Sri

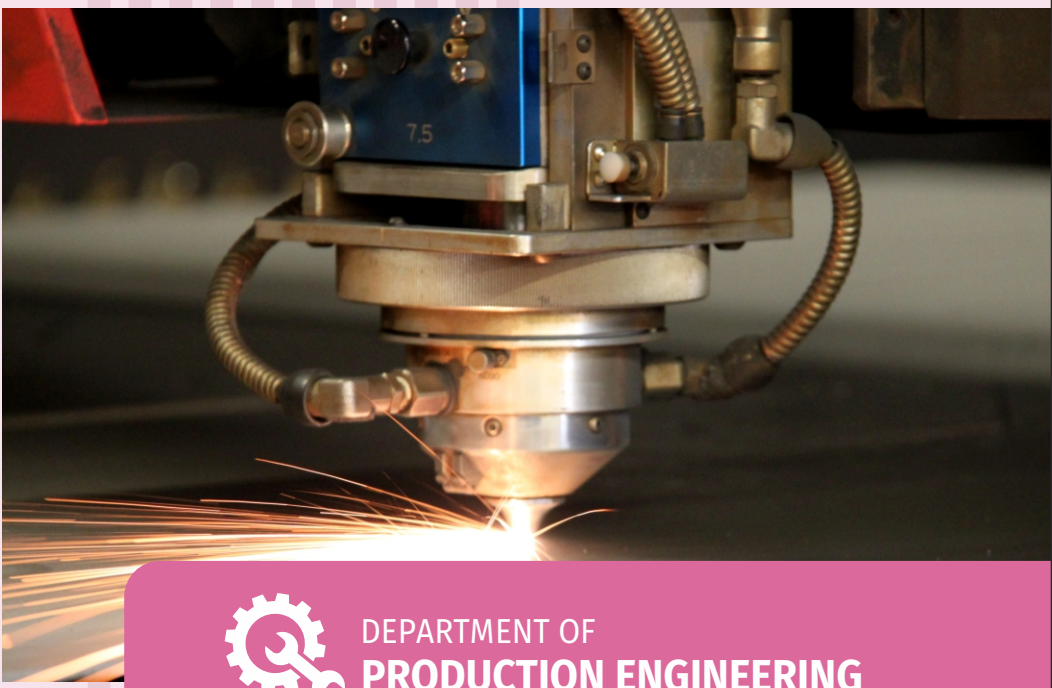
SAI RAM ENGINEERING COLLEGE

An Autonomous Institution

West Tambaram, Chennai - 44

www.sairam.edu.in

Approved by AICTE, New Delhi
Affiliated to Anna University



DEPARTMENT OF PRODUCTION ENGINEERING

REGULATIONS
2020

Academic Year 2020-21 onwards

AUTONOMOUS

CURRICULUM AND

SYLLABUS
I - VIII
SEMESTERS

SRI SAIRAM ENGINEERING COLLEGE

VISION

To emerge as a "Centre of excellence " offering Technical Education and Research opportunities of very high standards to students, develop the total personality of the individual and instil high levels of discipline and strive to set global standards, making our students technologically superior and ethically stronger, who in turn shall contribute to the advancement of society and humankind.

MISSION

We dedicate and commit ourselves to achieve, sustain and foster unmatched excellence in Technical Education. To this end, we will pursue continuous development of infra-structure and enhance state-of-the-art equipment to provide our students a technologically up-to date and intellectually inspiring environment of learning, research, creativity, innovation and professional activity and inculcate in them ethical and moral values.

QUALITY POLICY

We at Sri Sai Ram Engineering College are committed to build a better Nation through Quality Education with team spirit. Our students are enabled to excel in all values of Life and become Good Citizens. We continually improve the System, Infrastructure and Service to satisfy the Students, Parents, Industry and Society.

DEPARTMENT OF PRODUCTION ENGINEERING

VISION

To create highly knowledgable potential Production Engineers with ethical values and life skills understanding the social needs, in order to meet the global standards in manufacturing through promising innovation and social responsibility.

MISSION

Department of Production Engineering, SRI SAIRAM ENGINEERING COLLEGE is committed to

M1 Provide quality education through knowledge sharing by qualified resource persons.

M2 Encourage research and development activity through the state of modern art facilities and technologies

M3 Nurture ethical and moral values in students to become responsible human being.

AUTONOMOUS CURRICULUM AND SYLLABI
Regulations 2020

SEMESTER I

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20BSMA101	Engineering Mathematics-I	3	1	0	4	4
2	20HSEN101	Technical English-I	3	0	0	3	3
3	20BSPH101	Engineering Physics	3	0	0	3	3
4	20BSCY101	Engineering Chemistry	3	0	0	3	3
5	20ESCS101	Problem solving and Programming in C	3	0	0	3	3
6	20ESGE101	Engineering Graphics	1	2	0	3	3
PRACTICAL							
7	20BSPL101	Physics and Chemistry Lab	0	0	3	3	1.5
8	20ESPL101	Programming in C lab	0	0	3	3	1.5
VALUE ADDITIONS - I							
9	20TPHS101	Skill Enhancement	0	0	2	2	1
10	20HSMG101	Personal Values	2	0	0	2	0
TOTAL						**29**	**23**

SEMESTER II

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20BSMA201	Engineering Mathematics-II	3	1	0	4	4
2	20HSEN201	Technical English-II	3	0	0	3	3
3	20ESIT201	Python Programming with Lab	3	0	2	5	4
4	20BSCY201	Environmental Science and Engineering	3	0	0	3	3
5	20ESCE201	Engineering Mechanics	2	1	0	3	3
6	20BSPH202	Physics of Materials	3	0	0	3	3
PRACTICAL							
7	20ESGE201	Engineering Practices Laboratory	0	0	3	3	1.5
8	20PRPL201	Computer Aided Machine Drawing Lab	0	0	3	3	1.5
VALUE ADDITIONS - II							
9	20TPHS201	Skill Enhancement	0	0	2	2	1
10	20HSMG201	Interpersonal Values	2	0	0	2	0
TOTAL						**32**	**24**

SEMESTER III

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20PRPC301	Basic Machining Processes	3	0	0	3	3
2	20PRPC302	Foundry and Welding Technology	3	0	0	3	3
3	20MEPC303	Engineering Metallurgy	3	0	0	3	3
4	20ESME301	Applied Thermodynamics & Fluid Mechanics	3	0	0	3	3
5	20BSMA303	Partial Differential Equations and Probability Theory	3	1	0	4	4
PRACTICAL							
6	20PRPL301	Basic Machining Processes Laboratory	0	0	3	3	1.5
7	20PRPL302	Welding and Metallurgy Laboratory	0	0	3	3	1.5
8	20PRTE301	Live-in Lab I	0	0	2	2	1
VALUE ADDITIONS - III							
9	20PRTP301	Skill Enhancement	0	0	2	2	1
10	20MGMC301	Constitution of India	2	0	0	2	0
TOTAL						**28**	**21**

SEMESTER IV

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20PRPC401	Fluid Power Drives and Controls	3	0	0	3	3
2	20MEPC402	Metrology, Measurements and Computer Aided Inspection	3	0	0	3	3
3	20PRPC402	Computer Aided Product Design	3	0	0	3	3
4	20CEPC405	Strength of Materials	3	0	0	3	3
5	20PRPW401	Metal cutting and CNC Machines with lab	3	0	2	5	4
6	20BSMA403	Statistics and Numerical Methods	3	1	0	4	4
PRACTICAL							
7	20MEPL401	Metrology and Measurements Laboratory	0	0	3	3	1.5
8	20CEPL403	Strength of Materials and Fluid Mechanics & Machinery Laboratory	0	0	3	3	1.5
VALUE ADDITIONS - IV							
9	20PRTE401	Live-in Lab II	0	0	2	2	1
10	20PRTP401	Skill Enhancement	0	0	2	2	1
TOTAL						**31**	**25**

SEMESTER V

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20PRPC501	Mechanics of Machines	3	0	0	3	3
2	20PRPC502	Machine Element Design	3	0	0	3	3
3	20PRPC503	Metal Forming Technology	3	0	0	3	3
4	20PRPC504	Design of Jigs, Fixtures and Press tools	3	0	0	3	3
5	20XXELXXX	Professional Elective-I	3	0	0	3	3
6	20XXOEXXX	Open Elective –I	3	0	0	3	3
PRACTICAL							
7	20PRPL501	Metal Forming and Special Machines Laboratory	0	0	3	3	1.5
8	20MEPL502	Kinematics and Dynamics Laboratory	0	0	3	3	1.5
9	20PRTE501	Live-in Lab III	0	0	4	4	2
VALUE ADDITIONS - V							
10	20PRTP501	Skill Enhancement	0	0	2	2	1
TOTAL						**30**	**24**

SEMESTER VI

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20PRPC601	Production Planning and Control	3	0	0	3	3
2	20HSMG601	Statistics, Quality Control and Reliability Engineering	3	0	0	3	3
3	20ESIC601	Instrumentation and Control Systems	3	0	0	3	3
4	20MEPC603	Mechatronics	3	0	0	3	3
5	20XXELXXX	Professional Elective - II	3	0	0	3	3
PRACTICAL							
6	20XXOEXXX	Open Elective - II	3	0	0	3	3
7	20PRPL601	Mechatronics and Fluid Power Laboratory	0	0	3	3	1.5
8	20HSPL501	Communication and Soft Skills Laboratory	0	0	2	2	1
9	20PRPJ601	Innovative Design Project	0	0	2	2	1
VALUE ADDITIONS - VI							
10	20PRTP601	Skill Enhancement	0	0	2	2	1
TOTAL						**27**	**22.5**

SEMESTER VII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20HSMG701	Engineering Economics and Financial Management	3	0	0	3	3
2	20MEPC701	Finite Element Analysis	3	0	0	3	3
3	20MEPC502	Robotics	3	0	0	3	3
4	20PRPC701	Additive Manufacturing	3	0	0	3	3
5	20XXELXXX	Professional Elective-III	3	0	0	3	3
PRACTICAL							
6	20MEPL701	Computer Aided Simulation and Analysis Laboratory	0	0	3	3	1.5
7	20PRPJ701	Project Phase-I	0	0	4	4	2
VALUE ADDITIONS - VII							
8	20PRTP701	Skill Enhancement	0	0	2	2	1
		TOTAL				**24**	**19.5**

SEMESTER VIII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	20XXELXXX	Professional Elective-IV	3	0	0	3	3
PRACTICAL							
2	20PRPJ801	Project Phase - II	3	0	0	8	4
TOTAL						**11**	**7**

CREDIT DISTRIBUTION

Category	BS	ES	HS	EL	PC+PL	PW	OE	TE	PJ	TP	IS	MC	TOTAL
Credit	29.5	22	13	12	61.5	4	6	4	7	7	3	Y	169
Percentage	17.5	13.0	7.7	7.1	36.4	2.4	3.5	2.4	4.1	4.1	1.8	-	

*IS-Internship

PROFESSIONAL ELECTIVES - I

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDIT	STREAM
			L	T	P			
1	20PREL501	Surface Engineering	3	0	0	3	3	Manufacturing
2	20PREL502	Machine Tools and Processes	3	0	0	3	3	Manufacturing
3	20PREL503	Lean Manufacturing	3	0	0	3	3	Manufacturing
4	20PREL504	Design of Machine tool structure	3	0	0	3	3	Design
5	20MEEL504	Non Traditional Machining Techniques	3	0	0	3	3	Manufacturing
6	20PREL505	Supply Chain Management	3	0	0	3	3	Management

PROFESSIONAL ELECTIVES - II

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDIT	STREAM
			L	T	P			
1	20PREL601	Lean Six Sigma	3	0	0	3	3	Manufacturing
2	20ESEC603	Fuzzy Logic and Neural Networks	3	0	0	3	3	Automation
3	20MGEL602	Marketing Management	3	0	0	3	3	Management
4	20MGEL601	Total Quality Management	3	0	0	3	3	Management
5	20MEEL604	Non Destructive Testing & Evaluation	3	0	0	3	3	Manufacturing
6	20MEEL608	Product Lifecycle Management	3	0	0	3	3	Management

PROFESSIONAL ELECTIVES - III

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDIT	STREAM
			L	T	P			
1	20PREL701	Machine Vision	3	0	0	3	3	Manufacturing
2	20PREL702	Processing of Plastics and Composite Materials	3	0	0	3	3	Manufacturing
3	20MGEL702	Disaster Management	3	0	0	3	3	Management
4	20MGEL703	Entrepreneurship Development	3	0	0	3	3	Management
5	20PREL703	Precision Engineering	3	0	0	3	3	Manufacturing
6	20MEEL703	Process Planning & Cost Estimation	3	0	0	3	3	Manufacturing

PROFESSIONAL ELECTIVES - IV

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDIT	STREAM
			L	T	P			
1	20PREL801	Flexible Manufacturing Systems	3	0	0	3	3	Manufacturing
2	20PREL802	Production Management	3	0	0	3	3	Management
3	20MEEL803	Micro Electromechanical Systems	3	0	0	3	3	Automation
4	20PREL803	Design for Manufacture and Assembly	3	0	0	3	3	Design
5	20HSMG301	Professional Ethics and Values	3	0	0	3	3	Management
6	20PREL804	Industry 4.0 and Cloud Manufacturing	3	0	0	3	3	Automation

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1 Excel in the fundamental of mathematics, basic science, communication and manufacturing concept to create advanced production technology by imparting modern technical skills.

PEO2 Compete professionally with suitable and modern technological skills in the field of research and higher studies.

PEO3 Instil and follow ethical and professional responsibility for modern development of society and nation.

PEO4 Excel in leadership quality and continuous learning to adopt themselves in various domains.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1 The production engineers shall be capable of applying knowledge in design and analysis to solve problems in the areas of manufacturing and management applications.

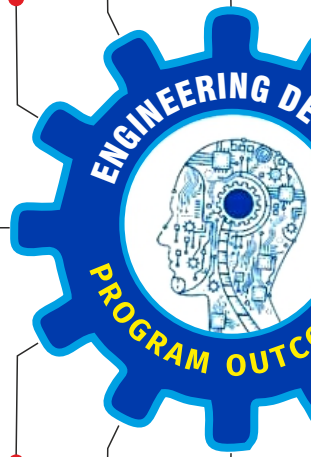
PSO2 The production engineers associate professionally in industries as a entrepreneurs by applying engineering knowledge and management practices.

COMPONENTS OF THE CURRICULUM (COC)

Course Component	Curriculum Content (% of total number of credits of the program)	Total number of contact hours	Total Number of credits
Basic Sciences(BS)	17.5	31	29.5
Engineering Sciences(ES)	13.0	26	22
Humanities and Social Sciences (HS)	7.7	19	13
Professional Electives(EL)	7.1	12	12
Program Core+Program Lab (PC+PL)	36.4	75	61.5
Program theory with Lab (PW)	2.4	05	4
Open Electives (OE)	3.5	06	6
Talent Enhancement (TE)	2.4	08	4
Project (PJ)	4.1	14	7
Training & Placement (TP)	4.1	14	7
Internships/Seminars (IS)	1.8	-	3
Mandatory Courses (MC)	NA	02	Y
Total number of Credits		**212**	**169**

PROGRAMME OUTCOMES(POs)

PROGRAM OUTCOME REPRESENTS THE KNOWLEDGE, SKILLS AND ATTITUDES THAT THE STUDENTS WOULD BE EXPECTED TO HAVE AT THE END OF THE 4 YEAR ENGINEERING DEGREE PROGRAM



01 Engineering knowledge
Apply the basic principle and knowledge of mathematics, science and engineering principles to solve technical problems.

02 Problem Analysis
Identify and analyze complex engineering problems reaching logical conclusions using the basic principles of mathematics, science and engineering.

03 Development of solutions
Design solutions for well-defined technical problems and assist with the design of systems, components or processes to meet specified needs.

04 Investigate complex problems
Perform investigations, use research based knowledge and conduct experiments, analyze and interpret the results to provide valid conclusions.

05 Modern tool usage
Create, select and apply the latest techniques, resources and modern engineering / IT tools to develop appropriate solutions with an understanding of the limitations.

06 The Engineer and Society
Apply reasoning based on contextual knowledge to assess societal, legal and cultural issues with competency in professional engineering practices.

07 Environment & Sustainability
Demonstrate professional skills, knowledge and contextual reasoning to assess / environmental / societal issues for sustainable development.

08 Apply ethical principles
Apply ethical principles and commit to professional ethics and responsibilities based on the norms of professional engineering pratices.

09 Individual & Teamwork
Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary professional settings.

10 Communicate effectively
Communicate effectively amongst the engineering community, being able to comprehend & write effective reports, make presentations & give/receive clear instructions.

11 Project management
Demonstrate knowledge and apply the principles of engineering & management in their own / team projects in multidisciplinary environments.

12 Life-long learning
Recognize the need for, and have the preparation, ability to engage in independent and life-long learning in the context of technological change.

SEMESTER - I

20BSMA101 SDG NO. 4 & 9	ENGINEERING MATHEMATICS-I	L	T	P	C
		3	1	0	4

OBJECTIVES:

The intent of this course is

- To understand and gain knowledge in the concepts of matrix algebra
- To introduce the notion of limits, continuity, differentiation and maxima and minima of functions
- To acquaint the concept of definite and improper integrals and their applications
- To provide an understanding of double and triple integrals
- To acquire knowledge in representing elementary and periodic functions as an infinite series

UNIT I MATRICES 12

Symmetric, skew symmetric and orthogonal matrices; Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem(excluding proof) – Reduction of a Quadratic form to Canonical form using Orthogonal Transformation - Nature of Quadratic forms.

UNIT II DIFFERENTIAL CALCULUS 12

Limit, continuity, Differentiation rules - Maxima and Minima of functions of one variable, partial derivatives, Taylor's series for functions of two variables, Jacobian, Maxima & Minima of functions of several variables, saddle points, Method of Lagrange multipliers.

UNIT III INTEGRAL CALCULUS 12

Evaluation of definite and improper integral - Techniques of Integration- Substitution rule - Integration by parts, Integration of rational functions by partial fraction, Integration of irrational functions - Applications of definite integrals to evaluate surface areas and volumes of revolution.

UNIT IV MULTIPLE INTEGRALS 12

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

UNIT V SEQUENCES AND SERIES **12**

Introduction to sequences and series – power series – Taylor's series – series for exponential, trigonometric, logarithmic, hyperbolic functions – Fourier series – Half range Sine and Cosine series – Parseval's theorem.

TOTAL: 60 PERIODS

TEXTBOOKS:

1. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.
2. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill, New Delhi, 11th Reprint, 2010.

REFERENCES:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic Geometry", 9th Edition, Pearson, Reprint, 2002.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
3. T. Veerarajan, "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
4. N.P. Bali and Manish Goyal, "A text-book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.
5. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2014.

WEB REFERENCES:

1. https://math.mit.edu/~gs/linearalgebra/ila0601.pdf
2. http://ocw.mit.edu/ans7870/18/18.013a/textbook/HTML/chapter30/
3. https://ocw.mit.edu/courses/mathematics/18-02sc-multivariable-calculus-fall-2010/2.-partial-derivatives/
4. http://ocw.mit.edu/ans7870/18/18.013a/textbook/HTML/chapter31/

ONLINE RESOURCES:

1. https://www.khanacademy.org/math/linear-algebra/alternate-bases/eigen-everything/v/linear-algebra-introduction-to-eigenvalues-and-eigenvectors
2. https://www.khanacademy.org/math/differential-calculus

OUTCOMES:

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

1. Find the eigen values, eigen vectors of a matrix, diagonalize the given matrix and apply matrix algebra to model various engineering problems.
2. Use differentiation techniques to optimize problems that arises in engineering.
3. Evaluate integrals and apply it in calculating surface areas and volumes of revolution.
4. Compute multiple integrals using change of variables technique and apply it in finding area and volume of solids.
5. Describe elementary and periodic functions as a series representation.

CO - PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	-	-	-	-	-	1	1
CO2	3	3	2	1	1	-	-	-	-	-	1	1
CO3	3	3	2	1	1	-	-	-	-	-	1	1
CO4	3	3	2	1	1	-	-	-	-	-	1	1
CO5	3	3	2	1	1	-	-	-	-	-	1	1

SEMESTER - I

20HSEN101 SDG NO. 4	TECHNICAL ENGLISH - I	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To develop the basic LSRW skills of the students
- To encourage the learners to adapt to listening techniques
- To help learners develop their communication skills and converse fluently in real contexts
- To help learners develop general and technical vocabulary through reading and writing tasks
- To improve the language proficiency for better understanding of core subjects

UNIT I INTRODUCTION 9

Listening – short texts – formal and informal conversations - **Speaking** – basics in speaking – speaking on given topics & situations – recording speeches and strategies to improve - **Reading** – critical reading – finding key information in a given text – shifting facts from opinions - **Writing** – free writing on any given topic – autobiographical writing - **Language Development** – tenses – voices- word formation: prefixes and suffixes – parts of speech – developing hints

UNIT II READING AND LANGUAGE DEVELOPMENT 9

Listening - long texts - TED talks - extensive speech on current affairs and discussions - **Speaking** – describing a simple process – asking and answering questions - **Reading** comprehension – skimming / scanning / predicting & analytical reading – question & answers – objective and descriptive answers –identifying synonyms and antonyms - process description - **Writing** instructions – **Language Development** – writing definitions – compound words - articles – prepositions.

UNIT III SPEAKING AND INTERPRETATION SKILLS 9

Listening - dialogues & conversations - **Speaking** – role plays – asking about routine actions and expressing opinions - **Reading** longer texts & making a critical analysis of the given text - **Writing** – types of paragraph and writing essays – rearrangement of jumbled sentences - writing recommendations - **Language Development** – use of sequence words - cause & effect expressions - sentences expressing purpose - picture based and newspaper based activities – single word substitutes.

UNIT IV VOCABULARY BUILDING AND WRITING SKILLS 9

Listening - debates and discussions – practicing multiple tasks – self introduction – **Speaking** about friends/places/hobbies - **Reading** -Making inference from the reading passage – Predicting the content of the reading passage - **Writing** – informal letters/e-mails - **Language Development** - synonyms & antonyms - conditionals – if, unless, in case, when and others – framing questions.

UNIT V LANGUAGE DEVELOPMENT AND TECHNICAL WRITING 9

Listening - popular speeches and presentations - **Speaking** - impromptu speeches & debates - **Reading** - articles – magazines/newspapers **Writing** – essay writing on technical topics - channel conversion – bar diagram/ graph – picture interpretation - process description - **Language Development** – modal verbs - fixed / semi-fixed expressions – collocations.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Board of Editors. Using English: A Coursebook for Undergraduate Engineers and Technologists. Orient Blackswan Limited, Hyderabad: 2015.
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai, 2011.

REFERENCES:

1. Anderson, Paul V. Technical Communication: A Reader – Centered Approach. Cengage, New Delhi, 2008.
2. Smith-Worthington, Darlene & Sue Jefferson. Technical Writing for Success. Cengage, Mason, USA, 2007.
3. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford, 2007.
4. Chauhan, Gajendra Singh and et.al.Technical Communication (Latest Revised Edition). Cengage Learning India Pvt. Limited, 2018.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_hs31/preview
2. http://engineeringvideolectures.com/course/696

ONLINE RESOURCES:

1. https://www.pearson.com/english/catalogue/business-english/technical-english.html
2. https://www.cambridgeenglish.org/learning-english/free-resources/

OUTCOMES:

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

1. Comprehend conversations and talks presented in English.
2. Speak fluently in informal and formal contexts.
3. Read articles of any kind and be able to comprehend.
4. Prepare informal letters and e-mails efficiently.
5. Write technical concepts and summaries in correct grammar and vocabulary.

CO - PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	2	3	-	1
CO2	-	-	-	-	-	-	-	-	2	3	-	1
CO3	-	-	-	-	-	1	1	-	2	3	-	1
CO4	-	-	-	-	-	-	-	-	2	3	-	1
CO5	-	-	-	-	-	1	-	-	2	3	-	1

SEMESTER - I

20BSPH101 SDG NO. 4	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To educate and enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology

UNIT I CRYSTAL PHYSICS 9

Single crystalline, Polycrystalline and Amorphous materials - single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal - Miller indices - Interplanar distance - Powder diffraction method - Debye Scherer formula - Calculation of number of atoms per unit cell - Atomic radius - Coordination number - packing factor for SC, BCC, FCC and HCP structures - Polymorphism and allotropy - Diamond and Graphite structure (qualitative) - Growth of single crystals: Solution and Melt growth Techniques.

UNIT II PROPERTIES OF MATTER 9

Elasticity - Stress - strain diagram and its uses - Poisson's ratio - Relationship between three moduli of elasticity (qualitative) - Factors affecting elastic modulus and tensile strength - Twisting couple - shaft - Torsion pendulum: theory and experiment - bending of beams - bending moment - cantilever: theory and experiment - uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.

UNIT III QUANTUM PHYSICS 9

Black body radiation - Planck's theory (derivation) - Compton effect: theory -

wave particle duality - electron diffraction - progressive waves - wave equation - concept of wave function and its physical significance - Schrödinger's wave equation - Time independent and Time dependent equations - particle in a box (one dimensional motion) - Tunneling (qualitative) - scanning tunneling microscope.

UNIT IV LASERS AND FIBER OPTICS **9**

Lasers: population of energy levels, Einstein's A and B coefficients derivation - pumping methods - resonant cavity, optical amplification (qualitative) - three level and four level laser - CO_2 laser - Semiconductor lasers: Homojunction and Heterojunction.

Fiber optics: Principle, Numerical aperture and Acceptance angle - Types of optical fibers (material, refractive index, mode) - Losses associated with optical fibers - Fiber Optical Communication system (Block diagram) - Fiber optic sensors: pressure and displacement.

UNIT V THERMAL PHYSICS **9**

Transfer of heat energy - thermal expansion of solids and liquids - bimetallic strips - thermal conduction, convection and radiation - heat conduction in solids (qualitative) - thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) - thermal insulation - applications: heat exchangers, refrigerators and solar water heaters.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. D.K. Bhattachary & T.Poonam, "Engineering Physics". Oxford University Press, 2015.
2. R.K. Gaur& S.L. Gupta, "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. B.K. Pandey & S.Chaturvedi, "Engineering Physics", Cengage Learning India, 2017.
4. V. Rajendran, "Engineering Physics", Mc Graw Hill Publications Ltd. New Delhi, 2014.
5. M.N. Avadhanulu& P.G. Kshirshagar, "A textbook of Engineering Physics", S. Chand & Co Ltd. 2016.

REFERENCES:

1. D. Halliday, . Resnick & J. Walker, "Principles of Physics", Wiley, 2015.
2. R.A. Serway, & J.W. Jewett, "Physics for Scientists and Engineers", Cengage Learning, 2010.
3. N.K. Verma," Physics for Engineers", PHI Learning Private Limited, 2014.

4. P.A. Tipler & G. Mosca "Physics for Scientists and Engineers", W.H.Freeman, 2020.
5. Brijlal and Subramanyam, "Properties of Matter", S. Chand Publishing, 2018.
6. Shatendra Sharma & Jyotsna Sharma, "Engineering Physics", Pearson, 2018.

OUTCOMES :

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

1. Understand the basics of crystals, their structures and different crystal growth techniques.
2. Understand the basics of properties of matter and its potential applications.
3. Get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscope.
4. Acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics.
5. Evaluate the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers.

CO - PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	-		1	-	-	-	-	1
CO2	3	3	3	3	-	3	2	-	-	-	-	1
CO3	3	3	3	3	-	1	1	-	-	-	-	2
CO4	3	3	3	3	-	3	3	-	-	-	-	3
CO5	3	3	3	3	-	3	2	-	-	-	-	1

SEMESTER - I

20BSCY101 SDG NO. 4,6&7	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques
- To illustrate the principles of electrochemical reactions, redox reactions in corrosion of materials and methods for corrosion prevention and protection of materials
- To categorize types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels
- To demonstrate the principles and generation of energy in batteries, nuclear reactors, solar cells, windmills and fuel cells
- To recognize the applications of polymers, composites and nano-materials in various fields

UNIT I WATER TECHNOLOGY AND SURFACE CHEMISTRY 9

Water Technology : Introduction – Hard water and Soft water. Hardness of water – types – expression of hardness (numerical problems). Boiler troubles – scale and sludge, priming and foaming, caustic embrittlement and boiler corrosion. Treatment of boiler feed water – Internal treatment (carbonate, phosphate, calgon, colloidal and sodium aluminate conditioning). External treatment – Ion exchange process, Zeolite process –Domestic water treatment (break point chlorination) –Desalination of brackish water – Reverse Osmosis.

Surface Chemistry: Adsorption – types – adsorption of gases on solids – adsorption of solutes from solution – applications of adsorption –role of adsorbents in catalysis and pollution abatement.

UNIT II ELECTROCHEMISTRY AND CORROSION 9

Electrochemistry: Cells – types (electrochemical and electrolytic cell) Redox reaction – single electrode potential (oxidation potential and reduction potential) – measurement and applications –Nernst equation (derivation and problems) – electrochemical series and its significance.

Corrosion: Causes, factors and types – chemical and electrochemical corrosion (galvanic, differential aeration). Corrosion control – material selection and design aspects, cathodic protection methods (sacrificial anodic and impressed current cathodic method) and corrosion inhibitors. Paints: Constituents and its functions. Electroplating of Copper and electroless plating of Nickel.

UNIT III FUELS AND COMBUSTION 9

Fuels: Introduction – classification of fuels – Coal – analysis of coal (proximate and ultimate). Carbonization – manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum – manufacture of synthetic petrol (Bergius process). Knocking – octane number and cetane number – Gaseous fuels – Compressed natural gas (CNG), Liquefied petroleum gases (LPG). Biofuels – Gobar gas and Biodiesel.

Combustion of Fuels: Introduction – calorific value – higher and lower calorific values- theoretical calculation of calorific value – flue gas analysis (ORSAT Method).

UNIT IV ENERGY SOURCES AND STORAGE DEVICES 9

Energy sources: Nuclear fission – nuclear fusion – differences between nuclear fission and fusion – nuclear chain reactions – nuclear energy – light water nuclear power plant – breeder reactor – solar energy conversion – solar cells – wind energy.

Storage devices: Batteries – types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium–ion–battery), fuel cells – H_2 -O_2 fuel cell and super capacitors.

UNIT V POLYMERS AND NANOMATERIALS 9

Polymers: Classification – types of polymerization – mechanism (Free radical polymerization) –Engineering polymers: Nylon–6, Nylon–6,6, Teflon, Kevlar and PEEK – preparation, properties and uses – Plastic and its types – Conducting polymers – types and applications. Composites – definition, types, polymer matrix composites – FRP.

Nanomaterials: Introduction – Nanoparticles, Nanoclusters, Nanorods, Nanotubes (CNT: SWNT and MWNT) and Nanowires – Properties (surface to volume ratio, melting point, optical and electrical), Synthesis (precipitation, thermolysis, hydrothermal, electrodeposition, chemical vapour deposition, laser ablation, sol-gel process) and Applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015.
2. P. C. Jain and Monika Jain, "Engineering Chemistry" DhanpatRai Publishing Company (P) LTD, New Delhi, 2015.
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.

REFERENCES:

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

OUTCOMES

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

1. Identify the origin of water resources and develop innovative methods to produce soft water for industrial use and potable water at cheaper cost.
2. Apply the principles of electrochemistry, corrosion and the applications of protective coatings to overcome the corrosion.
3. Illustrate the chemistry of fuels and combustion and its application in various levels.
4. Acquire the basics of non-conventional sources of energy and understand the principles and the reaction mechanism of batteries and fuel cells.
5. Build knowledge about the polymers, composites and nano-materials and their applications as engineering materials.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	1	2	-	-	-	-	2
CO2	3	2	3	2	2	1	2	-	-	-	-	3
CO3	3	2	2	2	-	1	2	1	-	-	-	1
CO4	3	2	3	2	-	1	2	1	-	-	1	1
CO5	3	2	3	1	2	1	1	-	-	-	1	3

SEMESTER - I

20ESCS101 SDG NO. 4&9	PROBLEM SOLVING AND PROGRAMMING IN C	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand about the programming language
- To develop C Programs using basic Programming Constructs, Loops Arrays and Strings
- To develop applications in C using Functions , Pointers and Structures
- To perform I/O operations and File Handling in C

UNIT I INTRODUCTION TO PROGRAMMING AND ALGORITHMS FOR PROBLEM SOLVING 10

The Basic Model of Computation, Programming Paradigms- Program Development Life Cycle - Algorithm –Pseudo Code – Flow Chart - Programming Languages - Compilation - Linking and Loading - Testing and Debugging - Documentation - Control Structures – Algorithmic Problem Solving- Problems Based on Sequential, Decision Making - Branching and Iteration.

UNIT II BASICS OF C PROGRAMMING 8

Structure of C program - C programming: Data Types – Storage Classes - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions – Input / Output Statements - Assignment Statements – Decision making Statements - Switch Statement - Looping Statements – Pre-Processor Directives - Compilation Process

UNIT III ARRAYS AND STRINGS 9

Introduction to Arrays: Declaration, Initialization – One Dimensional Array – Example Program: Computing Mean, Median and Mode - Two Dimensional Arrays – Example Program: Matrix Operations (Addition, Scaling, Determinant and Transpose) - String Operations: Length, Compare, Concatenate - Copy – Selection Sort - Linear and Binary Search.

UNIT IV FUNCTIONS AND POINTERS 9

Introduction to Functions: Function Prototype, Function Definition, Function Call, Built-in Functions (String Functions, Math Functions) – Recursion – Example Program: Computation of Sine Series - Scientific Calculator using Built-in Functions - Binary Search using Recursive Functions – Pointers – Pointer Operators – Pointer Arithmetic – Arrays and Pointers –

Array of Pointers – Example Program: Sorting of Names – Parameter Passing: Pass by Value - Pass by Reference – Example Program: Swapping of Two Numbers using Pass by Reference.

UNIT V STRUCTURES and FILE PROCESSING 9

Structure - Nested Structures – Pointer and Structures – Array of Structures – Example Program using Structures and Pointers – Self Referential Structures – Dynamic Memory Allocation - Singly Linked List – Typedef.

Files – Types of File Processing: Sequential Access, Random Access – Sequential Access File - Example Program: Finding Average of Numbers stored in Sequential Access File - Random Access File - Example Program: Transaction Processing Using Random Access Files – Command Line Arguments.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2012.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "C How to Program", Seventh edition, Pearson Publication.
2. Jeri R. Hanly & Elliot B. Koffman, "Problem Solving and Program Design in C", Pearson Education, 2013.
3. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009.
4. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.
6. Kanetkar Y, "Let us C", BPB Publications, 2007.
7. Hanly J R & Koffman E.B, "Problem Solving and Programme design in C", Pearson Education, 2009.

WEB REFERENCES:

1. https://www.learn-c.org/
2. https://codeforwin.org/
3. https://www.cprogramming.com/

ONLINE RESOURCES:

1. https://www.linuxtopia.org/online_books/programming_books/gnu_c_programming_tutorial
2. https://nptel.ac.in/courses/106105171
3. https://swayam.gov.in/nd1_noc19_cs42/preview

OUTCOMES:

Upon completion of the course the student should be able to

1. Develop efficient algorithms for solving a problem.
2. Use the various constructs in C to develop simple applications.
3. Design and Implement applications using Array & Strings.
4. Develop applications using Functions and Pointers.
5. Design and Develop applications using Structures and Files.

CO- PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	1	1	1	2	2	3	3
CO2	3	3	3	3	2	1	1	1	2	2	3	3
CO3	3	3	3	3	2	1	1	1	2	2	3	3
CO4	3	3	3	3	2	1	1	1	2	2	3	3
CO5	3	3	3	3	2	1	1	1	2	2	3	3

SEMESTER - I

20ESGE101 SDG NO. 4,6,7, 9, 12,14 &15	ENGINEERING GRAPHICS	L	T	P	C
		1	2	0	3

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products
- To visualize the job in three dimensions
- To have a clear conception and appreciation of the shape, size, proportion and design
- To expose the student community to existing national standards related to technical drawings

CONCEPTS AND CONVENTIONS (Not for Examination) **3**

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

UNIT I PLANE CURVES AND FREEHAND SKETCHING **6+9**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid on Horizontal Surfaces – construction of involutes of circle for one complete revolution – Drawing of tangents and normal to the above curves.

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.

UNIT II PROJECTION OF LINES AND PLANE SURFACE **6+9**

Orthographic projection- principles-Principal planes- 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- Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS **6+9**

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **6+9**

Sectioning of prisms, pyramids, cylinder and cone in simple vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and truncated solids in vertical position – Prisms, pyramids cylinder and cone.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS **6+9**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinder, cone- Perspective projection of simple solids-Prisms, pyramids and cylinder by visual ray method.

TOTAL: 78 PERIODS

TEXT BOOKS:

1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.
2. T. Jeyapoovan, "Engineering Graphics using AUTOCAD", Vikas Publishing House Pvt Ltd, 7th Edition.

REFERENCES:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
2. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
3. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
4. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
5. 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.
6. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
7. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/103/112103019/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105/104/105104148/

PUBLICATION OF BUREAU OF INDIAN STANDARDS:

1. IS10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods

OUTCOMES:

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

1. Familiarize with the fundamentals and standards of Engineering graphics and Perform freehand sketching of basic geometrical constructions and multiple views of objects.

2. Acquire knowledge in the Angle of Projection, projection of Points, Lines and Plane Surfaces.
3. Understand different Positions of Solids.
4. Able to visualize the Sectioned area of Solids and develop its Lateral Surfaces.
5. Generate and Interpret Orthographic, Pictorial and perspective views.

CO - PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	-	-	-	-	-	2	2	-	3
CO2	3	2	3	-	-	-	-	-	2	2	-	3
CO3	3	2	3	-	-	-	-	-	2	2	-	3
CO4	3	2	3	-	-	-	-	-	2	2	-	3
CO5	3	2	3	-	-	-	-	-	2	2	-	3

SEMESTER - I

20BSPL101 SDG NO. 4	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
		0	0	3	1.5

PHYSICS LABORATORY

OBJECTIVES:

- To acquaint the students with practical knowledge of physics principles in various fields such as optics, thermal physics and properties of matter for developing basic experimental skills
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis

LIST OF EXPERIMENTS (Any 5 Experiments)

1. Determination of Young's modulus by non-uniform bending method.
2. Determination of rigidity modulus –Torsion pendulum.
3. Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.
4. (a) Determination of wavelength and particle size using Laser.
   (b) Determination of acceptance angle in an optical fiber.

5. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
6. Determination of specific resistance of a given coil of wire – Carey Foster's bridge.
7. Determination of wavelength of mercury spectrum – spectrometer grating.
8. Determination of band gap of a semiconductor.
9. Determination of Hall coefficient by Hall Effect experiment.
10. Determination of solar cell characteristics.

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS / 6 (max.) STUDENTS PER EXPERIMENT

1. Young's modulus by non-uniform bending method-experimental set-up – 12 sets
2. Rigidity modulus - Torsion pendulum experimental set-up – 12 sets
3. Ultrasonic Interferometer to determine velocity of sound and compressibility of liquid – 6 sets
4. (a) Experimental set-up to find the wavelength of light, and to find particle size using Laser – 6 sets
   (b) Experimental set-up to find acceptance angle in an optical fiber – 6 sets
5. Lee's disc method- experimental set up to find thermal conductivity of a bad conductor – 6 sets
6. Experimental set-up to find specific resistance of a coil of wire-Carey Foster's Bridge – 6 sets
7. Experimental set-up to find the wavelength of mercury spectrum-spectrometer grating – 6 sets
8. Experimental set-up to find the band gap of a semiconductor – 12 sets
9. Experimental set-up to find the Hall coefficient by Hall Effect Experiment – 6 sets
10. Experimental set-up to study characteristics of solar cells – 6 sets

TEXTBOOKS:

1. J.D. Wilson& C.A. Hernandez Hall "Physics Laboratory Experiments" Houghton Mifflin Company, New York, 2010.

2. M.N. Srinivasan, S. Balasubramanian &R. Ranganathan, "Practical Physics", S. Chand & Sons educational publications, New Delhi, 2011.
3. R. Sasikumar, "Practical Physics", PHI Learning Pvt. Ltd., New Delhi, 2011.

CHEMISTRY LABORATORY

(Any five experiments to be conducted)

OBJECTIVES:

- To acquaint the students with practical knowledge of the basic concepts of chemistry, the student faces during the course of their study in the industry and engineering field
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis
- To understand and develop experimental skills for building technical competence

LIST OF EXPERIMENTS (Any five experiments to be conducted)

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water samples.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Determination of strength of given hydrochloric acid using pH meter.
6. Conductometric titration of strong acid vs strong base.
7. Estimation of iron content of the given solution using potentiometer.
8. Estimation of iron content of the water sample using spectrophotometer (1, 10- Phenanthroline / thiocyanate method).
9. Estimation of sodium and potassium present in water using flame photometers.
10. Determination of molecular weights of polymers using Ostwald's Viscometer.

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS / 6 (MAX.) STUDENTS PER EXPERIMENT.

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample - 6 sets

2. Determination of total, temporary & permanent hardness of water by EDTA method - 6 sets
3. Determination of DO content of water sample by Winkler's method - 6sets
4. Determination of chloride content of water sample by argentometric method – 6 sets
5. Determination of strength of given hydrochloric acid using pH meter - 6 sets
6. Conductometric titration of strong acid vs strong base - 6 sets
7. Estimation of iron content of the given solution using potentiometer - 6 sets
8. Estimation of iron content of the water sample using spectrophotometer (1,10- Phenanthroline / thiocyanate method) - 2 sets
9. Estimation of sodium and potassium present in water using flame photometer - 2 sets
10. Determination of molecular weights of polymer using Ostwald's Viscometer. - 6 sets

TOTAL: 30 PERIODS

TEXTBOOKS:

1. Vogel's Textbook of Quantitative Chemical Analysis (8th edition, 2014).

OUTCOMES:

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

1. Apply the principles of thermal physics and properties of matter to evaluate the properties of materials and to determine the physical properties of liquid using ultrasonic interferometer.
2. Understand measurement technique and usage of new instruments in optics for real time application in engineering.
3. Apply the knowledge of semiconductor materials to evaluate the band gap and Hall coefficient of materials and to study the characteristics of solar cell for Engineering solutions.
4. Apply basic techniques used in chemistry laboratories for water analyses/purification and estimates the ions/metal ions present in domestic/industry wastewater.
5. Utilize the fundamental laboratory techniques for analyses such as volumetric titrations, conductometric, potentiometric and spectroscopy.

CO- PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	1	3	3	2	2	1	1	3
CO2	3	3	3	3	3	3	3	2	2	2	2	3
CO3	3	3	3	3	3	3	3	2	1	1	2	3
CO4	3	2	3	3	1	1	2	2	2	2	3	2
CO5	3	2	3	3	1	1	2	2	2	2	3	2

SEMESTER - I

20ESPL101 SDG NO. 4&9	PROGRAMMING IN C LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To develop programs in C using basic Programming Constructs
- To develop applications in C using Arrays and Strings
- To design and implement applications in C using Functions, Structures
- To develop applications in C using Files

LIST OF EXPERIMENTS

1. Write a program using I/O statements and expressions.
2. Write programs using decision-making constructs.
3. Write a program to find whether the given year is leap year or not? (Hint: not every centurion year is a leap. For example 1700, 1800 and 1900 is not a leap year)
4. Write a program to perform the Calculator operations, namely, addition, subtraction, multiplication, division and square of a number.
5. Write a program to check whether a given number is Armstrong number or not?
6. Write a program tocheck whether a given number is odd or even?
7. Write a program to find the factorial of a given number.
8. Write a program to find out the average of 4 integers.
9. Write a program to display array elements using two dimensional arrays.
10. Write a program to perform swapping using function.
11. Write a program to display all prime numbers between two intervals using functions.
12. Write a program to reverse a sentence using recursion.

13. Write a program to get the largest element of an array using the function.
14. Write a program to concatenate two string.
15. Write a program to find the length of String.
16. Write a program to find the frequency of a character in a string.
17. Write a program to store Student Information in Structure and Display it.
18. The annual examination is conducted for 10 students for five subjects. Write a program to read the data and determine the following:
    (a) Total marks obtained by each student.
    (b) The highest marks in each subject and the marks of the student who secured it.
    (c) The student who obtained the highest total marks.
19. Insert, update, delete and append telephone details of an individual or a company into a telephone directory using random access file.
20. Count the number of account holders whose balance is less than the minimum balance using sequential access file.

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Standalone desktops with C compiler 30 Nos.

(or)

Server with C compiler supporting 30 terminals or more.

OUTCOMES:

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

1. Solve some simple problems leading to specific applications.
2. Demonstrate C programming development environment, compiling, debugging, linking and executing a program.
3. Develop C programs for simple applications making use of basic constructs, arrays and strings.
4. Develop C programs involving functions, recursion, pointers, and structures.
5. Design applications using sequential and random access file.

CO- PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	1	1	1	2	2	3	3
CO2	3	3	3	3	2	1	1	1	2	2	3	3
CO3	3	3	3	3	2	1	1	1	2	2	3	3
CO4	3	3	3	3	2	1	1	1	2	2	3	3
CO5	3	3	3	3	2	1	1	1	2	2	3	3

SEMESTER - I

20TPHS101 SDG NO. 4&5	SKILL ENHANCEMENT	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To enrich social network ethics
- To develop and enhance browsing culture
- To understand the concepts of networking
- To promote self professionalism
- To acquire knowledge about various digital identification procedures

UNIT I SOCIAL NETWORK ETIQUETTES **6**

Introduction to social network – Social Networking Etiquettes - Pros and Cons - Usage of Facebook, Instagram, WhatsApp , Telegram, Youtube, Evolution of Android and IOS, Introduction to Linkedin & Benefits. (Practicals – Official Mail id- Linkedin Id Creation, Linkedin Profile Bulilding , Facebook Id and Creation and Modifying the existing FB ID)

UNIT II BROWSING CULTURE **6**

Introduction to browsing – Search Engines-Google - Bing -Yahoo!-AOL -MSN –DuckDuckGo ,browsers, phishing – Cookies - URL – https:// extensions , browsing history, Incognito mode- VPN – Pros and Cons – Book mark.

UNIT III NETWORKING **6**

Basics of networking - LAN, MAN, WAN, Introduction to network topologies, Protocols , IP Commands (Command line prompt), Define online complier and

editor (Practicals – Find Your System IP,Ping Command, Firewall Fortinet, Basic DOS Commands)

UNIT IV PROFESSIONALISM **6**

Dress Code, Body Language, Appropriate Attire ,Communication Skills, Interview preparation – Introducing yourself - How to greet Superiors, Importance of Eye Contact During conversation.

UNIT V DIGITAL IDENTIFICATION **6**

Introduction to NAD - Importance of Aadhar, PAN Card, Passport, Bank Account, Bar Code, QR scan, Payment Gateway (Gpay, Phone Pe, UPI, BHIM, Paytm), Mobile Banking (Practicals - NAD registration Step by Step, Linking bank account with netbanking , Register for payment gateway).

TOTAL : 30 PERIODS

WEB REFERENCES :

Unit I: Social Network Etiquettes:

1. https://sproutsocial.com/glossary/social-media-etiquette/
2. https://www.shrm.org/resourcesandtools/tools-and-samples/hr-qa/pages/socialnetworkingsitespolicy.aspx
3. https://www.frontiersin.org/articles/10.3389/fpsyg.2019.02711/full
4. https://medium.com/@sirajea/11-reasons-why-you-should-use-telegram-instead-of-whatsapp-ab0f80fbfa79
5. https://buffer.com/library/how-to-use-instagram/
6. https://www.webwise.ie/parents/what-is-youtube/
7. https://www.androidauthority.com/history-android-os-name-789433/
8. https://www.mindtools.com/pages/article/linkedin.htm

Unit II: Browsing Culture:

1. https://sites.google.com/site/bethanycollegeofteacheredn/unit--ict-connecting-with-world/national-policy-on-information-and-communication-technology-ict/accessing-the-web-introduction-to-the-browser-browsing-web
2. https://www.wordstream.com/articles/internet-search-engines-history
3. https://www.malwarebytes.com/phishing/
4. https://www.adpushup.com/blog/types-of-cookies/
5. https://www.eff.org/https-everywhere
6. https://www.sciencedirect.com/topics/computer-science/browsing-history\

7. https://www.vpnmentor.com/blog/pros-cons-vpn/
8. https://www.tech-wonders.com/2016/10/use-hush-private-bookmarking-extension-chrome.html

Unit III:Networking

1. https://www.guru99.com/types-of-computer-network.html
2. https://www.studytonight.com/computer-networks/network-topology-types
3. https://www.cloudflare.com/learning/network-layer/what-is-a-protocol/
4. https://www.howtogeek.com/168896/10-useful-windows-commands-you-should-know/
5. https://paiza.io/en

Unit IV : Professionalism

1. https://career.vt.edu/develop/professionalism.html
2. https://englishlabs.in/importance-dress-code/
3. https://www.proschoolonline.com/blog/importance-of-body-language-in-day-to-day-life
4. https://www.thespruce.com/etiquette-of-proper-attire-1216800
5. https://shirleytaylor.com/why-are-communication-skills-important/
6. https://www.triad-eng.com/interview-tips-for-engineers/
7. https://www.indeed.co.in/career-advice/interviewing/interview-question-tell-me-about-yourself
8. https://toggl.com/track/business-etiquette-rules/

Unit V: Digital Identification

1. https://nad.ndml.in/nad-presentation.html
2. https://www.turtlemint.com/aadhaar-card-benefits/
3. https://www.bankbazaar.com/pan-card/uses-of-pan-card.html
4. https://www.passportindex.org/passport.php
5. https://consumer.westchestergov.com/financial-education/money-management/benefits-of-a-bank-account
6. https://en.wikipedia.org/wiki/QR_code
7. https://www.investopedia.com/terms/p/payment-gateway.asp
8. https://www.paisabazaar.com/banking/mobile-banking/

OUTCOMES:

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

1. Learn and apply social network ethics.
2. Understand the browsing culture.
3. Analyze the networking concepts.
4. Develop self professionalism.
5. Gain hands-on experience in various digital identification procedures.

CO- PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	3	2	-	3	2	3	-	2
CO2	-	-	-	-	3	2	-	3	2	3	-	2
CO3	-	-	-	-	3	2	-	-	1	3	-	2
CO4	-	-	-	-	3	2	-	3	3	3	-	2
CO5	-	-	-	-	3	2	-	-	2	3	-	2

SEMESTER - I

20HSMG101 SDG NO. 4&5	PERSONAL VALUES	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Values through Practical activities

UNIT I SELF CONCEPT **6**

Understanding self Concept – Identify Yourself – Who am I – an individual, engineer, citizen – Attitude – Measuring Behaviour – Change of Behaviour – Personality – Characteristics in personal, professional life.

UNIT II INDIVIDUAL VALUES **6**

Personal Values – Attributes –Courage – Creativity, Honesty, Perfection, Simplicity, Responsibility – Measuring personal values

UNIT III MORAL VALUES **6**

Moral – Understanding right and wrong – Positive thoughts – Respect to others – Doing good to society.

UNIT IV PHYSICAL AND MENTAL WELL-BEING **6**

Health – Physical fitness –Mental vigour – Diet management – Yoga – Meditation – Peaceful life – Happiness in life

UNIT V DECISION MAKING **6**

Goal Setting – Decision making skill – Overcome of Barriers – Success – Mental strength and weakness

TOTAL: 30 PERIODS

Note:

Each topic in all the above units will be supplemented by practice exercises and classroom activities and projects.

REFERENCE BOOKS:

1. Barun K. Mitra, "Personality Development and Soft Skills", Oxford University Press, 2016.
2. B.N.Ghosh, "Managing Soft Skills for Personality Development" McGraw Hill India, 2012.

OUTCOMES:

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

1. Become an individual in knowing the self.
2. Acquire and express Personal Values, Spiritual values and fitness.
3. Practice simple physical exercise and breathing techniques.
4. Practice Yoga asana which will enhance the quality of life.
5. Practice Meditation and get benefitted.

CO – PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	2	3	3	1	1	1
CO2	-	-	-	-	-	2	2	3	3	1	1	1
CO3	-	-	-	-	-	2	2	3	3	1	1	1
CO4	-	-	-	-	-	2	2	3	3	1	1	1
CO5	-	-	-	-	-	2	2	3	3	1	1	1

SEMESTER - II

20BSMA201 SDG NO. 4	ENGINEERING MATHEMATICS - II	L	T	P	C
		3	1	0	4

OBJECTIVES:

- The objective of this course is to familiarize the prospective engineers with techniques in Vector Calculus, Ordinary differential equations, Complex variables and Laplace transforms. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

UNIT I VECTOR CALCULUS 12

Gradient and Directional derivatives - Divergence and Curl- Vector identities - Irrotational and Solenoidal vector fields - Line integral over a plane curve - Surface integral - Volume integral – Gauss divergence, Green's and Stoke's theorems - Verification and application in evaluating line, Surface and volume integrals.

UNIT II ORDINARY DIFFERENTIAL EQUATIONS 12

Second and higher order linear differential equations with constant coefficients - Method of variation of parameters - Homogeneous equation of Euler's and Legendre's types - System of simultaneous linear differential equations with constant coefficients.

UNIT III COMPLEX DIFFERENTIATION 12

Analytic functions- Necessary and sufficient conditions for analyticity in cartesian and polar coordinates (without proof) - Properties - Harmonic conjugate - construction of analytic functions- Conformal mapping - Mapping by functions $w = z+a, w=az, w=1/z, w=z^2$ - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION 12

Contour integrals, Cauchy- Goursat theorem (without proof) - Cauchy Integral formula (without proof) - Taylor's series - Zeroes of Analytic functions - Singularities - Laurent's Series - Residues – Cauchy Residue theorem (without proof) – Application of Residue theorem for evaluation of real integrals – use of circular contour and semicircular contour(without poles on real axis).

UNIT V LAPLACE TRANSFORM 12

Existence conditions – Transforms of elementary functions – Transform of Unit step function and Unit impulse function – Basic properties – Shifting

theorems – Transforms of derivatives and integrals – Initial and Final value theorems – Convolution theorem – Transform of Periodic functions – Application of solution of linear second order ordinary differential equations with constant coefficients.

TEXT BOOKS:

1. Ramana.B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2008.
2. Erwin Kresizg, "Advance Engineering Mathematics", 9th Edition, John Wiley &Sons, 2006.

REFERENCES:

1. Dass, H.K., and Er. Rajnish Verma, "Higher Engineering Mathematics", S.Chand Private Ltd., 2011.
2. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2010.
3. Peter V.O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage learning, 2012.
4. E.A.Coddinton, "An Introduction to Ordinary Differential Equations", Prentice Hall India, 1995.
5. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 40th Edition, 2014.
6. N.P.Bali and Manish Goyal, "A text Book of Engineering Mathematics", Laxmi Publications, Reprint 2008.

WEB COURSES:

1. https://nptel.ac.in/courses/122107036/
2. https://nptel.ac.in/courses/111105134/
3. https://ocw.mit.edu/courses/mathematics/18-04-complex-variables-with-applications-spring-2018/
4. https://ocw.mit.edu/courses/mathematics/18-02-multivariable-calculus-fall-2007/
5. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes/

ONLINE RESOURCES:

1. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/lecture-1-introduction/
2. http://www.nptelvideos.com/course.php?id=90

COURSE OUTCOMES:

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

1. Apply the concepts of vector differentiation and integration in various engineering problems.
2. Use Differential equations in solving physical problems.
3. Construct analytic functions and discuss various transformations.
4. Identify the nature of singularities, evaluate residues and contour integrals.
5. Use Laplace transform techniques in solving differential equation that occurs in various engineering problems.

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	-	-	-	-	-	1	1
CO2	3	3	2	1	1	-	-	-	-	-	1	1
CO3	3	3	2	1	1	-	-	-	-	-	1	1
CO4	3	3	2	1	1	-	-	-	-	-	1	1
CO5	3	3	2	1	1	-	-	-	-	-	1	1

SEMESTER - II

20HSEN201 SDG NO. 4	TECHNICAL ENGLISH - II	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To strengthen the listening skills for comprehending and critically analyzing passages
- To enhance students' ability with multiple strategies and skills for making technical presentations
- To participate in group discussions for developing group attitude
- To develop skills for preparing effective job application
- To write effective technical reports.

UNIT I LANGUAGE DEVELOPMENT **9**

Listening – conversations involving two participants – multiple participants – **Speaking** – conversation methods in real life occurrences using expressions of different emotions and imperative usages – **Reading** passages and short stories - **Writing** – preparation of checklist – extended definition – **Language Development** – tenses - subject - verb agreement.

UNIT II VOCABULARY BUILDING 9

Listening – listening formal and informal conversation and participative exercises – **Speaking** - creating greetings/wishes/excuses and thanks – **Reading** – articles/novels - **Writing** summary of articles and concise writing identifying new words – homonyms, homophones, homographs – one-word substitutions – easily confused words - creating SMS and using emoticons - sharing information in social media. **Language Development** - reported speeches – regular and irregular verbs - idioms & phrases

UNIT III WRITING TECHNICAL REPORTS 9

Listening – listening conversation – effective use of words and their sound aspects, stress, intonation & pronunciation – **Speaking** - practicing telephonic conversations – observing and responding. **Reading** – regular columns of newspapers/magazines - **Writing** – reports – feasibility, accident, survey and progress - preparation of agenda and minutes – **Language Development** - using connectives – discourse markers.

UNIT IV TECHNICAL WRITING 9

Listening – Model debates & documentaries - **Speaking** – expressing agreement/disagreement, assertiveness in expressing opinions – **Reading** biographies/autobiographies – **Writing** – note-making – formal letters – inviting guests – acceptance/declining letters - **Language Development** – degrees of comparison - numerical adjectives – embedded sentences.

UNIT V GROUP DISCUSSION AND JOB APPLICATION 9

Listening - classroom lectures – recommending suggestions & solutions – **Speaking** – participating in group discussion – learning GD strategies – Reading – journal articles - **Writing** – Job application – cover letter - résumé preparation – **Language Development** – purpose statement – editing – verbal analogies.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Board of editors. "Fluency in English: A Course book for Engineering and Technology". Orient Blackswan, Hyderabad 2016.
2. Ashraf Rizvi. M, "Effective Technical Communication", 2nd ed. McGraw Hill, New Delhi, 2018.

REFERENCES:

1. Bailey, Stephen. "Academic Writing: A Practical Guide for Students", Routledge, New York,2011.
2. Raman, Meenakshi and Sharma, Sangeetha, "Technical Communication Principles and Practice", Oxford University Press, New Delhi, 2014.

3. Muralikrishnan & Mishra Sunitha, "Communication skills for Engineers", 2nd ed. Pearson, Tamilnadu, India 2011. P. Kiranmai and Rajeevan, Geetha. Basic Communication Skills, Foundation Books, New Delhi, 2013.
4. Suresh Kumar, E., "Engineering English", Orient Blackswan, Hyderabad, 2015.
5. Richards, Jack C. "Interchange Students" Book – 2, Cambridge University Press, New Delhi, 2015.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_hs21/preview
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/109106122/lec1.pdf
3. https://freevideolectures.com/course/3250/introduction-to-film-studies/10

ONLINE RESOURCES:

1. https://www.ef.com/wwen/english-resources/
2. https://www.smilesforlearning.org/gclid=EAIaIQobChMI49DF9bnd6AIVSY6PCh1d_gV9EAAYASAAEgIBPvD_BwE

OUTCOMES:

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

1. Acquire the ability to speak effectively in real life situations.
2. Adapt group behaviour and execute the role as a contribution team member.
3. Improve active and passive vocabulary.
4. Share opinions and suggestions effectively in conversations, debates and discussions.
4. Frame winning job applications and write reports convincingly.

CO - PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	3	3	-	-
CO2	-	-	-	-	-	-	-	-	3	3	-	1
CO3	-	-	-	-	-	1	1	2	3	3	-	1
CO4	-	-	-	-	-	-	-	-	3	3	-	1
CO5	-	-	-	-	-	1	-	2	3	3	-	1

SEMESTER - II

20ESIT201 SDG NO. 4	PYTHON PROGRAMMING WITH LABORATORY	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To Develop Python Programs with Conditionals and Loops
- To Use Python Data Structures – Lists, Tuples, Dictionaries, Sets
- To Define Python Functions and Work with Modules and Packages
- To Work with Python Classes, Objects and Handling Exceptions

UNIT I BASICS OF PYTHON PROGRAMMING 9

Python Interpreter and Interactive Mode - Features – History of Python – Literals – Variables and Identifiers – Data Types – Input Operation – Comments – Reserved Words – Indentation – Operators and Expressions – Operator Precedence– Operations on Strings – Other Data types – Type Conversion - Illustrative Programs: Use of various Operators, Evaluation of expressions, String Operations.

UNIT II DECISION CONTROL STATEMENTS 9

Conditionals: Boolean Values and Operators, Conditional (if) - Alternative (if-else) - Chained Conditional (if-elif-else) - Iteration: state - while - for - break - continue - pass - Illustrative Programs: Exchange the Values of Two Variables - Circulate the values of N Variables - Distance Between Two Points - Square Root - GCD - Exponentiation - Sum and Array of Numbers.

UNIT III STRING, LISTS, TUPLES, DICTIONARIES, SETS 9

Strings: String Slices - Immutability - String functions and methods - String Module - 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 - Sets: Creating Sets – Operations and Methods – Set Comprehension - Illustrative programs: Linear Search - Binary Search - Selection Sort - Insertion Sort - Merge Sort - Histogram.

UNIT IV FUNCTIONS, MODULES AND PACKAGES 9

Functions - Function Definition and Use - Flow of Execution - Parameters and Arguments - Fruitful Functions: Return values - Parameters - Local and Global

Scope - Function Composition - Recursion - Modules – from-import Statement – Name of Module – Making your own modules - Packages - Standard Library Modules – globals(), locals() and reload() - Illustrative programs: Fibonacci Series using functions - Arithmetic Operations using Module - Area of different shapes using Packages.

UNIT V CLASSES, OBJECTS AND EXCEPTION HANDLING 9

Classes and Objects – Defining Classes – Creating Objects – Data Abstraction and Hiding through Classes - init() method – Class Variables and Object Variables – Introduction to Errors and Exception Handling – Handling Exceptions – Multiple Except Blocks – else Clause – Raising Exceptions – Built-in and User-defined Exceptions – Finally Block.

LIST OF EXPERIMENTS 15

1. Write a Python program to perform
   a. Linear Search
   b. Binary Search
2. Write a Python program to perform Selection Sort.
3. Write a Python program to sort the given numbers using Insertion Sort.
4. Write a Python program to do sorting using Merge sort.
5. Write a Python program to find first n prime numbers.
6. Write a Python program to Multiply two matrices.
7. Write a Python program to create Student class and instantiate its Object.
8. Write a Python License verification process using Exception handling.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. ReemaThareja. "Python Programming Using Problem Solving Approach", Oxford University Press 2018.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, O'Reilly Publishers, 2016.

REFERENCES:

1. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python" Revised and updated for Python 3.2, Network Theory Ltd., 2011.
2. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-Disciplinary Approach", Pearson India

Education Services Pvt. Ltd., 2016.
4. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
5. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
6. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus", Wiley India Edition, 2013.
7. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition, Pragmatic Programmers, LLC, 2013.

WEB REFERENCES:

1. http://greenteapress.com/wp/think-python/
2. www.docs.python.org
3. https://nptel.ac.in/courses/106/106/106106182/

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OUTCOMES:

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

1. Describe the syntax, semantics and control flow statements of Python programming.
2. Determine the methods to create and manipulate strings, lists, dictionaries, tuples and sets.
3. Articulate the concepts of functions, modules and packages in Python.
4. Understand and apply the concepts of files, exception handling, classes and objects.
5. Applying the Problem solving concepts to various applications using Python.

CO - PO, MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	2	2	1	1	-	2	2	-	2
CO2	2	3	3	2	2	1	1	-	2	2	-	2
CO3	3	3	3	2	3	2	1	1	2	2	2	3
CO4	2	3	3	3	3	2	2	1	2	2	2	3
CO5	3	3	3	3	3	2	2	2	3	3	3	3

SEMESTER - II

20BSCY201 SDG NO. 1-17	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the nature and facts about environment
- To finding and implementing scientific, technological, economic and political solutions to environmental problems
- To study the interrelationship between living organism and environment
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness – concept of an ecosystem – structure and function of an ecosystem – producers - consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – 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 conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial /Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies-timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – Wasteland reclamation – Consumerism and Waste products – Environment Protection Act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment protection and human health – Case studies.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

REFERENCES

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD,New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hydrabad, 2015.
3. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.

OUTCOMES:

Upon completion of the course, the students should be able to

1. Understand the basics of Structure and functions of an ecosystem, the values of biodiversity and conservation of biodiversity.
2. Understand the causes, effects and control measures of different pollution and disasters.
3. Remember the importance of natural resources and to know the role of an individual in conservation of natural resources and their case studies.
4. Gain knowledge about the concept of Sustainable development, Environmental Laws and role of Government and Non- Governmental Organizations (NGO) in Environmental Protection.
5. Learn the importance of family welfare program, population explosion and Value education.

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	2	2	1	1	-	-	3	-	-
CO2	3	2	2	2	1	3	2	2	2	-	-	2	-	-
CO3	3	2	3	2	1	2	2	2	2	-	-	3	-	-
CO4	3	2	2	2	1	3	3	2	3	-	-	3	-	-
CO5	3	2	3	2	1	3	3	2	3	-	-	2	-	-

SEMESTER - II

20ESCE201 SDG NO. 4, 9, 12	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To predict the effect of force and motion in the course of carrying out the design functions of engineering

UNIT I STATICS OF PARTICLES **10**

Introduction – Units And Dimensions – Laws of Mechanics – Newton's Laws-lami's Theorem- Parallelogram, Triangular Law and Polygon Law of Forces-principle of Transmissibility - Vectorial Representation of Forces – Fundamental Vector Operations of Forces – Free Body Diagram - Equilibrium of a Particle in 2 D – Forces in Space – Equilibrium of a Particle in Space – Equivalent Systems of Forces.

UNIT II EQUILIBRIUM OF RIGID BODIES **10**

Moments And Couples - Vectorial Representation – Scalar Components of a Moment – Varignon's Theorem- Moment of a Force About a Point and About an Axis- Single Equivalent Force - Types of Supports – Action and Reaction Forces – Types of Equilibrium - Equilibrium of Rigid Bodies in Two and Three Dimensions.

UNIT III FRICTION **7**

Friction Force – Types of Friction - Laws of Coulomb Friction – Simple Contact Friction - Two Bodies in Contact - Wedge Friction, Ladder Friction - Rolling Resistance.

UNIT IV PROPERTIES OF SURFACES AND SOLIDS **9**

Centroids and Centre of Mass and Volume – Simple and Composite Areas and Solids - Theorems of Pappus - Area Moments of Inertia of Composite Areas – Parallel Axis Theorem and Perpendicular Axis Theorem – Polar Moment of Inertia - Radius of Gyration - Product of Inertia - Principal Moments of Inertia of Plane Areas and Composite Areas – Principal Axes of Inertia - Mass Moment of Inertia – Prismatic, Cylindrical and Spherical Solids from First Principle.

UNIT V DYNAMICS OF PARTICLES AND RIGID BODIES **9**

Displacement, Velocity and Acceleration – Relative Motion - Curvilinear Motion - Newton's Laws of Motion – D' Alembert's Principle, Work Energy Principle - Impulse and Momentum – Impact of Elastic Bodies. Rigid Body

Motion - Translation and Rotation – General Plane Motion of Simple Rigid Bodies such as Cylinder, Disc / Wheel and Sphere.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi, 2004.
2. N.H Dubey, "Engineering Mechanics – Statics and Dynamics", McGraw Hill Education (India) Pvt Ltd.
3. Vela Murali, "Engineering Mechanics", Oxford University Press, 2010.

REFERENCES:

1. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
2. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
3. Irving H. Shames and Krishna MohanaRao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education 2006.
4. Meriam J.L. and Kraige L.G., " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons,1993.
5. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics andDynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.
6. Dr.N.Kottiswaran, Engineering Mechanics (statics and Dynamics), Sri Balaji Publications, Erode.

WEB RESOURCES:

1. https://nptel.ac.in/courses/112/105/112105164/
2. https://nptel.ac.in/courses/112/103/112103109/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112/106/112106286/
2. https://nptel.ac.in/courses/112/103/112103108/
3. https://nptel.ac.in/courses/112/106/112106180/
4. https://www.coursera.org/learn/engineering-mechanics-statics

OUTCOMES:

Upon completion of the course, the students should be able to

1. Enumerate the basic concepts and laws of mechanics and solve problems on the Equilibrium of particles.
2. Understand the basic concepts of moments and couple and equilibrium of rigid bodies.

3. Evaluate centroid, area and mass moment of inertia, product of inertia and principal Moment of inertia for different surfaces and solids.
4. Understand the influence of friction between contact surfaces.
5. Apply the concepts of kinematics and kinetics on particles and rigid bodies.

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	-	1	1	-	-	-	-	2	3	3
CO2	3	3	1	1	-	1	1	-	-	-	-	2	3	3
CO3	3	3	1	1	-	2	1	-	-	-	-	2	3	3
CO4	3	3	1	1	-	1	1	-	-	-	-	2	3	3
CO5	3	3	1	1	-	1	1	-	-	-	-	2	3	3

SEMESTER - II

20BSPH202 SDG NO. 4	PHYSICS OF MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the formation of alloy and phase diagrams
- To interpret the properties of ferrous alloys and its uses
- To familiarize the mechanical properties of materials
- To expose the magnetic, dielectric and superconducting materials properties and application
- To explicate the properties and applications of advanced materials

UNIT I ALLOY FORMATION AND PHASE DIAGRAMS 9

Types of alloys - Solid solutions - Hume Rothery's rules - the phase rule - single component system - one-component system of iron - binary phase diagrams - isomorphous systems - the Tie-line rule - Lever rule - application to isomorphous system - eutectic phase diagram - peritectic phase diagram - other invariant reactions - free energy composition curves for binary systems - micro structural change during cooling

UNIT II FERROUS ALLOYS 9

The iron-carbon equilibrium diagram - phases, invariant reactions - microstructure of slowly cooled steels - eutectoid steel, hypo and hypereutectoid steels - effect of alloying elements on the Fe-C system - diffusion in solids - Fick's laws - phase transformations - T-T-T-diagram for eutectoid steel – pearlite, bainte and martensite transformations - tempering of martensite.

UNIT III MECHANICAL PROPERTIES 9

Tensile test - plastic deformation mechanisms - slip and twinning - role of dislocations in slip - strengthening methods - strain hardening - refinement of the grain size - solid solution strengthening - precipitation hardening - creep resistance - creep curves - mechanisms of creep - creep-resistant materials - fracture - the Griffith criterion - critical stress intensity factor and its determination - fatigue failure - fatigue tests - methods of increasing fatigue life - hardness - Brinell hardness - Vickers microhardness.

UNIT IV MAGNETIC, DIELECTRIC AND SUPERCONDUCTING MATERIALS 9

Ferromagnetism - domain theory - types of energy - hysteresis - hard and soft magnetic materials - ferrites - dielectric materials - types of polarization - Langevin-Debye equation - frequency effects on polarization - dielectric breakdown - Insulating materials -Ferroelectric materials - superconducting materials - properties - applications.

UNIT V ADVANCED MATERIALS 9

Metallic glasses: types, glass forming ability of alloys, melt spinning process, applications - shape memory alloys: phases, shape memory effect, pseudoelastic effect, NiTi alloy, applications – Advanced ceramics –applications – composites: classification, role of matrix and reinforcement – nanomaterials: preparation (bottom up and top down approaches), properties and applications – carbon nanotubes: types.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. W.F.Smith , J. Hashemi , & R.J.Prakash, "Materials Science and Engineering", Tata McGraw Hill Education Pvt. Ltd., 2014.
2. R.Balasubramaniam, "Callister's Materials Science and Engineering", Wiley India Pvt. Ltd., 2014.
3. V.Raghavan, "Physical Metallurgy: Principles and Practice", PHI Learning, 2015.

4. William D. Callister Jr., David G.Rethwisch, "Callister's Materials Science and Engineering", 10th edition, Global edition, John Wiley & Sons, 2019.
5. Donald R Askeland, Wedelin J Wright, "Essentials of Materials Science and Engineering", Cengage Learning India Private Ltd., 2018.

REFERENCES

1. George Dieter, "Mechanical Metallurgy",. McGraw Hill ,2013.
2. James F. Shackelford, " Introduction to Materials Science for Engineers", 8th edition, 8th edition, Pearson, 2015.
3. O.P.Kanna, " Materials science and Metallurgy", Dhanpat Raj Publications, 2nd edition, 2014.
4. Susan Troiler –Mckinstry and Robert E. Newnham, "Materials Engineering: Bonding, Structure, Structure – property relationship" Cambridge University press, 2018.
5. A.Daniel, Brandt, J.C.Warner, " Metallurgy Fundamentals: Ferro and Non Ferrous" 6th edition, Good Heart Wilcox, 2019.

OUTCOMES:

Upon completion of the course, the students should be able to

1. Analyze the various composition of alloy with respect to temperature to determine the relation between microstructure and properties of material
2. Apply the acquired knowledge of Fe-C phase diagram, various microstructures and alloys in the engineering material design.
3. Demonstrate the various techniques involved to test the mechanical properties of materials.
4. Utilize the magnetic, dielectric and superconducting properties of materials for particular application.
5. Attempt the design of new materials in engineering applications.

CO - PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	-	2	2	-	-	-	-	-	-	-
CO2	3	2	2	-	-	2	2	-	-	-	-	-	-	-
CO3	3	2	2	-	-	2	2	-	-	-	-	-	-	-
CO4	3	2	2	-	-	2	2	-	-	-	-	-	-	-
CO5	3	2	2	-	-	2	2	-	-	-	-	-	-	-

SEMESTER - II

20ESGE201 SDG NO. 4,9,12	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Electrical and Electronics Engineering, Civil and Mechanical Engineering

ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring.
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of electrical equipment.

ELECTRONICS ENGINEERING PRACTICE

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components, Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

CIVIL ENGINEERING PRACTICE

Buildings:

Study of plumbing and carpentry components of residential and industrial buildings, safety aspects.

Plumbing Works:

1. Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.

2. Study of pipe connections requirements for pumps and turbines.
3. Preparation of plumbing line sketches for water supply and sewage works.
4. Hands-on-exercise: Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
5. Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

1. Study of the joints in roofs, doors, windows and furniture.
2. Hands-on-exercise: Wood work, joints by sawing, planing and cutting.

MECHANICAL ENGINEERING PRACTICE

Welding:

1. Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
2. Gas welding practice.

Basic Machining:

1. Simple Turning and Taper turning.
2. Drilling Practice.

Sheet Metal Work:

1. Forming & Bending.
2. Model making – Trays and funnels.
3. Different type of joints.

Machine assembly practice:

1. Study of centrifugal pump.
2. Study of air conditioner.

Demonstration on:

1. Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
2. Foundry operations like mould preparation for gear and step cone pulley.
3. Fitting – Exercises – Preparation of square fitting and V – fitting models.

Total : 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. Electrical

1	Assorted electrical components for house wiring	15 Sets
2	Electrical measuring instruments	10 Sets
3	Study purpose items: Iron box, fan and regulator, emergency lamp	1 Each
4	Megger (250V/500V)	1 No
5	Power Tools: Range Finder Digital Live-wire detector	 2 Nos 2 Nos

2. Electronics

1	Soldering guns	10 Nos
2	Assorted electronic components for making circuits	50 Nos
3	Small PCBs	10 Nos
4	Multimeters	10 Nos

3. Civil

1	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets
2	Carpentry vice (fitted to work bench)	15 Nos
3	Standard woodworking tools	15 Sets
4	Models of industrial trusses, door joints, furniture joints	5 each
5	Power Tools: Rotary Hammer Demolition Hammer Circular Saw Planer Hand Drilling Machine Jigsaw	 2 Nos 2 Nos 2 Nos 2 Nos 2 Nos 2 Nos

4. Mechanical

1	Arc welding transformer with cables and holders	5 Nos
2	Welding booth with exhaust facility	5 Nos
3	Welding accessories like welding shield, chipping hammer, wire brush, etc	5 Sets

4	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos
5	Centre lathe	2 Nos
6	Hearth furnace, anvil and smithy tools	2 Sets
7	Moulding table, foundry tools	2 Sets
8	Power Tool: Angle Grinder	2 Nos
9	Study-purpose items: centrifugal pump, air-conditioner	1 each

OUTCOMES:

Upon completion of the course, the students should be able to

1. Calculate electrical parameters such as voltage, current, resistance and power.
2. Measure the electrical energy by single phase and three phase energy meters.
3. Prepare the carpentry and plumbing joints.
4. Perform different types of welding joints and sheet metal works.
5. Perform different machining operations in lathe and drilling.

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	2	1	-	-	1	1	1	1	2	2
CO2	2	2	1	1	1	1	-	-	1	1	1	1	2	2
CO3	1	1	1	-	-	2	-	-	1	1	1	2	1	2
CO4	2	1	1	-	-	1	1	1	1	1	1	2	2	2
CO5	2	1	1	-	-	1	-	1	1	1	1	2	2	2

SEMESTER - II

20PRPL201 SDG NO. 4,9	COMPUTER AIDED MACHINE DRAWING LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To familiarize the students with Indian Standards on drawing practices and standard components
- To gain practical experience in handling 2D drafting and 3D modeling software systems

LIST OF EXPERIMENTS (Restrict Max 10-12 Nos only)

2-D Drafting

1. Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed drawing.
2. Bearings - Bush bearing, Plummer block
3. Valves – Safety and non-return valves.

3-D Machine Drawing

1. Introduction of 3D Modelling software
2. Creation of 3D assembly model of following machine elements using 3D Modelling software
3. Knuckle Joint
4. Flange Coupling
5. Plummer Block
6. Screw Jack
7. Lathe Tailstock
8. Universal Joint
9. Machine Vice
10. Swivel Bearing
11. Stuffing box
12. Crosshead
13. Connecting rod
14. Piston
15. Crankshaft

TOTAL: 45 PERIODS

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S.No.	EQUIPMENTS	Nos.
1.	Pentium IV computer or better hardware, with suitable graphics facility	25
2.	Licensed software for Drafting and Modeling	5
3.	Laser Printer or Plotter to print / plot drawings	1

OUTCOMES:

On completion of this laboratory course, the student should be able to

1. Make the students understand and interpret drawings of machine components
2. Prepare assembly drawings both manually and using standard CAD packages
3. Create 2D multi view drawings from isometric projection and 3D models
4. Interpret the basic details of 3D models of engineering components
5. Create Assembly Models of Machine Components using 3D modelling Software's.

CO- PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	1	-	-	-	3	1	1	2	1
CO2	2	2	2	2	2	1	-	-	-	3	1	1	2	1
CO3	2	2	2	2	2	1	-	-	-	3	1	1	2	1
CO4	2	2	2	2	2	1	-	-	-	3	1	1	2	1
CO5	2	2	2	2	2	1	-	-	-	3	1	1	2	1

SEMESTER - II

20TPHS201 SDG NO. 4&5	SKILL ENHANCEMENT	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To understand the nuances in resume building
- To explore various virtual meeting tools
- To gain knowledge about online certification courses
- To develop knowledge in Google Suite products
- To enhance presentation skills

UNIT I RESUME BUILDING **6**

Your Strength, Projects, Internship, Paper Presentation, uploading your coding in github, Introduction to HackerRank, HackerEarth virtual online assessment (Auto Proctored) (Practicals - Construct a resume, Register for a online Mock Assessment / Contest)

UNIT II VIRTUAL MEETINGS **6**

Basic Etiquette of virtual meeting – Introduction to Skype - Zoom - Webex - Google Meet - Gotowebinar - Jio meet – Screen Share - Jamboard - Feedback polling - Chatbox

(Practicals - Accept and Register for a mock class to attend - How to host a meeting).

UNIT III ONLINE LEARNING **6**

Online Certification - Coursera – Udemy – Edx – Cisco – Online Practice Platforms - SkillRack – Myslate - FACEprep - BYTS - aptimithra - Contest Registrations - TCS Campus Commune - HackwithInfy, InfyTQ - Virtusa NurualHack - Mindtree Osmosis – Online assessment - AMCAT-PGPA.

(Practicals - Campus Commune Registration , Coursera registration - Mock Registration (KAAR Technologies as sample).

UNIT IV GOOGLE SUITE **8**

Define google suite - Benefits of google suite - Google Search - Sheet - Docs - Forms - Calender - Drive - Slide - Translate - Duo - Earch - Maps - Hangouts- Sites - Books - Blogger

(Practicals – Create google sheets and share - Create google Forms and share, Create Google Slide and share , Google drive creation and share (Knowledge of Rights), Create poll and share.

UNIT V PRESENTATION SKILLS **4**

Email Writing – Group Discussion - Power Point Presentation

(Practicals- Create a self SWOT Analysis report. A PowerPoint Slide Preparation)

TOTAL : 30 PERIODS

WEB REFERENCES :

Unit I: Resume Building:

1. https://zety.com/blog/resume-tips
2. https://resumegenius.com/blog/resume-help/how-to-write-a-resume
3. https://www.hackerearth.com/recruit/
4. https://www.hackerrank.com/about-us

Unit – II:Virtual Meetings

1. https://www.claphamschool.org/our-community/blog/online-learning-etiquette-guide-14-principles-to-guide-students
2. https://online.hbs.edu/blog/post/virtual-interview-tips?c1=GAW_SE_NW&source=IN_GEN_DSA&cr2=search__-__nw__-__in__-__dsa__-__general&kw=dsa__-__general& cr5=459341920955&cr7=c&gclid=Cj0KCQjw8fr7BRDSARIsAK0Qqr4dRRbboL3kltrwDsr7hm8oIHtN5dfjD3NIFZULuzNwEXxhjpNFQ2caApn5EALw_wcB
3. https://hygger.io/blog/top-10-best-group-meeting-apps-business/
4. https://www.zdnet.com/article/best-video-conferencing-software-and-services-for-business/

Unit – III:Online Learning

1. https://www.coursera.org/browse
2. https://support.udemy.com/hc/en-us/articles/229603868-Certificate-of-Completion
3. https://www.edx.org/course/how-to-learn-online
4. https://www.cisco.com/c/en/us/training-events/training-certifications/certifications.html
5. https://campuscommune.tcs.com/en-in/intro
6. https://www.freshersnow.com/tcs-campus-commune-registration/
7. https://www.infosys.com/careers/hackwithinfy.html
8. https://www.mindtree.com/blog/osmosis-2013-my-experiences
9. https://www.myamcat.com/knowing-amcat
10. https://www.admitkard.com/blog/2020/02/06/amcat/

Unit IV: Google Suite

1. https://www.inmotionhosting.com/blog/what-is-g-suite-and-why-should-i-consider-using-it/
2. https://en.wikipedia.org/wiki/G_Suite
3. https://blog.hubspot.com/marketing/google-suite
4. https://kinsta.com/blog/g-suite/

Unit V: Presentation Skills

1. https://www.mindtools.com/CommSkll/EmailCommunication.htm
2. https://www.grammarly.com/blog/email-writing-tips/
3. https://business.tutsplus.com/articles/how-to-write-a-formal-email--cms-29793
4. https://www.softwaretestinghelp.com/how-to-crack-the-gd/
5. https://www.mbauniverse.com/group-discussion/tips
6. https://slidemodel.com/23-powerpoint-presentation-tips-creating-engaging-interactive-presentations/
7. https://business.tutsplus.com/articles/37-effective-powerpoint-presentation-tips--cms-25421
8 https://blog.prezi.com/9-tips-on-how-to-make-a-presentation-a-success/
9. http://www.garrreynolds.com/preso-tips/design/

OUTCOMES:

On completion of this course, the student should be able to

1. Construct a suitable resume and registration procedure for online mock assessments
2. Handle various virtual meeting tools
3. Acquire exposure about online certification courses
4. Get involved and work in a collaborative manner
5. Gain knowledge in various presentation methodologies

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	3	2	-	3	2	3	-	2
CO2	-	-	-	-	3	2	-	3	2	3	-	2
CO3	-	-	-	-	3	2	-	-	1	3	-	2
CO4	-	-	-	-	3	2	-	3	3	3	-	2
CO5	-	-	-	-	3	2	-	-	2	3	-	2

SEMESTER - II

20HSMG201 SDG NO. 4 & 5	INTERPERSONAL VALUES	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Values through Practical activities

UNIT I INTERPERSONAL VALUES **6**

Interpersonal Relationships and Values – Importance and Barriers – Building and maintain relationships – Mutual understanding – Respect to others.

UNIT II EFFECTIVE COMMUNICATION **6**

Communication skills –Importance and Barriers - Impressive formation and management – Public speaking

UNIT III GROUP DYNAMICS **6**

Group formation –Teamwork – Identify others attitude and behaviour – Formation of relationship – Personal and professional.

UNIT IV MUTUAL RELATIONSHIP **6**

Building mutual understanding and cooperation – Enhancing decision making skills – Problem solving skills – Comparative Appraisal – Interpersonal needs.

UNIT V POSITIVE ATTITUDE **6**

Fostering trust and cooperation – Developing and maintain positive attitude – Improving socialization – Development of security and comfort.

TOTAL: 30 PERIODS

Note: Each topic in all the above units will be supplemented by practice exercises and classroom activities and projects.

REFERENCE BOOKS:

1. Barun K. Mitra, "Personality Development and Soft Skills", Oxford University Press, 2016.
2. B.N.Ghosh, "Managing Soft Skills for Personality Development", McGraw Hill India, 2012.

OUTCOMES:

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

1. Develop a healthy relationship & harmony with others.
2. Practice respecting every human being.
3. Practice to eradicate negative temperaments.
4. Acquire Respect, Honesty, Empathy, Forgiveness and Equality.
5. Manage the cognitive abilities of an Individual.

CO – PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	2	3	3	1	1	1
CO2	-	-	-	-	-	2	2	3	3	1	1	1
CO3	-	-	-	-	-	2	2	3	3	1	1	1
CO4	-	-	-	-	-	2	2	3	3	1	1	1
CO5	-	-	-	-	-	2	2	3	3	1	1	1

SEMESTER - III

20PRPC301 SDG NO. : 4,9,12,13	BASIC MACHINING PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart the knowledge on basic concepts of various machining processes
- To impart the knowledge on basic concepts of various machine tools

UNIT I LATHE **9**

Introduction to production processes – types of production (job, batch and mass) –Lathe – Engine Lathe – block diagram – sketch – functions of each part – work holding devices in lathe – functions – Chuck, Centre+, Dogs, Steady Rest and Follower Rest, mechanism of lathe – Apron, Feed, Tumbler Gear, various operations performed in Lathe – facing, turning, chamfering and knurling – relative positions of tool and job – Taper turning operations (three methods_ thread cutting – thread – RH and LH, single start and multi start with application – Method of thread cutting – selection and arrangement of tool and work. Problems in metric and inch thread conversion – Specifications of Lathe – Burnishing.

UNIT II SHAPER, PLANER AND SLOTTER **9**

Purpose of shaping – block diagram – functions of each part. Purpose of planer – block diagram – functions of each part. Purpose of slotting machine – block diagram – functions and working principle. Operations carried out – horizontal plane, vertical plane, v type with relative position – Comparison of planer with shaper – work holding devices in shaper and planer – Quick return mechanism in shaper – mechanical and hydraulic – cross feed mechanism –Types of planer with application – mechanism in planer – Comparison of shaping with slotting – tool holding devices in shaper, planer and slotter – specifications of shaper, planer and slotter simple problems to calculate the velocity – speed, feed and depth of cut.

UNIT III DRILLING **9**

Purpose of drilling – block diagram and function – types of drilling machines – portable drilling – bench type – sensitive drilling – radial arm drilling – functions of parts – purpose and operation – gang milling, multiple drill head, upright drilling, relative operations – reaming, boring, tapping, counter boring, courses sinking, trepanning and spot facing (with simple sketch, purpose and application). Work holding devices – specification torque calculation – speed, feed and depth of cut.

UNIT IV MILLING **9**

Milling machine purpose – up and down milling – classification of milling machines – slot, keyway machining – methods of milling – single piece, string, rotary, index, gang, progressive, copy. Horizontal milling machine – block diagram – functions of each part applications – Vertical milling machine – block diagram – functions of each part applications – Gear cutting using milling machine – procedure with neat sketch – milling cutters – peripheral, face, end T slot, form etc. – attachments and special accessories for milling – rotary, slotting attachment – indexing mechanism – methods of indexing – direct, plain, compound and differential indexing – problems – specifications – cutting conditions and parameters.

UNIT V GRINDING **9**

Purpose – classification – surface finish – applications – grinding wheel – types – specifications – selection – surface grinding machine – block diagram – functions of each part – cylindrical grinding – Centreless grinding – Comparison – infeed, end feed and through feed. Balancing, dressing, loading and Truing of wheel – special grinding machines – specification of machine – cutting condition. For all machines, demonstration to be done in a Workshop or using CD to explain the actual operation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. HMT Bangalore, "Production Technology", Tata McGraw Hill Publishing Company Limited, NewDelhi, 28TH REPRINT, 2008.
2. Sharma. P.C., "A Text Book of Production Technology", S. Chand and Company, 8th Edition, 2014.

REFERENCES:

1. Jain. R.K., "Production Technology", Khanna Publishers, New Delhi, 2001.
2. Hajra Choudhary etal, "Elements of Production Technology – Vol.II", Asia Publishing House,2010.
3. Kumar. B., "Manufacturing Technology", Khanna Publishers, New Delhi 2000.
4. Radhakrishnan. P., "Manufacturing Technology, Vol.I", Scitech Publications, 2002.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_me44/preview
2. https://nptel.ac.in/courses/112107219/

ONLINE RESOURCES :

1. https://www.coursera.org/courses?query=manufacturing%20process
2. https://www.edx.org/course/fundamentals-of-manufacturing-processes
3. https://www.classcentral.com/course/edx-fundamentals-of-manufacturing-processes-7224

OUTCOMES:

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

1. Understand the constructional features and working principles of Lathe, work holding devices and also understands the concepts of mechanics of metal cutting.
2. Understand the constructional features and working principles of shaper, planer and slotter, work holding devices and various machining operations performed.
3. Understand the constructional features and working principles of drilling machine and its types.
4. Understand the constructional features and working principles of milling machine and its types, work holding devices and various machining operations performed.
5. Understand the constructional features and working principles of grinding machine and its types.

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	1	2	1	1	1	1	2	2	2	2
CO2	2	1	2	1	2	2	1	1	1	1	2	2	2	2
CO3	2	2	1	2	2	2	1	1	1	1	2	2	2	2
CO4	2	1	2	1	1	2	1	1	1	1	2	2	2	2
CO5	2	2	1	2	1	2	1	1	1	1	2	2	2	2

SEMESTER - III

20PRPC302 SDG NO. 4, 9	FOUNDRY AND WELDING TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the principle, procedure and applications of various Foundry Processes
- To understand the principle, procedure and applications of various Welding Processes

UNIT I CASTING PROCESS **10**

Introduction to casting – pattern – materials allowances – coding – types – moulds – mould making, sand – properties, types and testing of sands – core making – type of cores – single box, two box and 3 box moulding processes, runner, riser and gate.

UNIT II WELDING PROCESSES **9**

Introduction to soldering, brazing and welding types of joining – plane of welding – edge preparation – filler material – flux – shielding gases – fusion welding – gas welding – gas flame types – Manual arc welding – arc theory – power supply – braze welding – Thermit welding – Resistance welding – spot, seam, projection, percussion & flash.

UNIT III SPECIAL CASTING PROCESSES **8**

Pressure die casting – Centrifugal – continuous – investment – shell moulding – squeeze – electro slag casting – CO_2 moulding – Plaster mould castings – Antioch process – Slush casting.

UNIT IV SPECIAL WELDING PROCESSES **9**

Atomic H_2 arc welding – Shielded gas arc welding GMAW & GTAW – Submerged arc welding – Electro slag welding – friction welding – explosive welding – Underwater welding – Diffusion bonding – EBW – LBW – PAW – Stud welding – welding of dissimilar materials – Friction stir welding.

UNIT V TESTING OF CASTINGS & WELDMENTS **9**

Causes and remedies for casting defects – welding defects – Destructive testing – NDT – Dye penetrant – magnetic particle – X-ray, ultrasonic cell – studies in testing of joints & castings.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R.S.Parmer, "Welding Engineering & Technology", Khanna Publishers, 2002.
2. Heime, Looper and Rosenthal, "Principles of metal casting", Tata McGraw Hill, 2001.

REFERENCES:

1. P.L.John, "Principle of Foundry Technology", Tata McGraw Hill, 2003.
2. B.Curry, "Modern Welding Technology", Prentice Hall, 2002.
3. Larry Jeff, "Welding Principle & applications", Delmar, 1997
4. Taylor HF Fleming, "Foundry Engineering", M.C. & Wiley Eastern Ltd., 1993.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_me35/preview
2. https://swayam.gov.in/nd1_noc20_me23/preview
3. https://nptel.ac.in/courses/112107089/

ONLINE RESOURCES :

1. http://www.nifft.ac.in/UserView/UserView.aspx?TypeID=1005
2. https://www.indianfoundry.org/cms-index.php?topsubmenu_id=Mw==

OUTCOMES:

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

1. Understand about various types of casting process.
2. Understand about various types of welding process.
3. Understand about various types of special casting process.
4. Understand about various types of special welding process.
5. Understand about various testing of castings and weldments.

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	1	2	1	1	1	1	1	2	2	1
CO2	2	1	2	1	2	2	1	1	1	1	2	2	2	1
CO3	2	2	2	2	2	2	1	1	1	1	1	2	2	2
CO4	2	1	2	1	2	2	1	1	1	1	2	2	2	2
CO5	2	2	1	2	1	2	1	1	1	1	2	2	2	2

SEMESTER - III

20MEPC303 SDG NO. 4,8,9,12	ENGINEERING METALLURGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic structure and the phase diagrams
- To impart knowledge on the various heat treatment processes and strengthening mechanisms.
- To study and test various metallic and non-metallic materials
- To identify and select suitable materials for various engineering applications

UNIT I ALLOYS AND PHASE DIAGRAMS **9**

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

UNIT II HEAT TREATMENT AND STRENGTHENING MECHANISMS **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 CCR – Hardenability, Jominy end quench test - Austempering, martempering – case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening.

Strengthening Mechanisms: Cold working, Grain size control, precipitation strengthening, dispersion strengthening, particulate and fiber strengthening, texture strengthening.

UNIT III FERROUS AND NON FERROUS METALS **9**

Effect of alloying additions on steel- α and β stabilisers– stainless and tool steels – HSLA, Maraging steels – Cast Iron - Grey, white, malleable, spheroidal – alloy cast irons, Copper and copper alloys Cupronickel – Aluminium and Al-Cu – precipitation strengthening treatment – Bearing alloys, Mg-alloys, Ni-based super alloys and Titanium alloys.

UNIT IV NON METALLIC MATERIALS **9**

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET,PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers – Urea and Phenol formaldehydes)- Engineering Ceramics –

Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON –Composites- Classifications- Metal Matrix and FRP - Applications of Composites

UNIT V MECHANICAL METALLURGY AND TESTING OF MATERIALS 9

Plastic Deformation: Dislocations and Deformations by Slip, Twinning, Stacking faults. Dislocation Theory. Fracture: Types, Griffth‟s theory of brittle fracture. Testing of Materials - Tension, Torsion, Shear, Delamination, Hardness, Impact, fatigue and Creep Testing of materials according to ASTM Standards.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Avner, S.H., “Introduction to Physical Metallurgy”, McGraw Hill Book Company,1997.
2. Williams D Callister, “Material Science and Engineering”, Wiley India Pvt Ltd, Revised Indian Edition 2014.

REFERENCES :

1. Kenneth G.Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 2010.
2. R.K.Rajput, “ Engineering Materials and Metallurgy”, S.Chand & Co
3. Raghavan.V, “Materials Science and Engineering”, Prentice Hall of India Pvt. Ltd., 2015.
4. U.C.Jindal : Material Science and Metallurgy, "Engineering Materials and Metallurgy", First Edition, Dorling Kindersley, 2012
5. Upadhyay. G.S. and Anish Upadhyay, “Materials Science and Engineering”, Viva Books Pvt. Ltd., New Delhi, 2006

WEB RESOURCES:

1. https://nptel.ac.in/courses/112/108/112108150/
2. https://nptel.ac.in/courses/113/106/113106032/
3. http://web.utk.edu/~prack/MSE%20300/surface%20treatments.pdf
4. http://nitc.ac.in/index.php/?url=users/view/270/12/3

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/122/102/122102008/
2. https://nptel.ac.in/courses/113/102/113102080/
3. https://nptel.ac.in/courses/113/104/113104074/
4. https://nptel.ac.in/courses/112/104/112104219/
5. https://nptel.ac.in/courses/113/105/113105028/
6. https://nptel.ac.in/courses/113/106/113106075/
7. https://nptel.ac.in/courses/112/104/112104220/

OUTCOMES:

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

1. Understand the concept of binary phase diagrams, reactions, terminologies associated with metallurgy and also able to describe the microstructure of steel and cast iron.
2. Identify the suitable heat treatment processes for a specific requirement and also able to demonstrate the Hardenability of steels.
3. Explain the effect of alloying elements on steel, the properties and applications of various ferrous and non-ferrous alloys in the broad engineering context.
4. Understand the properties and applications of the non-metallic materials like polymers, ceramics and composites for suitable engineering applications.
5. Comprehend the various plastic deformation mechanisms and its effect on mechanical properties and also able to test the mechanical properties of materials.

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	-	-	-	-	-	-	2	3	3
CO2	3	2	3	1	-	2	2	-	-	-	-	2	3	3
CO3	2	-	2	-	-	2	2	1	-	-	-	3	3	3
CO4	2	-	2	-	-	2	3	1	-	-	-	3	3	3
CO5	3	2	1	2	-	2	-	2	-	-	-	2	3	3

SEMESTER - III

20ESME301 SDG NO. 4,6,7, 9,12,14,15	APPLIED THERMODYNAMICS AND FLUID MECHANICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand Fundamental laws of thermodynamics its applications and basics of heat devices and its performance calculations
- Know about basic cycle analysis, comparison of cycles ,steam formation and Performance calculations
- Learn fluid properties, pressure measurement , application of energy equations and types of fluid flow

- Understand about methods of Dimensional analysis, Nondimesional numbers and importance of Model analysis
- Learn about various types of Pumps and Turbines, Performance calculations

UNIT 1 BASIC CONCEPTS AND LAWS OF THERMODYNAMICS 9

Systems- Types of systems- Zeroth law, First law of thermodynamics – concept of internal energy and enthalpy applications to closed and open systems – Second law of thermodynamics – concept of entropy – Application of second law of thermodynamics –Carnot Cycle- heat pump, refrigerator –Efficiency and COP- Combined cycles - Equivalence of second law- clausius inequality and principles of increase of entropy.

UNIT 2 IC ENGINES CYCLE ANALYSIS, STEAM POWER CYCLES AND BOILERS 9

Otto, Diesel and Dual and Brayton cycle analysis -Comparison of Cycles- Properties of steam – Rankine cycle– Boiler mountings and its accessories - Trail run of Engines & Boilers.

UNIT 3 FLUID PROPERTIES AND FLOW OF FLUIDS 9

Units and Dimensions – Fluid properties – Density, Specific gravity, Viscosity, Surface tension, capillarity, compressibility and bulk modulus – Pascal's Law – pressure measurements – manometers - Simple- Differential and Inverted U tube Manometers.

Fluid Kinematics - Lagrangian and Eulerian Descriptions - Types of fluid flow – control volume – continuity equation– Velocity and Acceleration - Energy equation – Euler and Bernoulli's equations and its Applications.

UNIT 4 DIMENSIONAL ANALYSIS AND MOMENTUM PRINCIPLE 9

Dimensional analysis- Need and Methods - dimensional homogeneity- Rayleigh method and Buckinghamtheorems - Applications- Similitude - types - prototype and model – model testing and analysis.

UNIT 5 HYDRAULIC TURBINES AND PUMPS 9

Principle-construction of velocity diagrams. Classification of Turbines - construction, working and design of Pelton wheel, Kaplan and Francis Turbines- operating characteristics.

Classification of pumps - centrifugal pump-working principle - discharge, work done and efficiencies- operating characteristics. Reciprocating pump – working principle- performance calculation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R.K.Rajput, "A Text Book Of Engineering Thermodynamics", Fifth Edition, 2017.
2. Yunus A. Cengel & Michael A. Boles, "Thermodynamics", 8th edition 2015.
3. Dr.R.K.Bansal, (2000), "Fluid Mechanics and Hydraulic Machines", Laxmi Publication (P) Ltd., New Delhi.
4. P.N.Modi and S.M.Seth (1999), "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House, Naisarak, Delhi.

REFERENCES:

1. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
2. Borgnakke & Sonnatag, "Fundamental of Thermodynamics", 8th Edition, 2016.
3. Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2016.
4. Michael J. Moran, Howard N. Shapiro, "Fundamentals of Engineering Thermodynamics", 8th Edition.
5. Nag.P.K., "Engineering Thermodynamics", 5th Edition, Tata McGraw-Hill, New Delhi, 2013.
6. Vijay Gupta and S.K.Gupta, (1999), "Fluid Mechanics and Applications", New-Age International Ltd.
7. D.S. Kumar,(2004), "Fluid Mechanics and Fluid Power Engineering", Katson Publishing House, Delhi.
8. V.L. Streeter, (2001), "Fluid Mechanics", McGraw Hill Book Co.
9. R.K. Rajput, "Fluid Mechanics and Hydraulic Machines", S.Chand& Company Ltd, 2010.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/104/112104113/
2. https://nptel.ac.in/courses/112/108/112108148/
3. https://nptel.ac.in/courses/112/106/112106133/
4. https://nptel.ac.in/courses/112/104/112104118/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112/102/112102255/
2. https://nptel.ac.in/courses/112/105/112105123/
3. https://nptel.ac.in/courses/112/105/112105220/
4. https://nptel.ac.in/courses/112/105/112105266/
5. https://nptel.ac.in/courses/112/105/112105171/

6. https://nptel.ac.in/courses/112/105/112105183/
7. https://nptel.ac.in/courses/112/105/112105269/

OUTCOMES:

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

1. Study the Fundamentals of Thermodynamics .
2. Analyse various Thermodynamic Cycles.
3. Study the properties of fluids, pressure measurement and types of fluid flow .
4. Apply the scientific learning and the properties of fluid for dimensional investigation.
5. Plan the appropriate kinds of pumps and turbines for different applications.

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	-	2	1	-	-	1	1	1	3	2
CO2	3	3	3	1	-	2	-	-	1	-	1	-	3	3
CO3	3	3	2	-	-	1	1	-	-	-	-	3	3	2
CO4	3	3	3	3	-	-	1	-	1	1	2	2	2	2
CO5	3	3	3	2	-	-	1	-	1	1	1	2	3	2

SEMESTER - III

20BSMA303 SDG NO. 4	PARTIAL DIFFERENTIAL EQUATIONS AND PROBABILITY THEORY	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To introduce the basic concepts of PDE for solving standard partial differential equations
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations
- To introduce Fourier Transform techniques for applications in engineering problems
- To provide necessary basic concepts in probability theory and random variables

- To introduce one dimensional and two-dimensional random variables and Learn some standard distributions applicable to engineering which can describe real life phenomenon

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of partial differential equations – Singular integrals – Solutions of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Classification of Partial Differential Equations – Method of separation of variables – Fourier Series Solutions of one-dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction.

UNIT III 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.

UNIT IV PROBABILITY AND RANDOM VARIABLES 12

Probability – Axioms of probability – Conditional probability – Baye's theorem – Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT V TWO – DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Veerarajan. T., "Transforms and Partial Differential Equations", Tata Mc-Graw Hill Education Pvt. Ltd., New Delhi, Third print, 2016.
2. Ibe. O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier, 1st Indian Reprint, 2007.

REFERENCES:

1. Erwin Kreyszig, “Advanced Engineering Mathematics”, 10th Edition, John Wiley & Sons, INC.
2. Trivedi. K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", John Wiley and Sons, 2nd Edition, 2002.
3. Ray Wylie. C and Barrett. L.C., "Advanced Engineering Mathematics", Tata McGraw Hill Education Pvt. Ltd, Sixth Edition, New Delhi, 2012
4. Ramana. B.V., "Higher Engineering Mathematics", Tata Mc Graw Hill Publishing Company Limited, New Delhi, 2008.
5. Yates. R.D. and Goodman. D. J., "Probability and Stochastic Processes", Wiley India Pvt. Ltd., Bangalore, 2nd Edition, 2012.
6. Veerarajan. T., “Probability, Statistics and Random Processes”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, Third print, 2016.

WEB RESOURCES:

1. https://ocw.mit.edu/courses/mathematics/18-600-probability-and-random-variables-fall-2019/lecture-notes/index.htm
2. https://nptel.ac.in/courses/122103012/

ONLINE RESOURCES:

1. https://youtu.be/vEt3eqihm80
2. https://www.youtube.com/watch?v=bjybXMwWjjc

OUTCOMES:

Upon completion of the course, the students should be able to

1. Understand the mathematical principles of partial differential equations and formulate the equations.
2. Solve boundary value problems using Fourier series.
3. Analyze problems arising in various domains of Engineering using Fourier transform techniques.
4. Understand the concepts of probability, random variables as well as certain special discrete and continuous distributions.
5. Extend the concepts to two-dimensional random variables and to compute various statistical quantities associated with them.

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	-	-	-	-	-	-	-	1	-	-
CO2	3	3	3	2	-	-	-	-	-	-	-	1	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	1	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	1	-	-
CO5	3	3	3	2	-	-	-	-	-	-	-	1	-	-

SEMESTER - III

20PRPL301 SDG NO. 4,9	BASIC MANUFACTURING PROCESS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To introduce different machining process to develop components
- To introduce different machine tool to develop components

LIST OF EXPERIMENTS (Restrict Max 10-12 Nos only)

1. Lathe: Facing, Plain turning, Step Turning
2. Lathe: Taper Turning, Threading, Knurling
3. Lathe: Multi start Threading, Burnishing
4. Shaper: Cube
5. Shaper: Cube, V-Block
6. Drilling: Counter sinking, Counter Boring, Tapping
7. Milling Vertical: Surfacing, Pocket Milling
8. Milling Horizontal: Polygonal shape milling
9. Grinding: Surface & Cylindrical grinding
10. Slotting: Machining an internal spline

TOTAL: 45 PERIODS

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S.No.	EQUIPMENTS	Nos.
1.	Lathe	15
2.	Drilling Machine	2
3.	Shaper	2
4.	Vertical Milling Machine	1
5.	Horizontal Milling Machine	1

6.	Surface Grinding Machine	1
7.	Cylindrical Grinding Machine	1
8.	Slotting Machine	1

OUTCOMES :

On completion of this laboratory course, the student should be able to

1. Select appropriate turning process to obtain finished components.
2. Select appropriate milling process to obtain finished components.
3. Select appropriate shaper and slotting process to obtain finished components.
4. Select appropriate grinding process to obtain optimum surface finish.
5. Coordinate various machining process in sequence to get desired design in final components.

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	1	2	1	1	1	1	2	2	2	2
CO2	2	1	2	1	2	2	1	1	1	1	2	2	2	2
CO3	2	2	1	2	2	2	1	1	1	1	2	2	2	2
CO4	2	1	2	1	1	2	1	1	1	1	2	2	2	2
CO5	2	2	1	2	1	2	1	1	1	1	2	2	2	2

SEMESTER - III

20PRPL302 SDG NO. 4 & 9	WELDING AND METALLURGY LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To practice various types of welding processes
- To train the students in observation and interpretation of microstructure of engineering materials
- To train students in heat treatment, hardenability and surface treatment of engineering materials
- To train the students in testing of foundry sand

LIST OF EXPERIMENTS (Restrict Max 10-12 Nos only)

Welding

1. Study of different welding equipments and accessories: Gas, Electric Welding
2. Oxy-acetylene gas welding of Lap joint, Butt Joint and T Joint.
3. Electric arc welding of Lap Joint, Butt Joint, and T Joint.
4. Welding of pipes in different positions.

Metallurgy

1. Specimen preparation for macro – examination.
2. Specimen preparation for micro examination and study of Micro structure of
   a) Carbon steels
   b) Cast Iron
   c) Brass , Bronze , Al-Si alloy, cupro-nickel, Ti alloy.
3. Quantitative metallography – Estimation of volume fraction, particle size, size distribution, and shape.
4. Heat treatments (carry out the following heat treatment and study the micro structure before and after heat treatments)
   a) Annealing
   b) Normalising
   c) Quench Hardening
   d) Tempering
5. Jominy End Quench Test
6. Foundry Sand testing
   a) Sieve analysis
   b) Strength of moulding sand
   c) Permeability of moulding sand
   d) Clay content of moulding sand
   e) Moisture content of moulding sand

TOTAL: 45 PERIODS

OUTCOMES

On completion of this laboratory course, the student should be able to

1. Perform gas welding operations to form the metals
2. Perform arc welding operations to form the metals
3. Interpret the microstructure of different ferrous and non ferrous alloy and perform performs quantitative metallography.
4. Perform heat treatment, surface treatment on metals.
5. Analyze the properties of Foundry Sand.

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	1	2	1	1	1	1	1	2	2	1
CO2	2	1	2	1	2	2	1	1	1	1	2	2	2	1
CO3	2	1	2	2	1	2	1	1	1	1	2	2	2	2
CO4	2	1	2	2	1	1	1	1	1	1	2	2	2	2
CO5	2	2	1	2	2	2	1	1	1	1	1	2	2	2

SEMESTER - III

20PRTE301 SDG NO. 4,6,7,8, 9,11,12,13, 17	LIVE-IN-LAB PROJECT - I	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same
- To train the students face reviews and viva voce examination

GUIDELINES TO BE FOLLOWED

The student individually works on a specific topic may be selected from published data or from the creative ideas approved by project supervisor who is familiar in the area of interest (Design/ Manufacturing/ Thermal/ Mechatronics) and head of the department. The selected topic may be analytical or experimental. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners. The student would apply the knowledge gained from theoretical and practical courses, so as to give confidence to the students to be creative, well planned, organized, coordinated in their Live-in Lab Project-II.

The progress of the project is reviewed and evaluated with a minimum of three reviews with the guidance of Project Coordinator. The review committee may be constituted by the Head of the Department. The student must submit a project report at the end of the semester for evaluation.

EVALUATION

Project work evaluation is based on Regulations of Credit system of Autonomous Regulatory Body.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students should be able to

1. Comprehend an industrial or real life problem and identify right/ real issue with solution.
2. Complete the necessary studies and review the literature, design a setup of equipment, complete the analysis
3. Write a project report based on the findings.

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	1	2	1	1	1	3	2	3	3	3	2

SEMESTER - III

20MGMC301 SDG NO. 4	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

OBJECTIVES:

At the end of the course, the student is expected

- To know about Indian constitution.
- To know about central government functionalities in India.
- To know about state government functionalities in India.
- To know about Constitution function.
- To Know about Constitutional remedies.

UNIT I INTRODUCTION **6**

Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties

UNIT II STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT 6

Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India

UNIT III STRUCTURE AND FUNCTION OF STATE GOVERNMENT 6

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.

UNIT IV CONSTITUTION FUNCTIONS 6

Indian Federal System – Centre – State Relations – President's Rule – Constitutional Amendments – Constitutional Functionaries.

UNIT V CONSTITUTIONAL REMEDIES 6

Enforcement of fundamental rights - Power of parliament to modify the rights the conferred by this part in their application to forces

TOTAL: 30 PERIODS

TEXT BOOKS:

1. Durga Das Basu, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi
2. R.C. Agarwal, (1997) "Indian Political System", S. Chand and Company, New Delhi.
3. M.V. Pyle (2019) , "An Introduction to The Constitution of India, 5/e", Vikas Publishing, New Delhi.
4 P.M. Bakshi, (2018) , "Constitution of India", Universal Law Publishing, New Delhi.

REFERENCES:

1. Sharma, Brij Kishore, "Introduction to the Constitution of India: Prentice Hall of India, New Delhi.
2. U.R.Gahai, "Indian Political System", New Academic Publishing House, Jalandhar.

OUTCOMES:

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

1. Understand about constitution & Fundamental rights of citizens.
2. Interpret the structure and hierarchy of central and state Government.
3. Analyze the functions of judiciary, Parliament and its constituent members.

4. Evaluate the functions and boundaries of central and state governments in respect of their powers, duties and centre, state relationship.
5. Distinguish Indian social structure in respect of caste, religion, language, rights to citizens particularly rights to women, children and weaker sections.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	--		-	-	-	-	1	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	2	-	3	-	-	-	-	-

SEMESTER - IV

20PRPC401 SDG NO. 4, 9	FLUID POWER DRIVES AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the working principle of hydraulic and pneumatic components and its selection
- To design hydraulic and pneumatic circuits for different applications

UNIT I INTRODUCTION TO FLUID POWER **9**

Introduction to fluid power controls – Hydraulics and pneumatics – Selection criteria, Application of Fluid power, Application of Pascal's Law, equation, Transmission and multiplication of force – Pressure Losses – Fluids, selection & properties – ISO symbols.

UNIT II FLUID POWER DRIVES **9**

Fluid Power drives – Pumps – working principle and construction details of Gear, vane and piston pumps, Hydraulic motors, Hydrostatic transmission drives and characteristics, Hydraulic supply components Pneumatic power supply – compressors, air distribution, air motors.

UNIT III FLUID POWER ELEMENTS **9**

Control valves – pressure, flow, direction - working principle and construction – Special type - valves – Cartridge, modular, proportional, and servo – Selection and actuation methods. Actuators – Selection and specification, cylinders, mounting, cushioning – Fluid conditioning elements – Accumulators

UNIT IV HYDRAULIC AND PNEUMATIC CIRCUITS DESIGN **9**

Design of Hydraulic and pneumatic circuits for automation, selection and specification of circuit components, sequencing circuits, Pump Unloading circuit, cascade, and karnaugh – Veitch map method – Regenerative, speed control and synchronizing circuits

UNIT V ELECTRO PNEUMATICS AND PLC CIRCUITS **9**

Use of electrical timers, switches, solenoid, relays and proximity sensors electro pneumatic sequencing - PLC – elements, functions and selection – PLC programming – Ladder diagram and different programming methods - Sequencing circuits.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Anthony Esposito, “Fluid power with applications”,7th Edition, Pearson education 2014.
2. Majumdar, “Oil hydraulics: Principles and Maintenance”,7th Edition, Tata McGraw Hill, 2005.
3. Majumdar, “Pneumatic System: Principles and Maintenance”, Tata McGraw Hill, 2006.

REFERENCES:

1. Srinivasan. R., “Hydraulic and Pneumatic Controls”, Vijay Nicole Imprints Private Limited, 2011.
2. William W.Reaves, "Technology of Fluid Power", Delmer Publishers, 1997.
3. Petor Rohner, "Fluid Power Logic circuit", Design Macmillon Press Ltd., 1990.
4. Andrew Parr “Hydraulics & Pneumatics”, Jaico Publishing House, 2004.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112106175/
2. https://nptel.ac.in/courses/112105046/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/4957/nptel-fundamentals-

industrial-oil-hydraulics-pneumatics

2. https://www.e4training.com/index.php
3. https://www.coursera.org/learn/fluid-power

OUTCOMES:

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

1. Understand the fundamentals of pneumatics and hydraulics and its principles.
2. Understand constructional and operational features about the hydraulic and pneumatic drives system.
3. Identify pneumatic and hydraulic components and their functions.
4. Design basic and advanced pneumatic and hydraulic circuits for industrial applications.
5. Understand the basic concepts, elements and functions of Programmable Logic Controller.

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	1	3	1	1	1	1	2	1	2	3	1
CO2	2	2	2	2	2	1	1	1	1	1	1	1	3	1
CO3	3	2	2	2	2	2	1	1	1	2	1	2	2	1
CO4	1	3	2	2	1	1	1	1	1	1	1	1	1	2
CO5	2	2	1	2	-	-	-	-	-	-	-	-	1	1

SEMESTER - IV

20MEPC402 SDG NO. 4,8,9, 12,16	METROLOGY, MEASUREMENTS AND COMPUTER AIDED INSPECTION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge on various metrological equipment available to measure the dimension of the components.
- To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.
- To measure recessed areas those are difficult to measure using optical systems.
- To improve the quality of the product, increase the productivity in the inspection process and reduce the lead times in manufacturing

UNIT I BASICS OF MEASUREMENT AND LINEAR MEASUREMENT 9

Definition of metrology-needs, elements and methods of measurement. Accuracy and Precision, Basic definitions in Measurements. Generalized measurement system - static characteristics of instruments - factors considered in selection of instruments - Errors - classification - sources of error. Calibration – uncertainty. General cares and rules in measurement, Standards and its types.

Linear Measuring Instruments: Evolution – Vernier caliper, Micrometer, feeler gauges, dial indicator, surface plates, Slip Gauge- classification and calibration. Comparators- mechanical, electrical, optical and pneumatic.

UNIT II ANGULAR, SURFACE MEASUREMENTS AND GAUGES 9

Angular Measuring Instruments: Types – Bevel protractor, Spirit level, Clinometers, Angle gauges, Sine bar – Angle alignment telescope – Autocollimator – applications, Angle dekkor. Principles and methods of straightness measurement – Flatness measurement – Surface finish measurement. Limit gauges – gauge design – terminology – procedure – concepts of interchangeability and selective assembly.

UNIT III FORM AND MECHANICAL PARAMETER MEASUREMENTS 9

Thread measurement, Gear measurement, Roundness measurement –Position sensors: Potentiometer, LVDT, Proximity sensors - types. Temperature sensors: Bimetallic strip, Thermocouples, Liquid in glass thermometer, Resistance temperature detector, Thermocouples and Thermopiles, Thermistor, Optical pyrometer. Force, Torque, Power measurement -Mechanical, Pneumatic, Hydraulic and Electrical type

UNIT IV CO-ORDINATE MEASURING MACHINE AND LASER METROLOGY 9

CMM: Need, Types and applications - Manual CMMs, CNC CMMs, Multi-sensor CMMs, Portable CMMs, CMM software, Modes of operation-Types of probes

LASER METROLOGY: Interferometry, applications of Interferometry, methods of Interferometry, Michelson‟s Interferometer, ACLI- N.P.L flatness Interferometer, Zeiss interferometer, Twyman-Green interferometer, sources of errors, corrections to be made, laser spectroscopy, laser holography, machine tool alignment

UNIT V MACHINE VISION SYSTEM 9

Machine Vision: Image sensing and acquisition, types of cameras and their principles, machine vision lightings, designing a machine vision system- lens design, choice of camera and illumination, laser vision system, software for image processing.

Industrial Applications: Machine vision in industry automation, dimensional measurement, identification of flaws and defects, pattern recognition applications, sorting and counting, study of surface finish, tool wear measurement, robot guidance, safety monitoring.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.
2. Jain R.K. "Engineering Metrology", Khanna Publishers, 2009.

REFERENCES

1. Alan S. Morris, "The essence of Measurement", Prentice Hall of India 1996.
2. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education , 2014.
3. Charles Reginald Shotbolt, "Metrology for Engineers", 5th edition, Cengage Learning EMEA,1990.
4. Davies E R, "Computer and Machine Vision: Theory, Algorithms, Practicalities", Academic Press, 2012.
5. Bhabatosh Chanda and Dutta Majumder D, "Digital Image Processing and Analysis", PHI Learning Pvt. Ltd., 2011.
6. Raghavendra and Krishnamurthy "Engineering Metrology & Measurements", Oxford Univ. Press, 2013.

WEB RESOURCES:

1. https://nptel.ac.in/courses/112/106/112106139/
2. https://www.matweb.com

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112/106/112106138/
2. https://nptel.ac.in/courses/112/106/112106179/
3. https://nptel.ac.in/courses/112/104/112104250/
4. https://nptel.ac.in/courses/112/103/112103261/
5. https://nptel.ac.in/courses/112/106/112106140/
6. https://nptel.ac.in/courses/112/107/112107242/
7. https://nptel.ac.in/courses/112/107/112107259/

OUTCOMES:

Upon completion of the course, the students should be able to

1. Describe the concepts of measurements to apply in various metrological instruments

2. Outline the principles of linear, angular and form measurement tools used for industrial applications.
3. Discuss various measuring techniques of mechanical properties in industrial applications.
4. Explain the procedure for conducting computer aided inspection.
5. Understand the Industrial Applications of Machine Vision.

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	1	1	1	-	2	-	2	2	3
CO2	2	2	1	1	-	2	1	1	-	2	-	2	2	3
CO3	2	2	1	1	-	1	1	1	-	2	-	2	2	3
CO4	2	2	2	2	1	1	1	1	-	2	2	2	2	3
CO5	2	2	2	2	1	1	1	1	-	2	2	2	2	3

SEMESTER - IV

20PRPC402 SDG NO. 4, 9	COMPUTER AIDED PRODUCT DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concepts and applications of CAD
- To introduce the various concepts and techniques used for Product design and to develop product design skills

UNIT I INTRODUCTION TO COMPUTER AIDED DESIGN 9

Introduction to Engineering Design – Various phases of systematic design – sequential engineering and concurrent engineering – Computer hardware & Peripherals – software packages for design and drafting.

UNIT II COMPUTER GRAPHICS FUNDAMENTALS 9

Computer graphics – applications – principles of interactive computer graphics – 2D, 3D transformations – projections – Curves – Hermite Cubic Spline -Bezier, B-Spline and NURBS – Concepts.

UNIT III GEOMETRIC MODELING 9

Geometric Modeling – types – Wire frame, surface and solid modeling –

Constructive Solid Geometry (CSG),Boundary Representation(B-Rep), Sweep Representation – Graphics standards – assembly modeling – use of software packages

UNIT IV PRODUCT DESIGN CONCEPTS **9**

Product modeling – types of product models; product development process tools – TRIZ – Altshuller's inventive principles – Design for reliability – design for manufacturability–machining, casting, and metal forming – design for assembly and disassembly - Design for environment; Benchmarking – FMEA – QFD – DOE – Taguchi method of DOE – Quality loss functions – Design for product life cycle.

UNIT V PRODUCT DATA MANAGEMENT **9**

Product Data Management – concepts – Collaborative product design and commerce – Information Acquisition – Sourcing factor – manufacturing planning factor – Customization factor – Product life cycle management.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Kevin Otto, Kristin Wood, "Product Design", Pearson Education, 2011
2. Ibrahim Zeid, "CAD/CAM theory and Practice", Tata McGraw Hill, 1991.

REFERENCES:

1. Biren Prasad, "Concurrent Engineering Fundamentals" Vol.11, Prentice Hall, 1997.
2. James G.Bralla, "Handbook of Product Design for Manufacturing", McGraw Hill, 1994.
3. David F.Rogers.J, Alan Adams, "Mathematical Elements for Computer Graphics", McGraw Hill, 1990.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_de05/preview
2. https://nptel.ac.in/courses/112102102/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/2362/computer-aided-design-and-manufacturing/1
2. https://www.coursera.org/specializations/cad-design-digital-manufacturing

OUTCOMES:

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

1. Will be able to design and develop a system or component systematically in various stages.
2. Have the ability to select suitable hardware and software for particular applications.
3. Have potential to create geometric modeling and assembly modeling based on requirement using computer graphics.
4. Have acquired knowledge to design a component by considering different aspects like manufacturing, assembly, usage etc.
5. Will be able to manage various product data.

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3	3	1	1	2	2	1	1	3	2
CO2	3	2	3	2	3	2	1	1	1	1	1	2	3	3
CO3	2	2	2	1	3	2	1	1	1	1	2	1	3	2
CO4	3	3	2	1	2	2	1	1	1	1	2	1	2	2
CO5	2	2	1	1	2	2	1	1	1	1	1	1	2	2

SEMESTER - IV

20CEPC405 SDG NO. 4, 9	STRENGTH OF MATERIALS FOR MECHANICAL ENGINEERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of stress and strain
- To determine the principal stresses and deformation in cylindrical and spherical shells
- To determine stresses and deformation in circular shafts and helical spring due to torsion
- To study the concept of shearing force and bending moment due to external loads in beams and their effect on stress distribution
- To compute slopes and deflections in determinate beams by various methods

UNIT I STRESS, STRAIN & DEFORMATIONS OF SOLIDS 9

Definition of Stress and Strain – Tension, Compression and Shear Stresses. Stress-Strain relationship and Hooke's law. Deformation of simple and compound bars – Thermal stresses – Elastic constants and their relations

UNIT II ANALYSIS OF STATE OF STRESS AND CYLINDRICAL AND SPHERICAL SHELLS (THIN AND THICK) 9

Stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress. Stresses and deformation in thin and thick cylinders due to internal pressure. Stresses and deformation in thin and thick spherical shells subjected to internal pressure. Lame's theorem.

UNIT III TORSION AND SPRINGS 9

Torsion Equation - Deformation in solid and hollows shafts – Stepped shafts–shafts fixed at the both ends- Stresses & deflection in open and closed coil helical springs with axial load – Stresses and deflection in carriage springs.

UNIT IV STRESSES IN BEAMS 9

Beams – types, Transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending–bending stress distribution- Shear stress distribution.

UNIT V DEFLECTION OF BEAMS & COLUMNS 9

Computation of slopes and deflections in beams - Double Integration method – Macaulay's method – Area moment method - Euler Equation and Rankine Formula for buckling of columns.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ferdinand P. Beer and E. Russell Johnston Jr., "Mechanics of Materials", 7th Edition in S.I. Units, McGraw Hill Education (India) Pvt. Ltd., 2017.
2. Bansal, R.K., "A Text Book of Strength of Materials", Laxmi Publications (P) Ltd. New Delhi, 2018.

REFERENCES

1. Rajput, R.K., "Strength of Materials", S. Chand Publications, 2018.
2. Jindal U.C., "Strength of Materials", 2nd Edition, Pearson India Education, 2018.
3. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2016.
4. Hibbeler, R.C., "Mechanics of Materials", Pearson India Education, 2017.

WEB RESOURCES:

1. https://nptel.ac.in/courses/112/106/112106141/
2. https://nptel.ac.in/courses/112/107/112107146/
3. https://nptel.ac.in/courses/105/102/105102090/
4. http://ocw.mit.edu/courses/mechanical-engineering
5. http://nitc.ac.in/index.php/?url=users/view/270/12/3

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112/107/112107147/
2. https://nptel.ac.in/courses/105/105/105105108/
3. https://nptel.ac.in/courses/105/106/105106116/
4. https://nptel.ac.in/courses/105/104/105104160/
5. https://nptel.ac.in/courses/105/106/105106172/

OUTCOMES:

Upon completion of the course, the students should be able to

1. Apply the fundamental concepts of stress, strain in designing structural elements with due consideration to safety.
2. Design thin and thick cylindrical shells, spherical shells that meet the specified requirement of the industry.
3. Determine the twisting moment induced in circular shafts and in turn design shafts and springs.
4. Analyze the shear force and bending moment induced in beams and in turn their stress distribution across the cross section that meets the design requirements of structures.
5. Estimate the slope and deflection in beams, crippling load on columns by using appropriate methods that meets the design requirements of structures.

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	2	1	-	-	-	-	2	2	3
CO2	3	2	2	-	-	2	1	-	-	-	-	2	2	3
CO3	3	2	2	-	-	-	-	-	-	-	-	2	2	2
CO4	3	2	1	-	-	-	-	-	-	-	-	2	2	2
CO5	3	2	1	-	-	-	-	-	-	-	-	2	2	2

SEMESTER - IV

20PRPW401 SDG NO. 4,9,12	METAL CUTTING AND CNC MACHINES WITH LABORATORY	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To understand the theory of metal cutting
- To understand the concepts of gear manufacture
- To understand CNC machines constructional features, working principle
- To train the students to write CNC Programming to simulate tool path simulation for different components

UNIT I MECHANICS OF METAL CUTTING 10

Tool nomenclature – single point and multipoint cutting tools – orthogonal & oblique cutting – cutting forces, Merchant circle diagram – force & velocity relationship

UNIT II TOOL MATERIAL, TOOL WEAR AND TOOL LIFE 9

Requisites of tool materials – types of tool materials – Tool wear – Types, mechanism – Tool life - Machinability - types of chips – cutting fluids.

UNIT III GEAR MANUFACTURE 11

Different methods of gear manufacture – Gear hobbling and gear shaping machines specifications – gear generation – different methods – gear finishing and shaving – grinding and lapping of hobs and shaping cutters – gear honing – gear broaching.

UNIT IV CNC MACHINES 10

NC, CNC & DNC – types of CNC – constructional features – drives and control systems – feed back devices – Interchangeable tooling system – preset & qualified tools – ISO specification – Machining center – Turning center – CNC wire cut EDM- Study of different control systems and NC codes

UNIT V CNC PROGRAMMING AND SIMULATION 35

- Program for turning, taper turning, Facing operation, thread cutting and for circular interpolation
- Program using Do-Loop and Sub-routine, profile milling,circular and rectangular pocket milling

- Program for drilling cycle, tool compensation

TOTAL: 75 PERIODS

TEXT BOOKS:

1. Nagpal G.R., "Machine Tool Engineering", Khanna Publishers, 2002.
2. Groover.M.P., "Automation, production systems and computer integrated manufacturing", Prentice Hall , 2008.

REFERENCES:

1. GE Thyer, "Computer Numerical Control of Machine Tools", BH. Newners, 1991.
2. Hajra Choudhury C.J., “Elements of Workshop Technology”, Vol.I and Vol.II, Asia Publishing House, 2010.
3. Jonathan Lin.S.C., "Computer Numerical Control from Programming to Networking", Delmar Publishers, 1994.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_me16/preview
2. https://swayam.gov.in/nd1_noc20_me41/preview

ONLINE RESOURCES:

1. https://swayam.gov.in/nd1_noc20_me45/preview
2. https://www.udemy.com/course/cnc-cutting-tools-and-machining-techniques/

OUTCOMES:

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

1. Apply the principles of metal cutting and mechanics in machining process.
2. Select tool materials based on requirement.
3. Understood the concepts of various gear manufacturing methods.
4. Acquire knowledge on modern material removal process like EDM.
5. Perform CNC and APT program for turning and machining centre.

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	3	2	1	3	2	1	1	3	2	1
CO2	3	1	1	1	3	2	1	3	2	1	1	3	2	1
CO3	3	1	1	1	3	2	1	3	2	2	1	3	2	1
CO4	3	1	1	1	3	2	1	3	2	1	1	3	2	1
CO5	3	1	1	1	3	2	1	3	2	2	2	3	2	1

SEMESTER - IV

20BSMA403 SDG NO. 4	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To define Null and Alternate hypothesis, identify small, large samples and gain knowledge in testing of hypothesis
- To differentiate between one way and two-way classification of ANOVA and gain knowledge in Design of experiments
- To impart knowledge on numerical solution of algebraic, transcendental and system of linear equations and learn to compute Eigen values and Eigen vectors
- To understand various numerical techniques of finding the interpolating polynomials in equal and unequal intervals and learn the concept of numerical differentiation and integration
- To gain knowledge in solving ordinary and partial differential equations using numerical techniques

UNIT I 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, Chi-square and F-distributions for mean, variance and proportion - Contingency table (test for independence) - Goodness of fit.

UNIT II DESIGN OF EXPERIMENTS 12

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT III 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 – Eigen values of a matrix by Power method and Jacobi's method for symmetric matrices .

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 12

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF 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-Bashforth predictor corrector methods for solving first order equations.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Grewal, B.S. and Grewal, J.S., “Numerical Methods in Engineering and Science ", 10th Edition, Khanna Publishers, New Delhi, 2015.
2. Johnson, R.A., Miller, I. and Freund J., “Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

REFERENCES

1. Burden, R.L and Faires, J.D, "Numerical Analysis”, 9th Edition, Cengage Learning, 2016.
2. Devore, J.L., "Probability and Statistics for Engineering and the Sciences”, Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald, C.F. and Wheatley, P.O. "Applied Numerical Analysis”, Pearson Education, Asia, New Delhi, 2006.
4. Spiegel, M.R., Schiller, J. and Srinivasan, R.A., "Schaum's Outlines on 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", 8th Edition, Pearson Education, Asia, 2007.

WEB RESOURCES:

1. https://www.classcentral.com/course/swayam-numerical-analysis-17709
2. https://online-learning.harvard.edu/course/statistics-and-r?delta=1

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3057/numerical-methods-and-computation
2. https://nptel.ac.in/courses/111107105/
3. https://www.maths.unsw.edu.au/courses/math2089-numerical-methods-and-statistics

OUTCOMES:

Upon completion of the course, the students should be able to

1. Apply test of hypothesis for small and large samples in real life problems.
2. Construct an optimal design for practical problems and analyze the data to obtain objective conclusions.
3. Obtain the numerical solution of Eigen value problems, algebraic and transcendental equations.
4. Find the numerical solution for interpolation, differentiation and integration problems arising in various engineering applications.
5. Solve ordinary and partial differential equations using numerical techniques.

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	1	-	-	-	-	-	-	1	1	1
CO2	3	3	2	1	1	-	-	-	-	-	-	1	1	1
CO3	3	3	2	1	1	-	-	-	-	-	-	1	1	1
CO4	3	3	2	1	1	-	-	-	-	-	-	1	1	1
CO5	3	3	2	1	1	-	-	-	-	-	-	1	1	1

SEMESTER - IV

20MEPL401 SDG NO. 4,7,12	METROLOGY AND MEASUREMENTS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To measure various parameters accurately using different measuring instruments for Quality Inspection in Industries
- To identify and classify different measuring tools and explain accuracy and precision
- To conduct, analyse, interpret, and present measurement data from measurements experiments
- To identify sources of variability, error, and uncertainties

LIST OF EXPERIMENTS

1. Calibration and use of measuring instruments – vernier caliper, micrometer, vernier height gauge – using gauge blocks
2. Calibration and use of measuring instruments – depth micrometer, bore gauge, telescopic gauge
3. Measurement of linear dimensions using Comparators
4. Measurement of angles using bevel protractor and sine bar
5. Measurement of screw thread parameters – Screw thread Micrometers and Three wire method (floating carriage micrometer)
6. Measurement of gear parameters – gear tooth vernier caliper
7. Measurement of features in a prismatic component using Coordinate Measuring Machine
8. Programming of CNC Coordinate Measuring Machines for repeated measurements of identical components
9. Non-contact (optical) measurement using toolmaker's microscope / profile projector.
10. Measurement of surface finish in components manufactured by various processes (turning, milling, grinding, etc.,) using stylus based instruments.
11. Machine tool metrology – Level tests using precision level, Testing of straightness of a machine tool guide way using autocollimator.
12. Measurement of force, torque and temperature

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

1	Micrometer and dial gauges	5
2	Vernier Caliper	5
3	Vernier Height Gauge	2

4	Vernier depth Gauge	2
5	Slip Gauge Set	2
6	Gear Tooth Vernier	2
7	Sine Bar	2
8	Floating Carriage Micrometer	1
9	Profile Projector / Tool Makers Microscope	1
10	Parallel / counter flow heat exchanger apparatus	1
11	Mechanical / Electrical / Pneumatic Comparator	1
12	Autocollimator	1
13	Temperature Measuring Setup	1
14	Force Measuring Setup	1
15	Torque Measuring Setup	1
16	Coordinate measuring machine	1
17	Surface finish measuring equipment	1
18	Bore gauge	1
19	Telescope gauge	1

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students should be able to

1. Understand the various parameters like length, height, angle, displacement, flatness, etc.
2. Understand the various linear and angular measurements using measurants like comparator, sine bar, floating carriage micrometer etc.
3. Inspect various profiles of small mechanical components using light illumination devices.
4. Develop the knowledge on measuring various physical and dynamic properties like Tolerance, force and temperature using LVDT, Load cell and Thermocouples.

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	1	-	-	2	2	2
CO2	3	2	2	-	-	-	-	-	1	-	-	2	2	2
CO3	3	1	2	-	-	-	-	-	1	-	-	2	2	2
CO4	2	2	2	-	-	-	-	-	1	-	-	2	2	2

SEMESTER - IV

20CEPL403 SDG NO. 4,9	STRENGTH OF MATERIALS AND FLUID MECHANICS & MACHINERY LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To supplement the theoretical knowledge gained in Mechanics of Solids and Fluid Mechanics with practical testing for determining the strength of materials under externally applied loads
- To enable the students to have a clear understanding of the Design for strength and stiffness and losses in pipe flow
- To understand the flow measurements.
- To analyses the Performance of various Pumps and Turbines

LIST OF EXPERIMENTS :

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Strain Measurement using Rosette strain gauge
9. Effect of hardening- Improvement in hardness and impact resistance of steels.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

S.No	NAME OF THE EQUIPMENT	QTY
1	Universal Tensile Testing machine with double shear attachment – 40 Ton Capacity	1
2	Torsion Testing Machine (60 NM Capacity)	1
3	Impact Testing Machine (300 J Capacity)	1
4	Brinell Hardness Testing Machine	1
5	Rockwell Hardness Testing Machine	1
6	Spring Testing Machine for tensile and compressive loads (2500 N)	1

FLUID MECHANICS AND MACHINERY LABORATORY

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Determination of friction factor for a given set of pipes.
4. Conducting experiments and drawing the characteristic curves of centrifugal pump/submergible pump.
5. Conducting experiments and drawing the characteristic curves of reciprocating pump.
6. Conducting experiments and drawing the characteristic curves of Gear pump.
7. Conducting experiments and drawing the characteristic curves of Pelton wheel, Francis and Kaplan Turbine.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

1	Bernoulli's Apparatus.	1 No.
2	Orifice meter setup	1 No.
3	Venturi meter setup	1 No.
4	Rotameter setup	1 No.
5	Pipe Flow analysis setup	1 No.
6	Centrifugal pump/submergible pump setup	1 No.
7	Reciprocating pump setup	1 No.
8	Gear pump setup	1 No.
9	Pelton wheel Turbine setup	1 No.
10	Francis turbine setup	1 No.
11	Kaplan turbine setup	1 No.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students should be able to

1. Explain and perform different destructive testing's such as Tension test, Shear test, Impact test, Hardness test to estimate the strength under externally applied loads with due consideration to safety.
2. Estimate and compare the elastic constants such as Young's modulus and Rigidity modulus of the given specimen through Deflection testing and spring testing with standard values.

3. Measure the flow rate of fluid using different flow measuring devices and calculate the friction loss and other minor losses in a pipe flow
4. Conduct experiments on pumps, turbines and to analyze their performance characteristics

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	1	1	-	-	-	-	1	1	2
CO2	3	2	1	-	-	1	1	-	-	-	-	1	1	2
CO3	3	3	2	-	-	1	1	-	-	2	2	2	3	2
CO4	3	3	-	-	-	2	2	-	-	-	3	-	2	1

SEMESTER - IV

20PRTE401 SDG NO. 4, 6,7,8, 9,11,12,13,17	LIVE-IN-LAB - II	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same
- To train the students face reviews and viva voce examination

GUIDELINES TO BE FOLLOWED

The student should continue the Live-in Lab Project-I on the selected topic under the same supervisor selected in Live-in Lab Project-I. The student has to complete design part and design evaluation of the selected project in Live-in Lab Project-I. At the end of the semester, the progress of the project is reviewed and evaluated with a minimum of three reviews with the guidance of Project Coordinator. The students will be evaluated through project report and the viva-voce examination by the panel of members. The review committee may be constituted by the Head of the Department. The student must submit a detailed project report at the end of the semester for evaluation.

EVALUATION

Project work evaluation is based on Regulations of Credit system of Autonomous Regulatory Body**.**

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students should be able to

1. Comprehend an industrial or real life problem and identify right/ real issue with solution.
2. Complete the necessary studies and review the literature, design a setup of equipment, complete the analysis.
3. Write a project report based on the findings.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	1	2	1	1	1	3	2	3	3	3	2

SEMESTER - V

20PRPC501 SDG NO. 4, 9	MECHANICS OF MACHINES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the principles in the formation of mechanisms and their kinematics
- To understand the effect of friction in different machine elements
- To understand the importance of balancing and vibration

UNIT I KINEMATICS OF MACHINES **9**

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons – Cam and follower –classifications – displacement diagrams - layout of plate cam profiles – follower motion-Uniform velocity, SHM, Uniform acceleration and retardation-knife edge, roller, flat faced follower.

UNIT II GEARS and GEAR TRAINS **9**

Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – gear trains – parallel axis gears trains – epicyclic gear trains.

UNIT III FRICTION **9**

Types of friction – Friction Drives -friction in bearings – Friction clutches – Belt drives

UNIT IV BALANCING **9**

Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines -Balancing a single cylinder engine – Balancing of Multi-cylinder inline, V-engines

UNIT V VIBRATION **9**

Free, forced and damped vibrations of single degree of freedom systems – force transmitted to supports – vibration Isolation – vibration absorption – torsional vibration of shafts – single and multirotor systems – critical speed of shafts.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ambekar A.G., “Mechanism and Machine Theory”, Prentice Hall of India, New Delhi, 2007.
2. Shigley J.E., Pennock G.R and Uicker J.J., “Theory of Machines and Mechanisms”, Oxford University Press, 2003.

REFERENCES:

1. Ghosh.A, and A.K.Mallick, “Theory and Machine”, Affiliated East-West Pvt. Ltd., New Delhi, 1988.
2. Ramamurthi. V., "Mechanisms of Machine", Narosa Publishing House, 2005.
3. Rao.J.S. and Dukkipatti R.V. “Mechanisms and Machines”, Wiley-Eastern Ltd., New Delhi, 1998.
4. Robert L.Norton, "Design of Machinery", McGraw-Hill, 2012.
5. Thomas Bevan, “Theory of Machines”, CBS Publishers and Distributors, 2010.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_me21/preview
2. https://nptel.ac.in/courses/112/105/112105268/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/2359/kinematics-of-machines
2. https://freevideolectures.com/course/2364/dynamics-of-machines

OUTCOMES:

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

1. Understand the principles in the formation of mechanisms and their kinematics.
2. Understand the construction features of gears and gear trains.
3. Understand the effect of friction in different machine elements.
4. Understand the importance of balancing.
5. Understand the importance of vibration.

CO-PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	1	1	1	1	2	1	1	3	1
CO2	3	2	2	3	1	1	1	1	2	2	1	1	3	2
CO3	3	2	2	2	1	1	1	1	1	2	1	1	3	1
CO4	3	2	2	3	1	1	1	1	1	2	1	1	3	1
CO5	3	3	2	2	1	1	1	1	1	2	1	1	3	1

SEMESTER - V

20PRPC502 SDG NO. 4, 9, 12	MACHINE ELEMENT DESIGN	L	T	P	C
		3	0	0	3

(Use of PSG Design Data Book is permitted)

OBJECTIVES:

- To understand the concepts of mathematical modelling and engineering fundamentals for solving complex engineering problems
- To analyze one and two dimensional elements
- To analyze the heat transfer and vibration in simple and complex geometries.
- To understand the concepts of iso-parametric and higher order elements.

UNIT I INTRODUCTION 9

Basic Concepts – History, Relevance and Scope of Finite Element Methods - FEM Procedure - Natural and Essential boundary conditions - Concepts of Potential Energy - Rayleigh Ritz – Weighted Residual Method- Gaussian Elimination Methods – Solved Problems.

UNIT II ONE-DIMENSIONAL ELEMENTS 9

Coordinate Systems -Global, Local and Natural - Shape function, Finite element formulation - Stiffness Matrix, Load Vector, Boundary Condition and Assembly of Global Equation, Temperature Effects for 1D bar, Truss and Beam Element – Solved Problems.

UNIT III TWO-DIMENSIONAL ELEMENTS 9

Shape function for linear triangular element-Finite element formulation-Constant Strain Triangular (CST) element -Plane Stress, Plane Strain conditions – Axisymmetric Elements formulation – Solved Problems

UNIT IV HEAT TRANSFER AND VIBRATION 9

Shape function for 1D and 2D Triangular Element - Stiffness Matrix, Load vector and Assembly of Global Equation - Heat Conduction, Convection and Internal heat Generation for Linear element - Longitudinal and Transverse Vibrations for Bar and Beam Elements.

UNIT V HIGHER ORDER AND ISO-PARAMETRIC ELEMENT 9

Higher order Elements, Serendipity elements, Shape function formulation - iso-parametric, Sub parametric, Super parametric Elements, iso-parametric Transformation, Jacobian formulation and Stress Strain relations for iso-parametric elements. Gaussian Quadrature. Introduction to CFD

TOTAL: 45 PERIODS

TEXT BOOKS:

1. J.N.Reddy, "An Introduction to the Finite Element Method" Third Edition, McGraw-Hill Mechanical Engineering, Reprint, 2015.
2. Singuresu S. Rao, "Finite Element method in Engineering", Fourth edition, Elsevier Science & Technology Books, Reprint 2015.

REFERENCES

1. Tirupathi R. Chandrupatla, Ashok D. Belagundu, "Introduction to Finite Elements in Engineering", Third Edition, Reprint, Prentice Hall, 2012.
2. R. D. Cook, D. S. Malkus, and M. E. Plesha, "Concepts and Applications of Finite Element Analysis", Third Edition, John Wiley and Sons, New York, Reprint 2010.
3. O. C. Zienkiewicz and R. L. Taylor, "The Finite Element Method: Volume 1 The Basis", 5th Edition, Butterworth-Heinemann, Oxford. Reprint 2011.
4. Daryl L. Logan A, "First Course in the Finite Element Method", Fourth Edition, Cengage Learning, 2007. 5. K. J. Bathe, "Finite Element Procedures", Second Edition, Prentice-Hall Inc., Englewood Cliffs, New Jersey, Reprint 2012.
5. S. Bhavikati, "Finite Element Analysis", New Age International Publishers, 2015.
6. David V. Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi,2005.

WEB RESOURCES:

1. https://www.simscale.com/blog/2016/11/learn-finite-element-analysis-fea/
2. https://nptel.ac.in/courses/112/104/112104116/
3. https://nptel.ac.in/courses/105/105/105105041/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112/104/112104193/
2. https://nptel.ac.in/courses/112/104/112104205/
3. https://nptel.ac.in/courses/105/106/105106051/
4. https://nptel.ac.in/courses/112/106/112106135/
5. https://nptel.ac.in/courses/112/104/112104115/

OUTCOMES:

Upon completion of the course, the students should be able to

1. Understand the knowledge of mathematical modeling and engineering fundamentals to solve complex engineering problems by finite element methods.
2. Analyze the one dimensional elements for bar, truss and beam elements.
3. Interpret the results for complex two dimensional CST and axisymmetric elements.
4. Compute the heat transfer and vibration problems for various elements.
5. Evaluate the solution for iso-parametric elements and to learn basics of CFD.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	-	2	-	-	-	-	-	2	3	2
CO2	3	3	1	-	-	2	-	-	-	-	-	2	3	2
CO3	3	3	1	-	-	2	-	-	-	-	-	2	3	2
CO4	3	3	1	-	-	2	-	-	-	-	-	2	3	2
CO5	3	3	1	2	2	2	-	-	2	2	-	3	3	2

SEMESTER - V

20PRPC503 SDG NO. 4, 9	METAL FORMING TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the principle, procedure and applications of bulk metal forming and sheet metal forming

UNIT I FUNDAMENTALS OF METAL FORMING 9

State of stress – Components of stress, symmetry of stress tensor, principal stresses – Stress deviator – von-mises, Tresca yield criteria – Octahedral shear stress and shear strain theory – Flow stress determination – Temperature in metal forming – Hot, cold and warm working – strain rate effects –metallurgical structures – residual stresses – Spring back.

UNIT II FORGING AND ROLLING 9

Principle – classification – equipment – tooling – processes parameters and calculation of forces during forging and rolling processes – Ring compression test - Post forming heat treatment – defects (causes and remedies) – applications – Roll forming.

UNIT III EXTRUSION AND DRAWING PROCESSES 9

Classification of extrusion processes – tool, equipment and principle of these processes – influence of friction – extrusion force calculation – defects (causes and remedies) – Rod/Wire drawing – tool, equipment and principle of processes – defects – Tube drawing and sinking processes – mannessmann process of seamless pipe manufacturing – Tube bending.

UNIT IV SHEET METAL FORMING PROCESSES 9

Classification – conventional and HERF processes – presses – types and selection of presses – formability studies – FLD, Limiting Draw ratio - processes: Deep drawing, spinning, stretch forming, plate bending, Rubber pad forming, bulging and press brake forming – Explosion forming, electro hydraulic forming, Magnetic pulse forming.

UNIT V RECENT ADVANCES 9

Super plastic forming – Electro forming – fine blanking – Hydro forming – Peen forming – Laser Forming – Micro forming - P/M forging – Isothermal forging – high speed hot forging – near net shape forming high velocity extrusion – CAD and CAM in forming.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Dieter G.E., "Mechanical Metallurgy", McGraw Hill, Co., S.I. Edition, 2001.
2. Nagpal G.R. "Metal forming processes", Khanna publishers, New Delhi, 2004.

REFERENCES:

1. Serope Kalpakjian, Steven R Schmid, "Manufacturing Process for Engineering Materials", 4th Edition, Pearson Education, 2003.

2. Rao, P.N. "Manufacturing Technology", TMH Ltd., 2003.
3. Edward M.Mielink, "Metal working Science Engineering", McGraw Hill, Inc, 2000.
4. Metal Handbook Vol.14, "Forming and Forging", Metal Park, Ohio, USA, 1990.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112106153/
2. https://nptel.ac.in/content/storage2/courses/112106153/Module%205/Lecture%201/Module_5_Extrusion_Lecture_1_Quiz-Key.pdf
3. https://nptel.ac.in/courses/112107250/

ONLINE RESOURCES:

1. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/112107250/lec32.pdf
2. https://www.me.iitb.ac.in/~ramesh/courses/ME649/extrusion.pdf

OUTCOMES:

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

1. Understand the fundamental mechanics of metal forming processes.
2. Learn the principle, classification, equipments used and applications of rolling and forging processes.
3. Learn the principle, classification, equipments used and applications of extrusion and drawing processes.
4. Understand the principle and procedure of various sheet metal forming processes.
5. Study about the recent advances in technology for metal forming.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	2	2	1	1	1	1	1	2	2	2
CO2	2	1	1	2	1	2	1	1	1	1	1	2	2	2
CO3	2	2	2	1	2	2	1	1	1	1	1	2	2	2
CO4	2	1	2	2	2	2	1	1	1	1	1	2	2	2
CO5	2	2	1	2	1	2	1	1	1	1	1	2	2	2

SEMESTER - V

20PRPC504 SDG NO. 4,9	DESIGN OF JIGS, FIXTURES AND PRESS TOOLS	L	T	P	C
		3	0	0	3

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

Objectives of tool design- Function and advantages of Jigs and fixtures – 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

Design and development of jigs and fixtures for given component- Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.

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 PERIODS

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.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112105127/

ONLINE RESOURCES:

1. https://pdhonline.com/courses/m261/m261_new.htm
2. https://edstelearning.com/engineering-fundamentals/mechanical/jigs-fixture/

OUTCOMES:

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

1. Summarize the different methods of locating jigs, fixtures and clamping principles.

2. Design and develop jigs and fixtures for given component.
3. Discuss the press working terminologies and elements of cutting dies.
4. Distinguish between bending and drawing dies.
5. Discuss the different types of forming techniques.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	1	2	1	-	1	-	-	1	2	2
CO2	2	3	2	3	1	2	1	-	1	-	-	1	2	2
CO3	2	3	2	3	1	2	1	-	1	-	-	1	2	2
CO4	2	3	2	3	1	2	1	-	1	-	-	1	2	2
CO5	2	2	2	2	1	2	1	-	1	-	-	1	2	2

SEMESTER - V

20PRPL501 SDG NO. 4, 9	METAL FORMING LAB AND SPECIAL MACHINES LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To establish hands-on experience in sheet metal forming, bulge forming and super plastic forming
- To get hands on experience in machining gear, V-block, dovetail, etc.
- To study tool wear, acceptance test for machine tool

LIST OF EXPERIMENTS (Restrict Max 10-12 Nos only)

Metal Forming Lab

1. Construction Flow Stress – Strain curve
2. Erichsen cupping Test
3. Determination of interface friction factor using ring compression test
4. Construction of FLD of sheet metal
5. Water hammer forming
6. Determination of Power consumption in sheet rolling process
7. Determination of strain rate sensitivity index of given specimen
8. Super-plastic forming studies on Pb-Sn alloys
9. Deep drawing

10. Forward Extrusion process
11. Micro-forming
12. Simulation studies on metal forming

Special Machines Lab

1. Gear Hobbing
   i. Spur Gear
   ii. Helical Gear
2. Planning Machine
   i. V-Block
   ii. Dove Tail
3. Centreless Cylindrical Grinding
4. Milling Machine
   i. Spur Gear
5. Tool And Cutter Grinding
6. Tool Wear Studies
7. Acceptance Test Of Machine Tool As Per ISI Test Chart
8. EDM
9. Capstan And Turret Lathe
10. Measurement Of Cutting Force

TOTAL: 45 PERIODS

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

S.No.	EQUIPMENTS	Nos.
1.	Universal Testing Machine 10T	1
2.	Erichsen cupping Tester	1
3.	Hydraulic Press 50T	1
4.	Water hammer forming apparatus	1
5.	Two high Rolling mill	1
6.	Top open muffle furnace (Max 1200°C)	1
7.	Dies for deep drawing	1
8.	Dies for Micro forming	1
9.	Dies for super plastic forming	1
10.	FEM package	1
11.	Dies for Constructing FLD of sheet metals	1

OUTCOMES:

On completion of this laboratory course, the student should be able to

1. Perform hydraulic metal forming.
2. Perform super plastic forming in metals.
3. Perform extrusion process in nonferrous metals.
4. Machine raw materials to prepare gear, V-block, etc.,
5. Conduct acceptance test for machine tool.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1	1	1	2	1	1	2	1	1	2	2
CO2	3	2	2	1	-	1	1	2	1	2	2	1	3	2
CO3	3	2	2	1	-	1	1	2	1	2	2	1	3	2
CO4	3	2	2	1	-	1	1	1	1	2	1	1	3	2
CO5	3	2	2	1	-	1	1	1	1	2	1	1	3	2

SEMESTER - V

20MEPL502 SDG NO. 4,9,12	KINEMATICS AND DYNAMICS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To supplement the principles learnt in kinematics and Dynamics of Machinery
- To gain practical knowledge about various mechanisms & their applications in machineries
- To understand how certain measuring devices are used for dynamic testing
- To understand Machine Kinematics and Dynamics

LIST OF EXPERIMENTS

1. a) Study of gear parameters.
   b) Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains
2. a) Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms
   b) Kinematics of single and double universal joints.

3. a) Determination of Mass moment of inertia of Fly wheel and Axle system.
   b) Determination of Mass Moment of Inertia of Axis-Symmetric bodies using Turn Table apparatus.
   c) Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
4. Motorized gyroscope – Study of gyroscopic effect and couple.
5. Governor - Determination of range sensitivity, effort etc., for Watt, Porter, Proell, and Hartnell Governors.
6. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
7. a) Single degree of freedom Spring Mass System – Determination of natural frequency and verification of Laws of springs – Damping coefficient determination
   b) Multi degree freedom suspension system – Determination of influence coefficient.
8. a) Determination of torsional natural frequency of single and Double Rotor systems.-. Undamped and Damped Natural frequencies
   b) Vibration Absorber – Tuned vibration absorber.
9. Vibration of Equivalent Spring mass system – Undamped and damped vibration.
10. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
11. a) Balancing of rotating masses. (b) Balancing of reciprocating masses.
12. a) Transverse vibration of Free-Free beam – with and without concentrated masses.
    b) Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.

Determination of transmissibility ratio using vibrating table

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

1	Cam follower setup	1 No.
2	Motorized gyroscope	1 No.
3	Governor apparatus - Watt, Porter, Proell and Hartnell governors	1 No.
4	Whirling of shaft apparatus	1 No.
5	Dynamic balancing machine.	1 No.
6	Two rotor vibration setup	1 No.
7	Spring mass vibration system	1 No.
8	Torsional Vibration of single rotor system setup	1 No.
9	Gear Models	1 No.
10	Kinematic Models to study various mechanisms	1 No.

11 Turn table apparatus 1 No.

12 Transverse vibration setup of a cantilever 1 No.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students should be able to

1. Explain gear parameters, kinematics of mechanisms, gyroscopic effect and working of lab equipments.
2. Determine mass moment of inertia of mechanical elements and critical speeds of shafts.
3. Study the governor effort and range sensitivity.
4. Determine the Natural frequency, damping coefficient and torsional frequency.
5. Perform balancing of rotating and reciprocating masses.

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	1	1	-	1	2	-	1	3	2
CO2	3	2	2	-	-	1	1	-	1	2	-	1	3	2
CO3	3	2	2	-	-	1	1	-	1	2	-	1	3	2
CO4	3	2	2	-	-	1	1	-	1	2	-	1	3	2
CO5	3	2	2	-	-	1	1	-	1	2	-	1	3	2

SEMESTER - V

20PRTE501 SDG NO. 4,11,15	LIVE-IN-LAB - III	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same
- To train the students face reviews and viva voce examination.

GUIDELINES TO BE FOLLOWED

The student should continue the Live-in Lab Project-II on the selected topic under the same supervisor. The student has to complete the analysis portion and validation of the project done in Live-in Lab Project-II. The students are asked submit as a product if the project involves fabrication. At the end of the

semester, the progress of the project is reviewed and evaluated with a minimum of three reviews with the guidance of Project Coordinator. The students will be evaluated through based on the report and the viva-voce examination by the panel of members. The review committee may be constituted by the Head of the Department. The student must submit a detailed project report at the end of the semester for evaluation.

EVALUATION

- Project work evaluation is based on Regulations of Credit system of Autonomous Regulatory Body.

Note: All the three evaluations are mandatory for course completion and for awarding the final grade.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students should be able to

1. Comprehend an industrial or real life problem and identify right/ real issue with solution.
2. Complete the necessary studies and review the literature, design a setup of equipment, complete the analysis.
3. Write a project report based on the findings.

CO-PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	1	2	1	1	1	3	2	3	3	3	2

SEMESTER - VI

20PRPC601 SDG NO. 4,9	COMPUTER AIDED PRODUCTION PLANNING AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, inventory control
- To know the recent trends like Manufacturing Requirement Planning (MRP II) and Enterprise Resource Planning (ERP)

UNIT I INTRODUCTION **9**

Objectives and benefits of planning and control-Functions of production control-Types of production job- batch and continuous-Product development and design-Marketing aspect - Functional aspects Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

UNIT II WORK STUDY **9**

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data Predetermined motion time standards.

UNIT III PRODUCT PLANNING AND PROCESS PLANNING **9**

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning Steps in process planning-Quantity determination in batch production-Machine capacity, balancing Analysis of process capabilities in a multi product system.

UNIT IV PRODUCTION SCHEDULING **9**

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance – Flow production scheduling Batch production scheduling-Product sequencing – Production Control systems-Periodic batch control-Material requirement planning kanban – Dispatching-Progress reporting and expediting Manufacturing lead time-Techniques for aligning completion times and due dates.

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC 9

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size ABC analysis-Recorder procedure-Introduction to computer integrated production planning systems elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. James.B.Dilworth, "Operations Management – Design, Planning and Control for Manufacturing and Services", McGraw Hill International Edition, 1992.
2. Martand Telsang, "Industrial Engineering and Production Management", First Edition, S. Chand and Company, 2000.

REFERENCES:

1. Chary. S.N., "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 1995.
2. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8th Edition John Wiley and Sons, 2000.
3. Jain. K.C. & Aggarwal. L.N., "Production Planning Control and Industrial Management", Khanna Publishers, 1990.
4. Kanishka Bedi, "Production and Operations management", 2nd Edition, Oxford university press, 2007.
5. Melynk, Denzler, "Operations management – A value driven approach", Irwin Mcgrawhill.
6. Norman Gaither, G. Frazier, "Operations Management" 9th Edition, Thomson learning IE, 2007.
7. Samson Eilon, "Elements of Production Planning and Control", Universal Book Corpn., 1984.
8. Upendra Kachru, " Production and operations management – Text and cases" 1st Edition, Excel books 2007.

WEB REFERENCES:

1. https://nptel.ac.in/courses/110/105/110105095/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/2367/industrial-engineering
2. https://www.managementstudyguide.com/production-planning-and-control.html

OUTCOMES:

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

1. Understand basic functions of production control.
2. Prepare production planning and control activities such as work study, time study and production study.
3. Understand about product planning and process planning processes.
4. Understand the process in production scheduling.
5. Plan manufacturing requirements, Manufacturing Requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

CO – PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	2	1	1	1	1	2	2	1	3	2
CO2	3	2	1	2	2	1	1	1	1	2	2	1	3	2
CO3	3	2	1	2	2	1	1	1	1	2	2	1	3	2
CO4	3	2	1	2	2	1	1	1	1	2	2	1	3	2
CO5	3	2	1	2	2	1	1	1	1	2	2	1	3	2

SEMESTER VI

20HSMG601 SDG NO. 4,9,12	STATISTICS, QUALITY CONTROL AND RELIABILITY ENGINEERING	L	T	P	C
		3	0	0	3

(Use of Statistics and Sampling Tables are permitted)

OBJECTIVES:

- To provide the basic concepts of statistical quality monitoring
- To learn various available statistical tools for quality monitoring
- To demonstrate the ability to design and implement these tools
- To understand the importance of reliability in engineering
- To develop the ability to measure the reliability of engineering system

UNIT I QUALITY CONTROL **8**

Definition of Quality, quality control, factors affecting quality, methods of control, chance causes and assignable causes. Quality control and Quality assurance, Quality Costs, Organization for quality, Quality circles.

UNIT II QUALITY CHARTS **9**

Statistical process control – Control charts for variables and attributes. purpose of the chart –X, R, p and np chart - construction of charts - choice between chart for p and chart for np - construction of c-chart- Process and machine capabilities. Six Sigma concept.

UNIT III ACCEPTANCE SAMPLING **10**

Types of sampling, sampling inspection, inspection by Attributes and Variables, Role of acceptance sampling - Producer's risk and consumer's risk, Procedure for sampling inspection, single, double, multiple sequential sampling plans, O.C. Curves, quality indices for acceptance sampling plans, acceptance sampling by attributes, AQL , LTPD , AOQL – Sampling plans.

UNIT IV RELIABILITY ENGINEERING **9**

Definition of reliability, quality, availability, maintainability, types of failures, various parameters of system effectiveness, concept of failure modes, Failure data analysis; Failure rate; Useful life and wear out phase of a system.

UNIT V MEASURES OF RELIABILITY **9**

Measures of reliability – MTTF, MTTR, MTBF – Evaluation of network reliability / Unreliability of simple Series, Parallel, Series-Parallel systems - Partially redundant systems – Reliability in terms of Hazard rate and failure density – Examples.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Douglas C. Montgomery, "Introduction to Statistical Quality Control", Wiley.
2. E. Balagurusamy, "Reliability Engineering", Tata McGraw- Hill.

REFERENCES

1. David Smith Chambers and Donald J. Wheeler, "Understanding Statistical Process Control", SPC Press.
2. John Oakland, "Statistical Process Control", Butterworth-Heineman
3. PeihuaQiu, "Introduction to Statistical Process Control", CRC Press.
4. Patrick D. T., O'Connor, "Practical Reliability Engineering", John Wiley & Sons, 4th edition.
5. L.S.Srinath, "Reliability Engineering", East West press (P) Ltd.
6. B.S. Dhillion, C. Singh, "Engineering Reliability", John Wiley & Sons.

WEB RESOURCES:

1. https://www.ipccnggip.iges.or.jp/public/gp/english/8_QA-QC.pdf

2. https://www.researchgate.net/publication/331514969_Quality_Control_and_Quality_Assurance
3. https://www.researchgate.net/publication/279355662_Statistical_Quality_Control
4. https://www.researchgate.net/publication/302006959_Reliability_Engineering_A_Perspective

ONLINE RESOURCES:

1. https://alison.com/courses/quality-control
2. https://www.koenig-solutions.com/quality-management-training-courses-certification?keyword=quality%20management%20online%20course&device=c&gclid=EAIaIQobChMI4ODP_tHB6QIVFqmWCh2OCQjhEAAYAyAAEgKx7fD_BwE
3. https://www.coursera.org/specializations/six-sigma-green-belt
4. https://www.udemy.com/course/an-introduction-to-reliability-engineering/
5. https://www.lifetime-reliability.com/cms/training/online-training-courses/reliability-engineering-training-course-beginners/
6. https://www.classcentral.com/course/site-reliability-engineering-slos-12834

OUTCOMES:

Upon completion of the course, the students should be able to

1. Understand the philosophy and basic concepts of quality improvement.
2. Demonstrate deep knowledge about statistical methods for quality control.
3. Demonstrate the ability to design, use, and interpret control charts.
4. Understand the importance of reliability in engineering system.
5. Measure reliability of various engineering systems.

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	1	-	-	-	1	-	2	1	1
CO2	1	1	1	1	2	1	2	-	-	1	-	2	2	2
CO3	2	1	2	1	2	1	2	-	-	-	-	3	1	2
CO4	2	2	3	1	-	1	-	-	-	1	-	2	1	1
CO5	1	-	1	-	2	1	2	-	-	1	-	3	2	2

SEMESTER - VI

20ESIC601 SDG NO. 4,9	INSTRUMENTATION AND CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of measurement technology
- To learn operating principle of mechanical sensors and transducers used to measure various physical parameters
- To familiarize with various recording and display devices
- To understand various systems and derive mathematical model of a system
- To study time response and frequency response of closed loop control systems
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I INTRODUCTION 9

Static and dynamic characteristics of measurement systems - standards and calibration - error and uncertainty analysis-statistical analysis of data-and curve fitting

UNIT II MECHANICAL MEASUREMENTS AND INDUSTRIAL INSTRUMENTATION 9

Measurement of displacement, velocity (linear and rotational) acceleration - shock – vibration - force torque power – strain - stress - pressure temperature

UNIT III DATA DISPLAY AND RECORDING DEVICES 9

Data display - CRO – LED - LCD - magnetic tape recorders - x-y recorders - UV recorders - Oscilloscope recorders - digital printers and data loggers.

UNIT IV SYSTEMS AND REPRESENTATION 9

Basic elements in control systems: – Open and closed loop systems – Electrical analogy of mechanical systems – Transfer function – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs.

UNIT V TIME AND FREQUENCY RESPONSE 9

Time response: – Time domain specifications – Types of test input -I and II order system response – Error coefficients – Generalized error series – Steady state error – Correlation between frequency domain and time domain

specifications- Frequency response: – Bode plot – Polar plot – Determination of closed loop response from open loop response

TOTAL: 45 PERIODS

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", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.
3. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers, 2017.
4. Benjamin C. Kuo, "Automatic Control Systems", Wiley, 2014.

REFERENCES:

1. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010.
2. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.
3. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.
4. Katsuhiko Ogata, "Modern Control Engineering", Pearson, 2015

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_ee41/preview
2. http://www.nptelvideos.in/2012/11/industrial-instrumentation.html
3. https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf
4. https://nptel.ac.in/courses/107106081

ONLINE RESOURCES:

1. https://instrumentationtools.com/tag/sensors-and-transducers-nptel-pdf/
2. https://electronics-tutorials.ws/io/io-
3. https://freevideolectures.com/course/2337/control-engineering
4. https://instrumentationtools.com/tag/sensors-and-transducers-nptel-pdf/
5. https://electronics-tutorials.ws/io/io-

OUTCOMES:

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

1. Understand various characteristics of measurement system and types of errors in measurement systems.
2. Understand the working principle and applications of various types of mechanical Sensors and Transducers.
3. Understand the working of various display devices and recorders used in Industries and Laboratories.
4. Able to obtain Mathematical model of different types of system by representation and transfer function derivation.
5. Derive and calculate time response and frequency response of closed loop control systems.

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	3	3	1	-	-	-	-	-	3	2	1
CO2	3	3	2	3	3	1	-	-	-	-	-	3	2	1
CO3	2	2	2	2	2	1	-	-	-	-	-	2	2	1
CO4	2	1	2	2	2	1	-	-	-	-	-	2	2	1
CO5	2	1	3	1	1	3	-	-	-	-	-	3	2	1

SEMESTER - VI

20MEPC603 SDG NO. 4,9,11,12	MECHATRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer systems for the control of mechanical and electronic systems
- To understand the architecture and operation of typical microprocessors and microcontrollers
- To understand the concept of PLC system and its programming
- To understand the key actuation elements and mechatronics system design

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 MECHATRONICS 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 PERIODS

TEXT BOOKS:

1. Bolton .W., "Mechatronics" , Pearson Education Limited, 5th Edition, 2011.
2. Devadas Shetty, Richard A. Kolk, "Mechatronics System Design", CENGAGE Learning, 2nd International student edition, 2010.

REFERENCES

1. Mazidi. M.A and Mazidi .M.J., MCkinlay.R.D, "The 8051 Microcontroller and Embedded Systems Using Assemblyand C", Pearson India, 2nd Edition, 2008.
2. Patranabis D., "Sensor and Actuators", Prentice Hall of India Pvt Ltd., 2nd edition 2005.

3. John P. Bentley., "Principle of Measurement systems", Pearson Prentice Hall, Fourth edition, 2005.

WEB RESOURCES:

1. https://nptel.ac.in/courses/112/103/112103174/
2. https://nptel.ac.in/courses/108/105/108105063/
3. https://nptel.ac.in/courses/112/102/112102011/
4. https://nptel.ac.in/courses/106/108/106108100/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/108/105/108105062/
2. https://nptel.ac.in/courses/108/105/108105088/
3. https://nptel.ac.in/courses/112/104/112104288/
4. https://nptel.ac.in/courses/108/108/108108147/
5. https://nptel.ac.in/courses/108/107/108107029/
6. https://nptel.ac.in/courses/108/105/108105102/

OUTCOMES:

Upon completion of the course, the students should be able to

1. Discuss the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical, Electronic Systems and sensor technology.
2. Discuss the architecture of Microprocessor and Microcontroller, Pin Diagram, Addressing Modes of Microprocessor and Microcontroller.
3. Discuss Programmable Peripheral Interface, Architecture of 8255 PPI, and various device interfacing.
4. Explain the architecture, programming and application of programmable logic controllers to problems and challenges in the areas of Mechatronic engineering.
5. Discuss various Actuators and Mechatronics system using the knowledge and skills acquired through the course and also from the given case studies,

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	-	1	1	-	1	-	-	2	2	3
CO2	3	3	2	1	-	1	1	-	1	-	-	2	2	3
CO3	3	3	2	1	-	1	1	-	1	-	-	2	2	3
CO4	3	3	2	3	-	1	1	-	1	-	-	2	2	3
CO5	3	3	2	2	-	1	1	-	1	-	-	2	2	3

SEMESTER - VI

20PRPL601 SDG NO. 4, 7,9, 11 & 12	MECHATRONICS AND FLUID POWER LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To know the method of programming the microprocessor and also the design, modeling and analysis of basic electrical, hydraulic and pneumatic systems for different applications which enable the students to understand the concept of mechatronics and fluid power
- To study the functional aspects of different pneumatic and hydraulic components and its usage in circuits

LIST OF EXPERIMENTS

1. Addition and subtraction of two 16- bit numbers.
2. Sorting a series of numbers in ascending and descending order.
3. Controlling stepper motor using microprocessor.
4. Traffic light interface.
5. Study and use of pneumatic and hydraulic elements.
6. Simulation of speed control circuits in a hydraulic trainer.
7. Simulation of single and double acting cylinder circuits using different directional control values.
8. Design of circuits with logic sequence using electro pneumatic trainer kits.
9. Simulation of basic hydraulic, pneumatic and electric circuits using software.
10. Simulation of pneumatic circuits using PLC.

11. Study the characteristics of gear pump.
12. Study the characteristics of vane pump.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students should be able to

1. Use the microprocessor to perform simple programme.
2. Simulate circuits using hydraulic, pneumatic and electrical components.
3. Select and apply different hydraulic and pneumatic components to design fluid power circuit.
4. Design, simulate and analyze the mechatronics systems with the help of simulation software and various controls.
5. Simulate PLC based electro pneumatic circuits.

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1	2	2	2	1	2	2	2	2	3	1
CO2	2	1	2	1	1	1	2	1	1	2	1	2	3	1
CO3	2	1	2	1	1	1	2	1	1	1	1	2	3	1
CO4	1	1	1	1	1	1	1	1	1	1	1	2	2	1
CO5	2	1	1	1	1	2	1	1	1	1	1	2	2	1

SEMESTER - VI

20HSPL501 SDG NO. 4, 8	COMMUNICATION AND SOFT SKILLS LAB	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To develop effective communication and presentation skills
- To enhance the employability and career skills of the learners
- To enable the learners for preparing job application and e-portfolio
- To make the learners use soft skills efficiently
- To develop their confidence and help them in attending interviews successfully

UNIT I LISTENING AND SPEAKING SKILLS 6

Conversational skills participate in formal and informal talks – general, – group discussion – time management – group dynamics – GD strategies - making effective presentations - listening/watching interviews conversations, documentaries - listening to lectures, discussions from social media – improving articulation.

UNIT II ADVANCED READING AND WRITING SKILLS 6

Reading different genres of texts - writing job applications – cover letter – résumé – emails – memos - writing abstracts – summaries – interpreting visual texts.

UNIT III SKILLS FOR COMPETITIVE EXAMS 6

Reading passages for competitive exams – language focus exercise – building vocabulary tasks - FAQs related to competitive exams – current affairs - improving global reading skills – elaborating ideas – summarizing – understanding arguments – identifying opinion/attitude and making inferences - critical reading.

UNIT IV SOFT SKILLS 6

Motivation – emotional intelligence – managing changes – stress management – leadership straits – team work – career planning – intercultural communication – creative and critical thinking.

UNIT V INTERVIEW SKILLS 6

Different types of interview – personal interview – panel interview – telephone/online interview - interview etiquette - answering questions – offering information – mock interviews – FAQs related to job interviews.

TOTAL: 30 PERIODS

REFERENCE SOURCES:

- Business English Certificate Materials, Cambridge University Press.
- Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge, 2011.
- International English Language Testing System Practice Tests, Cambridge
- University Press.
- Personality Development (CD-ROM), Times Multimedia, Mumbai.

WEB REFERENCES:

- http://www.slideshare.net/rohitjsh/presentation-on-group-discussion
- http://www.oxforddictionaries.com/words/writing-job-applications
- http://www.skillsyouneed.com/ips/interview-skills.html
- http://www.personalitydevelopment.org/

- https://nptel.ac.in/courses/109/107/109107121/
- https://swayam.gov.in/nd1_noc19_hs33/preview
- https://ict.iitk.ac.in/courses/enhancing-soft-skills-and-personality/

ONLINE RESOURCES:

- https://www.britishcoucil.my/english/courses-adults/learning-tips/importance-of-soft-skills
- https://www.skillsoft.com/content-solutions/business-skills-training/soft-skills-training/

OUTCOMES:

Upon completion of the course learners should be able to

1 Give oral presentations effectively.
2 Use technology to communicate effectively in various settings and context.
3 Develop skills required for workplace environment.
4 Communicate in forums like debate, group discussion and interviews confidently.
5 Develop skills required for workplace environment.

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	3	3	1	-	-	-	-	-	3
CO2	3	3	2	3	3	1	-	-	-	-	-	3
CO3	2	2	2	2	2	1	-	-	-	-	-	2
CO4	2	1	2	2	2	1	-	-	-	-	-	2
CO5	2	1	3	1	1	3	-	-	-	-	-	3

SEMESTER - VI

20PRPJ601 SDG NO. 4,11,15	INNOVATIVE DESIGN PROJECT	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To understand the engineering aspects of design with reference to simple products
- To foster innovation in design of products
- To develop design that add value to products and solve technical problems

COURSE PLAN

Study: : Take minimum three simple products, processes or techniques in the area of specialization, study, analyze and present them. The analysis shall be focused on functionality, construction, quality, reliability, safety, maintenance, handling, sustainability, cost etc. whichever are applicable. Each student in the group has to present individually; choosing different products, processes or techniques

Design: The project team shall identify an innovative product, process or technology and proceed with detailed design. At the end, the team has to document it properly and present and defend it. The design is expected to concentrate on functionality; design for strength is not expected.

Note: *The one hour/week allotted for tutorial shall be used for discussions and presentations. The project team (not exceeding four) can be students from different branches, if the design problem is multidisciplinary.*

EVALUATION

1. First evaluation (Immediately after first internal examination) : 20 marks
2. Second evaluation (Immediately after second internal examination): 20 marks
3. Final evaluation (Last week of the semester) : 60 marks

Note: All the three evaluations are mandatory for course completion and for awarding the final grade.

OUTCOMES:

Upon completion of the course, the students should be able to

1. Think innovatively on the development of components, products, processes or technologies in the engineering field
2. Analyze the problem requirements and arrive workable design solutions

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Co1	3	3	3	3	3	3	2	2	3	3	3	2	3	3
CO2	3	3	3	3	3	3	2	2	3	3	3	2	3	3

SEMESTER - VII

20HSMG701 SDG NO. 4 & 9	ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Introduce the concepts of economics as applied to engineering
- To understand the concept of management in accounting and finance in business

UNIT-I ENGINEERING ECONOMICS **9**

Economics – Engineering economics – Demand analysis – Laws of demand – Supply – Law of supply – Production and cost – Pricing methods

UNIT- II FINANCIAL ACCOUNTING **9**

Accounting – Accounting principles (GAAP) – Preparation and Interpretation of Trading account, Profit and Loss account – Balance sheet – Depreciation – Depreciation methods.

UNIT- III COST VOLUME PROFIT ANALYSIS **9**

Cost – Costing – Absorption costing vs. Marginal costing – relevant cost in decision making- Profit volume ratio analysis – Break even analysis – Margin of safety – Angle of incidence and Multi product Break even analysis – Effect of changes in volume, Selling price, Fixed cost and Variable cost.

UNIT- IV WORKING CAPITAL MANAGEMENT **9**

Concept of working capital – Types of working capital – Factors determining working capital – Estimation of working capital requirements – Management of accounts receivable – Inventory – – Inventory valuation methods – Cash management.

UNIT-V CAPITAL BUDGETING **9**

Significance of capital budgeting – Techniques of capital budgeting – Traditional and discounted cash flow method – Payback period – Accounting rate of return method – Present value method – present value index – Internal rate of return method

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R. Paneer Selvam, "Engineering economics", PHI learning private Limited, 2012.

2. S.N Maheswari, "Management Accounting and Financial Control", Sultan Chand, 3rd edition 2013.

REFERENCES

1. Charles T. Homgren, "Cost Accounting", PHI 9th edition 2009.
2. C. James, Vanhorn, "Fundamentals of Financial Management", PHI 5th edition 2012.
3. SP.Jain and KL Narang, "Financial accounting and analysis", Kalyani publishers.

OUTCOMES:

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

1. Understand the basics of economics.
2. Gain knowledge of accounting principles.
3. Acquire the knowledge of various costing and costing decisions.
4. Understand the knowledge of financial issues and management.
5. Understand the knowledge of financial analysis.

CO-PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	2	1	1	-	-	2	-	-	1	3
CO2	3	3	3	3	2	1	1	-	3	-	2	-	1	3
CO3	3	2	3	3	3	1	2	1	3	-	2	3	1	3
CO4	3	3	2	3	2	-	-	-	-	2	-	-	1	3
CO5	3	3	3	3	2	1	2	1	3	-	3	-	1	3

SEMESTER - VII

20MEPC701 SDG NO. 4, 9, 12	FINITE ELEMENT ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of mathematical modelling and engineering fundamentals for solving complex engineering problems
- To analyze one and two dimensional elements
- To analyze the heat transfer and vibration in simple and complex geometries
- To understand the concepts of iso-parametric and higher order elements

UNIT I INTRODUCTION **9**

Basic Concepts – History, Relevance and Scope of Finite Element Methods - FEM Procedure - Natural and Essential boundary conditions - Concepts of Potential Energy - Rayleigh Ritz – Weighted Residual Method- Gaussian Elimination Methods – Solved Problems.

UNIT II ONE-DIMENSIONAL ELEMENTS **9**

Coordinate Systems -Global, Local and Natural - Shape function, Finite element formulation - Stiffness Matrix, Load Vector, Boundary Condition and Assembly of Global Equation, Temperature Effects for 1D bar, Truss and Beam Element – Solved Problems.

UNIT III TWO-DIMENSIONAL ELEMENTS **9**

Shape function for linear triangular element-Finite element formulation-Constant Strain Triangular (CST) element -Plane Stress, Plane Strain conditions – Axisymmetric Elements formulation – Solved Problems

UNIT IV HEAT TRANSFER AND VIBRATION **9**

Shape function for 1D and 2D Triangular Element - Stiffness Matrix, Load vector and Assembly of Global Equation - Heat Conduction, Convection and Internal heat Generation for Linear element - Longitudinal and Transverse Vibrations for Bar and Beam Elements.

UNIT V HIGHER ORDER AND ISOPARAMETRIC ELEMENT **9**

Higher order Elements, Serendipity elements, Shape function formulation - Isoparametric, Sub parametric, Super parametric Elements, Iso parametric Transformation, Jacobian formulation and Stress Strain relations for Isoparametric elements. Gaussian Quadrature. Introduction to CFD

TOTAL: 45 PERIODS

TEXT BOOKS:

1. J.N.Reddy, "An Introduction to the Finite Element Method" Third Edition, McGraw-Hill Mechanical Engineering, Reprint, 2015.
2. Singuresu S. Rao, "Finite Element method in Engineering", Fourth edition, Elsevier Science & Technology Books, Reprint 2015.

REFERENCES

1. Tirupathi R. Chandrupatla, Ashok D. Belagundu, "Introduction to Finite Elements in Engineering", Third Edition, Reprint, Prentice Hall, 2012.
2. R. D. Cook, D. S. Malkus, and M. E. Plesha, "Concepts and Applications of Finite Element Analysis", Third Edition, John Wiley and Sons, New York, Reprint 2010.
3. O. C. Zienkiewicz and R. L. Taylor, "The Finite Element Method: Volume 1

The Basis", 5th Edition, Butterworth-Heinemann, Oxford. Reprint 2011.
4. Daryl L. Logan A, "First Course in the Finite Element Method", Fourth Edition, Cengage Learning, 2007. 5. K. J. Bathe, "Finite Element Procedures", Second Edition, Prentice-Hall Inc., Englewood Cliffs, New Jersey, Reprint 2012.
5. S. Bhavikati, "Finite Element Analysis", New Age International Publishers, 2015.
6. David V. Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi,2005.

WEB RESOURCES:

1. https://www.simscale.com/blog/2016/11/learn-finite-element-analysis-fea/
2. https://nptel.ac.in/courses/112/104/112104116/
3. https://nptel.ac.in/courses/105/105/105105041/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112/104/112104193/
2. https://nptel.ac.in/courses/112/104/112104205/
3. https://nptel.ac.in/courses/105/106/105106051/
4. https://nptel.ac.in/courses/112/106/112106135/
5. https://nptel.ac.in/courses/112/104/112104115/

OUTCOMES:

Upon completion of the course, the students should be able to

1. Understand the knowledge of mathematical modeling and engineering fundamentals to solve complex engineering problems by finite element methods.
2. Analyze the one dimensional elements for bar, truss and beam elements.
3. Interpret the results for complex two dimensional CST and axisymmetric elements.
4. Compute the heat transfer and Vibration problems for various elements.
5. Evaluate the solution for iso-parametric elements and to learn basics of CFD.

CO- PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	-	2	-	-	-	-	-	2	3	2
CO2	3	3	1	-	-	2	-	-	-	-	-	2	3	2
CO3	3	3	1	-	-	2	-	-	-	-	-	2	3	2
CO4	3	3	1	-	-	2	-	-	-	-	-	2	3	2
CO5	3	3	1	2	2	2	-	-	2	2	-	3	3	2

SEMESTER - VII

20MEPC502 SDG NO. 4, 8,9,12	ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the functions of the basic components of a robot.
- To study the use of various types of end of effectors and sensors and machine vision
- To impart knowledge in robot kinematics and programming
- To learn robot safety issues and economics.

UNIT I FUNDAMENTALS OF ROBOT 9

Robot - Definition - Robot Anatomy - Co ordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications.

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III SENSORS AND MACHINE VISION 9

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations

Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data- Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications- Inspection, Identification, Visual Serving and Navigation.

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 9

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

UNIT V APPLICATION OF ROBOTS 9

RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Groover M.P., "Industrial Robotics - Technology Programming and Applications", McGraw Hill, 2012.
2. Klafter R.D., Chmielewski T.A and Negin M., "Robotic Engineering - An Integrated Approach", Prentice Hall, 2003

REFERENCES

1. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2008.
2. Deb S.R., "Robotics Technology and Flexible Automation" Tata McGraw Hill Book Co., 2013.
3. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co., 1987.
4. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill, 1995.
5. Koren Y., "Robotics for Engineers", Mc Graw Hill Book Co., 1992.

WEB RESOURCES:

1. https://robots.ieee.org.https//www.robotic.org
2. https://nptel.ac.in/courses/112/101/112101098/

3. https://nptel.ac.in/courses/112/108/112108093/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112/101/112101099/
2. https://nptel.ac.in/courses/112/105/112105236/
3. https://nptel.ac.in/courses/112/105/112105249/
4. https://nptel.ac.in/courses/112/107/112107289/

OUTCOMES:

Upon completion of the course, the students should be able to

1. Explain the concepts of industrial robots, classification, specifications and coordinate systems. Also summarize the need and application of robots in different sectors.
2. Illustrate the different types of robot drive systems as well as robot end effectors.
3. Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
4. Develop robotic programs for different tasks and familiarize with the kinematics motions of robot.
5. Examine the implementation of robots in various industrial sectors and interpolate the economic analysis of robots.

CO- PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	-	-	-	-	1	2	2	-	1	3	3
CO2	2	2	1	-	-	-	-	-	2	2	-	2	3	3
CO3	3	2	2	2	-	-	-	-	2	2	1	2	3	3
CO4	3	2	2	2	2	2	2	-	1	2	-	2	3	3
CO5	1	1	1	-	-	-	-	-	2	2	1	2	3	3

SEMESTER - VII

20PRPC701 SDG NO. 4,9	ADDITIVE MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies- Product Life Cycle – Product Development Planning and Management.

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - System Design & Modeling - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT III DESIGN AND TESTING 9

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges in Integration of Engineering Disciplines - Concept Screening & Evaluation - Detailed Design - Component Design and Verification – Mechanical, Electronics and Software Subsystems -

High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – Prototyping - Introduction to Rapid Prototyping and Rapid Manufacturing - System Integration, Testing, Certification and Documentation

UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation- Sustenance -Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management – Configuration Management - EoL Disposal

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –The IPD Essentials - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
2. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

REFERENCES:

1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning Concepts”, Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013.

WEB REFERENCES

1. http://www.iitkgp.ac.in/research-areas/Additive%20and%20Laser%20based%20Manufacturing
2. https://nptel.ac.in/courses/112104265/

ONLINE RESOURCES

1. https://learn-xpro.mit.edu/additive-manufacturing
2. https://engineering.purdue.edu/online/certifications/additive-manufacturing
3. https://www.sme.org/training/additive-manufacturing-certification/

OUTCOMES:

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

1. Define, formulate and analyze a problem.
2. Solve specific problems independently or as part of a team.
3. Gain knowledge of the innovation & product development process in the business context.
4. Work independently as well as in teams.
5. Manage a project from start to finish.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	2	1	1	1	1	1	1	1	2	2	2
CO2	2	2	3	3	2	2	1	1	1	1	1	2	2	2
CO3	2	2	3	2	2	1	1	1	1	1	1	2	2	2
CO4	2	2	3	3	1	1	1	1	1	1	1	2	2	2
CO5	2	2	3	2	2	1	1	1	1	1	1	2	2	2

SEMESTER - VII

20MEPL701 SDG NO. 4,9,12	COMPUTER AIDED ANALYSIS AND SIMULATION LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To develop the student's skills in proper modeling, meshing, and setting up material properties, loads, and constraints for computer simulation and analysis
- To give exposure to software tools needed to analyze engineering problems
- To expose the students to different applications of simulation and analysis tools
- To provide the analysis skills to interpret and draw conclusion the results of computer analysis

LIST OF EXERCISES

1. Analysis of bar element under axial loads and thermal loads.
2. Analysis of truss structure.
3. Analysis of beams with point load, UDL, UVL, plotting shear force and bending moment diagrams.
4. Analysis of a Plate with various Boundary conditions.
5. Stress analysis of an Axi-symmetric component.
6. Modal Analysis of Beam and Plate Elements.
7. Harmonic Analysis of Beam and Plate Elements.
8. Analysis of Column with Buckling Loads.
9. Steady state heat transfer analysis of composite wall.
10. Vibration analysis of spring-mass systems.
11. Coupled field analysis of a solid object.
12. Fluid flow analysis on circular pipe.
13. Analysis of Joints and Springs.
14. Case Study - Structural/Thermal Analysis.
15. Case Study – Fluid Analysis.

TOTAL: 45 PERIODS

LIST OF EQUIPMENTS:

1. Pentium IV computer or better hardware, with suitable graphics facility.
2. Licensed Analysis software – 20 Licenses
3. LASER Printer

ONLINE REFERENCES:

1. https://studentcommunity.ansys.com/

2. https://www.mathworks.com/academia.html?s_tid=gn_acad
3. https://sites.ualberta.ca/~wmoussa/AnsysTutorial/
4. https://www.mathworks.com/academia/tah-portal/university-of-alberta-1088131.html

OUTCOMES:

Upon completion of the course, the students should be able to

1. Analyze and simulate the static solid and structural mechanics problems using FEA software.
2. Understand heat transfer and dynamic analysis.
3. Analyze and simulate fluid flow on pipes.
4. To model, analyse and simulate any problem irrespective of its shape and dimension.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	2	2	-	-	1	-	-	2	3	2
CO2	2	3	2	-	2	2	-	-	2	-	-	2	3	2
CO3	1	1	1	-	2	2	-	-	2	-	-	2	3	2
CO4	3	3	3	-	2	2	1	-	2	-	-	3	3	2
CO5	3	3	3	-	2	2	-	-	1	-	-	2	3	2

SEMESTER - VII

20PRPJ701 SDG NO. 4, 6,7, 8, 9,11,12,13, 17	PROJECT PHASE - I	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same
- To train the students face reviews and viva voce examination

GUIDELINES TO BE FOLLOWED:

The students may be grouped into 3 to 4 and work under a project supervisor and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor (faculty member). The progress of the project is

evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department. The Project Work Phase-I will have the following Sequence:

I. PROBLEM IDENTIFICATION:

1. A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)
2. List of possible solutions including alternatives and constraints
3. Cost benefit analysis
4. Time Line of activities

II. A REPORT HIGHLIGHTING THE DESIGN FINALIZATION :

[based on functional requirements and standards (if any)]

III. A PRESENTATION INCLUDING THE FOLLOWING:

1. Implementation Phase (Hardware / Software / both)
2. Testing and Validation of the developed system
3. Learning in the Project

IV. CONSOLIDATED REPORT PREPARATION:

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of the course, the students should be able to

1. Comprehend an industrial or real life problem and identify right/real issue with solution.
2. Complete the necessary studies and review the literature, design a setup of equipment, complete the analysis.
3. Write a project report based on the findings.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Co1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	1	2	1	1	1	3	2	3	3	3	2

SEMESTER - VIII

20PRPJ801 SDG NO. 4, 6, 7, 8, 9, 11, 12, 13, 17	PROJECT PHASE-II	L	T	P	C
		0	0	8	4

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same
- To train the students face reviews and viva voce examination

GUIDELINES TO BE FOLLOWED:

The students may be grouped into 3 to 4 and work under a project supervisor and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor (faculty member). The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department. The Project Work Phase-II will have the following Sequence:

I. Problem Identification:

1. A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)
2. List of possible solutions including alternatives and constraints
3. Cost benefit analysis
4. Time Line of activities

II. A report highlighting the design finalization:
[based on functional requirements and standards (if any)]

III. A presentation including the following:

1. Implementation Phase (Hardware / Software / both)
2. Testing and Validation of the developed system
3. Learning in the Project

IV. Consolidated report preparation

TOTAL: 120 PERIODS

OUTCOMES:

Upon completion of the course, the students should be able to

1. Comprehend an industrial or real life problem and identify right/real issue with solution.
2. Complete the necessary studies and review the literature, design a setup of equipment, complete the analysis.
3. Write a project report based on the findings.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Co1	3	3	2	2	2	2	2	2	3	2	2	3	3	3
CO2	3	3	3	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	1	2	1	1	1	3	2	3	3	3	2

PROFESSIONAL ELECTIVES - I

20PREL501 SDG NO. 4,9	SURFACE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the surface preparation techniques
- To import knowledge on thermal spraying process and electro deposited coating
- To study the process of hot dip and diffusion coating
- To induce the testing procedure for surface coating

UNIT I METAL CLEANING AND PREVIEW ON SURFACE ENGINEERING 9

Need and relevance of surface engineering – pre-treatment of coating, General cleaning process for ferrous and non-ferrous metals and alloys – selection of cleaning process – alkaline cleaning – emulsion cleaning- ultrasonic cleaning – acid and pickling salt bath descaling – abrasive bath cleaning–polishing and short peening – classification of surface engineering processes.

UNIT II THERMAL SPRAYING PROCESSES AND ELECTRO DEPOSITED COATINGS 9

Thermal spraying – flame, arc, plasma and HVOF processes – PLV process – design for thermally sprayed coatings – coating production – spray consumables principles of electroplating – Technology and control electroplating systems – properties and Faraday's Law – factors affecting throwing power–Applications of electrodeposites – non-aqueous and electroless deposition.

UNIT III HOT DIP COATING AND DIFFUSION COATINGS 9

Principles – surface preparation batch coating and continuous coating process – coating properties and applications, Principles of cementation – cladding – Diffusion coating of C.N. Al, Si, Cr and B – structure, properties and application of diffusion coatings – chemical vapour deposition – physical vapour deposition

UNIT IV NON-METALLIC COATING OXIDE AND CONVENTIONAL COATINGS 9

Plating coating – laequers – rubbers and elastomers – vitreous enamels – anodizing phosphating and chromating – application to aluminium, magnesium, tin, zinc, cadmium copper and silver – phosphating primers.

UNIT V QUALITY ASSURANCE, TESTING AND SELECTION OF COATINGS **9**

The quality plan – design – testing and inspection of thickness adhesion, corrosion, resistance and porosity measurement – selection of coatings – industrial applications of engineering coatings. Basic mechanisms of wear – abrasive, adhesive wear, contact fatigue – fretting corrosion – testing wear resistance practical diagnosis of wear.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Stand Grainger and J. Blunt, "Engineering coatings – design and application", Woodhead Publishing, 1998.
2. Peter Dearnley, "Introduction to surface engineering", Cambridge University Press, 2017.
3. J.S. Burnell-Gray and P.K. Datta , "Surface Engineering Casebook: Solutions to Corrosion and Wear-Related Failures", Woodhead Publishing, 1996.

REFERENCES:

1. J. Paulo Davim, "Materials and Surface Engineering, Research and Development", Woodhead Publishing Reviews: Mechanical Engineering Series, 2012
2. Joseph R. Davis, "Surface Engineering For Corrosion And Wear Resistance", ASM International, 2001.
3. Parthasarathy. N.V., "Electroplating Handbooks", Prentice Hall, 1992
4. Metals Hand Book vol.2 8th Edition, American society of metals 1994.
5. Gabe. D.R., "Principles of metal surface treatment and protection", Pergamon, 1990
6. Niku-Lavi, "Advances in surface treatments", Pergamon, 1990.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_me69/preview
2. https://nptel.ac.in/courses/112107248/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/4346/nptel-fundamentals-surface-engineering
2. https://www.classcentral.com/course/swayam-surface-engineering-for-corrosion-and-wear-resistance-application-13028

OUTCOMES:

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

1. Understand the important of surface engineering to industries.
2. Understand the principles involved in thermal spray for coating.
3. Analyze the process and mechanism of different diffusion coating process.
4. Understand the methods of non metallic coating.
5. Select appropriate coatings for industrial application with the knowledge in testing procedure and quality assurance.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	2	1	2	1	-	1	-	-	1	2	2
CO2	2	2	2	2	2	2	1	-	1	-	-	1	2	2
CO3	2	2	3	3	2	2	1	-	1	-	-	1	2	2
CO4	2	1	2	2	2	2	1	-	1	-	-	1	2	2
CO5	2	2	2	2	2	2	1	-	1	-	-	1	2	2

PROFESSIONAL ELECTIVES - I

20PREL502 SDG NO. 4, 9	MACHINE TOOLS AND PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To identify the necessity of manufacturing
- Define with examples the concept of manufacturing, machine tools and machining
- State with examples the main requirements for machining
- List the main classifications of the manufacturing processes with examples

UNIT I FUNDAMENTALS OF METAL CUTTING 9

Mechanics of orthogonal and oblique cutting - Mechanics of chip formation - Types of chips produced in cutting - Cutting forces and power - Numerical Problems - Temperature in cutting - Machinability - Tool life - Numerical problems - Wear and failure - surface finish and integrity - Cutting Tool Materials - cutting fluids.

UNIT II MACHINE TOOLS AND PROCESSES FOR PRODUCING ROUND SHAPES 9

Turning parameters - Lathes and Lathe operations - Cutting screw threads - Drilling and drills -Drilling machines - Boring and boring machines - reaming and reamers - tapping and taps -Design considerations for drilling, reaming and tapping.

UNIT III MACHINE TOOLS AND PROCESSES FOR PRODUCING VARIOUS SHAPES 9

Milling operations - Milling machines - Planner and shaper: Machines and Operations -Broaching and broaching machines - Sawing - filing and finishing - gear manufactured by machining.

UNIT IV ABRASIVE MACHINING AND FINISHING OPERATIONS 9

Abrasives - bonded abrasives - Grinding process - wheel, gear grinding operations and machines - grinding fluids - Design Consideration for Grinding - Finishing operations: Lapping, Honing, Burnishing- economics of grinding and finishing operation.

UNIT V MACHINE TOOL STRUCTURE AND AUTOMATION 9

Machine tools structures -erecting and testing of machine tools- Vibration and chatters in machining - Automation: Capstan and Turret lathe - single spindle and multi spindle automats - Swiss type and automatic screw machines- Feeding Mechanisms-Transfer mechanism-Tracercontroller Mechanism.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Sharma P.C., "A Text book of production Technology: manufacturing processes", S.Chand &Company Limited, 7th Edition, 2007.
2. Kalpakjian S. and SCHMID S., "Manufacturing Engineering and Technology", Prentice-Hall of India", 50th Edition (2006) , ISBN : 0131489658.

REFERENCES:

1. Krar S.F., "Technology of machine tools" McGraw-Hill, New York, 7th Edition, 2011.
2. Brown J.A. "Modern manufacturing processes", Industrial Press Inc., ISBN0831130342,9780831130343(1991).
3. Paul E.D., Black J.T. and Kosher R.A, "Materials and Processes in Manufacturing", Wiley 9thEdition (2003), ISBN 0471033065.

3. Lindberg R.A., "Process and Materials of Manufactures", Prentice-Hall of India, Fourth Edition, ISBN 8131701034(1994).

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_me16/preview
2. https://swayam.gov.in/nd1_noc19_me46/preview

ONLINE RESOURCES:

1. https://alison.com/course/nsdc-course-machining-technician-lathe
2. https://www.coursera.org/lecture/intelligent-machining/machining-basics-pSn3H

OUTCOMES:

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

1. Define with examples the concept of manufacturing, machine tools and machining.
2. State with examples the main requirements for machining.
3. List out the main classifications of the manufacturing processes with examples.
4. Use this knowledge to develop innovative ideas in the areas of machine building, work holding and tool holding methods.
5. Encourages involving in research in the area of machining.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	2	1	-	1	-	-	1	2	1
CO2	2	2	2	2	1	2	1	-	1	-	-	1	2	1
CO3	2	2	2	2	2	2	1	-	1	-	-	1	2	1
CO4	2	2	2	2	1	2	1	-	1	-	-	1	2	1
CO5	2	2	2	2	2	2	1	-	1	-	-	1	2	1

PROFESSIONAL ELECTIVES - I

20PREL503 SDG NO. 4,9	LEAN MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To gain insights about the importance of lean manufacturing
- To know about lean manufacturing tools, methodologies and lean implementation

UNIT I INTRODUCTION **9**

Objectives of lean manufacturing-key principles and implications of lean manufacturing- traditional vs lean manufacturing – Lean benefits.

UNIT II LEAN MANUFACTURING CONCEPTS **9**

Value creation and waste elimination- Major kinds of waste- pull production- different models of pull production-continuous flow-continuous improvement / Kaizen- Worker involvement Part family- Production flow analysis – Composite part concept – Machine cell design - Case studies.

UNIT III LEAN MANUFACTURING TOOLS AND METHODOLOGIES **9**

Standard work -communication of standard work to employees -standard work and flexibility -visual controls-quality at the source- 5S principles - preventive maintenance-total quality management-total productive maintenance -changeover/ setup time -batch size reduction.

UNIT IV VALUE STREAM MAPPING **9**

The as-is diagram-the future state map-application to the factory simulation scenario-line balancing -poke yoka - Kanban – overall equipment effectiveness -JIT - elements of JIT - Kanban system.

UNIT V IMPLEMENTING LEAN **9**

Road map-senior management Involvement-best practices- reconciling lean with other systems - Toyota production system - lean six sigma - lean and ERP-lean with ISO9001: 2000.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Michael L George, David T Rowlands, Bill Kastle, "What is Lean Six Sigma", McGraw Hill Inc., New York, 2004.
2. Askin R.G, Goldberg J.B, "Design and Analysis of Lean Production Systems", John Wiley and Sons, New York, 2003.

REFERENCES:

1. Joseph A De Feo, William W Bearnard, "Juran Institute Six Sigma Break Through and Beyond", Tata McGraw Hill, New Delhi, 2004.
2. Richard B Chase F Robert Jacobs and Nicholas J Aquilano, "Operations Management for Competitive Advantage", McGraw Hill Inc., New York, Tenth Edition, 2003.
3. Poka-Yoke, "Improving Product Quality by Preventing Defects", Productivity Press, Portland, Oregon, 1993.
4. Micheal Wader, "Lean Tools: A Pocket guide to Implementing Lean Practices", Productivity and Quality Publishing Pvt Ltd, 2002.

WEB REFERENCES:

1. https://www.leanproduction.com/top-25-lean-tools.html
2. https://www.leanproduction.com/

ONLINE RESOURCES:

1. https://www.udemy.com/course/introduction-to-basics-of-lean-management/
2. https://asq.org/quality-resources/lean

OUTCOMES:

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

1. Understand the fundamentals of lean manufacturing.
2. Understand the lean manufacturing concepts.
3. Understand the lean manufacturing tools and methodologies.
4. Understand the purpose of value stream mapping.
5. Understand the implementation of lean.

CO–PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	2	2	1	1	1	1	1	2	2	2
CO2	2	1	2	1	2	2	1	1	1	1	2	2	2	2
CO3	2	2	2	2	2	2	1	1	1	1	1	2	2	2
CO4	2	1	1	1	2	2	1	1	1	1	2	2	2	2
CO5	2	2	2	2	2	2	1	1	1	1	1	2	2	2

PROFESSIONAL ELECTIVES - I

20PREL504 SDG NO. 4, 9	DESIGN OF MACHINE TOOL STRUCTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand different machine tools used for machining
- To understand the design criteria for machine tool structures
- To know the designing of slide ways
- To understand the vibration in the machine tool during operation

UNIT I INTRODUCTION **9**

Classification of machining processes, machine tools – machine tool construction – factors – performance criteria – trends in modern machine tool – kinematic arrangement of different types of machine tools – work holding and tool holding devices – calculation of cutting forces and power requirements for turning, milling, boring and grinding – force distribution on different parts of drilling, milling and grinding machine tools.

UNIT II STRENGTH AND RIGIDITY OF MACHINE TOOL STRUCTURES 9

Basic principles of design – comparison of materials used in machine tool construction – dependence of process capability on rigidity – static compliance – design of lathe beds – materials – typical construction – torsional modulus of rectangular and box sections – methods of increasing rigidities

UNIT III SLIDE WAYS **9**

Slide ways – types – materials – constructions – clearance adjustments – Hydrostatically lubricated slide ways – slide way design – pressure distribution – antifriction ways – design – construction.

UNIT IV SPINDLES AND SPINDLE SUPPORTS **9**

Spindle units – materials – spindle design – spindle bearings – types of materials – constructions.

UNIT V MACHINE TOOL DYNAMICS **9**

Dynamic system – elastic system – working processes – vibration in machine tools – self excited vibration and dynamic stability – basic principles of chatter – effects of vibration – vibration elimination – damping – isolation of vibration – dynamic absorber with damping.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Sen. G.C., and A.Battacharya, "Principles of machine tools", New central book agency, 2009
2. Metha. N.K., "Machine Tool Design and Numerical control", Tata McGraw Hill publishing company, 2012.

REFERENCES:

1. Myer Kutz, Mechanical Engineers' Handbook: Materials and Mechanical Design, Volume 1, Third Edition John Wiley & Sons, 2006
2. Manfred week, "Hand Book of Machine Tools – Vol1, Vol 2, Vol.3" John Wiley & Sons, 1984.
3. Acherkan.N, "Machine Tool Design", Vol 3, MIR publishers, 1978

WEB REFERENCES:

1. https://www.iitk.ac.in/me/machining-dynamics
2. https://www.nitc.ac.in/CHAPTER14PDFunit14designofmachine structures

ONLINE RESOURCES:

1. https://www.docplayer.net/15721910-Unit-13-design-of-guideways-and-spindle.html
2. https://www.schlu.com›pdf›Guide_e_S...PDFGuidesandSlides

OUTCOMES:

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

1. Understand the construction features of machine tool structure.
2. Have ability to design machine tools based on strength and rigidity.
3. Understand the mechanism of slide ways.
4. Understand the construction features of spindles and spindle supports.
5. Understand the principles of machine tool dynamics.

CO–PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1	1	1	-	-	2	-	-	2	2	2
CO2	2	1	1	2	1	1	-	-	1	-	-	2	2	1
CO3	2	1	1	1	1	1	-	-	1	-	-	2	2	1
CO4	2	1	1	2	1	1	-	-	1	-	-	2	2	2
CO5	2	2	2	2	2	2	-	-	1	-	-	2	2	2

PROFESSIONAL ELECTIVES - I

20MEEL504 SDG NO. 4,9,12	NON TRADITIONAL MACHINING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn about various Non-traditional Machining processes, their process parameters and influence on the performance of end components
- To select appropriate machining technique for machining advanced materials
- To select appropriate machining technique for machining components with very tight tolerances
- To update the students with latest technological developments and research trends in the field of Non-traditional Machining.

UNIT I INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES 9

Unconventional machining Process – Need – classification – merits, demerits and applications. Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining - Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR-Applications. Numerical Problems

UNIT II THERMAL AND ELECTRICAL ENERGY BASED PROCESSES 9

Electric Discharge Machining (EDM) – Wire cut EDM – Working Principle-equipments-Process parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing –– Applications. Laser beam machining and drilling, Plasma arc machining (PAM), Electron Beam Machining (EBM) and Ion Beam Machining (IBM). Principles – Equipment – Types - Beam control techniques – Applications. Numerical Problems

UNIT III CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 9

Chemical machining - Etchants – Maskant - techniques of applying maskants - Principles of Electro Chemical Machining (ECM) - equipments - Process Parameters, MRR and Surface Finish. Electro Chemical Grinding (ECG) and Electro Chemical Honing (ECH), Electro Stem Drilling (ESD) - Applications. Numerical Problems

UNIT IV ADVANCED FINISHING PROCESSES 9

Abrasive flow machining, chemo-mechanical polishing, magnetic abrasive

finishing, magneto rheological finishing, magneto rheological abrasive flow finishing, plasma assisted polishing: their working principles, equipments, effect of process parameters, applications, advantages and limitations- Recent developments in finishing process.

UNIT V RECENT TRENDS IN NON-TRADITIONAL MACHINING PROCESSES 9

Recent developments in non-traditional machining processes, their working principles, equipments, effect of process parameters, applications, advantages and limitations. Comparison of non-traditional machining processes, Bio Machining, Ice Jet Machining, Elastic Emission Machining (EEM), Hybrid Machining Process – Micromachining and Nano machining, Non Traditional Machining and Industry 4.0, Sustainability in Non-traditional Machining.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Vijay.K. Jain, "Advanced Machining Processes", Allied Publishers Pvt. Ltd., New Delhi, 2007
2. Pandey P.C. and Shan H.S., "Modern Machining Processes", Tata McGraw-Hill, New Delhi, 2007.

REFERENCES

1. Benedict. G.F. "Nontraditional Manufacturing Processes", Marcel Dekker Inc., New York, 1987.
2. Mc Geough, "Advanced Methods of Machining", Chapman and Hall, London, 1998.
3. Paul De Garmo, J.T.Black, and Ronald. A.Kohser, "Material and Processes in Manufacturing", Prentice Hall of India Pvt. Ltd., 8thEdition, New Delhi, 2001.

WEB RESOURCES:

1. http://nitc.ac.in/index.php/?url=users/view/270/12/3
2. http://home.iitk.ac.in/~vkjain/micromachining.html

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112/104/112104028/
2. https://nptel.ac.in/courses/112/103/112103202/
3. https://nptel.ac.in/courses/112/105/112105212/
4. https://nptel.ac.in/courses/112/103/112103250/
5. https://nptel.ac.in/courses/112/103/112103264/

OUTCOMES:

Upon completion of the course, the students should be able to

1. Classify various mechanical energy based non traditional machining processes.
2. Compare various thermal energy and electrical energy based non traditional machining processes.
3. Summarize various chemical and electro-chemical energy based non traditional machining processes.
4. Explain various nano finishing processes.
5. Gain knowledge about recent trends and developments in non traditional machining.

CO-PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	1	1	-	-	-	-	-	2	3	2
CO2	2	2	2	2	1	1	-	-	-	-	-	2	3	2
CO3	2	2	2	2	1	1	-	-	-	-	-	2	3	2
CO4	2	2	2	2	1	1	-	-	-	-	-	2	3	2
CO5	2	2	2	2	1	1	-	-	-	-	-	2	3	2

PROFESSIONAL ELECTIVES - I

20PREL505 SDG NO. 4, 9	SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide an insight on the fundamentals of supply chain networks, tools and techniques
- To study about the role of information technology in supply chain

UNIT I INTRODUCTION **9**

Role of Logistics and Supply chain Management: Scope and Importance-Evolution of Supply Chain-Decision Phases in Supply Chain - Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles.

UNIT II SUPPLY CHAIN NETWORK DESIGN 9

Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network Distribution Network in Practice-Role of network Design in Supply Chain – Framework for network Decisions.

UNIT III LOGISTICS IN SUPPLY CHAIN 9

Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation.

UNIT IV SOURCING AND COORDINATION IN SUPPLY CHAIN 9

Role of sourcing supply chain supplier selection assessment and contracts-Design collaboration - sourcing planning and analysis - supply chain co-ordination - Bull whip effect – Effect of lack of co- ordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain.

UNIT V SUPPLY CHAIN AND INFORMATION TECHNOLOGY 9

The role IT in supply chain- The supply chain IT frame work Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain –E-Business in supply chain.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Sunil Chopra, Peter Meindl and Kalra, "Supply Chain Management, Strategy, Planning, and operation", Pearson Education, 2010.

REFERENCES:

1. David J.Bloomberg, Stephen Lemay and Joe B.Hanna, "Logistics", PHI 2002.
2. James B.Ayers, "Handbook of Supply chain management", St.Lucle press, 2000.
3. Jeremy F.Shapiro, "Modeling the supply chain", Thomson Duxbury, 2002.
4. Srinivasan G.S, "Quantitative models in Operations and Supply Chain Management", PHI, 2010.

WEB REFERENCES

1. https://swayam.gov.in/nd2_ugc19_hs51/preview
2. https://nptel.ac.in/courses/110106045/
3. https://scm.ncsu.edu/scm-articles

ONLINE RESOURCES

1. https://www.edx.org/learn/supply-chain-management
2. https://www.coursera.org/courses?query=supply%20chain

OUTCOMES:

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

1. Understand about the scope, importance and evolution of supply chain.
2. Understand about supply chain network design.
3. Understand about the role of logistics in supply chain.
4. Understand about sourcing and coordination in supply chain.
5. Understand about role of information technology in supply chain.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	2	2	2	2	-	1	-	1	1	3	2
CO2	2	2	3	2	2	2	2	-	1	-	1	1	3	2
CO3	2	2	3	2	2	2	2	-	1	-	1	1	3	2
CO4	2	2	3	2	2	2	2	-	1	-	1	1	3	2
CO5	2	2	3	2	2	2	2	-	1	-	1	1	3	2

PROFESSIONAL ELECTIVES - II

20PREL601 SDG NO. 4, 9	LEAN SIX SIGMA	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To gain insights about the importance of lean manufacturing and six sigma practices
- To study about six sigma methodologies, challenges and its implementation

UNIT I LEAN & SIX SIGMA BACKGROUND AND FUNDAMENTALS 9

Historical Overview – Definition of quality – What is six sigma -TQM and Six sigma - lean manufacturing and six sigma- six sigma and process tolerance – Six sigma and cultural changes – six sigma capability – six sigma need

assessments - implications of quality levels, Cost of Poor Quality (COPQ), Cost of Doing Nothing – assessment questions.

UNIT II THE SCOPE OF TOOLS AND TECHNIQUES 9

Tools for definition – IPO diagram, SIPOC diagram, Flow diagram, CTQ Tree, Project Charter – Tools for measurement – Check sheets, Histograms, Run Charts, Scatter Diagrams, Cause and effect diagram, Pareto charts, Control charts, Flow process charts, Process Capability Measurement, Tools for analysis – Process Mapping, Regression analysis, RU/CS analysis, SWOT, PESTLE, Five Whys, interrelationship diagram, overall equipment effectiveness, TRIZ innovative problem solving – Tools for improvement – Affinity diagram, Normal group technique, SMED, 5S, mistake proofing, Value stream Mapping, forced field analysis – Tools for control – Gantt chart, Activity network diagram, Radar chart, PDCA cycle, Milestone tracker diagram, Earned value management.

UNIT III SIX SIGMA METHODOLOGIES 9

Design For Six Sigma (DFSS), Design For Six Sigma Method - Failure Mode Effect Analysis (FMEA), FMEA process - Risk Priority Number (RPN)- Six Sigma and Leadership, committed leadership – Change Acceleration Process (CAP)- Developing communication plan – Stakeholder.

UNIT IV SIX SIGMA IMPLEMENTATION AND CHALLENGES 9

Tools for implementation – Supplier Input Process Output Customer (SIPOC) – Quality Function Deployment or House of Quality (QFD) – alternative approach –implementation – leadership training, close communication system, project selection – project management and team – champion training – customer quality index – challenges – program failure, CPQ vs six sigma, structure the deployment of six sigma – cultural challenge – customer/ internal metrics.

UNIT V EVALUATION AND CONTINUOUS IMPROVEMENT METHODS 9

Evaluation strategy – the economics of six sigma quality, Return on six Sigma (ROSS), ROI, poor project estimates – continuous improvement – lean manufacturing – value, customer focus, Perfection, focus on waste, overproduction – waiting, inventory in process (IIP), processing waste, transportation, motion, making defective products, underutilizing people – Kaizen – 5S.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Michael L.George, David Rownalds, Bill Kastle, “What is Lean Six Sigma”, McGraw – Hill 2003.

REFERENCES:

1. Fred Soleimannejed, "Six Sigma, Basic Steps and Implementation", Author House, 2004.
2. Forrest W. Breyfogle, III, James M. Cupello, Becki Meadows, "Managing Six Sigma:A Practical Guide to Understanding, Assessing, and Implementing the Strategy That Yields Bottom-Line Success", John Wiley & Sons, 2000.
3. James P. Womack, Daniel T.Jones, "Lean Thinking", Free Press Business, 2003.

WEB REFERENCES

1. https://swayam.gov.in/nd1_noc20_mg19/preview
2. https://nptel.ac.in/courses/110105039/
3. https://asq.org.in/iit-kgp/

ONLINE RESOURCES

1. https://www.benchmarksixsigma.com/online-lean-six-sigma-green-beltertification/?gclid=EAIaIQobChMIvbWT0rno6AIVByQrCh2GNgDcEAAYAyAAEgK4VPD_BwE
2. https://www.sixsigmaonline.org/
3. https://www.coursera.org/courses?query=six%20sigma

OUTCOMES:

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

1. Understand about the fundamentals of lean and six sigma.
2. Relate the tools and techniques of lean sigma to increase productivity .
3. Understand about the various tools and techniques in six sigma.
4. Understand about the six sigma methodologies, challenges and implementation.
5. Understand about various evaluation and continuous methods in six sigma.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	1	2	1	-	1	-	-	2	2	2
CO2	2	2	2	2	2	2	1	-	1	-	-	2	2	2
CO3	2	2	2	2	2	2	1	-	1	-	-	2	2	2
CO4	2	2	2	2	2	2	2	-	1	-	-	2	2	2
CO5	2	2	2	2	2	2	2	-	1	-	-	2	2	2

PROFESSIONAL ELECTIVES - II

20ESEC603 SDG NO. 3, 4, 9	FUZZY LOGIC AND NEURAL NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impact knowledge on fuzzy logic and artificial neural networks
- To understand models of ANN
- To use the fuzzy logic and neural network for application related to design and manufacture

UNIT I INTRODUCTION TO FUZZY LOGIC PRINCIPLES 9

Basic concepts of fuzzy set theory – operations of fuzzy sets – properties of fuzzy sets – Crisp relations – Fuzzy relational equations – operations on fuzzy relations – fuzzy systems – propositional logic – Inference – Predicate Logic – Inference in predicate logic – fuzzy logic principles – fuzzy quantifiers – fuzzy inference – fuzzy rule based systems – fuzzification and defuzzification – types.

UNIT II ADVANCED FUZZY LOGIC APPLICATIONS 9

Fuzzy logic controllers – principles – review of control systems theory – various industrial applications of FLC adaptive fuzzy systems – fuzzy decision making – Multi objective decision making – fuzzy classification – means clustering – fuzzy pattern recognition – image processing applications – syntactic recognition – fuzzy optimization.

UNIT III INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS 9

Fundamentals of neural networks – model of an artificial neuron – neural network architectures – Learning methods – Taxonomy of Neural network architectures – Standard back propagation algorithms – selection of various parameters – variations Applications of back propagation algorithms.

UNIT IV OTHER ANN ARCHITECTURES 9

Associative memory–exponential BAM–Associative memory for real coded pattern pairs–Applications adaptive resonance theory – introduction – ART 1 – ART2 – Applications – neural networks based on competition – Kohonen self organizing maps – learning vector quantization – counter propagation networks – applications.

UNIT V RECENT ADVANCES 9

Fundamentals of genetic algorithms – genetic modeling – hybrid systems –

integration of fuzzy logic, neural networks and genetic algorithms – non-traditional optimization techniques like ant colony optimization – Particle swarm optimization and artificial immune systems – applications in health sector, design and manufacturing.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rajasekaran. S.. Vijayalakshmi Pai. G.A., "Neural Networks, Fuzzy Logic and Genetic Algorithms", Prentice Hall of India Private Limited, 2003.
2. Timothy J.Ross, "Fuzzy logic with Engineering Applications", McGraw Hill, 2017 .
3. Zurada J.M., "Introduction to Artificial Neural Systems", Jaico publishing house, 2016.

REFERENCES:

1. Klir.G, Yuan B B, "Fuzzy sets and Fuzzy Logic", Prentice Hall of India private limited, 1997.
2. Laurene Fausett, "Fundamentals of Neural Networks", Prentice hall, 1992.

WEB REFERENCES:

1. https://swayam.gov.in › nd1_noc20_ge09
2. https://www.slideshare.net/sajidqaxi/fuzzy-logic-and-neural-networks
3. https://nptel.ac.in/courses/127105006/

ONLINE RESOURCES:

1. https://youtu.be/IZWTduVCrf8
2. https://www.slideshare.net/ehamzei/fuzzy-set

OUTCOMES:

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

1 Understand the principles behind fuzzy logic and artificial neural network.
2 Understand various fuzzy logic controllers, optimization techniques and genetic algorithm.
3 Apply ANN models and fuzzy logic principles to industrial application.
4 Apply optimization techniques in design and manufacturing field.
5 Analyze the fuzzy logic techniques using image processing and pattern recognition field.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	1	2	2	-	-	-	2	2	3	2
CO2	3	2	3	2	1	2	1	-	-	-	2	2	3	2
CO3	3	3	3	3	2	3	-	-	-	-	2	2	3	3
CO4	3	3	3	2	3	2	1	-	-	-	2	2	3	3
CO5	3	3	3	2	3	2	2	-	2	3	2	2	3	3

PROFESSIONAL ELECTIVES - II

20MGEL602 SDG NO. 4 & 9	MARKETING MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To describe the key marketing concepts, theories and techniques for analyzing a variety of marketing situations
- To make conversant with various marketing principles and strategies
- To acquaint with methodology for product pricing policies and distribution channels
- To make aware of promotional policies, advertising strategies and principles of market research

UNIT I INTRODUCTION **9**

Marketing – Definition, Concepts Significance & functions of Marketing, Evolution & Framework of Marketing, Relevance of Marketing in a developing economy. Role & functions of Marketing Manager Marketing mix; Social, ethical and legal aspects of marketing; Marketing of services.

UNIT II MARKETING MIX **9**

Product Decisions: Concept of a product; Classification of products; Major product decisions; Product line and product mix; Branding; Packaging and labeling; Product life cycle – strategic implications; New product development and consumer adoption process. Pricing Decisions: Factors affecting price determination; Pricing policies and strategies; Discounts and rebates.

UNIT III DISTRIBUTION CHANNELS & SALES PROMOTION **9**

Distribution Channels and Physical Distribution Decisions: Nature, functions,

and types of distribution channels; Distribution channel intermediaries; Channel management decisions; Retailing and wholesaling. Factors influencing channels, Elements of Promotion Mix – Sales Promotion System. Recent Trends in Promotion Sale. Advertising – Role of Advertising, Advertising Media, B to B and online marketing.

UNIT IV BUYER BEHAVIOUR **9**

Consumer buying behaviour & models, Market Segmentation Meaning, Definition, Different ways to Segmentation, Essential of effective Market Segmentation, Destination between Differential Marketing & Concentrated Marketing. Strategic marketing planning – an overview.

UNIT V MARKETING RESEARCH & TRENDS IN MARKETING **9**

Marketing Information System & Marketing Research. Concept & components of a Marketing Information System – Marketing Research – Meaning & scope – marketing research procedure – types & techniques of Marketing Research – Managements use of Marketing Research. Issues and Developments in Marketing

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Philip Kotler and Kevin Keller, "Marketing Management",15th edition, PHI, 2016.
2. KS Chandrasekar, "Marketing Management Text and Cases", McGrawHill, 2010.
3. Philip Kotler, Abraham Koshy, MithileswarJha, Kevin Lane Keller, "Marketing Management: A South Asian Perspective", 14th edition Pearson 2008.

REFERENCE BOOKS

1. Micheal R. Czinkota & Masaaki Kotabe, "Marketing Management", Vikas Thomson Learning, 2000.
2. Paul Baines, Chriss Fill Kelly Pagb, "Marketing", II Edition, Asian Edition.
3. Lam, Hair, Sharma, Mc Daniel, "Marketing-An Innovative Approach to Learning and Teaching - A South Asian Perspective", Cengaga Learning - 2012.

WEB REFERENCES

1. http://dl.ueb.edu.vn/bitstream/1247/2250/1/Marketing_ Management_-_ Millenium_Edition.pdf
2. https://open.umn.edu/opentextbooks/textbooks/principles-of-marketing

3. https://open.umn.edu/opentextbooks/textbooks/introducing-marketing.

ONLINE REFERENCES

1. https://swayam.gov.in/nd1_noc20_mg68/preview
2. https://www.coursera.org/learn/marketing-management
3. https://www.coursera.org/learn/marketing-management-two

OUTCOMES :

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

1. Understand the principles of marketing, outlined functions and strategies of marketing department.
2. Enable the importance of buyer behavior and market segmentation.
3. Illustrate product, product mix and production life cycle for developing marketing skills.
4. Understand the distribution channels and their selection.
5. Understand the branding decisions, image, identity, & personality to positioning the brand.

CO-PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	-	1	-	2	3	3	3	-	1
CO2	3	1	1	2	2	-	1	2	2	2	-	1
CO3	2	2	3	1	1	-	-	2	1	1	-	1
CO4	2	2	1	-	-	-	-	1	1	1	-	1
CO5	2	2	1	1	1	-	-	-	-	-	-	1

PROFESSIONAL ELECTIVES - II

20MGEL601 SDG NO. 4,8,9,12	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts and philosophies of quality management
- To know the impact and significance of TQM principles on organizations in recent times

UNIT 1 INTRODUCTION **8**

Need and Evolution of Quality, Quality-Definitions, statements and dimensions of product and service quality TQM - concepts, Elements and Framework, Benefits & Obstacles of TQM , TQM - Culture, Strategic Quality Management, Costs of Quality.

UNIT II CONTRIBUTIONS AND APPROACHES TO QUALITY MANAGEMENT **9**

Renowned quality gurus- Deming, Juran, Crosby and Ishikawa, Contributions of Taguchi – Loss Function, Signal to Noise Ratio and design of experiments, Kaizen -principles and practices-5 S tools, Poka Yoke-8Discipline Methodology, Just in time, Continuous process improvement-PDCA cycle and 5 why analysis.

UNIT III CUSTOMER FOCUS AND TEAMWORK **8**

Identifying Customer Needs, QFD - Process, Building HoQ, Customer Satisfaction Measurement Techniques. Employee Involvement Practices. Individual Participation - Suggestion Systems & Empowerment, Motivation ,Leadership, Partnerships - Cross-Functional Teams, Supplier/Customer Partnerships, Problem -Solving Teams - Quality Circles.

UNIT IV STATISTICAL TOOLS & TECHNIQUES **11**

SQC - Tools For Data Collection And Analysis – Seven tools(old and new),Statistical Process Control (SPC) – Construction of Control Chart – Variables and Attributes. Process Capability – concepts and measurement. Six Sigma models ,Lean six sigma, BPR, TPM, FMEA and Benchmarking.

UNIT V QUALITY SYSTEMS AND STANDARDS **9**

Need for ISO 9000- ISO 9001: 2015 quality system-guidelines and clausewise requirements, Quality audits-types and responsibilities, ISO 14001:2004 EMS, ISO / TS 16949:2002, ISO 27001:2005 ISMS, SEI – CMMIand Awards - Demings Prize, MBNQA and criteria.

TEXT BOOKS :

1. Besterfield, "Total Quality Management", 3rd Edition, Pearson India
2 Shridhara K Bhat, "Total Quality Management", Himalaya Publishing House, 2010.

REFERENCES:

1. Bedi Kanishka, "Quality Management", Oxford University Press

2. Kiran D.R., "Total Quality Management - Key Concepts and Case Studies", Butterworth-Heinemann, 2016.
3. Poornima M Charantimath, "Total Quality Management", Pearson India, 2017.
4. Sharma DD, "Total Quality Management, Principles, Practice and Cases", Sultan Chand and Sons.
5. Douglas C. Montgomory, "Introduction to Statistical Quality Control", Wiley Student Edition, 4th Edition, Wiley India Pvt Limited, 2008.

WEB REFERENCES:

1. https://www.coursera.org/lecture/supply-chain-management/total-quality-management-wLrvy
2. https://swayam.gov.in/nd1_noc20_mg34/preview
3. https://www.openlearning.com/courses/total-quality-management/
4. https://www.udemy.com/course/tqm-in-academics/

ONLINE RESOURCES:

1. https://www.unido.org/sites/default/files/2009-04/A_roadmap_to_quality_volume_1_0.pdf
2. https://www.investopedia.com/terms/t/total-quality-management-tqm.asp
3. https://www.researchgate.net/publication/237006071_Total_Quality_Management_in_Academic_Libraries_A_Study
4. https://www.isixsigma.com/methodology/total-quality-management-tqm/introduction-and-implementation-total-quality-management-tqm/
5. https://study.com/academy/lesson/five-principles-of-total-quality-management-tqm.html

OUTCOMES:

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

1. Understand the concepts of quality management.
2. Demonstrate the approaches of quality management.
3. Explore customer needs and enhance customer satisfaction.
4. Explore the tools and techniques of quality management.
5. Understand quality system management and implementation.

CO - PO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	-	1	-	1	1	-	-	-	1
CO2	3	3	3	2	2	-	1	1	-	-	-	1
CO3	3	3	2	2	2	-	1	1	-	-	-	1
CO4	2	2	3	2	2	-	1	1	-	-	-	1
CO5	3	3	3	2	2	2	1	1	-	-	-	1

PROFESSIONAL ELECTIVES - II

20MEEL604 SDG NO.4,8,9,11,12	NON DESTRUCTIVE TESTING AND EVALUATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To imbibe the students the basic principles of various NDT techniques, its applications, limitations, codes and standards
- To equip the students with proper competencies to locate a flaw in various materials
- To make the students to be ready to use NDT techniques for in-situ applications
- To inculcate the knowledge of selection of the right NDT technique for a given application

UNIT I INTRODUCTION AND VISUAL INSPECTION METHODS 9

NDT versus Mechanical testing, Need for NDT, Relative merits and limitations, various physical characteristics of materials and their applications in NDT.

Visual Inspection -Unaided, Aided- Borescopes -Videoscopes, Special features in Borescopes, Selection of borescopes, Optical sensors, Microscopes & replication Microscopy Technique and applications, Holography, Case study.

UNIT II LIQUID PENETRANT TESTING AND MAGNETIC PARTICLE TESTING 9

LPT - Principle, types, Procedures, Penetrants and their characteristics, Emulsifiers, Solvent Cleaners / Removers, Developers- properties and their forms, Equipments, Advantages and limitations, Inspection and Interpretation, Applications and case study.

MPT-Principle, Theory of Magnetism, Magnetising current, Magnetisation methods, Magnetic particles, Procedure, Interpretation, Relevant and Non-

relevant indications, Residual magnetism, Demagnetisation– need, methods, Advantages and Limitations, Applications, Magnetic Rubber Inspection, Magnetic Printing, Magnetic Painting, Case study.

UNIT III THERMOGRAPHY AND EDDY CURRENT TESTING 9

Thermography – Introduction, Principle, Contact & Non-Contact inspection methods, Active & Passive methods, Liquid Crystal – Concept, example, advantages & limitations. Electromagnetic spectrum, infrared thermography-approaches, IR detectors, Instrumentation and methods and applications, Case study.

Eddy current Testing – Principle, properties of eddy currents, Eddy current sensing elements, probes, Instrumentation, Types of arrangement, Advantages & Limitations, Interpretation of Results& applications, Case study.

UNIT IV ULTRASONIC TESTING AND ACOUSTIC EMISSION TESTING 9

Ultrasonic Testing-Principle, Basic Equipment, Transducers, couplants, Ultrasonic wave, Variables in UT, Transmission and Pulse-echo method, Straight beam and angle beam, A-Scan, B-Scan & C-Scan, Phased Array Ultrasound& Time of Flight Diffraction, Advantages & Limitations, Interpretation of Results& Applications, Case study.

Acoustic Emission Technique – Introduction, Types of AE signal, AE wave propagation, Source location, Kaiser effect, AE transducers, Principle, AE parameters, AE instrumentation, Advantages & Limitations, Interpretation of Results, Applications, Case study.

UNIT V RADIOGRAPHY AND REMOTE FIELD INSPECTION 9

Introduction, Principle, X-ray Production, Gamma ray sources, tubing materials, X-ray tubing characteristics, Interaction of X-ray with matter, Imaging, Film techniques, Filmless techniques, Types and uses of filters and screens, Real time radiography, geometric factors, inverse square law, characteristics of film, graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography,

Digital Radiography – Film Digitisation, Direct Radiography &Computed Radiography, Computed Tomography, Gamma ray Radiography, Safety in X-ray and Gamma Ray radiography, Case study. Radiation Safety Measures.

RFI: Introduction, Theory-Zones, probes, Instrumentation, Signal Interpretation and Reference Standards.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.

2. Ravi Prakash, "Non-Destructive Testing Techniques", New Age International Publishers, 1st revised edition, 2010.
3. J. Prasad and C.G.K. Nair, "Non-destructive Test and Evaluation of Materials", Mc Graw Hill Publication, 2017.

REFERENCES

1. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2nd edition New Jersey, 200
3. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook, Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing.
4. G. Gaussorgues, "Infrared Thermography", Chapman & Hall, University Press, Cambridge, 1994.
5. Lari and Kumar, "Basics of Non-Destructive Testing", S.K. Kataria & Sons, 2013.

WEB RESOURCES:

1. https://www.nde-ed.org/index_flash.htm
2. https://ndtlibrary.asnt.org/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/113/106/113106070/
2. https://nptel.ac.in/courses/112/107/112107259/

OUTCOMES:

Upon completion of the course, the students should be able to

1. Compare the differences between the various visual inspection techniques and apply the same to the components to be inspected.
2. Understand the procedures involved in the penetration methods and magnetic particle inspection.
3. Interpret the images obtained from the thermographic technique and results from the eddy current testing.
4. Evaluate and interpret the results obtained in the ultrasonic inspection and acoustic emission technique.
5. Explain the techniques involved in the radiographic testing and the various advancements in radiography.

CO-PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	2	1	-	1	-	-	-	1	1	2	2	2
CO2	3	3	2	1	-	1	-	-	-	1	1	2	3	2
CO3	3	3	2	1	-	1	-	-	-	1	1	2	3	2
CO4	3	3	2	1	-	1	-	-	-	1	1	2	3	2
CO5	3	3	2	1	-	2	-	-	-	1	1	2	3	2

PROFESSIONAL ELECTIVES - II

20MEEL608 SDG NO. 4,9,12	PRODUCT LIFECYCLE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn about increasing product revenues, reducing product-related costs, maximizing the value of the product portfolio
- To maximize the value of current and future products for both customers and shareholders
- To reduce time to market, improve product quality, reduce prototyping costs, identify potential sales opportunities
- To maintain and sustain operational serviceability, and reduce environmental impacts at end-of-life

UNIT I INTRODUCTION TO 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 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.

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

UNIT V BASICS ON CUSTOMIZATION / INTEGRATION OF PDM/PLM SOFTWARE 9

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

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Antti Saaksvuori and Anselmi Immonen, "Product Lifecycle Management", Springer Publisher, 2008.
2. Michael Grieves, "Product Life Cycle Management", Tata McGraw Hill, 2006.

REFERENCES

1. Arie Karniel and Yoram Reich, "Managing the Dynamics of New Product Development Processes: A New Product Lifecycle Management Paradigm", Springer, 2011.
2. Ivica Crnkovic, Ulf Asklund and Annita Persson Dahlqvist, "Implementing and Integrating Product Data Management and Software Configuration Management", Artech House Publishers, 2003.
3. John Stark, "Global Product: Strategy, Product Life cycle Management and the Billion Customer Question", Springer Publisher, 2007.
4. John Stark, "Product Life cycle Management: 21st Century Paradigm for Product Realisation", Springer Publisher, 2011.
5. Kevin Roebuck, "Product Life cycle Management (PLM): High-impact Strategies - What You Need to Know: Definitions, Adoptions, Impact, Benefits, Maturity, Vendors", Emereo, 2011.

WEB RESOURCES:

1. https://www.coursera.org/lecture/advanced-manufacturing-enterprise/product-life-cycle-management-plm-xk84J
2. https://wiki.scn.sap.com/wiki/display/PLM/SAP+PLM+Learning+Material

ONLINE RESOURCES:

1. https://www.udemy.com/course/organizing-and-optimizing-your-business-with-plm/
2. https://www.udemy.com/course/fundamentals-of-life-cycle-assessment-lca/
3. https://www.udemy.com/course/productmanagement101/
4. https://www.udemy.com/course/sapdms-document-management-system-training-sap-plm/
5. https://www.udemy.com/course/siemens-plm-teamcenter-lifecycle-visualization-mockup/

OUTCOMES:

Upon completion of the course, the students should be able to

1. Explain the history, concepts and terminology of PLM.
2. Apply the functions and features of PLM/PDM.
3. Apply different modules offered in commercial PLM/PDM tools.
4. Implement PLM/PDM approaches for industrial applications.
5. Integrate PLM/PDM with legacy data bases, CAX & ERP systems.

CO-PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	2	3	3	3	2	2	3	3	3	3
CO2	2	2	3	3	3	3	3	2	2	2	2	2	3	3
CO3	2	3	3	2	3	3	3	3	2	2	2	2	3	3
CO4	3	3	2	3	3	2	3	3	2	3	3	3	3	3
CO5	2	3	3	2	3	2	2	3	2	3	3	3	3	3

PROFESSIONAL ELECTIVES - III

20PREL701 SDG NO. 4,9,12	MACHINE VISION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the principle, importance of machine vision system in Manufacturing and measurement
- To understand their applications in various manufacturing and measurement industries

UNIT I INTRODUCTION TO MACHINE VISION 9

Machine Vision use of machine vision – tasks for a vision system – relation to other fields – place of vision in CIM.

UNIT II IMAGE ACQUISITION AND CONVERSION 9

Colour systems – light sources – lighting techniques – image formation by lensing – image scanning – television cameras – sensors, charge coupled devices – camera and system interface – frame buffers and frame grabbers – digital and smart cameras.

UNIT III IMAGE PROCESSING DECISION MAKING 9

Processing of binary images – thresholding, geometrical properties, topological properties – processing of gray scale images statistical operations, spatial operations, segmentation edge detection, morphological operations – image analysis – factors extraction – decision making.

UNIT IV PATTERN RECOGNITION 9

Fundamentals – parametric classifiers – nonparametric, classifiers nearest neighbour CART - neural networks - generic classifiers.

UNIT V MACHINE VISION APPLICATIONS 9

Applications in user industries automotive, semiconductor, electronic manufacturing, printing industries etc. – generic applications founding manufacturing metrology, inspection assembly verification – application analysis and implementation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Milan sonka, Vaclav hlavac, Roger boyie, "Image Processing, Analysis and Machine Vision" Cengage Learning India Pvt Ltd., 2008.

REFERENCES:

1. Richard O.Duda, Peter E. Hurt, "Pattern Classification and Scene Analysis", Johnweily Publisher, 2000.
2. Rafael C. Gonzaies, Richard E. Woods, "Digital Image Processing", Pearson, 2009.
3. Nella zuech, "Understanding & Applying Machine Vision", Marceldekker Inc., 2000.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106/105/106105216/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/4069/nptel-computer-vision
2. https://freevideolectures.com/course/4802/nptel-digital-image-processing

OUTCOMES:

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

1. Understand the machine vision principle.
2. Understand the image acquisition and conversion principle.
3. Understand the image processing procedures.
4. Use machine vision techniques to pattern recognizing.
5. Understand the use of machine vision in manufacturing industries in process implementation and assembly.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1	1	2	1	-	1	-	-	1	2	2
CO2	2	2	2	2	1	2	1	-	1	-	-	1	2	2
CO3	2	2	2	2	1	2	1	-	1	-	-	1	2	2
CO4	2	2	2	2	2	2	1	-	1	-	-	1	2	2
CO5	2	2	2	2	2	2	1	-	1	-	-	1	2	2

PROFESSIONAL ELECTIVES - III

20PREL702 SDG NO. 4, 9	PROCESSING OF PLASTICS AND COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- The purpose of this subject is to equip the students with the knowledge of processes utilized in developing materials or making components using plastics and composite materials
- This subject develops the competence of the students in major industrially practiced processing techniques

UNIT I INTRODUCTION TO PLASTICS AND COMPOSITE 9

Chemistry and Classification of Polymers - Properties of Thermo Plastics - Properties of Thermosetting Plastics – Elastomers- Applications - Merits and Disadvantages - Fibres - Glass, Boron, Carbon, Organic, Ceramic and Metallic Fibers - Matrix Materials - Polymers, Metals and Ceramics.

UNIT II PROCESSING OF PLASTICS 9

Thermoplastics: Extrusion moulding- Injection Moulding - Blow Moulding - Rotational moulding -calendaring - Film blowing - thermoforming - Thermoset plastics: Compression, Transfer Moulding, Jet moulding, Laminated plastics - Casting - Machining of Plastics: Machining Parameters and their effect - Joining of Plastics - Mechanical Fasteners - Chemical bonding- Thermal bonding -Thermal welding.

UNIT III PROCESSING OF POLYMER MATRIX COMPOSITES 9

Open Mould Processes, Bag Moulding, Compression Moulding with BMC and SMC – Filament winding - Pultrusion - Centrifugal Casting - Injection Moulding - Application of PMC's

UNIT IV PROCESSING OF METAL MATRIX COMPOSITES 9

Solid State Fabrication Techniques - Diffusion Bonding - Powder Metallurgy Techniques – Plasma Spray, Chemical and Physical Vapour Deposition of Matrix on Fibres - Liquid State Fabrication Methods: Infiltration - Squeeze Casting - Rheo Casting - Compo casting - Application of MMC's.

UNIT V PROCESSING OF CERAMIC MATRIX COMPOSITES 9

Cold pressing and sintering - hot pressing - reaction bonding processes - Liquid infiltration – Lanxide process - In situ chemical reaction techniques: chemical vapour infiltration - chemical vapour deposition-Reactive

consolidation - sol - gel techniques - pyrolysis - self propagating high temperature synthesis - Electro-pherotic deposition - Application of CMC's.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Muccio E.A., "Plastics processing technology", ASM International, 1994.
2. Chawla K.K., "Composite Materials - Science and Engineering (Materials Research and Engineering)", Spinger, New York, 2012.
3. Brent Strong A., "Fundamentals of Composites Manufacturing: Materials, Methods and Applications", Society of Manufacturing Engineers, Michigan, 2008.
4. Chawla K.K., "Ceramic matrix composites Springer", 2nd Edition, 2003.
5. Gowri S., Hariharan P. and Suresh Babu A, "Manufacturing Technology-I" Pearson Education, 2008.

REFERENCES:

1. Belofsky K., "Plastics : Product Design and Process Engineering", Hanser Publishers, 1995.
2. Kobyashi A., "Machining of Plastics", Mc-Graw Hill, 1967.
3. Chawla K.K., "Composite Materials science and Engineering", 2nd Edition Springer, 1988.
4. Agarwal D. and Broutman L.J., "Analysis and Performance of Fiber Composites", Wiley,1990.
5. Mallick P.K. and Newman S., "Composite Materials Technology", Hanser Publishers,1991.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_me29/preview
2. https://swayam.gov.in/nd1_noc19_me67/preview
3. https://swayam.gov.in/nd1_noc20_me13/preview

ONLINE RESOURCES:

1. http://www.materials.unsw.edu.au/tutorials/online-tutorials/composites
2. https://online.stanford.edu/courses/aa256-mechanics-composites

OUTCOMES:

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

1. Understand about the basic introduction on plastics and composites.
2. Understand about the processing of plastics.
3. Understand about the processing of polymer matrix composites.
4. Understand about the processing of metal matrix composites.
5. Understand about the processing of ceramic matrix composites.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	1	2	-	1	-	1	1	3	2
CO2	3	2	2	2	2	1	2	-	1	-	1	1	3	2
CO3	3	2	2	2	2	1	2	-	1	-	1	1	3	2
CO4	3	2	2	2	2	1	2	-	1	-	1	1	3	2
CO5	3	2	2	2	2	1	2	-	1	-	1	1	3	2

PROFESSIONAL ELECTIVES - III

20MGEL702 SDG NO. 4,13,16	DISASTER MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psycho social, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change - Do's and Dont's during various types of disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of community, Panchayat Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre and other stake- holders-

Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programme and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, 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.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Singhal J.P., "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN- 13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361.
3. Gupta Anil K, Sreeja S. Nair., "Environmental Knowledge for Disaster Risk Management", NIDM, New Delhi, 2011.
4. Kapur Anu, "Vulnerable India: A Geographical Study of Disasters", IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES:

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy, 2009.

WEB REFERENCES:

1. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=89620
2. https://www.coursera.org/learn/health-che
3. https://www.coursera.org/learn/disaster-preparedness

ONLINE RESOURCES:

1. https://notes.iasscore.in/printed-notes/mains-study-material/disaster-management-for-ias-mains-2/
2. https://www.sciencedirect.com/science/article/pii/S1877050917329058

OUTCOMES:

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

1. Differentiate the types of disasters, causes and their impact on environment and society.
2. Assess vulnerability and various methods of risk reduction measures as well as mitigation.
3. Draw the hazard and vulnerability profile of India.
4. Draw the hazard and vulnerability Scenarios in the Indian context.
5. Disaster damage assessment and management.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	2	2	1	1	1	-	3
CO2	2	3	3	2	3	3	2	2	2	2	1	2
CO3	2	1	2	1	1	1	2	2	1	1	1	2
CO4	2	1	2	1	1	1	2	2	1	1	1	2
CO5	2	3	2	2	2	2	2	1	2	1	1	2

PROFESSIONAL ELECTIVES - III

20MGEL703 SDG NO. 4,6,7,8,9,11,12	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively
- To write a business plan the project report
- Learn the steps involved in starting and running a business
- Gain knowledge and skills needed to run a business successfully

UNIT 1 ENTREPRENEURSHIP **9**

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in economic growth, factors affecting entrepreneurial growth.

UNIT 2 MOTIVATION **9**

Major Motives influencing an entrepreneur – Achievement motivation training, self rating, Business games, thematic apperception test – Stress management, entrepreneurship development programs – need, objectives.

UNIT 3 BUSINESS **9**

Small Enterprises – Definition, classification – characteristics, ownership structures – Project formulation– Steps involved in setting up a business – identifying, selecting a good business opportunity, market survey and research, techno economic feasibility assessment – Preparation of preliminary project reports – Project appraisal – sources of information – Classification of needs and agencies.

UNIT 4 FINANCING AND ACCOUNTING **9**

Need – Sources of finance, term loans, capital structure, financial institution, management of working capital, costing, break even analysis, taxation – income tax, excise duty – Sales tax.

UNIT 5 SUPPORT TO ENTREPRENEURS **9**

Sickness in small business – Concept, magnitude, Causes and consequences, corrective measures - Business incubators – Government policy for small scale

enterprises – Growth strategies in small industry-Expansion, diversification, joint venture, merger and sub contracting.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Donald F Kuratko, "Entrepreneurship – Theory, Process and Practice", 9th edition cengage Learning, 2014.
2. Khanka. S.S., "Entrepreneurial Development" S.Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.

REFERENCES:

1. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.
2. Hisrich R D, Peters M P, "Entrepreneurship", 8th Edition, Tata McGraw-Hill, 2013.
3. Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis", 2nd Edition Dream tech, 2005.
4. Rajeev Roy, "Entrepreneurship", 2nd Edition, Oxford University Press, 2011.

WEB REFERENCES:

1. https://www.ediindia.org/
2. https://nptel.ac.in/courses/110/101/110101004/
3. https://www.editn.in/pages/view/edp-course-materials

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/110/106/110106141/
2. https://nptel.ac.in/courses/127/105/127105007/
3. https://nptel.ac.in/courses/110/107/110107094/
4. https://nptel.ac.in/courses/109/104/109104109/
5. https://nptel.ac.in/courses/110/105/110105067/
6. https://nptel.ac.in/courses/110/101/110101003/
7. https://nptel.ac.in/courses/110/107/110107127/
8. https://nptel.ac.in/courses/110/101/110101132/
9. https://nptel.ac.in/courses/110/101/110101131/
10. https://www.edx.org/learn/entrepreneurship
11. https://www.coursera.org/courses?query=business%20development

OUTCOMES:

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

1. Understand the qualities of becoming an entrepreneur.
2. Know the motives influencing an entrepreneur.
3. Understand the project appraisal, steps involved in setting up a business.
4. Learn the financial viability of the business.
5. Understand the concept of business sickness and growth strategies in small industry.

CO-PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	-	-	-	1	2	3	1	1	1
CO2	2	2	1	-	-	-	1	-	3	3	2	1
CO3	1	1	2	2	2	1	1	2	2	2	2	-
CO4	-	-	-	2	1	-	-	2	2	2	2	2
CO5	2	2	2	3	-	1	2	2	2	2	2	-

PROFESSIONAL ELECTIVES - III

20PREL703 SDG NO. 4, 9	PRECISION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge in the increasing quality concepts of parts, accuracy requirement of machine tools
- To introduce latest topics in manufacturing like micro machining and smart materials so as to equip them to join core electronic manufacturing industries

UNIT I CONCEPTS OF ACCURACY AND MACHINE TOOLS 9

Part Accuracy – errors, accuracy of machine tools – spindle accuracy – displacement accuracy –errors due to numerical interpolation – definition of accuracy of NC system – errors in the NC machines – feed stiffness – zero stability.

UNIT II STIFFNESS, THERMAL EFFECTS AND FINISH MACHINING 9

Overall stiffness of Lathe – compliance of work piece – errors caused by cutting forces – deformation in turning – boring – milling – heat sources – thermal effects – Finish Turning, boring, grinding – Surface roughness.

UNIT III DIMENSIONING 9

Definition of terms – Key dimension – Superfluous dimension – dimensional stepped shaft – assigning tolerances in the constituent dimensions – dimensional chains

UNIT IV MICRO-MACHINING MICRO FABRICATION 9

Micro Machining – Photo resist process – Lithography – LIGA Process – Optical, processing of materials – electron beam machining – beam machining – micro forming, diamond turning – micro positioning devices – etching – physical vapour deposition – Chemical vapour deposition.

UNIT V SMART STRUCTURES, MATERIALS AND MICRO ACTUATORS 9

Smart structures – Smart materials types and applications - smart sensors – micro valves – MEMS – micro motors – micro pumps – micro dynamometer – micro machines – micro optics – micro nozzles.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Murthy R.L. "Precision Engineering in Manufacturing", New Age Internaional Pvt. Limited, 2005.
2. Juliar W.Gardner. Vijay K. Varadan, "Micro sensors, MEMS and Smart Devices", John wiley and sons, 2001.

REFERENCES:

1. Stephen A.Campbell, "The Science and Engineering of Micro electronic Fabrication", Oxford University Press, 1996.
2. Raady Frank, "Understanding smart sensors", Artech. House, Boston, 1996.
3. MEMS Hand Book, CRC Press, 2001.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/104/112104251/
2. https://nptel.ac.in/courses/112/105/112105231/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/4385/nptel-smart-materials-intelligent-system-design
2. https://www.engineering.com/AdvancedManufacturing/ArticleID/19533/Machine-Tool-Error-Sources.aspx

OUTCOMES:

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

1. Understand about the concepts of accuracy and machine tools.
2. Understand about stiffness, thermal effects and finish machining.
3. Understand about basic dimensioning.
4. Understand about micromachining and micro fabrication.
5. Understand smart structures, materials and micro actuators.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	1	2	1	-	1	-	-	1	2	2
CO2	2	3	2	3	1	2	1	-	1	-	-	1	2	2
CO3	2	2	2	2	1	2	1	-	1	-	-	1	2	2
CO4	2	3	2	3	1	2	1	-	1	-	-	1	2	2
CO5	2	2	2	2	1	2	1	-	1	-	-	1	2	2

PROFESSIONAL ELECTIVES - III

20MEEL703 SDG NO. 4,8,9,12	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the process planning concepts and to make cost estimation for various products and processes
- To determine the methods by which a product is to be manufactured economically and competitively
- To prepare a detailed specification which lists the operations, tools, facilities and instructions that describes how to manufacture the product and its parts

- To prepare the functional requirements of the product, quantity, tools and equipment, and eventually the cost for manufacture

UNIT I INTRODUCTION TO PROCESS PLANNING 9

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

UNIT II PROCESS PLANNING ACTIVITIES 9

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

UNIT III INTRODUCTION TO COST ESTIMATION 9

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

UNIT IV PRODUCTION COST ESTIMATION 9

Estimation of Different Types of Jobs - Estimation of Forging jobs , Estimation of Welding Jobs, Estimation of Foundry jobs.

UNIT V MACHINING TIME CALCULATION 9

Estimation of Machining Time - Importance of Machine Time Calculation-Calculation of Machining time for different lathe operations - drilling and boring - milling, shaping and planning - grinding

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Peter Scallan, "Process planning, Design/Manufacture Interface", Elsevier science technology books, Dec 2002.
2. M. Aadithan, "Process Planning and Cost Estimation", New Age International Pvt. Ltd., 2007.

REFERENCES

1. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", 9th Edition, John Wiley, 1998.

2. Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2003.
3. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.

WEB RESOURCES:

1. http://www.ignou.ac.in/upload/Unit-9-CRC.pdf

ONLINE RESOURCES:

1. https://www.udemy.com/course/process-costing-system-cost-accounting-managerial-accounting/
2. https://www.udemy.com/course/cost-volume-profit-and-breakeven-analysis/
3. https://nptel.ac.in/courses/110/101/110101132/

OUTCOMES:

Upon completion of the course, the students should be able to

1. Understand the different production processes, drawing interpretation and material selection.
2. Calculate the various process parameters in selecting proper jigs and fixtures along with tooling and equipment.
3. Estimate the material cost, labour cost, overhead and depreciation for manufacturing a product in industry.
4. Calculate the production cost such as forging, welding, foundry and other shop cost.
5. Calculate the machining time depending upon the machining process like threading, knurling, drilling, shaping etc.

CO-PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	-	-	-	-	-	2	2	-	1	1	1
CO2	2	2	1	-	-	-	-	-	2	2	-	2	2	2
CO3	2	2	-	-	-	-	-	-	2	2	1	2	2	2
CO4	2	2	-	-	-	-	-	-	2	2	1	2	2	2
CO5	2	2	-	-	-	-	-	-	2	2	1	2	2	2

PROFESSIONAL ELECTIVES - IV

20PREL801 SDG NO. 4, 9, 12	FLEXIBLE MANUFACTURING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the modern manufacturing systems
- To understand the concepts and applications of flexible manufacturing systems

UNIT I PLANNING, SCHEDULING AND CONTROL OF FLEXIBLE MANUFACTURING SYSTEMS 9

Introduction to FMS - development of manufacturing systems - benefits - major elements of FMS -types of flexibility - FMS application and flexibility –single product, single batch, n – batch scheduling problem - knowledge based scheduling system.

UNIT II COMPUTER CONTROL AND SOFTWARE FOR FLEXIBLE MANUFACTURING SYSTEMS 9

Introduction - composition of FMS - hierarchy of computer control - computer control of work center and assembly lines - FMS supervisory computer control - types of software specification and selection - trends.

UNIT III FMS SIMULATION AND DATA BASE 9

Application of simulation - model of FMS - simulation software - limitation - manufacturing data systems - data flow - FMS database systems - planning for FMS database.

UNIT IV GROUP TECHNOLOGY AND JUSTIFICATION OF FMS 9

Introduction - matrix formulation - mathematical programming formulation - graph formulation -knowledge based system for group technology - economic justification of FMS - application of possibility distributions in FMS systems justification.

UNIT V APPLICATIONS OF FMS AND FACTORY OF THE FUTURE 9

FMS application in machining, sheet metal fabrication, prismatic component production -aerospace application - FMS development towards factories of the future - artificial intelligence and expert systems in FMS - design philosophy and characteristics for future.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jha.N.K., "Handbook of flexible manufacturing systems", Academic Press Inc., 1991.

REFERENCES:

1. Groover M.P., "Automation, Production Systems And Computer Integrated Manufacturing", Prentice Hall of India Pvt., New Delhi, 2007.
2. Kalpakjian S., "Manufacturing Engineering and Technology", Addison-Wesley PublishsingCo., 2013.
3. Radhakrishnan P. and Subramanyan S., "CAD/CAM/CIM", Wiley Eastern Ltd., New AgeInternational Ltd., 1994.
4. Raouf A. and Daya B.M., "Flexible manufacturing systems: recent development", ElsevierScience, 1995.
5. Ohno T., "Toyota production system: beyond large-scale production", Productivity Press(India) Pvt. Ltd., 1992.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_me78/preview
2. https://nptel.ac.in/courses/110106044/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3068/manufacturing-systems-management/37

OUTCOMES:

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

1. Perform planning, scheduling and control of flexible manufacturing systems.
2. Understand various computer controls and softwares for flexible manufacturing systems.
3. Understand about FMS simulation and data base.
4. Perform simulation on software's use of group technology to product classification.
5. Analyse various applications of FMS and factory of the future.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	1	2	-	1	-	1	1	2	2
CO2	2	2	2	2	2	1	2	-	1	-	1	1	2	2
CO3	2	2	2	2	2	1	2	-	1	-	1	1	2	2
CO4	2	2	2	2	2	1	2	-	1	-	1	1	2	2
CO5	2	2	2	2	2	1	2	-	1	-	1	1	2	2

PROFESSIONAL ELECTIVES - IV

20PREL802 SDG NO. 4, 9, 12	PRODUCTION MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the evolution of management
- To study the functions and production management
- To learn the application of the principles in an organization

UNIT I PRINCIPLES OF MANAGEMENT AND PERSONNEL MANAGEMENT **9**

General principles of management – management functions – organization – types – comparison – functions of personnel management – recruitment training leadership/motivation – communication – Conflict industrial relations – trade union.

UNIT II INVENTORY MANAGEMENT **9**

Purpose of Inventory – Cost related to inventors – Basic EOQ model – variations in EOQ model – Finite Production quality discounts – ABC Analysis – MRP Analysis.

UNIT III OPERATIONS MANAGEMENT **9**

Plant Location – Layout – Materials Handling – Method Study – Time Study – Ergonomics – Aggregate Planning – Value Analysis.

UNIT IV FINANCIAL MANAGEMENT 9

Capital – Types – sources – break even analysis – financial statements – income statement – balance – balance sheet – capital budgeting – working capital management – inventory pricing.

UNIT V MARKETING MANAGEMENT 9

Functions of marketing – sales promotion methods – advertising – product packaging – marketing variables – distribution channels – organization – market research market research techniques.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Kesavan. R., C.Elanchezhian and T.Sundar Selwyn, "Engineering Management", Eswar Press, 2005.
2. Panneerselvam. K., "Production and Operations Management", Prentice Hall of India, 2003.

REFERENCES:

1. Koont and G'donnel, "Essentials of Management", McGraw Hill 1992.
2. Philips Kotler, "Principles of Marketing", Prentice Hall of India, 1995.
3. I.M. Pandey, "Financial Management", Vikas Publishing house, 1995.
4. K.K.Ahuja, "Personal Management", Kalyane Publication 1992.
5. Martand T. Telesand, "Industrial and Business Management", S.Chand & Co., 2001.

WEB REFERENCES:

1. https://nptel.ac.in/courses/110106044/#
2. https://nptel.ac.in/courses/112102106/#download_transcripts
3. https://nptel.ac.in/courses/112102107/#

ONLINE RESOURCES:

1. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=5692
2. http://www.nitc.ac.in/app/webroot/img/upload/Production%20Management%201%20Course%20notes.pdf

OUTCOMES:

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

1. Understand the principles of management and personnel management.
2. Understand the principle of inventory management.

3. Understand the principles of operations management.
4. Understand the principles of financial management.
5. Understand the principles of marketing management.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1	1	2	1	2	1	-	3	1	2	2
CO2	2	1	2	1	1	2	1	2	1	-	3	1	2	2
CO3	2	1	2	1	1	2	1	2	1	-	3	1	2	2
CO4	2	2	2	2	2	2	1	2	1	-	3	1	2	2
CO5	2	1	2	1	2	2	1	2	1	-	3	1	2	2

PROFESSIONAL ELECTIVES - IV

20MEEL803 SDG NO. 4,7,9,13,15	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices
- To educate on the rudiments of micro fabrication techniques
- To introduce various sensors and actuators
- To introduce different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond electrical and mechanical engineering

UNIT I INTRODUCTION TO MEMS **9**

Electrostatic sensors Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection..

UNIT II MICRO SENSORS AND ACTUATORS - I **9**

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors – Thermal Sensing and Actuation

Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph

– Applications - Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators-Actuation using Shape Memory Alloys

UNIT III MICRO SENSORS AND ACTUATORS - II **9**

Transmission Piezo resistive sensors – Piezo resistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

UNIT IV MICRO MACHINING **9**

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.

UNIT V POLYMER AND OPTICAL MEMS **9**

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Chang Liu, "Foundations of MEMS", Pearson Education Inc., 2006.
2. Stephen D Senturia, "Microsystem Design", Springer Publication, 2000.

REFERENCES

1. Tai Ran Hsu, “MEMS & Micro systems Design and Manufacture” Tata McGraw Hill, New Delhi, 2002.
2. James J.Allen, "Micro Electro Mechanical System Design", CRC Press Publisher, 2010.
3. Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "Micro Sensors MEMS and Smart Devices", John Wiley & Son LTD,2002.
4. Mohamed Gad-el-Hak, editor, “ The MEMS Handbook”, CRC press Baco Raton, 2000.
5. Nadim Maluf,“ An Introduction to Micro Electro Mechanical System Design”, Artech House, 2000.
6. Thomas M.Adams and Richard A.Layton, “Introduction MEMS, Fabrication and Application,” Springer 2012.

WEB RESOURCES:

1. https://nptel.ac.in/courses/103/106/103106075/
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-777j-design-and-fabrication-of-microelectromechanical-devices-spring-2007/lecture-notes/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/117/105/117105082/
2. https://nptel.ac.in/courses/112/104/112104181/
3. https://nptel.ac.in/courses/108/108/108108113/

OUTCOMES:

Upon completion of the course, the students should be able to

1. Explain the characteristics and application of MEMS and microsystems.
2. Explain the working principle of MEMS sensors and actuators.
3. Study the detection of thermal, mechanical, magnetic, and electromagnetic changes that can be converted by electronic circuitry into usable data by creating physical changes.
4. Select appropriate micromachining process for fabricating MEMS devices and model MEMS device.
5. Explain current state of the art in polymer micro-optic fabrication technology and applications to optical MEMS.

CO-PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	1	1	-		-	-	1	2	3	3	2
CO2	3	2	2	1	2	-	-	-	-	1	2	3	2	3
CO3	3	2	2	1	2	-	-	-	-	1	2	3	3	3
CO4	3	1	2	1	2	-	-	-	-	1	2	3	3	2
CO5	3	1	1	1	1	-	-	-	-	1	2	3	2	2

PROFESSIONAL ELECTIVES - IV

20PREL803 SDG NO. 4,9,12	DESIGN FOR MANUFACTURE AND ASSEMBLY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable students to deal with newer concepts of design for manufacturing and assembly process
- To enable students to deal with the usage of dimensioning and tolerancing

UNIT I DFM APPROACH, SELECTION AND SUBSTITUTION OF MATERIALS 9

DFM approach, DFM guidelines, standardization, group technology, value engineering, comparison of materials on cost basis, design for assembly, DFA index, Poka - Yoke principle; concept.

UNIT II TOLERANCE ANALYSIS 9

Cumulative effect of tolerances, sure fit law, normal law and truncated normal law, obtainable tolerances in axial dimensions for various machining operations, Process capability, process capability metrics, Cp, Cpk, cost aspects, feature tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process.

UNIT III GEOMETRIC DIMENSIONING AND TOLERANCING 9

Introduction to GD&T, ASME Y 14.5 standard. Examples for application of geometric tolerances – Feature control frame-Rule 1 and Rule 2 of GD&T – Modifiers - Form tolerances – Orientation tolerances –Location tolerances - Profile tolerances. True Position Theory - Comparison between co-ordinate and convention method of feature location tolerancing and true position tolerancing, virtual size concept, floating and fixed fasteners, projected tolerance zone, zero true position tolerance, functional gauges, paper layout gauging, compound assembly, examples.

UNIT IV SELECTIVE ASSEMBLY 9

Interchangeable and selective assembly, deciding the number of groups-model-I: group tolerances of mating parts equal; model-II: total and group tolerances of shaft, model-III, control of axial play-introducing secondary machining operations, laminated shims, examples.

UNIT V DATUM SYSTEMS 9

Degrees of freedom, grouped datum systems-different types, two and three

mutually perpendicular groupeddatum planes, grouped datum system with spigot and recess, pin and hole, grouped datum system with spigot and recess pair and tongue-slot pair-computation of translational and rotational accuracy, geometric analysis and applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Bryan R.Fischer, "Mechanical Tolerance Stackup and Analysis", CRC Press, 2011.
2. Paul J Drake, “Dimensioning and tolerancing handbook”, McGraw Hill Publications, 1999.

REFERENCES:

1. Creveling C M, "Tolerance Design - A Hand Book for Developing Optimal Specifications", Addison Wesley LongmanInc., USA, 1997.
2. Harry Peck, "Designing for Manufacture", Pitman Publications, London, 1983..
3. Spotts M F, "Dimensioning and Tolerance for Quantity Production", Prentice Hall Inc., New Jersey, 1983.
4. Oliver R Wade, "Tolerance Control in Design and Manufacturing", Industrial Press Inc., New York, 1967.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_me48/preview
2. https://nptel.ac.in/courses/112101005/
3. https://ocw.mit.edu/courses/mechanical-engineering/2-008-design-and-manufacturing-ii-spring-2004/lecture-notes/

ONLINE RESOURCES:

1. https://www.studocu.com/da/document/danmarks-tekniske-universitet/design-for-manufacture/foredragsnoter/design-for-manufacture-notes-from-lecture-11/4018397/view
2. https://www.sae.org/learn/content/92047/

OUTCOMES:

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

1. Understand the DFM approach.
2. Understand the effects of tolerance analysis.
3. Understand the basics of geometric dimensioning and tolerancing.
4. Use machine vision techniques in selective assembly.
5. Understand the use of datum systems.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1	1	2	1	-	1	-	-	1	2	2
CO2	2	2	2	2	1	2	1	-	1	-	-	1	2	2
CO3	2	3	2	3	1	2	1	-	1	-	-	1	2	2
CO4	2	2	2	2	1	2	1	-	1	-	-	1	2	2
CO5	2	2	2	2	1	2	1	-	1	-	-	1	2	2

PROFESSIONAL ELECTIVES - IV

20HSMG301 SDG NO. 3,4,5,8,10, 13,14,15,16	PROFESSIONAL ETHICS AND VALUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objectives of this course are to provide students of engineering with:

- An understanding of their duties and responsibilities as professionals through gaining knowledge of the philosophies of ethics, professional practice, and world culture
- Basic knowledge to make informed ethical decisions when confronted with problems in the working environment
- Improved awareness of potential ethical issues within an engineering context
- Team skills through working in teams on assignments and in-class assignments
- Subjective analytical skills through investigation and evaluation of ethical problems in engineering settings using accepted tests for moral problem solving
- An understanding of how societal morals vary with culture and its influence on ethical thought and action
- Improved communications skills with regard to ethical and professional issues in engineering
- Know some of the classic cases as well as contemporary issues in engineering ethics

UNIT I HUMAN VALUES & PRINCIPLES FOR HARMONY 9

Morals, Values, and Ethics –Value Education – Human Dignity – Human Rights – Fundamental Duties – Aspirations and Harmony (I, We & Nature) – Gender Bias – Emotional Intelligence – Salovey – Mayer Model – Emotional Competencies – Conscientiousness.

UNIT II ENGINEERING ETHICS AND SOCIAL EXPERIMENTATION 9

History of Ethics – Need of Engineering Ethics – Engineering Ethics - Profession and Professionalism - Self Interest – Moral Autonomy – Utilitarianism – Virtue Theory – Uses of Ethical Theories – Deontology- Types of Inquiry –Kohlberg's Theory – Gilligan's Argument – Heinz's Dilemma – Comparison with Standard Experiments –– Learning from the Past – Engineers as Managers – Role of Codes – Codes and Experimental Nature of Engineering.

UNIT III ENGINEERS' RESPONSIBILITIES TOWARDS SAFETY AND RISK 9

The concept of Safety – Safety and Risk – Types of Risks – Voluntary v/s Involuntary Risk – Consequences – Risk Assessment – Accountability – Liability – Reversible Effects – Threshold Levels of Risk – Delayed v/s Immediate Risk – Safety and the Engineer – Designing for Safety – Risk-Benefit Analysis - Accidents.

UNIT IV ENGINEERS' DUTIES AND RIGHTS 9

Concept of Duty – Professional Duties – Collegiality – Professional and Individual Rights – Confidential and Proprietary Information – Conflict of Interest-Ethical egoism – Collective Bargaining – Confidentiality – Gifts and Bribes – Problem solving - Occupational Crimes - Industrial Espionage - Price Fixing-Whistle Blowing.

UNIT V GLOBAL ISSUES

Globalization and MNCs – Cross Culture Issues – Business Ethics – Media Ethics – Environmental Ethics – Endangering Lives – Bio Ethics – Computer Ethics – War Ethics – Research Ethics -Intellectual Property Rights.

TEXT BOOKS:

1. M.Govindarajan, S.Natarajan and V.S.SenthilKumar, "Engineering Ethics & Human Values", PHI Learning Pvt. Ltd., 2009.

REFERENCE BOOKS:

1. Sekhar, R.C., "Ethical Choices in Business Response Books", New Delhi, Sage Publications, 1997.

2. Kitson, Alan and Campebell, Robert, "The Ethical Organisation", Great Britain Macmillan Press Ltd., 1996.
3. Pinkus, Rosa Lyun B., Larry J Shulman, Norman Phummon, Harvey Wolfe, "Engineering Ethics",New York, Cambridge Uty., Press, 1997.
4. R. Subramaniam, "Professional Ethics", Oxford Publications, New Delhi.
5. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw-Hill – 2003.
6. Prof.A.R.Aryasri, Dharanikota Suyodhana, "Professional Ethics and Morals" Maruthi Publications.
7. Harris, Pritchard, and Rabins, "Engineering Ethics", Cengage Learning, New Delhi.
8. S. B. Gogate, "Human Values & Professional Ethics", Vikas Publishing House Pvt. Ltd., Noida.
9. A. Alavudeen, R.Kalil Rahman and M. Jayakumaran, "Professional Ethics and Human Values", University Science Press.
10. Prof.D.R.Kiran, "Professional Ethics and Human Values" Tata McGraw-Hill – 2013.
11. Jayshree Suresh and B. S. Raghavan, "Human Values and Professional Ethics", S.Chand Publications.

WEB REFERENCES :

- Ethos Education provides a concise guide on developing a code of ethics for primary and secondary schools.
- The Ethics Resource Center has a toolkit available for use. When used for commercial purposes, a nominal license fee is required.
- Creating A Code Of Ethics for Your Organization, with many suggested books, by Chris MacDonald.
- The Deloitte Center for Corporate Governance offers a variety of resources for those who are active in governance, including a variety of resources and a set of suggested guidelines for writing a code of ethics or a code of conduct.

ONLINE RESOURCES:

- https://www.udemy.com/course/worlplace-ethics-and-attitude/
- https://www.udemy.com/course/business-ethics-how-to-create-an-ethical-organization/
- https://nptel.ac.in/courses/110/105/110105097/Ethics in Engineering Practice
- https://nptel.ac.in/courses/109/104/109104068/Human Values

- https://www.coursera.org/learn/ethics-technology-engineering
- https://www.classcentral.com/course/ethics-technology-engineering-10485

OUTCOMES:

Upon completion of the course, the students should be able to

1. Improved ability to distinguish between ethical and non-ethical situations.
2. The ability to practice moral judgment in conditions of dilemma.
3. The understanding to relate the code of ethics to social experimentation.
4. The knowledge to apply risk and safety measures in various engineering fields.
5. The broad education necessary to better understand the impact of engineering solutions in a global/societal context.

CO- PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	2	3	3	3	3	3	1	3
CO2	2	3	2	2	2	3	3	3	3	3	2	3
CO3	3	2	3	2	2	3	3	3	3	3	1	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3
CO5	2	2	2	2	2	3	3	3	3	3	1	3

PROFESSIONAL ELECTIVES - IV

20PREL804 SDG NO. 4,8,9,12,13,15	INDUSTRY 4.0 AND CLOUD MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- This course provides students with an introduction to Industry 4.0, its building blocks, its applications and advantages compared to conventional production techniques
- This course provides a comprehensive overview of the role of digitization, big data, cyber-physical manufacturing systems, robots, human robot collaboration, artificial intelligence and all relevant Industry 4.0 technologies can be used to build up the production of the future
- This course will provide an insight into the application of cloud computing in manufacturing enabling high level integration of product development phases.
- It gives an idea about different tools and methodologies used for cloud based product management
- To study the Design approaches, methods and tools for sustainability

UNIT 1 INTRODUCTION TO INDUSTRY 4.0 7

Introduction to Industry 4.0: The Various Industrial Revolutions - Digitalization and the Networked Economy - Drivers, Enablers, Compelling Forces, Opportunities and Challenges for Industry 4.0 - The Journey so far: Developments in USA, Europe, China and other countries - Comparison of Industry 4.0 Factory and Today's Factory - Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation - Augmented Reality, Virtual Reality, Artificial Intelligence, and Advanced Analysis.

UNIT 2 ROAD TO INDUSTRY 4.0 9

Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services - Industrial Processes-Industrial Sensing & Actuation, Industrial Internet Systems - Communication parts and Networking parts - Smart Manufacturing - Smart Devices and Products - Cyber Physical Systems and Next Generation Sensors - Smart Logistics - Smart Cities- Predictive Analytics-Cyber physical Systems - Robotic Automation and Collaborative Robots - Support System for Industry 4.0 - Mobile Computing -Related Disciplines - Cyber Security - Future of Works and Skills for Workers in the Industry 4.0 Era - Strategies for competing in an Industry 4.0 world.

UNIT 3 CLOUD MANUFACTURING SYSTEM 10

Cloud based manufacturing systems- Introduction to cloud computing –definition- architecture of cloud manufacturing-resource requirements –service oriented manufacturing environment – IaaS, SaaS, PaaS, interoperability of systems, cloud based systems and interoperability –virtual service layer- Distributed service – definition – application of manufacturing ,assembly processes and management of products for recycling of e-waste – customizable decision making model. Development of cloud community for small and medium industries- IIoT case studies.

UNIT 4 CLOUD SERVICES 9

Integrating OEMs and suppliers, outsourcing machining process – Cloud based manufacturing of parts, Vendor selection and supply chain management in cloud environment-Factors affecting cloud technology adoption and implementation – Benefits of cloud, Barriers and approaches of cloud adoption, various perspectives of users, developers and market teams, Data as a service, Business process as a service.

UNIT 5 SUSTAINABLE MANUFACTURING AND CLOUD INTEGRATED SYSTEMS 10

Sustainable manufacturing system, product design, manufacturing – Needs of sustainability - adaption of sustainability factors in product development-manufacturing requirement, strategy, domain for production paradigm, Re use, Recycle, Remanufacture for sustainability- Lifecycle sustainable information management- Cloud based integrated systems for design and manufacturing –collaborative cloud based systems - visualization information sharing – Designing by service for collaborative product development – Real time work in progress management- modeling for operational information exchange network.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, (Apress) ISBN: 9781484220474 (2016).
2. Christoph Jan Bartodziej, “The Concept Industry 4.0", Best Masters ISBN 978-3-658-16501-7 (eBook), Springer Gabler.
3. Christoph Jan Bartodziej, “An Empirical Analysis of Technologies and Applications in Production Logistics”, Best Masters, ISBN 978-3-658-16502-4 (eBook), Springer Gabler.
4. Alp Ustundag, Emre Cevikcan, “Industry 4.0: Managing The Digital Transformation”, ISSN 1860-5168 ISSN 2196-1735 (electronic) Springer

Series in Advanced Manufacturing ;ISBN 978-3-319-57869-9 ISBN 978-3-319-57870-5 (eBook).
5. Weidong Li , Jorn Mehnen, "Cloud Manufacturing Distributed computing technologies for global and sustainable manufacturing", Springer New York.
6. Stark, J., "Product Lifecycle Management - 21st Century Paradigm for Product Realization", Springer-Verlag, London, 2005

REFERENCES:

1. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, "Industrial Internet of Things: Cyber Manufacturing Systems" (Springer).
2. Bruno s. Sergi, Elena g. Popkova, Saleksei v. Bogoviz And Tatiana n. Litvinova, "Understanding Industry 4.0: Ai, The Internet Of Things, And The Future Of Work", Emerald Publishing , First edition 2019, ISBN: 978-1-78973-312-9 (Print).
3. Peter P. Rogers, Kazi F. Jalal and John A. Boyd, "An Introduction to Sustainable Development", Glen Educational Foundation, 2008.
4. Gunther Seliger, "Sustainable Manufacturing: Shaping Global Value Creation", Springer Science & Business Media, 2012.

WEB REFERENCES:

1. https://doi.org/10.1007/978-3-319-57870-5.
2. www. searchsoa.techtarget.com
3. www.cimdata.com
4. www.aberdeen.com
5. Klaus Schwab 2016: The Fourth Industrial Revolution, https://www.weforum.org/about/the-fourth-industrial-revolution-by-klaus-schwab.
6. https://doi.org/10.1080/17517575.2012.683812

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/106105195/
2. http://nraoiekc.blogspot.com/2017/12/industrial-engineering-40-ie-in-era-of.html.
3. https://tutorials.one/industry-4-0/
4. https://www.edx.org/course/industry-40-how-to-revolutionize-your-business

OUTCOMES:

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

1. Know the industrial revolution in history, the main features and trends of the fourth industrial revolution.
2. Understand the basis of IoT and cyber-physical systems. Also the application of robotics in the I4.0. Industrial Internet of Things.
3. Understand the concept of cloud based distributed environment for collaborative manufacturing.
4. Understand about sustainable product, service system and sustainable manufacturing and gain knowledge on sustainability, sustainable development and product life cycle design.
5. Apply the cloud concepts in a sustainable and global product development.

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2	0	-	-	-	1	1	2	-	1	3	2
CO2	1	1	3	1	3	-	1	1	2	3	-	2	3	3
CO3	1	1	3	1	3	-	1	1	2	3	-	2	3	3
CO4	1	0	1	0	1	-	3	1	2	2	-	2	2	2
CO5	1	0	1	0	1	-	3	1	2	2	-	2	2	2

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