata, Automata with output – Moore machine & Mealy machine, Finite Automata, Memory requirement in a recognizer, Definitions, unionintersection and complement of regular languages, Non Deterministic Finite Automata, Conversion from NFA to FA, ??- Non Deterministic Finite Automata, Conversion of NFA- ? to NFA, Kleene's Theorem, Minimization of Finite automata, Regular And Non Regular Languages – pumping lemma.

UNIT III CONTEXT FREE GRAMMAR (CFG) AND PUSHDOWN AUTOMATA **9**

Definitions and Examples, Unions Concatenations And Kleene's of Context free language, Regular Grammar for Regular Language, Derivations and Ambiguity, Unambiguous CFG and Algebraic Expressions, BacosNaur Form (BNF), Normal Form – CNF. Definitions, Deterministic PDA, Equivalence of CFG and PDA & Conversion, Pumping lemma for CFL, Intersections and Complements of CFL, Non-CFL.

UNIT IV VALUE OF VISUALIZATION **9**

Information Visualization, In Readings in Information Visualization, Graphical Excellence, Graphical Integrity, Sources of Graphical Integrity In The Visual Display of Quantitative Information

UNIT V VISUALIZATION DESIGN **9**

The Power of Representation, Data-Ink and Graphical Redesign, Data-Ink Maximization and Graphical Design, Data Density and Small Multiples

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO 1 Discussing the concepts and techniques of discrete mathematics for theoretical computer science.
CO 2 Explain the different formal languages and their relationship.
CO 3 Discussing to classify and construct grammars for different languages and vice-versa.
CO 4 Explaining the Visualization, Graphical and Quantitative Information.
CO 5 Appling the Visualization design and data Ink..

TEXT BOOKS

1. Introduction to the Theory of Computation by Michael Sipser
2. Automata Theory, Languages, and Computation By John Hopcroft, Rajeev Motowani, and Jeffrey Ullman.

REFERENCES

1. Introduction to Languages and the Theory of Computation, 4th by John Martin, Tata Mc Graw Hill
2. An introduction to automata theory and formal languages By Adesh K. Pandey, Publisher: S.K. Kataria & Sons
3. Introduction to computer theory By Deniel I. Cohen, Joh Wiley & Sons, Inc
4. Computation: Finite and Infinite By Marvin L. Minsky Prentice-Hall.

Course Code	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C
ME4V54		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Understand the importance, principles, and search methods of Al
- Provide knowledge on predicate logic and Prolog.
- Introduce machine learning fundamentals
- Study of supervised learning algorithms.
- Study about unsupervised learning algorithms

UNIT I INTELLIGENT AGENT AND UNINFORMED SEARCH 6

Introduction - Foundations of Al - History of Al - The state of the art - Risks and Benefits of Al -Intelligent Agents - Nature of Environment - Structure of Agent - Problem Solving Agents -Formulating Problems - Uninformed Search - Breadth First Search - Dijkstra's algorithm or uniformcost search - Depth First Search - Depth Limited Search.

UNIT II PROBLEM SOLVING WITH SEARCH TECHNIQUES 6

Informed Search - Greedy Best First - A* algorithm - Adversarial Game and Search - Game theory - Optimal decisions in game - Min Max Search algorithm - Alpha-beta pruning – Constraint Satisfaction Problems (CSP) - Examples - Map Coloring - Job Scheduling - Backtracking Search for CSP

UNIT III LEARNING 6

Machine Learning: Definitions - Classification - Regression - approaches of machine learning models - Types of learning - Probability - Basics - Linear Algebra - Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, Bias and Variance - Regression: Linear Regression - Logistic Regression

UNIT IV SUPERVISED LEARNING 6

Neural Network: Introduction, Perceptron Networks - Adaline - Back propagation networks -Decision Tree: Entropy - Information gain - Gini Impurity - classification algorithm - Rule based Classification - Na"ive Bayesian classification - Support Vector Machines (SVM)

UNIT V UNSUPERVISED LEARNING 6

Unsupervised Learning - Principle Component Analysis - Neural Network: Fixed Weight Competitive Nets - Kohonen Self-Organizing Feature Maps - Clustering: Definition - Types of Clustering - Hierarchical clustering algorithms - k-means algorithm

TOTAL: 30 HOURS

PRACTICAL EXERCISES: 30 HOURS

Programs for Problem solving with Search

1. Implement breadth first search
2. Implement depth first search
3. Analysis of breadth first and depth first search in terms of time and space

4. Implement and compare Greedy and A* algorithms.

Supervised learning

1. Implement the non-parametric locally weighted regression algorithm in order to fit data points.
2. Select appropriate data set for your experiment and draw graphs
3. Write a program to demonstrate the working of the decision tree based algorithm.
4. Build an artificial neural network by implementing the back propagation algorithm and test the same using appropriate data sets.
5. Write a program to implement the na"ive Bayesian classifier.

Unsupervised learning

5. Implementing neural network using self-organizing maps
6. Implementing k-Means algorithm to cluster a set of data.
7. Implementing hierarchical clustering algorithm.

Note:

• Installation of gnu-prolog, Study of Prolog (gnu-prolog).

• The programs can be implemented in using C++/JAVA/ Python or appropriate tools can be used by designing good user interface

• Data sets can be taken from standard repositories

(https://archive.ics.uci.edu/ml/datasets.html) or constructed by the students.

COURSE OUTCOMES:

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

CO1 : Understand the foundations of Al and the structure of Intelligent Agents

CO2: Use appropriate search algorithms for any Al problem

CO3: Study of learning methods

CO4: Solving problem using Supervised learning

CO5: Solving problem using Unsupervised learning

TEXT BOOKS

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Fourth Edition, 2021
2. S.N.Sivanandam and S.N.Deepa, Principles of soft computing-Wiley lndia.3 rd ed,

REFERENCES

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. Bratko, "Prolog: Programming for Artificial lntelligencell, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
3. C. Muller & Sarah Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020

Course Code	ADVANCED STATISTICS AND DATA ANALYTICS	L	T	P	C
ME4V55		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To introduce the basic concepts of linear regression and multiple regression
- To introduce exploratory data analysis
- To study logistic regression models for classification
- To develop the forecasting techniques for the predictions
- To introduce the time series analysis for the prediction of future behave

UNIT I REGRESSION **9**

Introduction - Linear regression - Correlation analysis -Limitations, errors, and caveats of using regression and correlation analyses - Multiple regression and correlation analysis - Inferences about population parameters - Modeling techniques. - Coefficient of determination, Interpretation of regression coefficients, Categorical variables, heteroscedasticity, Multi-co linearity outliers, Ridge regression

UNIT II EXPLORATORY DATA ANALYSIS **9**

Rise of statistics, Data Wrangling, Data Quality. Visual encoding - Mapping Data to Visual Variables, Encoding Effectiveness, Scales & Axes, Aspect Ratio, Regression Lines, Multidimensional Data, Parallel Coordinates, Dimensionality Reduction.

UNIT III LOGISTIC AND MULTINOMIAL REGRESSION **9**

Logistic function, Estimation of probability using Logistic regression, Variance, Wald Test, Hosmer Lems how Test, Classification Table, Gini Co-efficient

UNIT IV FORECASTING AND CAUSAL MODELS **9**

Moving average, Exponential Smoothing, Casual Models

UNIT V TIME SERIES ANALYSIS **9**

Auto regression (AR), Moving Average (MA) Models, ARMA, ARIMA models, Multivariate Models

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO 1 Apply the fundamentals of CFD, and develop case specific governing equations.

CO 2 Discuss finite difference and finite volume-based analysis for steady and transient diffusion problems.

CO 3 Implement various mathematical schemes under finite volume method for convention diffusion.

CO 4 Solve complex problems in the field of fluid flow and heat transfer with the support of high-speed computers.

CO 5 Apply the various discretization methods, solution procedure and the concept of turbulence modelling.

TEXT BOOKS

1. Versteeg, H.K., and Malalasekera, W.,"An Introduction to Computational Fluid Dynamics": The finite volume Method, Pearson Education, 2014.
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REFERENCES

1. John. F. Wendt, "Computational Fluid Dynamics - An Introduction", Springer, 2013.

2. K. Muralidhar & T.Sundararajan, Computational Fluid Flow and Heat Transfer, Narora Publishing House, 1994.

3. Suhas V, Patankar, "Numerical Heat transfer and Fluid flow", Taylor & Francis, 2009.

4. Uriel Frisch, Turbulence, Cambridge University Press, 1999.Yogesh Jaluria & Kenneth E. Torrance, "Computational Heat Transfer'', CRC press, 2002.

Course Code	CAD AND CAE	L	T	P	C
ME4V56		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Applying the fundamental concepts of computer graphics and its tools in a generic framework.
- Creating and manipulating geometric models using curves, surfaces, and solids.
- Applying concept of 3D modeling, visual realism, and CAD standard practices in engineering design
- Developing mathematical models for Boundary Value Problems and their numerical solution.
- Formulating solution techniques to solve non-linear problems

UNIT I FUNDAMENTALS OF COMPUTER GRAPHICS 6

Design process - Computer Aided Design – Computer graphics – co-ordinate systems- 2D and 3D transformations - Graphic primitives (point, line, circle drawing algorithms) - Clipping- viewing transformation. Standards for computer graphics

UNIT II GEOMETRIC MODELING 6

Representation of curves - Hermite cubic spline curve, Bezier curve, B-spline curves, Surface Modeling – Surface Entities, Representation of Surface, Bezier Surface, B-Spline Surface and Coons Surface. Solid Modeling - Solid Entities, Solid Representation, Boundary Representation (B-Rep), Sweeps Representation, Constructive Solid Geometry (CSG)

UNIT III VISUAL REALISM and CAD STANDARDS 6

Need for hidden surface removal, The Depth - Buffer Algorithm, Properties that help in reducing efforts, Scan Line coherence algorithm, Span - Coherence algorithm, Area-Coherence Algorithms, Warnock's Algorithm, Priority Algorithms– shading – colouring – computer animation. Standards for computer - Graphical Kernel System (GKS) - standards for exchange images Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc

UNIT IV FINITE ELEMENT ANALYSIS 6

Historical Background – Weighted Residual Methods - Basic Concept of FEM – Variational Formulation of Boundary Value Problems – Ritz Method – Finite Element Modelling – Element

Equations – Linear and Higher order Shape functions – Bar, Beam Elements –Applications to Heat Transfer problems.

UNIT V NON-LINEAR ANALYSIS 6

Introduction to Non-linear problems - some solution techniques- computational procedure-material non-linearity-Plasticity and visco-plasticity, stress stiffening, contact interfaces-problems of gaps and contact - geometric non-linearity - modeling considerations - Free and Mapped meshing -Mesh quality- Error estimate- Introduction to Analysis Software.

TOTAL: 30 HOURS

CAD & CAE LABORATORY

Experiments

1. Design and animate Piston Cylinder assembly and motion study using CAD software.

2. Design and simulate Connecting rod and crank shaft using CAD software.

3. Design and simulate Two Cylinder Engine assembly using CAD software.

4. Coupled Simulation of structural /thermal analysis

5. Harmonic, Transient and spectrum analysis of simple systems.

6. Buckling analysis

OUTCOMES: At the end of the course, the students would be able to

1. Discuss the fundamental concepts of computer graphics and its tools in a generic framework.

2. Create and manipulate geometric models using curves, surfaces and solids.

3. Discuss concept of 3D modeling , visual realism and standard CAD practices in engineering design.

4. Develop the mathematical models for one dimensional finite element problems and their numerical solutions.

5. Formulate solution techniques to solve non-linear problems**.**

TEXT BOOKS

1. Ibrahim Zeid “Mastering CAD CAM” Tata McGraw-Hill Publishing Co.2007

2. Seshu.P, “Textbook of Finite Element Analysis”, PHI Learning Pvt. Ltd., NewDelhi, 2012.

REFERENCES

1. William M Neumann and Robert F. Sproul “Principles of Computer Graphics”, McGraw Hill Book Co. Singapore, 1989.
2. Donald Hearn and M. Pauline Baker “Computer Graphics”’. Prentice Hall, Inc, 1992.
3. Foley, Wan Dam, Feiner and Hughes – “Computer graphics principles & practice”, Pearson Education - 2003
4. Rao, S.S., “The Finite Element Method in Engineering”, 6th Edition, ButterworthHeinemann,2018.
5. Reddy,J.N. “Introduction to the Finite Element Method”, 4thEdition, Tata McGrawHill,2018.

Course Code	MACHINE LEARNING FOR INTELLIGENT SYSTEMS	L	T	P	C
ME4V57		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To introduce basic machine learning techniques such as regression, classification
- To learn about introduction of clustering, types and segmentation methods
- To learn about fuzzy logic, fuzzification and defuzzification
- To learn about basics of neural networks and neuro fuzzy networks.
- To learn about Recurrent neural networks and Reinforcement learning.

UNIT I INTRODUCTION TO MACHINE LEARNING 9

Philosophy of learning in computers, Overview of different forms of learning, Classifications vs. Regression, Evaluation metrics and loss functions in Classification, Evaluation metrics and loss functions in Regression, Applications of AI in Robotics.

UNIT II CLUSTERING AND SEGMENTATION METHODS 9

Introduction to clustering, Types of Clustering, Agglomerative clustering, K-means clustering, Mean Shift clustering, K-means clustering application study, Introduction to recognition, K-nearest neighbor algorithm, KNN Application case study, Principal component analysis (PCA), PCA Application case study in Feature Selection for Robot Guidance.

UNIT III FUZZY LOGIC 9

Introduction to Fuzzy Sets, Classical and Fuzzy Sets, Overview of Classical Sets, Membership Function, Fuzzy rule generation, Fuzzy rule generation, Operations on Fuzzy Sets, Numerical examples, Fuzzy Arithmetic, Numerical examples, Fuzzy Logic, Fuzzification, Fuzzy Sets, Defuzzification, Application Case Study of Fuzzy Logic for Robotics Application

UNIT IV NEURAL NETWORKS 9

Mathematical Models of Neurons, ANN architecture, Learning rules, Multi-layer Perceptrons, Back propagation, Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks, Application Case Study of Neural Networks in Robotics

UNIT V RNN AND REINFORCEMENT LEARNING 9

Unfolding Computational Graphs, Recurrent neural networks, Application Case Study of recurrent networks in Robotics, Reinforcement learning, Examples for reinforcement learning, Markov decision process, Major components of RL, Q-learning. Application Case Study of reinforcement learning in Robotics

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO 1 Understand basic machine learning techniques such as regression, classification
CO 2 Understand about clustering and segmentation
CO 3 Model a fuzzy logic system with fuzzification and defuzzification
CO 4 Understand the concepts of neural networks and neuro fuzzy networks.
CO 5 Gain knowledge on Reinforcement

TEXT BOOKS

1. Micheal Negnevitsky, Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition, Addision Wesley, England, 2011

REFERENCES

1. Bruno Siciliano, Oussama Khatib, “Handbook of Robotics”, 2016 2nd Edition, Springer
2. Simon Haykin, “Neural Networks and Learning Machines: A Comprehensive Foundation”, Third Edition, Pearson, delhi 2016.
3. Timothy J Ross, “Fuzzy Logic with Engineering Applications”, 4th Edition, Chichester, 2011, Sussex Wiley

Course Code	ADVANCED FINITE ELEMENT ANALYSIS	L	T	P	C
ME4V58		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To study concept of Finite Element Analysis to solve problems involving plate and shell elements
- To learn concept of Finite Element Analysis to solve problems involving geometric and material non linearity
- To study solution techniques to solve dynamic problems
- To study the concepts of Finite Element Analysis to solve fluid mechanics and heat transfer problems.
- To study error norms, convergence rates and refinement.

UNIT I BENDING OF PLATES AND SHELLS **9**

Review of Elasticity Equations – Bending of Plates and Shells – Finite Element Formulation of Plate and Shell Elements - Conforming and Non-Conforming Elements – C0 and C1 Continuity Elements –Degenerated shell elements-Application and Examples.

UNIT II NON-LINEAR PROBLEMS **9**

Introduction – Iterative Techniques – Material non-linearity – Elasto Plasticity – Plasticity – Visco Plasticity – Geometric Non linearity – large displacement Formulation –Solution procedure Application in Metal Forming Process and Contact Problems.

UNIT III DYNAMIC PROBLEM **9**

Direct Formulation – Free, Transient and Forced Response – Solution Procedures – Eigen solution-Sub space Iterative Technique – Response analysis - Houbolt, Wilson, Newmark–Methods – Explicit & Implict Methods-Lanchzos, Reduced method for large size system equations.

UNIT IV FLUID MECHANICS AND HEAT TRANSFER **9**

Governing Equations of Fluid Mechanics – Solid structure interaction - Inviscid and Incompressible Flow – Potential Formulations – Slow Non-Newtonian Flow – Metal and Polymer Forming–Navier Stokes Equation–Steady and Transient Solution.

UNIT V ERROR ESTIMATES AND ADAPTIVE REFINEMENT **9**

Error norms and Convergence rates–h-refinement with adaptivity – Adaptive refinement

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO 1 Apply concept of Finite Element Analysis to solve problems involving plate and shell elements
CO 2 Apply concept of Finite Element Analysis to solve problems involving geometric and material non linearity
CO 3 Formulate solution techniques to solve dynamic problems
CO 4 Apply concepts of Finite Element Analysis to solve fluid mechanics and heat transfer problems
CO 5 Investigate error norms, convergence rates and refinement.

REFERENCES

1. Bathe K.J., “Finite Element Procedures in Engineering Analysis”, Prentice Hall, 1990
2. Logan. D. L.,“A first course in Finite Element Method”, Cengage Learning, 2012
3. Reddy, J.N. “An Introduction to Non linear Finite Element Analysis”, 2nd Edition, Oxford, 2015
4. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, “Concepts and Applications of Finite Element Analysis”, 4th Edition, Wiley Student Edition, 2004
5. Tirupathi R. Chandrupatla and Ashok D. Belegundu, “Introduction to Finite Elements in
6. Engineering”, International Edition, Pearson EducationLimited,2014
7. Zienkiewicz, O. C., Taylor, R. L. and Zhu. J .Z. , “The Finite Element Method: Its Basis and Fundamentals”, 7th Edition, Butterworth-Heinemann,2013.

Course Code	SENSORS AND INSTRUMENTATION	L	T	P	C
ME4V61		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development
- To learn about the optical, pressure and temperature sensor
- To understand the signal conditioning and DAQ systems.

UNIT I INTRODUCTION **9**

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT II MOTION, PROXIMITY AND RANGING SENSORS **9**

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR)

UNIT III FORCE, MAGNETIC AND HEADING SENSORS **9**

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS **9**

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V SIGNAL CONDITIONING AND DAQ SYSTEMS **9**

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multichannel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO1: Recognize with various calibration techniques and signal types for sensors.

CO2: Describe the working principle and characteristics of force, magnetic, heading, pressure and temperature, smart and other sensors and transducers.

CO3: Apply the various sensors and transducers in various applications

CO4: Select the appropriate sensor for different applications.

CO5: Acquire the signals from different sensors using Data acquisition systems.

TEXT BOOKS

1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009
2. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, Dhanpat Rai & Co, 12th edition New Delhi, 2013

REFERENCES

1. C. Sujatha ... Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons, Canada, 2001
2. Hans Kurt Tönshoff (Editor), Ichiro, “Sensors in Manufacturing” Volume 1, Wiley-VCH April 2001.
3. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 1999
4. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2011
5. Richard Zurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press, 2015

Course Code	ELECTRICAL DRIVES AND CONTROL	L	T	P	C
ME4V62		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To familiarize a relay and power semiconductor devices
- To get a knowledge on drive characteristics
- To obtain the knowledge on DC motors and drives.
- To obtain the knowledge on AC motors and drives.
- To obtain the knowledge on Stepper and Servo motor.

UNIT I RELAY AND POWER SEMI-CONDUCTOR DEVICES 9

Study of Switching Devices – Relay and Types, Switching characteristics -BJT, SCR, TRIAC, GTO, MOSFET, IGBT and IGCT-: SCR, MOSFET and IGBT - Triggering and commutation circuit - Introduction to Driver and snubber circuits

UNIT II DRIVE CHARACTERISTICS 9

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, torque, and Direction starting & stopping – Selection of motor

UNIT III DC MOTORS AND DRIVES 9

DC Servomotor - Types of PMDC & BLDC motors - principle of operation- emf and torque equations - characteristics and control – Drives- H bridge - Single and Three Phases – 4 quadrant operation – Applications

UNIT IV AC MOTORS AND DRIVES 9

Introduction – Induction motor drives – Speed control of 3-phase induction motor – Stator voltage control – Stator frequency control – Stator voltage and frequency control – Stator current control – Static rotor resistance control – Slip power recovery control

UNIT V STEPPER AND SERVO MOTOR 9

Stepper Motor: Classifications- Construction and Principle of Operation – Modes of Excitation Drive System-Logic Sequencer - Applications. Servo Mechanism – DC Servo motor-AC Servo motor – Applications.

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO 1: Recognize the principles and working of relays, drives and motors.

CO 2: Explain the working and characteristics of various drives and motors.

CO 3: Apply the solid state switching circuits to operate various types of Motors and Drivers
CO 4: Interpret the performance of Motors and Drives.
CO 5: Suggest the Motors and Drivers for given applications

TEXT BOOKS

1. Bimbhra B.S., "Power Electronics", 5th Edition, Kanna Publishers, New Delhi, 2012
2. Mehta V.K. & Rohit Mehta, "Principles of Electrical Machines", 2nd Edition, S.Chand& Co. Ltd., New Delhi, 2016

REFERENCES

1. Gobal K. Dubey, "Fundamentals of Electrical Drives", 2nd Edition, Narosal Publishing House, New Delhi, 2001
2. Theraja B.L. &Theraja A.K., "A Text Book of Electrical Technology", 2nd Edition, S.Chand & Co. Ltd., New Delhi, 2012
3. Singh M.D. & Kanchandhani K.B., "Power Electronics", McGraw Hill, New Delhi, 2007

Course Code	EMBEDDED SYSTEMS AND PROGRAMMING	L	T	P	C
ME4V63		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To familiarize the architecture and fundamental units of microcontroller.
- To know the microcontroller programming methodology and to acquire the interfacing skills and data exchange methods using various communication protocols.
- To design the interface circuit and programming of I/O devices, sensors and actuators.
- To understand ARM processor architecture and its functions to meet out the computational and interface needs of growing mechatronic systems.
- To acquaint the knowledge of real time embedded operating system for advanced system Developments

UNIT I INTRODUCTION TO MICROCONTROLLER 6

Fundamentals Functions of ALU - Microprocessor - Microcontrollers – CISC and RISC – Types Microcontroller - 8051 Family - Architecture - Features and Specifications - Memory Organization - Instruction Sets – Addressing Modes.

UNIT II PROGRAMMING AND COMMUNICATION 6

Fundamentals of Assembly Language Programming – Instruction to Assembler – Compiler and IDE - C Programming for 8051 Microcontroller – Basic Arithmetic and Logical Programming - Timer and Counter - Interrupts – Interfacing and Programming of Serial Communication, I2C, SPI and CAN of 8051 Microcontroller – Bluetooth and WI-FI interfacing of 8051 Microcontroller

UNIT III PERIPHERAL INTERFACING 6

I/O Programming – Interfacing of Memory, Key Board and Displays – Alphanumeric and Graphic, RTC, interfacing of ADC and DAC, Sensors - Relays - Solenoid Valve and Heater - Ste pper Motors, DC Motors - PWM Programming – Closed Loop Control Programming of Servomotor – Traffic Light

UNIT IV ARM PROCESSOR 6

Introduction ARM 7 Processor - Internal Architecture – Modes of Operations – Register Set – Instruction Sets – ARM Thumb - Thumb State Registers – Pipelining – basic programming of ARM 7 – Applications

UNIT V SINGLE BOARD COMPUTERS AND PROGRAMMING 6

System on Chip - Broadcom BCM2711 SoC – SBC architecture - Models and Languages – Embedded Design – Real Time Embedded Operating Systems - Real Time Programming Languages -– Python for Embedded Systems- GPIO Programming – Interfacing

TOTAL: 30 HOURS

LIST OF EXPERIMENTS

1. Assembly Language Programming and Simulation of 8051.
2. Alphanumeric and Graphic LCD Interfacing using 8051 Microcontroller.
3. Input switches and keyboard interfacing of 8051.
4. Sensor Interfacing with ADC to 8051 and DAC & RTC Interfacing with 8051. .
5. Timer, Counter and Interrupt Program Application for 8051.
6. Step Motor (Unipolar & Bipolar Motor) and PWM Servo Motor Control to Interfacing with 8051.
7. UART Serial and Parallel Port Programming of 8051.I2C, SPI and CAN Programming of 8051.
8. Interfacing and Programming of Bluetooth and Wi-Fi with 8051
9. Programming of ARM Processor for Sensor Interface.
10. Stepper Motor and Servo Motor Control Using ARM Processor.
11. Serial Communication of ARM Processor with Computation Platform.
12. Wireless Communication of ARM Processor with Computation Platform.
13. GPIO Programming of Real Time Embedded Operating Systems.
14. IOT application using SBC.

(Any 7 experiments) **TOTAL: 30 HOURS**

COURSE OUTCOMES:

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

CO 1: Know the various functional units of microcontroller, processors and system-on-chip based on the features and specifications.

CO 2: Recognize the role of each functional units in microcontroller, processors and system-on-chip based on the features and specifications.

CO 3: Interface the sensors, actuators and other I/O's with microcontroller, processors and system on chip based interfacing

CO4: Design the circuit and write the programming microcontroller, processors and system on chip

CO 5: Develop the applications using Embedded system

TEXT BOOKS

1. Frank Vahid and Tony Givagis, "Embedded System Design", 2011, Wiley.
2. Kenneth J. Aylala, "The 8051 Microcontroller, the Architecture and Programming Applications", 2003

REFERENCES

1. Muhammad Ali Mazidi and Janice GillispicMazdi, "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2006.
2. 2. Simon Monk, Programming the Raspberry Pi, Second Edition: Getting Started with Python McGraw Hill TAB; 2nd edition,2015
3. 3. James W. Stewart, "The 8051 Microcontroller Hardware, Software and Interfacing", Regents Prentice Hall, 2003.
4. John B. Peatman, "Design with Microcontrollers", McGraw Hill International, USA, 200

Course Code	HYDRAULICS AND PNEUMATICS	L	T	P	C
ME4V64		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To provide the knowledge on the working principles of fluid power systems.
- To study the fluids and components used in modern industrial fluid power system.
- To develop the design, construction and operation of fluid power circuits.
- To learn the working principles of pneumatic power system and its components.
- To provide the knowledge of trouble shooting methods in fluid power systems.

COURSE DESCRIPTION

Hydraulics and Pneumatics is a foundational engineering course that introduces students to the principles, components, and applications of fluid power systems. The course covers topics related to hydraulic and pneumatic systems, including fluid properties, pumps, valves, actuators, circuits, and control mechanisms. Students learn about fluid power transmission, energy conversion, system design, troubleshooting, maintenance, and safety aspects of hydraulic and pneumatic systems.

PREREQUISITES

- Basic knowledge of physics, mechanics, and engineering principles
- Familiarity with fluid mechanics concepts (e.g., pressure, flow, energy, Bernoulli's equation)
- Understanding of mechanical systems, components, and terminology

UNIT I FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS 9

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque- Problems, Sources of Hydraulic power: Pumping Theory-– Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of pumps – Fixed and Variable displacement pumps – Problems.

UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Rotary Actuators-Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Accessories: Reservoirs, Pressure Switches – Filters –types and selection- Applications – Fluid Power ANSI Symbols – Problems

UNIT III HYDRAULIC CIRCUITS AND SYSTEMS 9

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double- Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Deceleration circuits, Sizing of hydraulic systems, Hydrostatic transmission, Electro hydraulic circuits, –Servo and Proportional valves – Applications- Mechanical, hydraulic servo systems.

UNIT IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9

Properties of air –Air preparation and distribution – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit –classification- single cylinder and multi cylinder circuits-Cascade method –Integration of fringe circuits, Electro Pneumatic System – Elements Ladder diagram – timer circuits-Problems, Introduction to fluidics and pneumatic logic circuits

UNIT V TROUBLE SHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications- mobile hydraulics; Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits. – Low-cost Automation – Hydraulic and Pneumatic power packs, IOT in Hydraulics and pneumatics.

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

- **CO1** Apply the working principles of fluid power systems and hydraulic pumps.
- **CO2** Apply the working principles of hydraulic actuators and control components.
- **CO3** Design and develop hydraulic circuits and systems.
- **CO4** Apply the working principles of pneumatic circuits and power system and its components.
- **CO5** Identify various troubles shooting methods in fluid power systems.

TEXT BOOKS

1. Anthony Esposito, “Fluid Power with Applications”, Prentice Hall, 2009.
2. James A. Sullivan, “Fluid Power Theory and Applications”, Fourth Edition, Prentice Hall, 1997

REFERENCES

1. Jagadeesha. T., “Pneumatics Concepts, Design and Applications “, Universities Press, 2015.
2. Joshi.P., Pneumatic Control”, Wiley India, 2008.
3. Majumdar, S.R., “Oil Hydraulics Systems – Principles and Maintenance”, Tata Mc Graw Hill, 2001.
4. Shanmugasundaram.K., “Hydraulic and Pneumatic Controls”. Chand & Co, 2006.
5. Srinivasan.R., “Hydraulic and Pneumatic Controls”, Vijay Nicole Imprints, 3rd edition,2019.

YOUTUBE RESOURCES:

1. **Hydraulic Basics by Learn Engineering:** This video provides a clear introduction to hydraulic systems, including principles, components, and applications.
2. **Pneumatics Basics by RealPars:** RealPars offers a series of videos covering the basics of pneumatics, including components, circuits, and operation.
3. **Hydraulics and Pneumatics Playlist by SDC Publications:** SDC Publications provides a playlist covering various topics in hydraulics and pneumatics, including circuits, symbols, and components.
4. **Hydraulic Systems and Components by Aftab Khan:** Aftab Khan's channel offers detailed explanations of hydraulic systems, components, and working principles

Course Code	SMART MOBILITY AND INTELLIGENT VEHICLES	L	T	P	C
ME4V65		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To introduce students to the various technologies and systems used to implement smart mobility and intelligent vehicles.
- To learn Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, LIDAR Sensor Technology and Systems and other sensors for automobile vision system.
- To learn Basic Control System Theory applied to Autonomous Automobiles.
- To produce overall impact of automating like various driving functions, connecting the automobile to sources of information that assist with a task
- To allow the automobile to make autonomous intelligent decisions concerning future actions of the vehicle that potentially impact the safety of the occupants through connected car & autonomous vehicle technology.

UNIT I INTRODUCTION TO AUTOMATED, CONNECTED, AND INTELLIGENT VEHICLES 9

Concept of Automotive Electronics, Electronics Overview, History & Evolution, Infotainment, Body, Chassis, and Powertrain Electronics, Introduction to Automated, Connected, and Intelligent Vehicles. Case studies: Automated, Connected, and Intelligent Vehicles

UNIT II SENSOR TECHNOLOGY FOR SMART MOBILITY 9

Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems

UNIT III CONNECTED AUTONOMOUS VEHICLE 9

Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data Networks and Autonomy

UNIT IV VEHICLE WIRELESS TECHNOLOGY & NETWORKING 9

Wireless System Block Diagram and Overview of Components, Transmission Systems – Modulation/Encoding, Receiver System Concepts– Demodulation/Decoding, Wireless Networking and Applications to Vehicle Autonomy, Basics of Computer Networking – the Internet of Things, Wireless Networking Fundamentals, Integration of Wireless Networking and On-Board Vehicle Networks

UNIT V CONNECTED CAR & AUTONOMOUS VEHICLE TECHNOLOGY 9

Connectivity Fundamentals, Navigation and Other Applications, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Autonomous Vehicles - Driverless Car Technology, Moral, Legal, Roadblock Issues, Technical Issues, Security Issues

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO1: Recognize the concept of cyber-physical control systems and their application to collision avoidance and autonomous vehicles

CO2: Select the concept of remote sensing and the types of sensor technology needed to implement remote sensing

CO3: Familiar with the concept of fully autonomous vehicles

CO4: Apply the basic concepts of wireless communications and wireless data networks

CO 5: Analyse the concept of the connected vehicle and its role in automated vehicles.

TEXT BOOKS

1. Intelligent Transportation Systems and Connected and Automated Vehicles, 2016,Transportation Research Board

2. Radovan Miucic, Connected Vehicles: Intelligent Transportation Systems", 2019, Springer

REFERENCES

1. Tom Denton, "Automobile Electrical and Electronic systems, Roultedge", Taylor & Francis Group,5th Edition,2018.

Course Code	MECHATRONICS and IoT	L	T	P	C
ME4V66		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To make students get acquainted with the sensors and the actuators, which are commonly used in mechatronics systems.
- To provide insight into the signal conditioning circuits, and also to develop competency in PLC programming and control
- To make students familiarize with the fundamentals of IoT and Embedded systems.
- To impart knowledge about the Arduino and the Raspberry Pi.
- To inculcate skills in the design and development of mechatronics and IoT based systems.

UNIT – I SENSORS AND ACTUATORS 9

Introduction to Mechatronics - Modular Approach, Sensors and Transducers: Static and Dynamic Characteristics, Transducers - Resistive, Capacitive, Inductive and Resonant, Optical Sensors – Photodetectors - Vision Systems – Laser - Fibre optic - Non-fibre Optic, Solid State Sensors, Piezoelectric and Ultrasonic Sensors. Actuators – Brushless Permanent Magnet DC Motor – PM, VR and Hybrid Stepper motors – DC and AC Servo Motors

UNIT – II SIGNAL CONDITIONING CIRCUITS AND PLC 9

Operational Amplifiers – Inverting and Non-Inverting Amplifier – Wheatstone bridge Amplifier – Instrumentation Amplifier – PID Controller, Protection Circuits, Filtering Circuits, Multiplexer, Data Logger and Data Acquisition System –, Switching Loads by Power Semiconductor Devices Circuits – Thyristors – TRIAC – Darlington Pair –MOSFET and Relays.

PLC – Architecture – Input / Output Processing – Logic Ladder Programming – Functional Block Programming using Timers and Counters – Applications.

UNIT – III FUNDAMENTALS OF IoT AND EMBEDDED SYSTEMS 9

The Internet of Things (IoT) - Introduction to the IoT Framework – IoT Enabling Technologies- The Effective Implementation of IoT: The Detailed Procedure. Embedded Systems: An Introduction - Single-Chip Microcontroller Systems - Single-Board Microcontroller Systems - Single-Board Computer Systems - Embedded Systems: Peripherals - Software Considerations

UNIT – IV CONTROLLERS 9

Foundation topics: Programming Languages: C++ and Python - The Linux Operating System. Arduino: The Arduino Boards - Arduino Peripherals- Arduino IDE – ESP8266 Wi-Fi module. Raspberry Pi: The Raspberry Pi Boards - The Raspberry Pi Peripherals - The Raspberry Pi Operating System. (typical peripherals) Interfacing and Controlling I/O devices by Arduino and Raspberry Pi: LEDs - Push buttons - Light intensity sensor - Ultrasonic distance sensor – Temperature sensor- Humidity sensor - Sensor and Actuator interactions

UNIT – V MECHATRONICS AND IoT CASE STUDIES 9

Mechatronics systems: Drone actuation and Control -Autonomous Robot with Vision System, Automotive Mechatronics: Electronic Ignition System - ABS - EBD - Adaptive Cruise Control. IoT case studies: Remote Monitoring Systems- Remotely Operated Autonomous Systems - Centralized Water Management System - IoT

Enabled Robotic Camera Dolly - Portable, Wireless, Interactive IoT Sensors for Agriculture - IoT Vehicle Management System with Network Selection.

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO1 Explain Select suitable sensors and actuators to develop mechatronics systems.

CO2 Discuss Devise proper signal conditioning circuit for mechatronics systems, and also able to implement PLC as a controller for an automated system.

CO3 Elucidate the fundamentals ofIot and Embedded Systems

CO4 Discuss Control I/O devices through Arduino and Raspberry Pi.

CO5 Design and develop an apt mechatronics/IoT based system for the given real-time application.

TEXT BOOKS

1. Bradley D.A., Burd N.C., Dawson D., Loader A.J., "Mechatronics: Electronics in Products and Processes", Routledge, 2017.
2. Sami S.H and Kisheen Rao G "The Internet of Mechanical Things: The IoT Framework for Mechanical Engineers", CRC Press, 2022.

REFERENCES

1. John Billingsley, "Essentials of Mechatronics", Wiley, 2006
2. David H., Gonzalo S., Patrick G.,Rob B. and Jerome H.,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Pearson Education, 2018.
3. Nitin G and Sharad S, "Internet of Things: Robotic and Drone Technology", CRC Press, 2022
4. Newton C. Braga, "Mechatronics for The Evil Genius", McGrawHill, 2005.
5. Bell C., "Beginning Sensor Networks with Arduino and Raspberry Pi", Apress, 2013

Course Code	DRONE TECHNOLOGIES	L	T	P	C
ME4V67		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To understand the basics of drone concepts
- To learn and understand the fundaments of design, fabrication and programming of drone
- To impart the knowledge of an flying and operation of drone
- To know about the various applications of drone
- To understand the safety risks and guidelines of fly safely

UNIT I INTRODUCTION TO DRONE TECHNOLOGY 9

Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability.

UNIT II DRONE DESIGN, FABRICATION AND PROGRAMMING 9

Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.

UNIT III DRONE FLYING AND OPERATION 9

Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment Drone controls Flight operations –management tool –Sensors-Onboard storage capacity - Removable storage devices- Linked mobile devices and applications.

UNIT IV DRONE COMMERCIAL APPLICATIONS 9

Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing.

UNIT V FUTURE DRONES AND SAFETY 9

The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones - The use of drones in swarms

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO1: Know about a various type of drone technology, drone fabrication and programming.

CO2: Execute the suitable operating procedures for functioning a drone

CO3: Select appropriate sensors and actuators for Drones

CO4: Develop a drone mechanism for specific applications

CO5: Create the programs for various drones.

TEXT BOOKS

1. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", 2021 John Wiley & Sons, Inc.

2. Terry Kilby and Belinda Kilby, "Make: Getting Started with Drones ",Maker Media, Inc, 2016

REFERENCES

1. John Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs", Que Publishing, 2016

2. Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2018.

Course Code	AUTOMATION IN MANUFACTURING	L	T	P	C
ME4V68		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

1. To give a brief exposure to automation principles and control technologies.
2. To introduce the concept of fixed automation using transfer lines.
3. To train the students in the programmable automation such as CNC and industrial robotics.
4. To provide knowledge on the use of automated material handling, storage and data capture

UNIT I MANUFACTURING OPERATIONS 9

Automation in production systems, principles and strategies, Product/production relationships, Production concepts and mathematical models, manufacturing economics.

UNIT II CONTROL TECHNOLOGIES 9

Automated systems – elements, functions, levels, Continuous Vs discrete control, Computer process control, Sensors, Actuators, ADC, DAC, Programmable logic controllers – ladder logic diagrams.

UNIT III TRANSFER LINES 9

Automated production lines – applications, Analysis – with and without buffers, automated assembly systems, line unbalancing concept.

UNIT IV NUMERICAL CONTROL AND ROBOTICS 9

NC - CNC – Part programming – DNC – Adaptive control – Robot anatomy – Specifications –End effectors – Industrial applications.

UNIT V AUTOMATED HANDLING AND STORAGE 9

Automated guided vehicle systems, AS/RS, Carousel storage, Automatic data capture - Bar code technology

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO1: Ability to understand the requirements of automation in manufacturing systems.

CO2: Knowledge in the techniques of machinery automation, shop floor automation.

CO3: Selection of material handling systems for automated industries.

CO4: Gaining basic knowledge in CAD systems.

CO5: Explore how IIoT technologies can enhance data collection, monitoring, and control in manufacturing processes.

TEXT BOOKS

1. Mikell P.Groover, Automation, “Production Systems and Computer Integrated Manufacturing”, PHI, 2008.

REFERENCES

1. John Baichtal, “Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs”, Que Publishing, 2016
2. Zavrsnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance”, Springer, 2018.

Course Code	QUALITY CONTROL	L	T	P	C
ME4V71		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To introduce the concept of SQC
- To understand process control and acceptance sampling procedure and their application.
- To learn the concept of reliability.

UNIT I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES 9

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality cost-Variation in process causes of variation – Theory of control chart- uses of control chart –X chart, R chart and chart - process capability – process capability studies and simple problems. Six sigma concepts

UNIT II PROCESS CONTROL FOR ATTRIBUTES 9

Control chart for attributes –control chart for non-conforming– p chart and np chart – control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern

UNIT III ACCEPTANCE SAMPLING 9

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans

UNIT IV LIFE TESTING – RELIABILITY 9

Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves

UNIT V QUALITY AND RELIABILITY 9

Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development–Product life cycles. Note: Use of approved statistical table permitted in the examination

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO1 Summarize the concept of Quality and Process control for variables

CO2 Apply the process control for attributes

CO3 Explain the concept of sampling and to solve problems

CO4 Explain the concept of Life testing

CO5 Explain the concept Reliability and techniques involved.

TEXT BOOKS

1. Douglas.C. Montgomery, "Introduction to Statistical quality control", 7th edition, John Wiley 2012.
2. Srinath. L.S., "Reliability Engineering", Affiliated East west press, 2008.

REFERENCES

1. Besterfield D.H., "Quality Control", Prentice Hall, 2013.
2. Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 2012
3. Danny Samson, "Manufacturing & Operations Strategy", Prentice Hall, 1991
4. Grant, Eugene .L "Statistical Quality Control", McGraw-Hill, 2017
5. Gupta. R.C, "Statistical Quality control", Khanna Publishers, 2001

Course Code	TOTAL QUALITY MANAGEMENT	L	T	P	C
ME4V72		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Understand the Principles and Concepts of Total Quality Management (TQM)
- Analyze Quality Improvement Tools and Techniques
- Evaluate the Role of Leadership and Organizational Culture in TQM
- Develop Strategies for Customer Satisfaction and Quality Assurance
- Implement and Monitor TQM Practices in an Organization

UNIT I INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

UNIT II TQM PRINCIPLES **9**

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I **9**

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II **9**

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs – Performance measures

UNIT V QUALITY MANAGEMENT SYSTEM **9**

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 - Requirements—Implementation - Documentation—Internal Audits—Registration--ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO 1 Understanding of Quality Management Principles and Frameworks:

CO 2 Application of TQM Principles in Organizational Contexts:

CO 3 Proficiency in TQM Tools and Techniques:

CO 4 Implementation and Management of Quality Systems:

CO 5 Integration of Environmental and Quality Management Systems:

TEXT BOOKS

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

REFERENCES

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality",8 th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006. ISO 9001-2015 standards

Course Code	PRINCIPLES OF MANAGEMENT	L	T	P	C
ME4V73		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Comprehend the fundamental functions of management, including planning, organizing, leading, and controlling.
- Evaluate the evolution of management thought and how contemporary practices are influenced by historical perspectives.
- Learn to formulate strategic plans and make informed decisions that align with organizational goals.
- Explore the principles of organizational behavior, including motivation, communication, and team development.
- Engage in case studies, simulations, and projects that involve real-world management challenges and scenarios, fostering the ability to manage effectively in diverse environments.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management

UNIT IV DIRECTING 9

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication – communication and IT

UNIT V CONTROLLING 9

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO 1 Understanding Management Fundamentals and Organizational Contexts:
CO 2 Competence in Strategic Planning and Decision-Making:
CO 3 Skills in Organizing and Resource Management
CO 4 Ability to Direct and Motivate Teams:
CO 5 Proficiency in Control and Performance Evaluation Techniques:

TEXT BOOKS

1. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson Education, 2004.
2. Stephen P. Robbins & Mary Coulter, "Management", Prentice Hall (India)Pvt. Ltd., 10 th Edition, 2009.

REFERENCES

1. Harold Koontz & Heinz Weihrich, "Essentials of Management", Tata McGraw Hill, 1998.
2. Robert Kreitner & Mamata Mohapatra, "Management", Biztantra, 2008.
3. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management", 7 th Edition, Pearson Education, 2011.
4. Tripathy PC & Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999

Course Code	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
ME4V74		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Understand the strategic planning process and how to develop strategies for business growth and sustainability.
- Study methods for identifying and evaluating business opportunities.
- Develop skills to assess the feasibility and viability of new business ideas and ventures.
- Understand various sources of funding for start-ups, including venture capital, angel investors, and crowd funding.
- Learn the principles of financial management, budgeting, and financial planning for new enterprises.

UNIT I ENTREPRENEURAL COMPETENCE **9**

Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality - Characteristics of Successful Entrepreneurs – Knowledge and Skills of an Entrepreneur

UNIT II ENTREPRENEURAL ENVIRONMENT **9**

Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support Organizational Services - Central and State Government Industrial Policies and Regulations

UNIT III BUSINESS PLAN PREPARATION **9**

Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product - Ownership - Capital Budgeting- Project Profile Preparation - Matching Entrepreneur with the Project - Feasibility Report Preparation and Evaluation Criteria.

UNIT IV LAUNCHING OF SMALL BUS **9**

Finance and Human Resource Mobilisation - Operations Planning - Market and Channel Selection - Growth Strategies - Product Launching – Incubation, Venture capital, Start-ups

UNIT V MANAGEMENT OF SMALL BUSINESS **9**

Monitoring and Evaluation of Business - Business Sickness - Prevention and Rehabilitation of Business Units - Effective Management of small Business - Case Studies.

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO 1 The learners will gain entrepreneurial competence to run the business efficiently.
CO 2 The learners are able to undertake businesses in the entrepreneurial environment.
CO 3 The learners are capable of preparing business plans and undertake feasible projects.
CO 4 The learners are efficient in launching and develop their business ventures successfully
CO 5 The learners shall monitor the business effectively towards growth and development:

REFERENCES

1. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, NewDelhi,2016.
2. R.D.Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2018.
3. Rajeev Roy ,Entrepreneurship, Oxford University Press, 2nd Edition, 2011.
4. Donald F Kuratko,T.V Rao. Entrepreneurship: A South Asian perspective. CengageLearning, 2012.
5. Dr. Vasant Desai, "Small Scale Industries and Entrepreneurship", HPH, 2006.
6. Arya Kumar. Entrepreneurship, Pearson, 2012.
7. Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill, 8th edition, 2017

Course Code	INDUSTRIAL ENGINEERING	L	T	P	C
ME4V75		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To introduce the fundamental concepts and history of Industrial Engineering.
- To teach the tools and techniques of operations research used in problem-solving.
- To understand the design and management of manufacturing systems.
- To explore human factors and ergonomics in the engineering process.
- To apply quality control methods in industrial settings.

UNIT I INTRODUCTION TO INDUSTRIAL ENGINEERING 9

History and Evolution of Industrial Engineering- Roles and Responsibilities of Industrial Engineers Systems Approach to Problem Solving.

UNIT II OPERATIONS RESEARCH 9

Linear Programming: Models and Applications- Queuing Theory: Models and Analysis- Simulation Techniques: Applications in Industrial Engineering.

UNIT III MANUFACTURING SYSTEMS 9

Design and Analysis of Manufacturing Systems- Production Planning and Inventory Control - Facility Layout and Location Planning.

UNIT IV HUMAN FACTORS ENGINEERING 9

Ergonomics and Workstation Design-Human-Machine Interaction-Safety Management Systems.

UNIT V QUALITY CONTROL 9

Fundamentals of Quality Control-Statistical Quality Control Techniques-Total Quality Management

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO 1 Understand and apply the fundamental principles and tools of Industrial Engineering.

CO 2 Utilize operations research methodologies to optimize solutions in various industrial scenarios.

CO 3 Design efficient and effective manufacturing systems and processes.

CO 4 Address ergonomic and safety concerns in industrial settings

CO 5 Implement and manage quality control systems to maintain standards

TEXT BOOKS

1. Khanna, O. P. (2014). Industrial Engineering and Management. Dhanpat Rai Publications.
2. Turner, W. C., Mize, J. H., Case, K. E., & Nazemtz, J. W. (1993). Introduction to Industrial and Systems Engineering. Prentice Hall.

REFERENCES

1. Taha, H. A. (2017). Operations Research: An Introduction. Pearson Education.
2. Buffa, E. S., & Sarin, R. K. (1987). Modern Production/Operations Management. Wiley.

Course Code	SUSTAINABLE MANAGEMENT	L	T	P	C
ME4V76		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Learn the basic concepts and importance of sustainability in business.
- Gain knowledge on how to implement sustainable and ethical practices in business operations.
- Learn to assess and report on sustainability performance using global standards.
- Acquire skills to formulate and implement sustainability strategies in organizations.
- Study case studies to understand practical applications and outcomes of sustainable management.

UNIT I INTRODUCTION TO SUSTAINABLE MANAGEMENT 9

Definition and concept of sustainability- Triple bottom line approach- Sustainable development goals

UNIT II SUSTAINABLE BUSINESS PRACTICES 9

Environmental management and green marketing- Corporate social responsibility- Ethical sourcing and sustainability in the supply chain

UNIT III SUSTAINABILITY REPORTING AND PERFORMANCE 9

Tools and techniques for sustainability assessment- Global reporting initiatives, Carbon disclosure project- Life cycle assessment

UNIT IV STRATEGIES FOR SUSTAINABLE BUSINESS 9

Policy frameworks for sustainability- Strategic sustainability planning- Stakeholder engagement and communication

UNIT V CASE STUDIES IN SUSTAINABILITY 9

Success stories of sustainable management in corporations- Innovation and sustainable business models- Emerging trends in sustainable management

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO 1 Understand the basic concepts of sustainability and its applications in business.

CO 2 Implement sustainable practices effectively within business operations..

CO 3 Evaluate and report sustainability performance using recognized frameworks.

CO 4 Develop strategic approaches to integrate sustainability into business policies

CO 5 Analyse case studies to understand the impact and implementation of sustainability in business.

TEXT BOOKS

1. Young, S. T., & Dhanda, K. K. (2013). Sustainability: Essentials for Business. SAGE Publications, Inc.
2. Chandler, D. (2016). Sustainable Management: Leadership Ethics. Routledge.

REFERENCES

1. Weybrecht, G. (2010). The Sustainable MBA: The Manager's Guide to Green Business. Wiley.
2. Camilleri, M. A. (2017). Corporate Sustainability, Social Responsibility and Environmental Management. Springer.

Course Code	METROLOGY AND MEASUREMENTS	L	T	P	C
ME4V77		2	0	2	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- To learn basic concepts of the metrology and importance of measurements.
- To teach measurement of linear and angular dimensions assembly and transmission elements.
- To study the tolerance analysis in manufacturing.
- To develop the fundamentals of GD & T and surface metrology.
- To provide the knowledge of the advanced measurements for quality control in manufacturing industries.

UNIT I BASICS OF METROLOGY **6**

Measurement – Need, Process, Role in quality control; Factors affecting measurement - SWIPE; Errors in Measurements – Types – Control – Measurement uncertainty – Types, Estimation, Problems on Estimation of Uncertainty, Statistical analysis of measurement data, Measurement system analysis, Calibration of measuring instruments, Principle of air gauging- ISO standards..

UNIT II MEASUREMENT OF LINEAR, ANGULAR DIMENSIONS, ASSEMBLY AND TRANSMISSION ELEMENTS **6**

Linear Measuring Instruments – Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, Bore gauge, Telescoping gauge; Gauge blocks – Use and precautions, Comparators – Working and advantages; Opto-mechanical measurements using measuring microscope and Profile projector - Angular measuring instruments – Bevel protractor, Clinometer, Angle gauges, Precision level, Sine bar, Autocollimator, Angle dekkor, Alignment telescope. Measurement of Screw threads - Single element measurements – Pitch Diameter, Lead, Pitch. Measurement of Gears – purpose – Analytical measurement – Runout, Pitch variation, Tooth profile, Tooth thickness, Lead – Functional checking – Rolling gear test.

UNIT III TOLERANCE ANALYSIS **6**

Tolerancing– Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables IS919); Design of Limit gauges, Problems. Tolerance analysis in manufacturing, Process capability, tolerance stackup, tolerance charting.

UNIT IV METROLOGY OF SURFACES **6**

Fundamentals of GD & T- Conventional vs Geometric tolerance, Datums, Inspection of geometric deviations like straightness, flatness, roundness deviations; Simple problems – Measurement of Surface finish – Functionality of surfaces, Parameters, Comparative, Stylus based and Optical Measurement techniques, Filters, Introduction to 3D surface metrology- Parameters.

UNIT V ADVANCES IN METROLOGY **6**

Lasers in metrology - Advantages of lasers – Laser scan micrometers; Laser interferometers – Applications – Straightness, Alignment; Ball bar tests, Computer Aided Metrology - Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Multisensor CMMs. Machine Vision - Basic concepts of Machine Vision System – Elements – Applications - On-line and in process monitoring in production - Computed tomography – White light Scanners

TOTAL: 30 HOURS

LIST OF EXPERIMENTS

1.Calibration and use of linear measuring instruments – Vernier caliper, micrometer, Vernier height gauge, depth micrometer, bore gauge, telescopic gauge, Comparators.

2. Measurement of angles using bevel protractor, sine bar, autocollimator, precision level.

3. Measurement of assembly and transmission elements - screw thread parameters – Screw thread Micrometers, Three wire method, Toolmaker's microscope.

4. Measurement of gear parameters – Micrometers, Vernier caliper, Gear tester.

5. Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM), Programming of CNC Coordinate Measuring Machines for repeated measurements of identical components.

6. Non-contact (Optical) measurement using Measuring microscope / Profile projector and Video measurement system.

7. Surface metrology - Measurement of form parameters – Straightness, Flatness, Roundness, Cylindricity, Perpendicularity, Runout, Concentricity – in the given component using Roundness tester.

8. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus based instruments**.**

TOTAL: 30 HOURS

COURSE OUTCOMES:

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

CO 1 Discuss the concepts of measurements to apply in various metrological instruments.

CO 2 Apply the principle and applications of linear and angular measuring instruments, assembly

and transmission elements.

CO 3 Apply the tolerance symbols and tolerance analysis for industrial applications.

CO 4 Apply the principles and methods of form and surface metrology.

CO 5 Apply the advances in measurements for quality control in manufacturing Industries.:

TEXT BOOKS

1. Dotson Connie, "Dimensional Metrology", Cengage Learning, First edition, 2012. 2. Mark Curtis, Francis T. Farago, "Handbook of Dimensional Measurement", Industrial Press, Fifth edition, 2013.

REFERENCES

1. Ammar Grous, J "Applied Metrology for Manufacturing Engineering", Wiley-ISTE, 2011.
2. Galyer, J.F.W. Charles Reginald Shotbolt, "Metrology for Engineers", Cengage Learning EMEA; 5th revised edition, 1990.
3. National Physical Laboratory GuideNo. 40, No. 41, No. 42, No. 43, No. 80, No. 118, No. 130, No. 131. http://www.npl.co.uk.
4. Raghavendra N.V. and Krishnamurthy. L., Engineering Metrology and Measurements, Oxford University Press, 2013.

Venkateshan, S. P., "Mechanical Measurements", Second edition, John Wiley &Sons, 2015.

Course Code	MATERIAL HANDLING EQUIPMENT, REPAIR AND MAINTENANCE	L	T	P	C
ME4V78		3	0	0	3

COURSE OBJECTIVES

The objective of this course is to enable the student to:

- Gain foundational knowledge of material handling principles, system approaches, and problem analysis techniques
- Acquire comprehensive understanding of different types of material handling equipment and their selection criteria.
- Learn to design effective material handling systems, considering influencing factors and layout planning.
- Master maintenance strategies and troubleshooting for essential material handling equipment.
- Explore the latest technologies and automation trends in material handling through case studies.

UNIT I INTRODUCTION TO MATERIAL HANDLING **9**

Definitions and Objectives of Material Handling-Principles of Material Handling - Systems Approach in Material Handling -Analysis of Material Handling Problems

UNIT II MATERIAL HANDLING EQUIPMENTS **9**

Types of Material Handling Equipment's-Conveyors, Cranes, Hoists -Elevators, Forklifts -Selection of Material Handling Equipment's

UNIT III DESIGN OF MATERIAL HANDLING SYSTEMS **9**

Factors Influencing the Selection and Design of Material Handling Equipments -Layouts of Material Handling Systems - Design of Integrated Material Handling Systems

UNIT IV MAINTENANCE OF MATERIAL HANDLING EQUIPMENTS **9**

Maintenance Strategies - Preventive, Predictive, and Corrective -Maintenance of Conveyors, Cranes, Hoists, and Elevators-Troubleshooting and Repairs

UNIT V ADVANCED MATERIAL HANDLING SYSTEMS **9**

Automation in Material Handling-Recent Developments in Material Handling Systems -Case Studies of Material Handling System

TOTAL: 45 HOURS

COURSE OUTCOMES:

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

CO 1 Apply the foundational principles, system approaches, and techniques in material handling.

CO 2 Study the foundational principles, system approaches, and problem-solving techniques in material handling.

CO 3 Study the foundational principles, system approaches, and problem-solving techniques in material handling.

CO 4 Acquired the foundational principles, system approaches, and problem-solving techniques in material handling.

CO 5 Master the foundational principles, system approaches, and problem-solving techniques in material handling.

TEXT BOOKS

1. "Materials Handling Handbook" by Raymond A. Kulwiec, Publisher: Wiley.
2. "Design of Material Handling Equipment" by M. Anoop Kumar, Publisher: CRC Press.

REFERENCES

1. Material Handling Equipment by N. Rudenko, Publisher: Mir Publishers.
2. Introduction to Materials Management by J. R. Tony Arnold, Publisher: Pearson.