PAAVAI ENGINEERNG COLLEGE (Autonomous) M.E. - ENGINEERING DESIGN REGULATIONS 2023 (CHOICE BASED CREDIT SYSTEM) CURRICULUM

(For the candidates admitted during the Academic Year 2024-2025 onwards) SEMESTER - I

S.No.	Category	Course Code	Course Title	L	Т	Р	С
Theory	7						
1	PC	PED23101	Advanced Engineering Materials	3	0	0	3
2	PC	PED23102	Concepts of Engineering Design	3	0	0	3
3	PC	PED23103	Computer Applications in Design	3	0	0	3
4	PC	PED23104	Vibration Analysis and Control	3	1	0	4
5	MC	PEN23101	Research Methodology and IPR	3	0	0	3
6	PE	PED23***	Professional Elective I	3	0	0	3
7	AC	PAC23101	PAC23101 English for Research Paper Writing (Audit Course I)		0	0	0
Practic	cal						
1	PC	PED23105	Computer Aided Design Laboratory	0	0	4	2
TOTAL					1	4	21

SEMESTER – II

S.No.	Category	Course Code	Course Title	L	Т	Р	С
Theor	·y			•			
1	PC	PED23201	Finite Element Methods in Mechanical Design	3	1	0	4
2	PC	PED23202	Integrated Product Development	3	0	0	3
3	PC	PED23203	Mechanical Behavior of Materials	3	0	0	3
4	PC	PED23204	Advanced Mechanics of Materials	3	1	0	4
5	PE	PED23***	Professional Elective II	3	0	0	3
6	PE	PED23***	Professional Elective III	3	0	0	3
7	AC	PAC23201	Pedagogy Studies (Audit Course II)	2	0	0	0
Practi	ical		-				
1	PC	PED23205	Simulation and Analysis Laboratory	0	0	4	2
			Approved AP TOTAL	20	2	4	22

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S.No.	Category	Course Code	Course Title	L	Т	Р	C
Theory	7				•		
1	PC	PED23301	Engineering Fracture Mechanics	3	0	0	3
2	PE	PED23***	Professional Elective IV	3	0	0	3
3	PE	PED23***	Professional Elective V	3	0	0	3
4	OE	PED23***	Open Elective	3	0	0	3
Practio	cal						
1	EE	PED23302	Project Work (Phase I)	0	0	12	6
			TOTAL	12	0	12	18

SEMESTER - III

SEMESTER – IV

S.No.	Category	Course Code	Course Title	L	Т	Р	С			
Practic	Practical									
1	EE	PED23401	Project Work (Phase II)	0	0	24	12			
			TOTAL	0	0	24	12			
	TOTAL CREDITS: 21+22+18+12-73									

TOTAL CREDITS: 21+22+18+12=73

S.No.	Category	Course Code	Course Title	L	Т	Р	С
1.	PE	PED23151	Design for Sustainability	3	0	0	3
2.	PE	PED23152	Mechanics of Composite Materials	3	0	0	3
3.	PE	PED23153	Design of Hydraulic and Pneumatic Systems	3	0	0	3
4.	PE	PED23154	Tribology in Design	3	0	0	3
5.	PE	PED23155	Advanced Mechanisms in Design	3	0	0	3
6.	PE	PED23156	Product Lifecycle Management	3	0	0	3
7.	PE	PED23157	Surface Engineering	3	0	0	3
8.	PE	PED23158	Optimization Techniques in Design	3	0	0	3
9.	PE	PED23159	Mechanical Measurements and Analysis	3	0	0	3
10.	PE	PED23160	Design for X	3	0	0	3
11.	PE	PED23161	Vehicle Dynamics	3	0	0	3

PROFESSIONAL ELECTIVE COURSES



S.No	Category	Course Code	Course Title	L	Т	Р	С
12.	PE	PED23163	Solid Freeform Manufacturing	3	0	0	3
13.	PE	PED23165	Advanced Finite Element Analysis	3	0	0	3
14.	PE	PED23166	Design of Hybrid and Electric Vehicles	3	0	0	3
15.	PE	PED23168	Material Handling Systems and Design	3	0	0	3
16.	PE	PED23169	Artificial Intelligence and Machine Learning	3	0	0	3
17.	PE	PED23170	Industrial Internet of Things	3	0	0	3
18.	PE	PED23171	Materials Characterization Techniques	3	0	0	3
19.	PE	PED23172	Composite Materials and Testing	3	0	0	3
20.	PE	PED23173	Soft Computing	3	0	0	3

OPEN ELECTIVE COURSES

S. No	Category	Course Code	Course Title	L	Т	Р	С
1	OE	PED23901	Industrial Safety		0	0	3
2	OE	PSE23901	Climate change and Adaptation	3	0	0	3
3	OE	PPS23901	Alternate Energy Sources	3	0	0	3
4	OE	PCS23901	Design of Digital Elements	3	0	0	3
5	OE	PCE23901	Big Data Analytics	3	0	0	3



PED23101

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COURSE OBJECTIVES

To enable the students to

1. understand the structure of various materials and its behaviors in the engineering field.

2. learn imperfection, deformation, diffusion, dislocation and strengthening mechanisms.

3. create phase diagram in iron carbon system to improve and enhance their research activities.

4. acquire the knowledge of various failures of metals.

5. familiarize the processing of metals like ceramics, polymers and composites.

UNIT I STRUCTURE OF MATERIALS

Properties of materials - Classification of materials. Advanced Materials, Future materials and modern materials, Atomic structure. Atomic bonding in solids, Crystal structures, Crystalline and non-crystalline materials. Miller indices. Anisotropic elasticity. Elastic behavior of composites. Structure and properties of polymers. Structure and properties of ceramics.

UNIT II IMPERFECTIONS IN SOLIDS, DIFFUSION, DISLOCATIONS AND STRENGTHENING MECHANISMS

Point defects. Theoretical yield point. Line defects and dislocations. Interfacial defects. Bulk or volume defects. Atomic vibrations; Elastic deformation. Plastic deformation. Diffusion mechanisms. Non-equilibrium transformation and microstructure, Dislocation and plastic deformation. Mechanisms of strengthening in metals. Recovery, re-crystallization and grain growth. Strengthening by second phase particles. Optimum distribution of particles. Lattice resistance to dislocation motion.

UNIT III PHASE DIAGRAMS

Equilibrium phase diagrams. Particle strengthening by precipitation. Precipitation reactions. Kinetics of nucleation and growth. The iron-carbon system. Phase transformations. Transformation rate effects and TTT diagrams. Microstructure and property changes in iron carbon system.

UNIT IV FAILURES OF MATERIALS

Fracture. Ductile and brittle fracture. Fracture mechanics. Impact fracture. Ductile brittle transition. Fatigue. Crack initiation and propagation. Crack propagation rate. Creep - Generalized creep behavior. Stress and temperature effects.

UNIT V PROCESSING OF MATERIALS

Thermal processing of metals. Heat treatment. Precipitation hardening. Types and applications of ceramics. Mechanical behavior of polymers. Mechanisms of deformation and strengthening of polymers. Polymer types. Polymer synthesis and processing, Particle reinforced composites. Fiber reinforced composites. Structural composites, Economic, Environmental and Social Issues of Material Usage. Recycling issues. Life cycle analysis and its use in design.

COURS	COURSE OUTCOMES BT MAPPED										
At the er	d of the course,	the students will b	e able to		(High	est Level)					
CO1	demonstrate an metals, ceramic	understanding o s and polymers	f physical proper	ties of materials	including Unde	rstanding (K2)					
CO2	understand exis	tence of imperfect	ions and their caus	se of failure	Unde	rstanding (K2)					
CO3	demonstrate understanding of phase diagrams and their use in predicting phase Understanding (K2) transformation and microstructure										
CO4	understand and predict various types of failures using concept of fracture Understanding (K2) mechanics, creep and effect of impact										
CO5	know the proces	ssing of metals, ce	ramics, polymers	and composites	Appl	ying (K3)					
REFER	ENCES					k.					
1. Ma	terials Science a	nd Engineering, W	Villiam D. Calliste	r, Jr, John Wiley &	c sons, 2007						
2. Ad	vanced Enginee	ring Materials an	d Modeling, Ash	utosh Tiwari, N.	Arul Murugan	, Rajeev Ahujar,					
На	rdcover, 2016.										
3. Ad	vanced Engineer	ring Materials, M	N Avadhanulu, I	Dr. Shilpa A. Pand	e, Dr. Arti R. Go	olhar, Dr. Mohan					
Gi	riva. S Chand A	nd Company Ltd.	2019.								
4 Int	roduction to Mat	erials Science for	Engineers, James	F Shackelford, Pea	rson; 7 th edition,	2008.					
CO - P(MAPPING										
0-10	MAITING		Outromos mi	th Drogramma Quit							
	(1/2)	Mapping of Co	urse Outcomes wi	3-Strong 2-Med	ium 1-Weak						
	(1/2/	5 mulcates streng	Programme (Outcomes(POs)	ium și vican						
COs	PO1	PO2	PO3	PO4	PO5	PO6					
CO1	3	3		2	2	3					
CO2	3	3	2	2	2	3					
CO3	3	3	2	-	2	3					
CO4	3	2	2	-	2	3					
CO5	3	2	-	-	2	3					



00	D23102	CONCEPTS OF ENGINEERING DES	IGN	3	0	0	3
CO	URSE	OBJECTIVES					
То	enable	the students to	192				-
1.	impart	t the fundamentals designing cost effective, preservation and pre-	oductive.				
2.	familia	arize with the customer-oriented design and societal considerati	ons.				
3.	unders	stand reinforces the knowledge being learned and shortens the o	verall learning	of design m	nethc	ds.	
4.	know	the concepts of materials for the design process.					
5.	acquir	e the knowledge in the design of reliability of failure mode effe	ct analysis and p	probability	cond	epts	
UN	ITI	DESIGN FUNDAMENTALS					9
Imp	ortance	of design- The design process-Considerations of Good Design	- Morphology o	of Design –	Org	aniza	tior
for	design	Computer Aided Engineering -Designing to codes and standard	ds – Concurren	nt Engineer	ing –	- Pro	duc
and	process	s cycles – Technological Forecasting – Market Identification – G	Competition Ber	nch markin	g.		
UNIT II CUSTOMER ORIENTED DESIGN AND SOCIETAL CONSIDERATIONS							9
Ider	ntificatio	on of customer needs- customer requirements- Quality Fu	inction Deploy	ment- Pro	duct	De	sigr
Spe	cificatio	ons- Human Factors in Design - Ergonomics and Aesthetics	. Societal cons	ideration –	Co	ntrac	ts –
Pro	duct liab	pility - Protecting intellectual property - Legal and ethical doma	ins – Codes of e	ethics – Eth	ical	conf	licts
– Ei	nvironm	ent responsible design-future trends in interaction of engineerin	g with society.				
UN	IT III	DESIGN METHODS					9
Crea	ativity a						
		and Problem Solving –Creativity Methods-Theory of Inventive	Problem Solvir	ng (TRIZ) -	- Co	ncep	tual
deco	omposit	ion-Generating design concepts-Axiomatic Design – Evaluation	Problem Solvir methods- Embo	ng (TRIZ) - odiment De	- Co sign	ncep -Proc	tual luct
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CO2	familiarize the p	product design spe	cifications, ergone	omics and aestheti	cs. Apply	ving (K3)
CO3	identify the suit	able design metho	ds for problem so	lving.	Under	rstanding (K2)
CO4	understand the p	proper material sel	ection processing		Under	rstanding (K2)
CO5	apply the probal	bility concepts in a	design foe reliabil	ity	Apply	ving (K3)
REFER	ENCES				l	
1. Ge	eorge E.Dieter and	d Linda C.Schmid	t, Engineering De	sign,McGraw Hill	, 5 th International I	Editions, 2012.
2. Pa	hl, G, and Beitz.	W, Engineering D	esign, Springer –	Verlag, London, 2	007.	
3. Su	h, N.P., —The pr	inciples of Design	, Oxford Univers	ity Press, NY.199).	
4. Ka	arl T. Ulrich and S	Steven D. Eppinge	er, Product Design	and Developmen	,McGraw Hill, 5 th	Edition 2011.
CO - PO	O MAPPING					
		Mapping of Co	urse Outcomes wi	th Programme Ou	tcomes:	
	(1/2/.	3 indicates streng	th of correlation) 3-Strong, 2-Mee	lium , 1-Weak	
COs			Programme	Outcomes(POs)		
	PO1	PO2	PO3	PO4	PO5	PO6
C01	3	3	3	-	3	1
CO2	3	3	3	-	3	1
CO3	3	3	3	-	3	1
C04	3	3 3 3	3	2-2	3	1
C05	3	3	3	-	3	1



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COURSE OBJECTIVES

To enable the students to

1.		understand fundamenta	l concepts of computer	graphics and its tools in	a generic framework.
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2. impart the parametric fundamentals to create and manipulate geometric models using curves, surfaces and solids.

3. impart the parametric fundamentals to create and manipulate geometric models using NURBS and solids.

4. provide clear understanding of CAD systems for 3D modeling and viewing.

5. create strong skills of assembly modeling and prepare the student to be an effective user of a standards in CAD system.

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Overview of Graphics systems: Video Display Devices, Raster-Scan System, Random-Scan Systems, Graphics Monitors and Workstations, Input Devices, Hard-Copy Devices, Graphics Software. Output primitives: Line Drawing Algorithm - DDA, Bresenham's and Parallel Line Algorithm. Circle generating algorithm – Midpoint Circle Algorithm. Geometric Transformations: Coordinate Transformations, Windowing and Clipping, 2D Geometric transformations -Translation, Scaling, Shearing, Rotation and Reflection, Composite transformation, 3D transformations.

UNIT II CURVES AND SURFACES MODELLING

Introduction to curves - Analytical curves: line, circle and conics – synthetic curves: Hermite cubic spline- Bezier curve and B-Spline curve – curve manipulations. Introduction to surfaces - Analytical surfaces: Plane surface, ruled surface, surface of revolution and tabulated cylinder – synthetic surfaces: Hermite bi cubic surface- Bezier surface and B-Spline surface- surface manipulations.

UNIT III NURBS AND SOLID MODELING

NURBS- Basics- curves, lines, arcs, circle and bi linear surface. Regularized Boolean set operations - primitive instancing - sweep representations - boundary representations - constructive solid Geometry- comparison of representations - user interface for solid modeling.

UNIT IV VISUAL REALISM

Hidden Line removal, Hidden Surface removal – Hidden Solid Removal algorithms – Shading - Rendering – Coloring. Animation - Conventional, Computer animation, Engineering animation - types and techniques.

UNIT V ASSEMBLY OF PARTS AND PRODUCT LIFE CYCLE MANAGEMENT

Assembly modeling – Design for manufacture – Design for assembly – computer aided DFMA - inferences of positions and orientation - tolerances analysis –Center of Gravity and mass property calculations - mechanism simulation. Graphics and computing standards – Data Exchange standards. Product development and management – new product development –models utilized in various phases of new product development – managing product life cycle.

TOTAL PERIODS:	45
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COUR	SE OUTCOMES	5			BT M	APPED			
At the end of the course, the students will be able to (Highest Level)									
CO1	solve 2D and 3	Under	standing (K2)						
CO2	formulate the basic mathematics fundamental to CAD system. Applying (K3)								
CO3	use the different surface modeling	nt geometric mode	eling techniques li ing.	ke feature based modelin	^{ng,} Under	standing (K2)			
CO4	create geometri	c models through	animation and tran	nsform them into real wo	rld Apply	ing (K3)			
CO5	simulate assem	bly of parts using	Computer-Aided I	Design software.	Apply	ing (K3)			
REFE	RENCES								
1.	Ibrahim Zeid, "Ma	astering CAD/CAN	M", McGraw Hill,	2nd Edition, 2006.					
2.	Boothroyd, G, "A	ssembly Automati	on and Product De	esign" Marcel Dekker, Ne	w York, 19	97.			
3.	Chitale A.K and (Gupta R.C "Produc	et design and man	ufacturing " PHI learning	private lim	ited, 6 th Edition,			
	2015.								
4.	David Rogers, Ja	mes Alan Adams	"Mathematical E	Elements for Computer (Graphics" 2	nd Edition, Tata			
	McGraw-Hill edit	ion.2003							
CO - F	PO MAPPING								
		Mapping of Co	urse Outcomes wi	th Programme Outcomes:					
	(1/2/	3 indicates streng	th of correlation) 3-Strong, 2-Medium , 1	-Weak				
COs			Programme (Dutcomes(POs)					
	PO1	PO2	PO3	PO4	PO5	PO6			
C01	3	3	3	2	3	1			
CO2	3	2	3	2	3	1			
C03	3	2	3	2	3	1			
C04	3	2	3	-	3	1			
C05	2	2	2		3	1			

SCHEE Approved	
Mechanical Engineering	
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AUTONOMOUS	
	BOARD OF STUDIES Hechanical Engineering

PED23104

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COURSE OBJECTIVES

To enable the students to

1. appreciate the basic concepts of vibration in damped and undamped systems

2. calculate the natural frequencies and mode shapes of the two degree freedom systems

3. determine the natural frequencies and mode shapes of the multi degree freedom and continuous systems

4. learn the fundamentals of control techniques of vibration and noise levels

5. use the instruments for the measuring and analyzing the vibration levels in a body

UNIT I FUNDAMENTALS OF VIBRATION

Introduction -Sources of Vibration-Mathematical Models- Displacement, velocity and Acceleration Review of Single Degree Freedom Systems -Vibration isolation Vibrometers and accelerometers - Response to Arbitrary and non- harmonic Excitations – Transient Vibration –Impulse loads, Critical Speed of Shaft-Rotor systems.

UNIT II TWO DEGREE FREEDOM SYSTEM

Introduction-Free Vibration of Undamped and Damped - Forced Vibration with Harmonic Excitation System – Coordinate Couplings and Principal Coordinates.

UNIT III MULTI-DEGREE FREEDOM SYSTEM AND CONTINUOUS SYSTEM

Multi Degree Freedom System –Influence Coefficients and stiffness coefficients- Flexibility Matrix and Stiffness Matrix – Eigen Values and Eigen Vectors-Matrix Iteration Method –Approximate Methods: Dunkerley, Rayleigh's, and Holzer Method -Geared Systems-Eigen Values & Eigenvectors for large system of equations using sub space, Lanczos method – Continuous System: Vibration of String, Shafts and Beams.

UNIT IV VIBRATION AND NOISE CONTROL

Specification of Vibration Limits – Vibration severity standards- Vibration as condition Monitoring Tool-Vibration Isolation methods - Dynamic Vibration Absorber - Static and Dynamic Balancing machines – Field balancing -Major sources of noise – Noise survey techniques – Measurement technique for vehicular noise – Road vehicle noise standards – Industrial noise sources – Control Strategies – Noise control at the source and along the path – use of acoustic barriers – Noise control at the receiver.

UNIT V	EXPERIMENTAL METHODS IN VIBRATION ANALYSIS	12				
Vibration Analysis Overview - Experimental Methods in Vibration AnalysisVibration Measuring Instruments -						
Selection of Sensors- Accelerometer MountingsVibration Exciters-Mechanical, Hydraulic, Electromagnetic And						
Electrodyna	mics -Frequency Measuring Instruments System Identification from Frequency Response	-Testing				
for resonance	ee and mode shapes.					
	TOTAL PERIODS:	60				
COURSE (DUTCOMES BT MAPPED)				

COUR	SE OUTCOMES	BT MAPPED
At the	end of the course, the students will be able to	(Highest Level)
CO1	apply the basic concepts of vibration in damped and undamped systems	Understanding (K2)

CO2	determine the m	atural frequencies	and mode shapes	s of the two degree	e freedom App	lying (K3)					
	systems.										
CO3	calculate the na	tural frequencies a	and mode shapes	of the multi degree	e freedom Und	erstanding (K2)					
	and continuous	and continuous systems									
CO4	control the vibration and noise levels in a body Applying (K3)										
CO5	measure and analyze the vibration levels in a body Applying (K3)										
REFER	ENCES										
1. Gr	aham Kelly, San	d Shashidhar K. K	udari, "Mechanic	al Vibrations", Tat	a McGraw – Hi	ll Publishing Com.					
Lto	1 2007										
				· · ·	- 1 2017						
2. Sir	ngiresu S. Rao, "	Mechanical Vibrat	ions, "Pearson Ed	lucation Incorporat	ed, 2017						
3. Ra	mamurti. V, "Me	echanical Vibration	n Practice with Ba	sic Theory", Naro	sa Publishing Ho	ouse, 2010					
4. W	illiamT. Thomso	n, "Theory of Vibi	ration with Applic	ations", Taylor &	Francis, 2018						
CO-PO) MAPPING										
		Mapping of Co	urse Outcomes wi	th Programme Out	comes:						
	(1/2/	3 indicates streng	th of correlation) 3-Strong, 2-Med	ium , 1-Weak						
COs			Programme	Outcomes(POs)							
	PO1	PO2	PO3	PO4	PO5	PO6					
C01	3	3	3	2	1	-					
CO2	3	3	3	2	1	2					
CO3	3	3	3	2	1	2					
CO4	3	3	3	2	1	2					
C05	3	3	3	2	1	-					



PEN2	3101	RESEARCH METHODOLOGY AND I	PR	3 0	0	3
COU	RSE OB.	IECTIVES				
To en	able the s	tudents to	Second Street	The Logic Line		
1. u	nderstand	the formulation of research problem		ज्यात्र विकास		-
2. b	e familiar	with data collection and literature survey process				
3. k	now the s	tatistical concepts in experimentation		فيراديه الم		
4. a	cquire kn	owledge in writing research proposal		general track		
5. le	earn abou	t patent rights and its importance		Citra Mar	1.0	sŢ
UNIT	I R	ESEARCH PROBLEM FORMULATION	Segres S			
Meani	ing of res	earch, Objectives of Research, Types of research, Signifi	cance of Resea	arch, Research	h pro	ces
Select	ing the pr	oblem, Necessity of defining the problem, Meaning of Rese	earch design, N	eed for resear	ch de	sig
feature	es of a go	od design, Different research designs.				
UNIT	II	TERATURE SURVEY			4	
Quant	itative an	d Qualitative data, Scaling, Scaling Techniques, Experimen	nts and Surveys	, Collection c	of prin	nai
and se	condary o	lata, Data preparation process. Research problems, Effectiv	e literature stud	lies approache	es, Su	rve
for exi	isting liter	rature, Procedure for reviewing the literature, Analysis and a	assessment.			
UNIT	III DI	ESIGN OF EXPERIMENTS				
Strateg	gy of Exp	erimentation - Typical applications of experimental design,	Guidelines for	designing exp) erim	ent
Basic	statistical	concepts - Statistical concepts in experimentation, Regressi	on approach to	analysis of va	rianc	e.
UNIT	IV RI	ESEARCH PROPOSAL AND WRITING				
Conter	nts of a re	esearch proposal, Writing a research report - Research writ	ing in general,	Referencing,	Writi	ng
bibliog	graphy, Pi	esentation and assessment by a review committee, Plagiaris	m, Research etl	hics.		0
UNIT	V IN	TELLECTUAL PROPERTY RIGHTS				-
Intelle	ctual Pro	perty - Definition, WTO, Fundamentals of Patent, Copy	right, Rights o	of the owner.	Tern	n
copyri	ght, Regi	ster of trademark. Procedure for trade mark. Term of tra	demark: New	Development	s in 1	IPF
Admin	istration	of patent system, IPR of Biological Systems, Computer Soft	ware.	Zerenopment		
			TOTAL	PERIODS:	4	5
COUF	RSE OUT	COMES		BT MAPPE	D	
At the	end of the	e course, the students will be able to		(Highest Lev	el)	
CO1	Col identify research problems				Linderstanding (V2)	
CO2	collect a	nd prepare suitable data for research		Annlying (K)	3)	-)
CO3	design e	xperiments for different statistical concepts		Understandin	')	2)
CO4	write res	search proposals and reports		Applying (K)	3)	-)
CO4write research proposals and reports.Apple				Applying (K3)		
CO5	apply the research work for patent through IPR.					

REFE	REFERENCES								
1. (C.R Kothari and	Gaurav Garg,	"Research Metho	odology Methods	and Techniques	s", 4th Edition,			
נ	New Age International Publishers, 2019.								
2. 1	2. Ranjit Kumar, "Research Methodology": A step by Step Guide for beginners, 2nd Edition, Pearson								
1	Education, 2010.								
3. 1	Douglas C. Montgo	omery, "Design and	d Analysis of Expe	eriments", 9th editi	on, Wiley Publish	ers, 2017.			
4. 1	Neeraj Pandey and	Khushdeep Dharn	i, "Intellectual Pro	operty Rights", Pre	entice Hall India L	earning, 2014.			
CO - 1	PO MAPPING								
	Mapping of Course Outcomes with Programme Outcomes:								
	(1/2/	3 indicates streng	th of correlation	3-Strong, 2-Med	lium , 1-Weak				
COs			Programme O	utcomes(POs)					
	PO1	PO2	PO3	PO4	PO5	PO6			
C01	3	3	3	1	-	-			
CO2	3	3	-	1	2	-			
CO3	3	3	3	2	2	-			
CO4	3	3	- 11	-	1	1			
C05	3	-	-	2	2	3			

RING COLLEGE A CIN EERING Approved BOARD OF STUDIES English NAL 6 4 2 AUTONOMOU

PAC23101 ENGLISH FOR RESEARCH PAPER WRITING 2 0 0 0 **COURSE OBJECTIVES** To enable the students to 1. improve the writing skills and level of readability. 2. learn about what to write in each section and to understand the skills required to develop a title. choose a topic of interest and paraphrase, summarize, using correct attribution and following documentation 3. guidelines. 4. craft a research paper in their discipline. 5. ensure the good quality of a research paper at first-time submission PLANNING AND PREPARATION UNIT I 6 Precision of Words; Breaking up long sentences; Structuring Paragraphs and Sentences; Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness. Expressing independent thought with grace, clarity and force. **UNIT II** LITERATURE REVIEWS AND CITATIONS 6 Key skills required - write a title, an abstract, write an introduction, write the review of the literature, conduct a literature review of all current research in their field; Review of the Literature; Methods; Results; Discussion and Conclusions; citing references correctly and avoiding plagiarism. **UNIT III** WRITING STANDARDS 6 Useful phrases - to ensure paper is as good as it could possibly be the first-time submission - first draft, second draft, final draft of research report; journal article; literature review; chapters, grant proposal; Avoid inadequate support of generalizations, slipshod or hurried style, poor attention to detail, straying from directions, mechanical errors, underwritten and/or marred by confused purpose, lack of organization, repetition of ideas, improper use of words, and frequent grammatical, spelling and punctuation errors. UNIT IV STRUCTURE OF A PAPER 6 Details of all the parts, Clarifying Who Did What; Highlighting the Findings; Hedging and Criticizing; Skills to identify something we really need to know, some ways to find a topic; to venture out across the swamp of research without losing our bearings; Paraphrasing; Sections of a Paper - Abstract, Introduction to Free writing. UNIT V **EDITING AND ORGANISING SKILLS** 6 Skills required - write the Methods, write the Discussion, write the Results, write Conclusions; write about what we've learned truthfully so the reader really gets it in thought and expression, demonstrating a clear understanding and execution of the research. **TOTAL PERIODS:** 30 **COURSE OUTCOMES BT MAPPED** At the end of the course, the students will be able to (Highest Level) CO1 plan and write a research paper in their discipline Understanding (K2)

CO2	understand the ba	asics of citations,	avoiding plagiaris	m and literature reviews	Applyi	ng (K3)			
CO3	write paraphrase,	results and concl	usions.		Unders	tanding (K2)			
CO4	culminate the act	ual crafting and r	evising of a resear	ch paper	Applyi	ng (K3)			
CO5	use suitable voc writing	use suitable vocabulary, grammar and punctuation to write flawless piece of writing (K3)							
REFE	RENCES								
1. (Goldbort R (2006)	Writing for Scien	ce, Yale Universit	y Press.					
2. I	Day R (2006) How	to Write and Pub	lish a Scientific Pa	per, Cambridge University	Press.				
3. I	Highman N (1998)	, Handbook of Wi	riting for the Math	ematical Sciences, SIAM. I	lighman's	book.			
4. /	Adrian Wallwork,	English for Writi	ng Research Paper	s, Springer New York Dord	lrecht Heid	elberg London,			
	2011								
CO -]	PO MAPPING								
		Mapping of Co	ourse Outcomes wi	ith Programme Outcomes:					
	. (1/2/	3 indicates stren	gth of correlation) 3-Strong, 2-Medium , 1-	Weak				
COs			Programme O	Dutcomes(POs)					
	PO1	PO2	PO3	PO4 P	05	PO6			
C01	-	-	-	2	-	1			
CO2	-	3	-	2	2	2			
C03		1	-	-	-	-			
CO4		-	-	3	-	-			
C05	-	2	2	3	-	-			



PED23105

COMPUTER AIDED DESIGN LABORATORY

0

COURSE OBJECTIVES

To enable the students to

1. understand sketches for given mechanical component

2. learn features of the software for solid modeling and surface modeling with the help of software tools

3. model and assemble mechanical components like couplings, joints, Engine parts and miscellaneous components

4. gain knowledge on drafting and form layouts for assembled components

CAD INTRODUCTION

1. Sketcher

- 2. Solid modeling & Surface Modeling Extrude, Sweep, Trim etc., and Mesh of curves, freeform etc. Feature manipulation- Copy, Edit, Pattern, Suppress, History operations etc.
- 3. Assembly Constraints, Exploded Views, Interference check.
- 4. Drafting Layouts, Standard & Sectional Views, Detailing & Plotting.
- 5. Couplings -Flange, Universal, Oldham's, Muff, Gear couplings.
- 6. Joints -Knuckle, Gib & cotter, strap, sleeve & cotter joints.
- 7. Engine parts -Piston, connecting rod, cross-head (vertical and horizontal), stuffing box, multi-plate clutch.
- 8. Miscellaneous machine components -Screw jack, machine vice, tail stock, chuck, vane and gear pumps.
- 9. Assembly using Parametric and feature based modeling packages.

-		TOTAL	L PERIODS:	60
COURS	SE OUTCOMES		BT MAPPEI	D
At the e	nd of the course, the students will be able to		(Highest Leve	el)
CO1	create sketches for given mechanical component		Understandin	g (K2)
CO2	use features of the software to develop solid modeling and surface model	ling	Applying (K3	5)
CO3	modeling and assembling of mechanical components like couplings. Engine parts and miscellaneous components	, joints,	Understandin	g (K2)
CO4	draft and form layouts for assembled components		Applying (K3	5)
CO DO) MADDINC			

CO - PO MAPPING

Mapping of Course Outcomes with Programme Outcomes:

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

COs			Programme	Outcomes(POs)		
203	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	2	3	-
CO2	3	-	3	2	3	-
CO3	3	-	3	2	3	-
CO4	3	-	3	2	3	-



PEI	PED23201FINITE ELEMENT METHODS IN MECHANICAL DESIGN3104							
CO	URSE	DBJECTIVES						
To	enable t	he students to		-				
1.	learn n	nathematical models for one dimensional problems and their numerical solution	ns					
2.	learn t	vo dimensional scalar and vector variable problems to determine field variable	es			_		
3.	learn is	oparametric transformation and numerical integration for evaluation of eleme	nt matr	ices				
4.	study v	arious solution techniques to solve Eigen value problems						
5.	learn s	olution techniques to solve non-linear problems						
UN	ITI	FINITE ELEMENT ANALYSIS OF ONE DIMENSIONAL PROBLEM	IS				12	
Historical Background - Weighted Residual Methods - Basic Concept of FEM - Variational Formulation of							V.P.	
– Ri	itz Meth	od – Finite Element Modelling – Element Equations – Linear and Higher orde	er Shap	e fu	nctic	ns –	Bar,	
Bear	m Elem	ents – Applications to Heat Transfer problems.						
UNI	ITI	FINITE ELEMENT ANALYSIS OF TWO DIMENSIONAL PROBLEM	AS				12	
Basi	ic Boun	dary Value Problems in two-dimensions – Linear and higher order Triangular,	quadri	later	alel	eme	nts –	
Pois	son's a	nd Laplace's Equation – Weak Formulation – Element Matrices and Vectors	- Ap	olica	tion	to so	calar	
varia	able pro	oblems - Introduction to Theory of Elasticity – Plane Stress – Plane St	rain a	nd A	Axis	/mm	etric	
Form	nulatior	- Principle of virtual work - Element matrices using energy approach.						
UNI	TIII	ISO-PARAMETRIC FORMULATION					12	
Natu	ıral Co-	ordinate Systems – Lagrangian Interpolation Polynomials – Iso parametric F	lement	s _F	orm	ulati	00-	
Shar	be funct	ions -one dimensional, two dimensional triangular and quadrilateral element	s -Sere	ndir	ity e	leme	onte-	
Jaco	bian tra	nsformation - Numerical Integration - Gauss quadrature - one two and three	s-Sere	narp	nty c		1115-	
IINI	TIV	FIGEN VALUE PROBLEMS	point ii	negi	ation	1.	10	
Dun	amio A	Provide Equations of Mation Consistent and humand more matrices.	17.1				. 12	
Note	anne A	anysis – Equations of Motion – Consistent and tumped mass matrices – Fi	ree Vit	oratio	on a	nalys	51S —	
Inatu	duction	to transient field and have	Eigen	valu	e pro	obler	ns -	
Intro		to transient field problems.						
UNI	TV	NON-LINEAR ANALYSIS					12	
Intro	oduction	to Non-linear problems - some solution techniques- computational procedure	e mater	rial 1	non-l	inea	rity-	
Plast	ticity an	d viscoplasticity, stress stiffening, contact interfaces- problems of gaps and c	ontact	- ge	ome	tric 1	10n-	
linea	arity - m	odeling considerations - Free and Mapped meshing -Mesh quality- Error estin	nate.					
		TOTAL	PER	IOD	S:	6	0	
COL	URSE C	DUTCOMES	BT N	IAP	PEL)		
At th	ne end o	f the course, the students will be able to	(High	lest]	Leve	l)		
CO1	de sol	velop mathematical models for one dimensional problems and their numerical utions	Unde	rstar	nding	g (K2	2)	
CO2 determine field variables for two dimensional scalar and vector variable Applying (K3))		

CO3	apply iso-param element matrice	netric transformat es	ion and numerical	integration for eva	luation of Apply	ving (K3)
CO4	apply various so	Apply	ving (K3)			
CO5 formulate solution techniques to solve non-linear problems App						ving (K3)
REFER	RENCES					
1.	Bathe K.J., "Fini	te Element Procee	lures in Engineerir	ig Analysis", Pren	tice Hall, 1990	
2.	David Hutton, "F	fundamentals of F	inite Element Ana	lysis", Tata McGr	awHill, 2005	
3.	Rao, S.S., "The F	Finite Element Me	ethod in Engineerin	ng", 6th Edition, Bu	utterworth Heinem	ann,2018.
4.	Reddy,J.N. "Intro	oduction to the Fi	nite Element Meth	od", 4 th Edition, T	ata McGrawHill,2	018
CO - P	O MAPPING					
		Mapping of Co	ourse Outcomes wi	th Programme Out	tcomes:	
	(1/2/	3 indicates stren	gth of correlation	3-Strong, 2-Med	lium , 1-Weak	
COs			Programme (Outcomes(POs)		
003	PO1	PO2	PO3	PO4	PO5	PO6
C01	3	3	2	2	3	2
CO2	3	3	2	1	2	2
CO3	3	3	2	2	3	2
CO4	3	3	2	1	3	2
C05	3	3	2	1	3	2



3	0	3	INTEGRATED PRODUCT DEVELOPM	PED				
		Service Reality and)BJECTIVES	COL				
		1.	ne students to	To e				
		omer need analysis	and the principles of development process, product planning a	1.				
		t concepts	e the understanding of product specifications, generate, screen	2.				
2	1	lesign principles	ne principles of product architecture and the importance of ind	3.				
	19	and Report Property	the different Prototyping techniques for developing robust des	4.				
			e concepts of economics principles and project management p	5.				
9		and the second	INTRODUCTION TO PRODUCT DESIGN	UNI				
iges of	Challe	ct Development -	ics of Successful Product development -Duration and Cost of	Char				
rocess	ess -	duct Planning Pro	elopment - Product Development Processes and Organization	Prod				
			g Customer Needs.	of Id				
9		ELECTION AND	PRODUCT SPECIFICATIONS, CONCEPT GENERATI	UNI				
			TESTING					
ng and	creen	ration - Concept S	rget and Final product specifications - Activities of Concep	Estat				
			ncept Testing Methodologies.	Scori				
9	T		PRODUCT ARCHITECTURE AND INDUSTRIAL DES	UNI				
anning	orm P	fferentiation - Platf	nitecture - Implications and establishing the architecture - Dela	Prod				
gement	mana	ial design process -	stem level design issues - Need and impact of industrial design -	-Rel				
			rial design process - assessing the quality of industrial design.	of the				
9		INIT IV DESIGN FOR MANEACTURE PROTOTVRING AND DORUGT DESIGN						
nction	ting f	T DESIGN	DESIGN FOR MANFACTURE, PROTOTYPING AND F	UNI				
ping –		T DESIGN sts, costs of suppor	DESIGN FOR MANFACTURE, PROTOTYPING AND F tion - Estimation of Manufacturing cost- Reducing the compo	UNI DFM				
	protot	ST DESIGN sts, costs of support rs – Principles of	DESIGN FOR MANFACTURE, PROTOTYPING AND F tion - Estimation of Manufacturing cost- Reducing the compo y costs – Impact of DFM decision on other factors - Prototyp	UNI: DFM and a				
9	protot	ST DESIGN sts, costs of support cs – Principles of p n Process.	DESIGN FOR MANFACTURE, PROTOTYPING AND H tion - Estimation of Manufacturing cost- Reducing the compo y costs – Impact of DFM decision on other factors - Prototyp echnologies - Planning for prototypes - Robust design –Robust	UNI DFM and a Proto				
Project		ST DESIGN sts, costs of support cs – Principles of p n Process. FPROJECTS	DESIGN FOR MANFACTURE, PROTOTYPING AND H tion - Estimation of Manufacturing cost- Reducing the compo y costs – Impact of DFM decision on other factors - Prototyp technologies - Planning for prototypes - Robust design –Robust PRODUCT DEVELOPMENT ECONOMICS AND MAN	UNI DFM and a Proto				
J	eline	ST DESIGN sts, costs of support cs – Principles of p n Process. S PROJECTS esenting tasks- Bas	DESIGN FOR MANFACTURE, PROTOTYPING AND I tion - Estimation of Manufacturing cost- Reducing the compo y costs – Impact of DFM decision on other factors - Prototy echnologies - Planning for prototypes - Robust design –Robust PRODUCT DEVELOPMENT ECONOMICS AND MAN nalysis – Elements of Economic Analysis - Understanding an	UNI DFM and a Proto UNI Econ				
	eline	ST DESIGN sts, costs of support cs – Principles of p n Process. S PROJECTS esenting tasks- Bast ation.	DESIGN FOR MANFACTURE, PROTOTYPING AND I tion - Estimation of Manufacturing cost- Reducing the compo y costs – Impact of DFM decision on other factors - Prototy echnologies - Planning for prototypes - Robust design –Robust PRODUCT DEVELOPMENT ECONOMICS AND MAN nalysis – Elements of Economic Analysis - Understanding an eccelerating the project - Project execution – Postmortem project	UNI DFM and a Proto UNI Econ				
45	eline S:	ST DESIGN sts, costs of support cs – Principles of p in Process. S PROJECTS esenting tasks- Base ration. TOTAL PERIOD	DESIGN FOR MANFACTURE, PROTOTYPING AND I tion - Estimation of Manufacturing cost- Reducing the compo y costs – Impact of DFM decision on other factors - Prototy technologies - Planning for prototypes - Robust design –Robus PRODUCT DEVELOPMENT ECONOMICS AND MAN , nalysis – Elements of Economic Analysis - Understanding an ccelerating the project - Project execution – Postmortem project	UNI DFM and a Proto UNI Econ				
45	eline S: PED	ST DESIGN sts, costs of support cs – Principles of p in Process. S PROJECTS esenting tasks- Base ation. TOTAL PERIOD BT MAP	DESIGN FOR MANFACTURE, PROTOTYPING AND I tion - Estimation of Manufacturing cost- Reducing the compo y costs – Impact of DFM decision on other factors - Prototy technologies - Planning for prototypes - Robust design –Robust PRODUCT DEVELOPMENT ECONOMICS AND MANA nalysis – Elements of Economic Analysis - Understanding an ccelerating the project - Project execution – Postmortem project UTCOMES	UNI DFM and a Proto UNI Econ Plann				
45	eline S: PED _evel	ST DESIGN sts, costs of support cs – Principles of process. S PROJECTS esenting tasks- Base ation. TOTAL PERIOD BT MAP (Highest)	DESIGN FOR MANFACTURE, PROTOTYPING AND I tion - Estimation of Manufacturing cost- Reducing the compo y costs – Impact of DFM decision on other factors - Prototy technologies - Planning for prototypes - Robust design –Robust PRODUCT DEVELOPMENT ECONOMICS AND MAN. nalysis – Elements of Economic Analysis - Understanding an ccelerating the project - Project execution – Postmortem project UTCOMES `the course, the students will be able to	UNIT DFM and a Proto UNIT Econ Plann COU				
45 K2)	eline S: PED Level ding	ST DESIGN sts, costs of support cs – Principles of process. S PROJECTS esenting tasks- Base ation. TOTAL PERIOD BT MAP (Highest and Understan)	DESIGN FOR MANFACTURE, PROTOTYPING AND I tion - Estimation of Manufacturing cost- Reducing the compo y costs – Impact of DFM decision on other factors - Prototy technologies - Planning for prototypes - Robust design –Robus PRODUCT DEVELOPMENT ECONOMICS AND MAN. nalysis – Elements of Economic Analysis - Understanding an ccelerating the project - Project execution – Postmortem project UTCOMES `the course, the students will be able to illiarize with the principles of development process, product tomer need analysis	UNIT DFM and a Proto UNIT Econ Plant COU At the				
45 K2)	eline S: PED Level (K3)	ST DESIGN sts, costs of support cs – Principles of process. S PROJECTS esenting tasks- Base ation. TOTAL PERIOD BT MAP (Highest 1) ng and Understan eration Applying	DESIGN FOR MANFACTURE, PROTOTYPING AND I tion - Estimation of Manufacturing cost- Reducing the compo y costs – Impact of DFM decision on other factors - Prototy technologies - Planning for prototypes - Robust design –Robust PRODUCT DEVELOPMENT ECONOMICS AND MAN . nalysis – Elements of Economic Analysis - Understanding an ccelerating the project - Project execution – Postmortem project UTCOMES The course, the students will be able to tiliarize with the principles of development process, product tomer need analysis ize knowledge gained on product specifications, concept iniques for product development	UNIT DFM and a Proto UNIT Econ Plant COU At the CO1				
45 K2)	eline S: PED Level (K3) (K3)	ST DESIGN sts, costs of support cs – Principles of process. G PROJECTS esenting tasks- Base nation. TOTAL PERIOD BT MAP (Highest process) eration Applying es Applying	DESIGN FOR MANFACTURE, PROTOTYPING AND I tion - Estimation of Manufacturing cost- Reducing the compo y costs – Impact of DFM decision on other factors - Prototyj technologies - Planning for prototypes - Robust design –Robus PRODUCT DEVELOPMENT ECONOMICS AND MAN, nalysis – Elements of Economic Analysis - Understanding an ccelerating the project - Project execution – Postmortem project UTCOMES `the course, the students will be able to illiarize with the principles of development process, product tomer need analysis ize knowledge gained on product specifications, concep miques for product development ly the principles of product architecture and industrial design p	UNIT DFM and a Proto UNIT Econ Plant COU At the CO1 CO2				

CO5	exhibit knowle	edge on the con-	cepts of econom	ics principles an	d project App	lying (K3)
	management pr	actices				
REFER	ENCES					
1. Ka	arl T.Ulrich, Ste	even D.Eppinger,	Anita Goyal, "P	roduct Design an	d Development	", McGraw –Hill
Ec	lucation (India) F	vt. Ltd, 4th Editio	n, 2012.			
2. Ke	enneth Crow, "(Concurrent Engine	eering/Integrated	Product Develop	ment". DRM A	ssociates, 6/3, Via
O	ivera, Palos Vero	les, CA 90274(310)) 377-569,Worksl	nop Book		
3. Ke	evin N Otto, Kri	stin L Wood, "Pro	oduct Design – Te	chniques in Reve	rse Engineering	and New Product
De	evelopment", Pea	rson Education, In	ic, 2016.			
4. St	ephen Rosenthal,	"Effective Produc	t Design and Deve	elopment", Busine	ss One Orwin Ho	omewood, 1992.
CO - P	O MAPPING					
		Mapping of Co	urse Outcomes wit	h Programme Out	comes:	
	(1/2/	3 indicates streng	th of correlation)	3-Strong, 2-Med	ium , 1-Weak	
COs			Programme (Outcomes(POs)		
COS	PO1	PO2	PO3	PO4	PO5	PO6
C01	3	3	3	-	3	3
CO2	3	3	3	-	2	3
CO3	3	3	3	-	3	3
CO4	3	3	3	-	3	3
C05	3	3	3	-	3	3



PE	D2320	3 MECHANICAL BEHAVIOR OF MATERIALS	-	3 0	0	3
CC	DURSE	OBJECTIVES			1	
То	enable	the students to				
1.	learn	different strengthening and failure mechanism of the metals				T
2.	under	stand the behavior of materials under different types of loads				
3.	know	various aspects of selection of materials and processing				
4.	get ex	sposed to modern metallic materials and their composition				
5.	gain l	knowledge on non-metallic materials for engineering applications				
UN	IT I	BASIC CONCEPTS OF MATERIAL BEHAVIOR				
Eng	gineerii	ng Design process and the role of materials; materials classification and their I	properties	, Stre	ngthe	nin
mee	chanisr	ns-grain size reduction, solid solution strengthening, strain hardening, grain	boundary	strei	ngther	ning
pre	cipitati	on, particle, fibre and dispersion strengthening, Effect of temperature, strain a	and strain	rate	on pl	asti
beh	avior-	Super plasticity–Failure of metals.				
UN	IT II	BEHAVIOUR UNDER CYCLIC LOADS AND DESIGN APPROACH	ES			
Stre	ess inte	nsity factor and fracture toughness–Fatigue low and high cycle fatigue test, f	fracture m	acha	<u>.</u>	
			nacture n	iculta	nisms	an
Par	is law	Effect of surface and metallurgical parameters on fatigue– Safe life, Stress-life	e, strain-li	ife an	nisms d fail-	an
Par des	is law ign app	Effect of surface and metallurgical parameters on fatigue– Safe life, Stress-life proaches-Fracture of non-metallic Materials–Failure analysis, sources of failure.	e, strain-li	ife an edure	d fail- of fai	an sat
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CO2	comprehend the behavior of materials under different types of loads	Applying (K3)					
CO3	analyze and apply various aspects of selection of appropriate materials	Analyzing (K4)					
CO4	express knowledge on modern metallic materials and their composition	Understanding (K2)					
CO5	demonstrate understand of non-metallic materials for engineering applications	Understanding (K2)					
REFI	RENCES						
1.	1. George E.Dieter, Mechanical Metallurgy, McGraw Hill, 1988						
2.	2. Thomas H.Courtney, Mechanical Behavior of Materials, (2nd edition), McGraw Hill, 2000						

- 3. Willam D. CallisterJr.and David G. Rethwisch, Callister's Materials Science and Engineering, (2nd edition)Wiley Editorial,2018
- 4. Flinn, R.A., and Trojan, P.K., Engineering Materials and their Applications, (4th Edition) Jaico, 1999

CO - PO MAPPING

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs			Programme	Outcomes(POs)		
COs	PO1	PO2	PO3	PO4	PO5	PO6
C01	3	2	1	1	2	1
CO2	3	2	1	1	2	1
C03	3	2	1	1 ·	2	1
CO4	3	2	1	1	2	1
C05	3	2	1	1	2	1



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COU	URSE OB	JECTIVES				1
To e	enable the	students to				
1.	learn the c	concepts of theory of elasticity in three-dimensional stress system.	6			
2.	study the s	shear center of various cross-sections and deflections in beams subjected	to unsym	metri	cal be	nding
3.	acquire kn	owledge on the stresses in flat plates and curved members.		a harris		
4.	understand	d torsional stress of non-circular sections.				
5.	know the s	stresses in rotating members, contact stresses in point and line contact ap	plications			
UNI	TI E	LASTICITY			-	12
tensi UNI	on general	ized hook's law - St. Venant's principle – plane stress - Airy's stress functions HEAR CENTRE AND UNSYMMETRICAL BENDING	ee - dimer	rgy m	ethod:	s of a s. 12
Loca	tion of she	ear center for various thin sections - shear flows. Stresses and Deflect	ons in be	ams	subiec	ted to
unsy	mmetrical	loading-kern of a section.		unio	Juojee	
UNI		TRESSES IN FLAT PLATES AND CURVED MEMBERS			-	12
Circi	mformo	and radial stragges deflections surred have with metrics dealers	1 1		<u> </u>	12
conc	entrated lo	ad and uniform load - chain links and crane hooks. Solution of rectangul	ar plates -	- pure	bend	ing of
conc plate UNI	entrated lo s – deflect T IV T	ad and uniform load - chain links and crane hooks. Solution of rectangul ion – uniformly distributed load – various end conditions. ORSION OF NON-CIRCULAR SECTIONS	ar plates -	- pure	bend	ing of
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conc plate UNI' Torsi torsic UNI' Radia Meth COU At th CO1 CO2 CO3 CO4 CO5	entrated lo s - deflect T IV Tender ion of rectant onal stress $T V ST al and tange ods of contant DRSE OUT e end of the apply determines subject evaluation contant contant contant contant contant contant subject contant contant subject contant contant contant subject contant contant contant subject contant contant$	ad and uniform load - chain links and crane hooks. Solution of rectangul ion – uniformly distributed load – various end conditions. ORSION OF NON-CIRCULAR SECTIONS angular cross section - St.Venants theory - elastic membrane analogy - in hollow thin walled tubes. TRESSES IN ROTATING MEMBERS AND CONTACT STRESSE gential stresses in solid disc and ring of uniform thickness and varying the nputing contact stress-deflection of bodies in point and line contact applie TOT TCOMES the concepts of theory of elasticity in three-dimensional stress system. nine the shear centre of various cross-sections and deflections in beam ted to unsymmetrical bending. ate the stresses in flat plates and curved members. ate torsional stress of non-circular sections. ute the stresses in rotating members, contact stresses in point and line et applications	ar plates - Prandtl's S nickness a cations. AL PERI BT M (High Apply ^{IS} Under Under Apply ^e Apply	- pure stres stres illowa iODS iAPP est La /ing () rstand /ing () /ing ()	e bend s func s func ible sp ible sp i	ing o 1: tion 1: reeeds 6((2) (2)

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CO - PO MAPPING

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	(1726) Indicates Strongth of correlation) of Strong, 2 incentant, y a volume								
COs			Programme	Outcomes(POs)					
	PO1	PO2	PO3	PO4	PO5	PO6			
C01	3	3	2	2	3	2			
CO2	3	3	2	1	2	2			
CO3	3	3	2	2	3	2			
CO4	3	3	2	1	3	2			
C05	3	3	2	1	3	2			

COLLE BOARD OF STUDIES chanical Engineering AUTONC

PAC23201

COURSE OBJECTIVES

To enable the students to

1. understand the aims, objectives and educational philosophies of education.

2. acquire the knowledge of Instructional objectives of teaching and teaching skills.

3. apply the knowledge of methods and strategies of teaching in real classroom situation.

4. utilize the instructional aids and tools for effective classroom teaching.

5. acquaint with the knowledge of professional development of teachers.

UNIT I EDUCATION AND ITS PHILOSOPHY

Education- Definition, Aims, Objectives, Scope, Educational philosophy of Swami Vivekananda, Mahatma Gandhi, Rabindranath Tagore, Sri Aurobindo and J.Krishnamoorthy, Montessori, Jean - Jacques Rousseau, Friedrich Froebel and John Dewey. Current trends and issues in Education - Educational reforms and National policy on Education - 1968 and 1986 - its objectives and features.

UNIT II INSTRUCTIONAL OBJECTIVES AND DESIGN

Instructional Objectives: Taxonomy of Educational objectives - Writing of general and specific objectives. Instructional design: Planning and designing the lesson, Writing of lesson plan: meaning, its need and importance, format of lesson plan. Types of lesson plan Skills of teaching: various ways of introducing lessons, explaining skills, problem solving skills, illustrative skills, scaffolding skills, integrating ICT skills, questioning skills, Reinforcement skills, skill of probing questions, skill of Stimulus variation and computation skills.

UNIT III INSTRUCTIONAL METHODS AND STRATEGIES

Instructional strategies Lecture, demonstration, laboratory, Inductive method, Deductive method, Inquiry method, seminar, panel discussion, symposium, problem solving, project based learning (PBL), Learning by doing, workshop, role - play (socio-drama), Recent trends: Constructivist learning - Problem - based learning - Brain - based learning - Collaborative learning - Flipped learning - Blended learning - e-Learning trends - Video conferencing.

UNIT IV INSTRUCTIONAL MEDIA

Key concepts in the selection and use of media in education, Developing learning resource material using different media, Instructional aids - types, uses, selection, preparation, utilization. Dale cone of Experience, Teacher's role in procuring and managing instructional Aids - Projected and non-projected aids, multimedia, video - teleconferencing etc.

UNIT V TEACHER PREPARATION

Teacher - roles and responsibilities, functions, characteristics, competencies, qualities, Preparation of Professional teacher, Organizing professional aspects of teacher preparation programs, Professional Development of teachers - In-service training, Refresher programmes, workshop and higher studies.

TOTAL PERIODS: 30

2 | 0 | 0

0

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6

6

6

6

PRAC	TICUM					
•	Writing of three	lesson plans				
•	Practice teaching	g for 15 days				
•	Preparation of or	ne teaching aid				
•	A seminar on on	e educational philo	osophy			
•	Assignment on a	any of these five un	its			1
COUF	RSE OUTCOME	S			BT M	IAPPED
At the	end of the course,	the students will b	be able to		(High	est Level)
CO1	explain the education	ational philosophie	es of education.		Unde	rstanding (K2)
CO2	write instruction	al and specific obje	ectives in lesson pla	an.	Apply	ying (K3)
CO3	utilize the teachi	ng skills and metho	ods effectively.		Unde	rstanding (K2)
CO4	use instructional	media efficiently.			Appl	ying (K3)
CO5	update themselv	es in the area of pr	ofessional develop	ment.	Appl	ying (K3)
REFE	CRENCES					
1. 1	National Policy on	Education 1968 ar	nd 1986- National I	Policy on Educatio	n 1986-Programm	e of Action1992.
2. 1	Benjamin S.Bloom	netal. (1987). Taxo	no my of educatior	nal objectives. Lon	gman Group.	
3. 5	Siddiqui, Mujibul I	Hasan(2005). Tech	niques of classroom	m teaching A.P.H.		
4	Jeffrey Bennett (20	014).On Teaching	Science: Principle	s and Strategies T	hat Every Educate	or Should Know.
]	Big Kid Science: H	Boulder, CO				
5.	Bawa,M.S.& Nag	pal,B.M.(2010).De	veloping teaching	competencies. Nev	v Delhi: Viva Boo	k House.
CO -	PO MAPPING					
		Mapping of Co	ourse Outcomes wi	th Programme Out	comes:	
	(1/2	2/3 indicates stren	gth of correlation) 3-Strong, 2-Med	lium , 1-Weak	
COs			Programme O	outcomes(POs)	207	DO(
	PO1	PO2	PO3	PO4	PO5	PO6
C01	- U	2		3	-	-
CO2	-	-	-		-	-
CO3	-	-	-	3	2	3
CO4	1	-	-	-	3	3
C05			_	3	· 3	3



PED	23205	SIMULATIO	ON AND ANALY	SIS LABORATO	RY	0	0	4	
COU	RSE OBJECTIV	/ES				I			
To e	nable the students	to							
1.]	earn behaviour of	machine elements	under static loads						
2.	gain knowledge or	n the analysis of me	echanical systems	under thermal loads					
3. l	ise commercial sc	oftware packages to	simulate stress an	alysis of axis-symm	etric comp	oonents			
4. s	study response of	different mechanisi	ns using kinemation	es and dynamics sin	nulation so	ftware			
LIST	OF EXPERIMI	ENTS							-
Analy	sis of Mechanica	l Components – Us	e of commercial F	EA Packages					
Exerc	ises shall include	analysis of							
1	. Machine elemen	nts under Static load	ds						
2	2. Thermal Analys	is of mechanical sy	vstems						
3	8. Modal Analysis								
2	I. Stress Analysis	of an Axis -Symme	etric Component						
4	5. Machine elemer	nts under Dynamic	loads						
e	6. Harmonic Resp	onse Analysis							
7	. Non-linear syste	ems							
8	3. Use of kinemati	cs and dynamics si	mulation software						
9	. Analysis of velo	city and acceleration	on for mechanical	linkages of different	t mechanis	sms.			
					TOTAL	PERIOI	S:	6	0
COU	RSE OUTCOMI	ES				BT MAI	PEI)	
At the	e end of the course	e, the students will l	be able to			(Highest	Leve	el)	
201	analyze behavio	or of machine eleme	ents under static lo	oads		Analyzin	g (K	4)	
CO2	demonstrate the	e analysis of the me	chanical systems u	inder thermal loads		Applying	(K3)	
CO3	simulate and stu	udy the stress analy	sis of axis-symme	tric components		Understa	nding	g (K2	2)
CO4	use kinematics	and dynamics simu	ulation software to	study response of	different	Applying	(K3)	
	mechanisms						, (115	,	
.0-	PO MAPPING								
	(1/	Mapping of Co 2/3 indicates strend	ourse Outcomes wi	th Programme Outcome 3-Strong 2-Medi	omes:	ak			
<u> </u>		mulcates streng	Programme C	outcomes(POs)	um , 1- we	an			
CUS	PO1	PO2	PO3	PO4	PO5		Р	06	
CO1	3	3	3	2	3			2	
CO2	3	3	3	2	3			2	



CO3

CO4

PED23151

9

9

9

9

9

3

COURSE OBJECTIVES

To enable the students to

1. identify the relevant process; applying the general design principles for manufacturability; GD &T.

2. learn the design considerations while designing the cast and welded components.

3. know the design considerations while designing the formed and machined components.

4. apply design considerations for assembled systems.

5. gain knowledge design considerations for environmental issues.

UNIT I INTRODUCTION

Introduction - Economics of process selection - General design principles for manufacturability; Geometric Dimensioning & Tolerance (GD&T) – Form tolerancing: straightness, flatness, circularity, cylindricity – Profile tolerancing: profile of a line, and surface – Orientation tolerancing: angularity, perpendicularity, parallelism – Location tolerancing: position, concentricity, symmetry – run out tolerancing: circular and total–Supplementary symbols.

UNIT II CAST AND WELDED COMPONENTS DESIGN

Design considerations for: Sand cast – Die cast – Permanent mold parts. Arc welding – Design considerations for: Cost reduction – Minimizing distortion – Weld strength – Weldment. Resistance welding–Design considerations for: Spot–Seam–Projection–Flash and Upset weldment.

UNIT III FORMED AND MACHINED COMPONENTS DESIGN

Design considerations for: Metal extruded parts – Impact/Cold extruded parts – Stamped parts – Forged parts. Design considerations for: Turned parts– Drilled parts – Milled, planned, shaped and slotted parts–Ground parts.

UNIT IV DESIGN FOR ASSEMBLY

Design for assembly – General assembly recommendations – Minimizing the no. of parts – Design considerations for: Rivets – Screw fasteners – Gasket and Seals – Press fits – Snap fits – Automatic assembly– Computer Application for DFMA.

UNIT V DESIGN FOR ENVIRONMENT

Introduction– Environmental objectives–Global issues–Regional and local issues–Basic DFE methods– Design guide lines–Example application–Life cycle assessment–Basic method–AT&T's environmentally responsible product assessment-Weighted sum assessment method–Life cycle assessment method– Techniques to reduce environmental impact–Design to minimize material usage–Design for disassembly–Design for recyclability– Design for manufacture–Design for energy efficiency–Design to regulations and standards.

		TOTAL PERIODS:	45
COURS	SE OUTCOMES	BT MAPPE	D
At the en	nd of the course, the students will be able to	(Highest Leve	el)
CO1	Applying (K3	3)	

CO2	utilize design considerations while designing the cast and welded components.	Applying (K3)
CO3	employ design considerations while designing the formed and machined components.	Understanding (K2)
CO4	justify the design considerations for assembled systems.	Applying (K3)
CO5	apply the design considerations to solve environmental issues.	Applying (K3)
DEFED	INCES	

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- 2. Bralla, Design for Manufacture handbook, McGrawhill, 1999
- 3. Boothroyd, G, Heartz and Nike, Product Design for Manufacture, MarcelDekker, 1994
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CO - PO MAPPING

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes(POs)								
	PO1	PO2	PO3	PO4	PO5	PO6			
C01	3	2	3	1	2	2			
CO2	3	2	3	2	2	2			
CO3	3	2	3	2	2	2			
CO4	3	2	3	1	2	2			
CO5	3	2	3	1	2	2			



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То	enable	he students to			50 0	201800	1			1.3	1992		1
1.	learn t	ne significance	and future	enhanceme	ents in c	compos	ite mater	ials.		104			1
2.	analyz	e the geometric	and physic	al propertie	ies of ty	ypical co	omposite	materia	ıls.		- 1 8		
3.	unders	and the concept	ts of mathe	ematical rel	lations	and mee	chanical	propert	ies.	213.0	trail		-
4.	get kn	wledge in failu	re theories	and strengt	th para	ameters.				16-274			
5.	design	and analyze the	e structure	and various	s lamina	nates of o	composit	e mater	ials.		A. 10 A.	1.9	
UN	UNIT I INTRODUCTION												
Cha	aracteris	ics, Overview	of advanta	ge and lin	nitation	ns of co	mposite	materia	lls, Signif	icance a	and ob	jectiv	es
con	nposite	naterials, Scien	ce and tech	nology, cui	rrent st	tatus and	d future p	prospect	us.				
UN	II TI	BASIC CON	CEPTS A	ND CHAR	RACTE	ERISTI	CS						
Stru	uctural	performance o	f convent	ional mate	erial, (Geometr	ric and	physic	al definit	ion, M	aterial	resp	ons
Cla	assificati	on of composit	e materials	, Scale of	analysi	sis; Micı	romechar	nics, Ba	sic lamin	a prope	rties, C	onsti	tue
mat	terials a	d properties, Pr	operties of	typical cor	mposite	te materi	als.				2		
UN	III TII	ELASTIC B	EHAVIOR	OF UNID	DIREC	CTIONA	L LAM	INA				1	-
Stre	acc strai												
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and	l elastic	a relations, Rela parameters.	tion betwe	en mathem	natical	and eng	gineering	consta	nts, transf	ormatio	n of str	ess, s	stra
and UN	l elastic	arameters. STRENGTH	of UNID	en mathem	natical a	and eng	gineering	consta	nts, transf	ormation	n of str	ess, s	stra
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and UN Mic theo UN Bas mon stru	l elastic ITTIV cromech ories, Ap ITTV sic assur- ment re- actural co	Trelations, Relations, Relations, Relations, Relations, STRENGTH Infices of failure; plicability of variability	OF UNID failure me arious failu CHAVIOR displaceme l load-defe als.	ren mathem IRECTIO chanisms, N re theories. OF LAMD ent relation prmation re	natical a DNAL I Macro- INATE ns, Stre relations	and eng LAMIN -mechan E ess-strai ns, Anal	ineering A ical strer n relatio ysis of o	constant ngth part n of la differen	ameters, M yer within t types o TOTA	Macro m n a lam f lamin L PERI	n of str nechani inate, ates. I IODS: IAPPE	cal fa	an fi 15
and UN Mic theo UN Bass mor stru CO At t	I elastic ITTIV cromech ories, Ap ITTV sic assur- ment re- actural co DURSE (the end o	a relations, Rela parameters. STRENGTH unics of failure; plicability of va ELASTIC BH uptions, Strain- ultant, Genera mposite materi DUTCOMES f the course, the	OF UNID failure me arious failu CHAVIOR displaceme l load-defe als.	en mathem IRECTIO chanisms, N re theories. OF LAMI ent relation prmation re	PNAL I Macro- INATH ns, Stre relations	and eng LAMIN -mechan E ress-strain ns, Anal	A ical strer	constant ngth part n of la differen	ameters, M yer within t types o TOTA	Macro m n a lam f lamin L PERI BT M (High	n of str nechani inate, ates. I IODS: IAPPF est Lev	cal fa cal fa Force Design	iilu ar 15
and UN Mic theo UN Bass mon stru CO At t	I elastic I elastic IT IV cromech ories, Ap IT V sic assur- ment re- actural co DURSE (the end (1 ur	relations, Relations, Relations, Relations, Strain- STRENGTH unics of failure; plicability of value ELASTIC BH uptions, Strain- ultant, Genera mposite materi DUTCOMES f the course, the derstand the signal	OF UNID failure me arious failu CHAVIOR displaceme l load-defe als.	en mathem IRECTIO chanisms, N re theories. OF LAMD ent relation ormation re vill be able nd future e	PNAL I Macro	and eng LAMIN -mechan E ess-strain ns, Anal eements i	A ical stren	constant ngth part n of la different site ma	ameters, M yer within t types o TOTA terjals.	Macro m n a lam f lamin L PERI BT M (High Under	n of str nechani inate, ates. I IODS: IAPPE est Lev rstandin	ress, s cal fa cal fa Force Design Design (D yel) ng (K	ar ar ar ar ar ar ar ar ar ar ar ar ar a
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CO - PO MAPPING

	(1/2)	Mapping of Cou	urse Outcomes wi	th Programme Out	tcomes:						
COs	(1/2/	(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak Programme Outcomes(POs)									
COs	PO1	PO2	PO3	PO4	PO5	PO6					
C01	3	3	2	-	2	-					
CO2	3	3	2	-	2	-					
CO3	3	3	2	-	2	-					
CO4	3	3	2		2	-					
C05	3	3	2	-	2						

COI BOARD OF STUDIES Mechanical Engineering UTONO

PED231	.53	DESIGN OF HYDRAULIC AND PNEUMATIC	SYSTEMS	3	0	0	3		
COURS	E OB.	JECTIVES							
To enabl	le the s	students to							
1. fam	iliarize	the students with various hydraulic systems and hydraulic a	actuators.						
2. und	erstand	the control elements and actuation systems.							
3. learn	n to de	sign Hydraulic circuits effectively.							
4. acqu	uire kn	owledge to design the pneumatic systems and circuits.	i mésitai, k						
5. know	w abou	tt pneumatic equipment's, design calculation and use of mic	roprocessors						
UNIT I	0	OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS9							
Hydrauli	ic Pow	er Generators - Selection and specification of pumps, pu	mp characteris	tics. Line	ar ar	d Ro	otary		
Actuator	s – sele	ection, specification and characteristics.							
UNIT II	JNIT II CONTROL AND REGULATION ELEMENTS 9								
Pressure	- direc	tion and flow control valves - relief valves, non-return and s	safety valves –	actuation	syste	ms.	-		
UNIT II	I H	YDRAULIC SYSTEMS AND CIRCUITS	£				9		
Reciproc	ation,	quick return, sequencing, synchronizing circuits - accumula	ator circuits - in	ndustrial c	ircui	ts – p	oress		
circuits -	- hydra	ulic milling machine - grinding, planning, copying, - for	klift, earth mo	ver circui	ts- de	esign	and		
selection	of con	nponents – safety and emergency mandrels.							
UNIT IV		NEUMATIC SYSTEMS AND CIRCUITS				1	9		
Pneumati	ic fund	amentals - FRL unit - control elements, position and pressu	ure sensing - lo	ogic circui	ts – s	swite	hing		
circuits -	fringe	conditions modules and these integration -sequential circuits	s - cascade met	hods - maj	oping	met	hods		
- step co	unter n	nethod -compound circuit design - combination circuit desig	yn.						
UNIT V	IN	STALLATION, MAINTENANCE AND SPECIAL CIR	CUITS				9		
Pneumati	ic equi	ipment's- selection of components - design calculations	- application	-fault fin	ding	– h	ydro		
pneumati	ic circu	its - use of microprocessors for sequencing -PLC, Low cost	automation -R	obotic cir	cuits.				
		2	TOTAI	L PERIO	DS:	4	5		
COURS	E OUI	TCOMES		BT MA	PPEI)			
At the en	d of th	e course, the students will be able to		(Highest	Leve	el)			
CO1	demor actuate	nstrate knowledge on hydraulic power generator, pumps ors.	and various	Understa	ndin	g (K2	2)		
CO2	identif	y proper control and regulation elements.		Applying	g (K3)			
CO3	design	appropriate hydraulic circuits for various Engineering appl	ications.	Understa	ndin	g (K2	2)		
CO4	descri	be design procedure for pneumatic circuits.		Applying	g (K3)			
CO5	select	suitable components for designing hydro pneumatic circuits		Applying	g (K3)			
REFERE	ENCES	5							
1. Ant	tony Es	spossito, "Fluid Power with Applications", Prentice Hall, 20	13						

- 2. Bolton. W., "Pneumatic and Hydraulic Systems", Butterworth -Heinemann, 1997
- 3. Andrew Parr, "Hydraulic and Pneumatics" (HB), Jaico Publishing House, 2011.
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CO - PO MAPPING

	Mapping of Course Outcomes with Programme Outcomes:										
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak											
COs		Programme Outcomes(POs)									
005	PO1	PO2	PO3	PO4	PO5	PO6					
C01	3	2	2	-	3	1					
CO2	3	2	2	-	3	1					
CO3	3	2	2	-	3	1					
CO4	3	2	2	-	3	1					
CO5	3	2	2	-	3	1					



PED23	154	TRIBOLOGY IN DESIGN			3	0
COUR	SE OI	BJECTIVES				
To ena	ble the	e students to			-	-
1. im	part th	e knowledge in friction and surface measurement				
2. un	dersta	nd the basics of theories of wear and wear prevention				
3. lea	rn the	bearing material properties which influence the tribological ch	aracteristics o	f surfac	ces a	and
4. kn	ow abo	out the design of bearings and its types	100000000000000000000000000000000000000			
5. gai	in kno	wledge on the analytical behavior and design of bearings based	d on analytical	/theore	tical	l ap
UNIT I	[]]	FRICTION AND SURFACE MEASUREMENT				_
Friction stick-sli	i, theor	ries of friction, Friction control, Surface texture and measureme ion.	ent, genesis of	friction	n, ins	stal
UNIT I		WEAR				-
Wear, t	Vear, types of wear, theories of wear, wear prevention.					
UNIT I	II I	BEARING MATERIALS AND LUBRICANTS				
Tribolo	gical p	properties of bearing materials and lubricants.				_
Tribolo UNIT I	gical p	properties of bearing materials and lubricants. BEARINGS				
Tribolo UNIT I Lubrica	gical p V I tion, F	properties of bearing materials and lubricants. BEARINGS Reynolds's equation and its limitations, idealized bearings, in	finitely long p	plane p	oivot	ed
Tribolog UNIT I Lubrica show sl	gical p V I tion, F iders,	properties of bearing materials and lubricants. BEARINGS Reynolds's equation and its limitations, idealized bearings, in infinitely long and infinitely short (narrow) journal bearings,	nfinitely long p lightly loaded	plane p 1 infini	bivot itely	ed
Tribolog UNIT I Lubrica show sl bearing	gical p V J tion, F iders, (Petro	properties of bearing materials and lubricants. BEARINGS Reynolds's equation and its limitations, idealized bearings, in infinitely long and infinitely short (narrow) journal bearings, off's solution), Finite Bearings, Design of hydrodynamic journa	nfinitely long p lightly loaded al bearings.	plane p 1 infini	oivot	ed lo
Tribolo UNIT I Lubrica show sl bearing UNIT V	gical p V 1 tion, F iders, (Petro	properties of bearing materials and lubricants. BEARINGS Reynolds's equation and its limitations, idealized bearings, in infinitely long and infinitely short (narrow) journal bearings, off's solution), Finite Bearings, Design of hydrodynamic journa FHEORY OF HYDROSTATIC AND HYDRODYNAMIC	nfinitely long p lightly loaded al bearings. LUBRICATI	plane p 1 infini ON	bivot tely	ted lo
Tribolo UNIT I Lubrica show sl bearing UNIT V Hydrost	gical p V I tion, H iders, (Petro	properties of bearing materials and lubricants. BEARINGS Reynolds's equation and its limitations, idealized bearings, in infinitely long and infinitely short (narrow) journal bearings, off's solution), Finite Bearings, Design of hydrodynamic journa FHEORY OF HYDROSTATIC AND HYDRODYNAMIC	afinitely long p lightly loaded al bearings. LUBRICATIO ternating loads	plane p 1 infini ON , piston	bivot itely	lo lo
Tribolo UNIT I Lubrica show sl bearing UNIT V Hydrost applicat	gical p V I tion, F iders, (Petro V 7 tatic, so ion to	properties of bearing materials and lubricants. BEARINGS Reynolds's equation and its limitations, idealized bearings, in infinitely long and infinitely short (narrow) journal bearings, off's solution), Finite Bearings, Design of hydrodynamic journa FHEORY OF HYDROSTATIC AND HYDRODYNAMIC queeze film Circular and rectangular flat plates, variable and alt journal bearings. Elasto-hydrodynamic lubrication – pressure	afinitely long p lightly loaded al bearings. LUBRICATION ternating loads viscosity term	olane p l infini ON , piston in Rey	bivot itely n pin nold	ied lo lu ls's
Tribolo UNIT I Lubrica show sl bearing UNIT V Hydrost applicat Hertz' t	gical p V I tion, F iders, (Petro V 7 tatic, so ion to heory,	broperties of bearing materials and lubricants. BEARINGS Reynolds's equation and its limitations, idealized bearings, in infinitely long and infinitely short (narrow) journal bearings, off's solution), Finite Bearings, Design of hydrodynamic journa THEORY OF HYDROSTATIC AND HYDRODYNAMIC queeze film Circular and rectangular flat plates, variable and alt journal bearings. Elasto-hydrodynamic lubrication – pressure v lubrication of spheres, gear teeth, Air lubricated bearings.	nfinitely long p lightly loaded al bearings. LUBRICATION ternating loads viscosity term	olane p 1 infini ON , piston in Reyn	ivot itely n pin nold	ied lo lul
Tribolo UNIT I Lubrica show sl bearing UNIT V Hydrost applicat Hertz' t	gical p V I tion, F iders, (Petro V 7 tatic, so ion to heory,	broperties of bearing materials and lubricants. BEARINGS Reynolds's equation and its limitations, idealized bearings, in infinitely long and infinitely short (narrow) journal bearings, off's solution), Finite Bearings, Design of hydrodynamic journa THEORY OF HYDROSTATIC AND HYDRODYNAMIC queeze film Circular and rectangular flat plates, variable and alt journal bearings. Elasto-hydrodynamic lubrication – pressure v lubrication of spheres, gear teeth, Air lubricated bearings.	afinitely long p lightly loaded al bearings. LUBRICATION ternating loads viscosity term TOTAI	olane p 1 infini ON , piston in Reyn	ivot itely n pin nold	ied lo lul ls's S:
Tribolog UNIT I Lubrica show sl bearing UNIT V Hydrost applicat Hertz' th	gical p gical p tion, F iders, (Petro V 1 tatic, so ion to heory, SE OU	Dispersion of bearing materials and lubricants. BEARINGS Reynolds's equation and its limitations, idealized bearings, in infinitely long and infinitely short (narrow) journal bearings, off's solution), Finite Bearings, Design of hydrodynamic journal THEORY OF HYDROSTATIC AND HYDRODYNAMIC queeze film Circular and rectangular flat plates, variable and alt journal bearings. Elasto-hydrodynamic lubrication – pressure v lubrication of spheres, gear teeth, Air lubricated bearings. JTCOMES	afinitely long p lightly loaded al bearings. LUBRICATION ternating loads viscosity term TOTAI	olane p l infini ON , piston in Rey L PERI BT M	iivot itely n pin nold IOD	led lo lul ls's S: PE
Tribolo UNIT I Lubrica show sl bearing UNIT V Hydrost applicat Hertz' th COURS At the e	gical p gical p tion, F iders, (Petro / 7 tatic, so ion to heory, SE OU nd of t	broperties of bearing materials and lubricants. BEARINGS Reynolds's equation and its limitations, idealized bearings, in infinitely long and infinitely short (narrow) journal bearings, off's solution), Finite Bearings, Design of hydrodynamic journal FHEORY OF HYDROSTATIC AND HYDRODYNAMIC queeze film Circular and rectangular flat plates, variable and alt journal bearings. Elasto-hydrodynamic lubrication – pressure v lubrication of spheres, gear teeth, Air lubricated bearings. UTCOMES the course, the students will be able to	nfinitely long p lightly loaded al bearings. LUBRICATION ternating loads viscosity term TOTAL	plane p l infini ON , piston in Reyr L PERI BT M (High	ivot itely n pin nold IOD IAP est l	lo lu lu ls's S: PE
Tribolo UNIT I Lubrica show sl bearing UNIT V Hydrost applicat Hertz' th COURS At the e CO1	gical p gical p tion, F iders, (Petro 7 7 tatic, so ion to heory, SE OU nd of t unders	broperties of bearing materials and lubricants. BEARINGS Reynolds's equation and its limitations, idealized bearings, in infinitely long and infinitely short (narrow) journal bearings, off's solution), Finite Bearings, Design of hydrodynamic journa FHEORY OF HYDROSTATIC AND HYDRODYNAMIC queeze film Circular and rectangular flat plates, variable and alt journal bearings. Elasto-hydrodynamic lubrication – pressure lubrication of spheres, gear teeth, Air lubricated bearings. JTCOMES the course, the students will be able to stand theories of friction and surface measurement	afinitely long p lightly loaded al bearings. LUBRICATION ternating loads viscosity term TOTAI	plane p l infini ON , piston in Reyn L PERI BT M (High Under	ivot itely i pin nold IOD IAP est l	lo lo lul ls's S: PE Lev Idin
Tribolo UNIT I Lubrica show sl bearing UNIT V Hydrost applicat Hertz' t COURS At the e CO1 CO2	gical p gical p tion, F iders, (Petro / 7 tatic, so ion to heory, SE OU ad of t unders acquir	broperties of bearing materials and lubricants. BEARINGS Reynolds's equation and its limitations, idealized bearings, in infinitely long and infinitely short (narrow) journal bearings, off's solution), Finite Bearings, Design of hydrodynamic journal FHEORY OF HYDROSTATIC AND HYDRODYNAMIC queeze film Circular and rectangular flat plates, variable and alt journal bearings. Elasto-hydrodynamic lubrication – pressure lubrication of spheres, gear teeth, Air lubricated bearings. UTCOMES the course, the students will be able to stand theories of friction and surface measurement re knowledge on the theories of wear and prevention of wear	afinitely long p lightly loaded al bearings. LUBRICATION ternating loads viscosity term TOTAI	plane p l infini ON , piston in Rey PERI BT M (High Under Apply	ivot itely i pin nold IOD IAP est l rstar	Iced Io Iul Is's S: PE Lev Idin (K
Tribolo UNIT I Lubrica show sl bearing UNIT V Hydrost applicat Hertz' t COURS At the e CO1 CO2	gical p gical p tion, F iders, (Petro V 7 tatic, so ion to heory, SE OU nd of t unders acquir approp	Aroperties of bearing materials and lubricants. BEARINGS Reynolds's equation and its limitations, idealized bearings, in infinitely long and infinitely short (narrow) journal bearings, off's solution), Finite Bearings, Design of hydrodynamic journal FHEORY OF HYDROSTATIC AND HYDRODYNAMIC queeze film Circular and rectangular flat plates, variable and alt journal bearings. Elasto-hydrodynamic lubrication – pressure lubrication of spheres, gear teeth, Air lubricated bearings. JTCOMES the course, the students will be able to stand theories of friction and surface measurement re knowledge on the theories of wear and prevention of wear priately select materials and lubricants and suggest a tribological	al solution to	olane p l infini ON , piston in Reyn PERI BT M (High Under Apply	ivot itely n pin nold IOD IAP est l rstar	In I
Tribolog UNIT I Lubrica show sl bearing UNIT V Hydrost applicat Hertz' th COURS At the e CO1 CO2 CO3	gical p gical p tion, F iders, (Petro V 7 tatic, so ion to heory, SE OU nd of t unders acquir approp a parti	broperties of bearing materials and lubricants. BEARINGS Reynolds's equation and its limitations, idealized bearings, in infinitely long and infinitely short (narrow) journal bearings, off's solution), Finite Bearings, Design of hydrodynamic journal FHEORY OF HYDROSTATIC AND HYDRODYNAMIC queeze film Circular and rectangular flat plates, variable and alt journal bearings. Elasto-hydrodynamic lubrication – pressure v lubrication of spheres, gear teeth, Air lubricated bearings. JTCOMES the course, the students will be able to stand theories of friction and surface measurement re knowledge on the theories of wear and prevention of wear priately select materials and lubricants and suggest a tribological icular situation.	al solution to	olane p l infini ON , piston in Reyn L PERI BT M (High Under Apply Under	ivot itely n pin nold IOD IAP est I rstar	In I
Tribolog UNIT I Lubrica show sl bearing UNIT V Hydrost applicat Hertz' tl COURS At the e CO1 CO2 CO3 CO4	gical p gical p tion, F iders, (Petro V 7 tatic, so ion to heory, SE OU nd of t unders acquir approp a parti design	A properties of bearing materials and lubricants. BEARINGS Reynolds's equation and its limitations, idealized bearings, in infinitely long and infinitely short (narrow) journal bearings, off's solution), Finite Bearings, Design of hydrodynamic journal FHEORY OF HYDROSTATIC AND HYDRODYNAMIC queeze film Circular and rectangular flat plates, variable and alt journal bearings. Elasto-hydrodynamic lubrication – pressure v lubrication of spheres, gear teeth, Air lubricated bearings. JTCOMES the course, the students will be able to stand theories of friction and surface measurement re knowledge on the theories of wear and prevention of wear priately select materials and lubricants and suggest a tribologica cular situation. a bearing using various bearing charts.	al solution to	olane p l infini ON , piston in Reyn Apply Under Apply	ivot itely n pin nold IAP est l rstar ving	lo lo lo ls's PE Lev idin (K

- 2. John Williams, "Engineering Tribology", Cambridge University Press, 2006
- S.K.Basu, S.N.Sengupta & B.B.Ahuja ,"Fundamentals of Tribology", Prentice-Hall of India Pvt Ltd New Delhi., 2005
- 4. G.W.Stachowiak & A.W.Batchelor, Engineering Tribology, Butterworth Heinemann, UK, 2005

CO - PO MAPPING

	(1/2	Mapping of Co 2/3 indicates stren	ourse Outcomes wi gth of correlation	th Programme Out) 3-Strong, 2-Med	tcomes: lium , 1-Weak					
COs	Programme Outcomes(POs)									
003	PO1	PO2	PO3	PO4	PO5	PO6				
C01	3	3	3	3	1	1				
CO2	3	3	1	3	1	1				
CO3	3	3	1	3	1	1				
CO4	3	3	1	3	1	1				
C05	3	3	3	3	1	1				



PED23155 ADVANCED MECHANISMS IN DESIGN 3 0 0 3 COURSE OBJECTIVES To enable the students to learn the concepts of gross motion capability and develop multi loop kinematic chains and equivalent 1 mechanisms 2. study complex mechanisms to determine velocity and acceleration of output links. 3. locate inflection points and to draw the inflection circle 4. gain knowledge on the synthesis of planar mechanisms 5. comprehend design of six bar coupler driven mechanisms and cam mechanisms UNIT I **INTRODUCTION** 9 Review of fundamentals of kinematics-classifications of mechanisms-components of mechanisms - mobility analysis - formation of one D.O.F. multi loop kinematic chains, Network formula - Gross motion concepts-Basic kinematic structures of serial and parallel robot manipulators-Compliant mechanisms - Equivalent mechanisms. **UNIT II** KINEMATIC ANALYSIS 9 Position Analysis - Vector loop equations for four bar, slider crank, inverted slider crank, geared five bar and six bar linkages. Analytical methods for velocity and acceleration Analysis- four bar linkage jerk analysis. Plane complex mechanisms-auxiliary point method. Spatial RSSR mechanism-Denavit-Hartenberg Parameters - Forward and inverse kinematics of robot manipulators. PATH CURVATURE THEORY, COUPLER CURVE UNIT III 9 Fixed and moving centrodes, inflection points and inflection circle. Euler Savary equation, graphical constructions - cubic of stationary curvature. Four bar coupler curve-cusp -crunode - coupler driven six-bar mechanisms-straight line mechanisms. **UNIT IV** SYNTHESIS OF FOUR BAR MECHANISMS 9 Type synthesis - Number synthesis - Associated Linkage Concept. Dimensional synthesis - function generation, path generation, motion generation. Graphical methods-Pole technique inversion technique-point position reduction-two, three and four position synthesis of four- bar mechanisms. Analytical methods- Freudenstein's Equation-Bloch's Synthesis. SYNTHESIS OF COUPLER CURVE BASED MECHANISMS & CAM UNIT V 9 **MECHANISMS** Hydrostatic, squeeze film Circular and rectangular flat plates, variable and alternating loads, piston pin lubrications, application to journal bearings. Elasto-hydrodynamic lubrication - pressure viscosity term in Reynolds's equation, Hertz' theory, lubrication of spheres, gear teeth, Air lubricated bearings. TOTAL PERIODS: 45 **COURSE OUTCOMES BT MAPPED** At the end of the course, the students will be able to (Highest Level)

CO1	apply concepts of gross motion capability and develop multi loop kinematic chains and equivalent mechanisms	Applying (K3)
CO2	determine velocity and acceleration of complex mechanisms	Applying (K3)
CO3	evaluate inflection points and draw the inflection circle	Understanding (K2)
CO4	synthesis four bar mechanisms	Understanding (K2)
CO5	design of six bar coupler driven mechanisms and cam mechanisms	Applying (K3)

REFERENCES

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CO - PO MAPPING

		Mapping of Co	ourse Outcomes wi	th Programme Ou	tcomes:					
	(1/2	/3 indicates streng	gth of correlation) 3-Strong, 2-Mee	lium , 1-Weak					
COs	Programme Outcomes(POs)									
	PO1	PO2	PO3	PO4	PO5	PO6				
C01	3	3	3	2	2	1				
CO2	3	2	3	2	2	1				
CO3	3	2	3	2	2	2				
CO4	3	3	3	2	2	2				
CO5	3	3	3	2	2	1				

onro RD OF STUDIES ROA nical Engineering

CO	PED23156PRODUCT LIFECYCLE MANAGEMENT300											
COURSE OBJECTIVES												
То	enable t	he students to		tern all	1							
1.	study h	istory, concepts and terminology of PLM	for the local state	P.L.s.								
2.	learn fi	inctions and features of PLM/PDM		n helende	66							
3.	underst	and different modules offered in commercial PLM/PDM tools	Saladi A. Millow	(and the second								
4.	demons	strate PLM/PDM approaches for industrial applications			in the							
5. use PLM/PDM with legacy data bases, CAx & ERP systems												
UNIT I HISTORY, CONCEPTS AND TERMINOLOGY OF PLM												
Intro	oduction	to PLM, Need for PLM, opportunities of PLM, Differen	t views of PLI	M – Eng	inee	ring	Data					
Mar	nagemen	t (EDM), Product Data Management (PDM), Collaborative Pr	oduct Definition	n Manager	men	t (cP	Dm),					
Coll	laborativ	e Product Commerce (CPC), Product Lifecycle Manageme	nt (PLM).PLM	/PDM In	fras	tructu	ire –					
Net	work and	Communications, Data Management, Heterogeneous data sou	rces and applica	ations.								
UNI	TI	PLM/PDM FUNCTIONS AND FEATURES		1			10					
Use	r Functio	ons – Data Vault and Document Management, Workflow and F	rocess Manager	ment, Pro	duct	Stru	cture					
Man	agemen	t, Product Classification and Programme Management. Uti	lity Functions -	– Commi	inic	ation	and					
Noti	fication,	data transport, data translation, image services, system admini	stration and app	lication in	nteg	ratio	1.					
UNI	TIII	DETAILS OF MODULES IN APDM/PLM SOFTWARE					5					
Case	e studies	based on top few commercial PLM/PDM tools.		Case studies based on top few commercial PLM/PDM tools								
UNI	UNIT IV BOLE OF PLM IN INDUSTRIES											
UNIT IV ROLE OF PLM IN INDUSTRIES 12												
Case	T IV e studies	ROLE OF PLM IN INDUSTRIES on PLM selection and implementation (like auto, aero, election	etronic) - other	possible	sect	ors, 1	12 PLM					
Case visio	T IV studies	ROLE OF PLM IN INDUSTRIES on PLM selection and implementation (like auto, aero, elec LM strategy, PLM feasibility study, change management for	etronic) - other PLM, financial	possible l justificat	sect	ors, 1 of P	12 PLM LM,					
Case visic barri	T IV e studies oning, Pl iers to P	ROLE OF PLM IN INDUSTRIES on PLM selection and implementation (like auto, aero, elec LM strategy, PLM feasibility study, change management for LM implementation, ten step approach to PLM, benefits of F	etronic) - other PLM, financial PLM for-busine	possible l justificat ss, organi	sect tion zati	ors, 1 of P on, u	12 PLM LM, sers,					
Case visic barri prod	T IV e studies oning, Pl ers to P uct or se	ROLE OF PLM IN INDUSTRIES on PLM selection and implementation (like auto, aero, elec LM strategy, PLM feasibility study, change management for LM implementation, ten step approach to PLM, benefits of F ervice, process performance.	etronic) - other PLM, financial LM for-busine	possible l justificat ss, organi	sect tion zati	ors, 1 of P on, u	12 PLM LM, sers,					
Case visic barri prod UNI	T IV e studies oning, Pl ers to P uct or se T V	ROLE OF PLM IN INDUSTRIES on PLM selection and implementation (like auto, aero, elec LM strategy, PLM feasibility study, change management for LM implementation, ten step approach to PLM, benefits of F prvice, process performance. BASICS ON CUSTOMISATION/INTEGRATION OF PD	etronic) - other PLM, financial PLM for-busine M/PLM SOFT	possible l justificat ss, organi WARE	sect tion zati	ors, d of P on, u	12 PLM LM, sers, 6					
Case visic barri prod UNI PLM	T IV e studies oning, Pl iers to P uct or se T V	ROLE OF PLM IN INDUSTRIES on PLM selection and implementation (like auto, aero, elec LM strategy, PLM feasibility study, change management for LM implementation, ten step approach to PLM, benefits of F ervice, process performance. BASICS ON CUSTOMISATION/INTEGRATION OF PD nization, use of EAI technology (Middleware), Integration with	etronic) - other PLM, financial LM for-busine M/PLM SOFT legacy data base	possible l justificat ss, organi WARE e, CAD, Sl	sect tion zati	ors, 1 of P on, u and I	12 PLM LM, sers, 6 ERP.					
Case visic barri prod UNI PLM	T IV e studies oning, Pl iers to P uct or se T V	ROLE OF PLM IN INDUSTRIES on PLM selection and implementation (like auto, aero, elec LM strategy, PLM feasibility study, change management for LM implementation, ten step approach to PLM, benefits of F ervice, process performance. BASICS ON CUSTOMISATION/INTEGRATION OF PD hization, use of EAI technology (Middleware), Integration with	etronic) - other PLM, financial LM for-busine M/PLM SOFT legacy data base TOTAL	possible l justificat ss, organi WARE e, CAD, SI PERIOD	sect tion zati	ors, 1 of P on, u and I	12 PLM LM, sers, 6 ERP.					
Case visic barri prod UNI PLM	T IV e studies oning, Pl iers to P uct or se T V I Custom	ROLE OF PLM IN INDUSTRIES on PLM selection and implementation (like auto, aero, elec LM strategy, PLM feasibility study, change management for LM implementation, ten step approach to PLM, benefits of F ervice, process performance. BASICS ON CUSTOMISATION/INTEGRATION OF PD nization, use of EAI technology (Middleware), Integration with UTCOMES	etronic) - other PLM, financial LM for-busine M/PLM SOFT legacy data base TOTAL	possible l justificat ss, organi WARE c, CAD, SI PERIOD BT MAP	sect tion zati LM PS: PE	ors, 1 of P on, u and I 4 D	12 PLM LM, sers, 6 ERP. 5					
Case visic barri prod UNI PLM COU	T IV e studies oning, Pl ers to P uct or se T V I Custom URSE O ue end of	ROLE OF PLM IN INDUSTRIES on PLM selection and implementation (like auto, aero, elec LM strategy, PLM feasibility study, change management for LM implementation, ten step approach to PLM, benefits of F ervice, process performance. BASICS ON CUSTOMISATION/INTEGRATION OF PD nization, use of EAI technology (Middleware), Integration with UTCOMES The course, the students will be able to	etronic) - other PLM, financial LM for-busine M/PLM SOFT legacy data base TOTAL	possible l justificat ss, organi WARE c, CAD, SI PERIOD BT MAP (Highest	sect tion zati LM S: PE Lev	ors, 1 of P on, u and I 4 D el)	12 PLM LM, sers, 6 ERP. 5					
Case visic barri prod UNI PLM COI	T IV e studies oning, Pl ers to P uct or se T V I Custom JRSE O ue end of summ	ROLE OF PLM IN INDUSTRIES on PLM selection and implementation (like auto, aero, elec LM strategy, PLM feasibility study, change management for LM implementation, ten step approach to PLM, benefits of F ervice, process performance. BASICS ON CUSTOMISATION/INTEGRATION OF PD nization, use of EAI technology (Middleware), Integration with UTCOMES The course, the students will be able to marize the history, concepts and terminology of PLM	etronic) - other PLM, financial LM for-busine M/PLM SOFT legacy data base TOTAL	possible l justificat ss, organi WARE c, CAD, SJ PERIOD BT MAP (Highest J Understar	sect tion zati LM DS: PE Leven	ors, 1 of P on, u and I 4 D el) g (K:	12 PLM LM, sers, 6 ERP. 5					
Case visic barri prod UNI PLM COI At th CO1 CO2	T IV e studies oning, Pl ers to P uct or se T V I Custom URSE O ue end of summ use th	ROLE OF PLM IN INDUSTRIES on PLM selection and implementation (like auto, aero, elec LM strategy, PLM feasibility study, change management for LM implementation, ten step approach to PLM, benefits of F prvice, process performance. BASICS ON CUSTOMISATION/INTEGRATION OF PD hization, use of EAI technology (Middleware), Integration with UTCOMES The course, the students will be able to narize the history, concepts and terminology of PLM he functions and features of PLM/PDM	etronic) - other PLM, financial LM for-busine M/PLM SOFT legacy data base TOTAL	possible l justificat ss, organi WARE c, CAD, SJ PERIOD BT MAP (Highest Understat Applying	sect tion zati LM PE Levendin (K3	ors, 1 of P on, u and I 4 D el) g (K2 3)	12 PLM LM, sers, 6 ERP. 5					
Case visic barri prod UNI PLM COI At th CO1 CO2 CO3	T IV e studies oning, P ers to P uct or se T V I Custon URSE O e end of summ use tl apply	ROLE OF PLM IN INDUSTRIES on PLM selection and implementation (like auto, aero, elec LM strategy, PLM feasibility study, change management for LM implementation, ten step approach to PLM, benefits of F prvice, process performance. BASICS ON CUSTOMISATION/INTEGRATION OF PD hization, use of EAI technology (Middleware), Integration with UTCOMES The course, the students will be able to marize the history, concepts and terminology of PLM he functions and features of PLM/PDM y different modules offered in commercial PLM/PDM tools	etronic) - other PLM, financial LM for–busine M/PLM SOFT legacy data base TOTAL	possible l justificat ss, organi WARE b, CAD, Sl PERIOD BT MAP (Highest Understat Applying Applying	sect tion zati LM DS: PE Levendin (K3	ors, 1 of P on, u and I el) g (K: 3)	12 PLM LM, sers, 6 ERP. 5					
Case visic barri prod UNI PLM COI At th CO1 CO2 CO3 CO4	T IV e studies oning, P) fers to P uct or se T V I Custon URSE O te end of sumr use th apply imple	ROLE OF PLM IN INDUSTRIES on PLM selection and implementation (like auto, aero, elec LM strategy, PLM feasibility study, change management for LM implementation, ten step approach to PLM, benefits of F ervice, process performance. BASICS ON CUSTOMISATION/INTEGRATION OF PD nization, use of EAI technology (Middleware), Integration with UTCOMES The course, the students will be able to narize the history, concepts and terminology of PLM ne functions and features of PLM/PDM different modules offered in commercial PLM/PDM tools ement PLM/PDM approaches for industrial applications	etronic) - other PLM, financial LM for–busine M/PLM SOFT legacy data base TOTAL	possible l justificat ss, organi WARE c, CAD, SI PERIOD BT MAP (Highest Understat Applying Understat	sect tion zati LM S: PE Levendin (K3 (K3 (K3)	ors, 1 of P on, u and I el) g (K: 3) g (K:	12 PLM LM, sers, 6 ERP. 5 2)					

REF	ERENCES					Ξ.				
1.	1. Michael Grieves, "Product Life Cycle Management", Tata McGraw Hill, 2006.									
2.	2. Antti Saaksvuori and Anselmi Immonen, "Product Lifecycle Management", Springer Publisher, 2008									
3.	. John Stark, "Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question",									
	Springer Publisher, 2007									
4.	Ivica Crnkovic, Ul	f Asklund and A	nnita Persson Dah	ılqvist, "Implemer	ting and Integrati	ng Product Data				
	Management and S	oftware Configura	ation Management	", Artech House P	ublishers, 2003.					
CO-	PO MAPPING									
		Mapping of Co	ourse Outcomes wi	th Programme Ou	tcomes:					
	(1/2/	3 indicates stren	gth of correlation) 3-Strong, 2-Mee	lium , 1-Weak					
COs			Programme C	Outcomes(POs)						
	PO1	PO2	PO3	PO4	PO5	PO6				
C01	3	3	1	3	3	2				
CO2	3	3	1	3	3	2				
CO3	3	3	1	3	3	2				
CO4	3	3	1	3	3	2				
COS	3	3	1	3	3	2				

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COURSE OBJECTIVES

To enable the students to

1. learn the basics of surface features and different types of friction in metals and nonmetals.

2. analyze the different types of wear mechanism and international standard used in friction and wear measurement

3. understand the different types of corrosion and its preventive measures.

4. study the different types of surface treatments and surface modification techniques.

5. comprehend different types of materials used in the friction and wear applications

UNIT I FRICTION

Topography of Surfaces– Surface features – Properties and measurement– Surface interaction - Adhesive Theory of Sliding Friction–Rolling Friction- Friction properties of metallic and nonmetallic materials–Friction in extreme conditions – Thermal considerations in sliding contact.

UNIT II WEAR

Introduction – Abrasive wear, Erosive, Cavitation, Adhesion, Fatigue wear and Fretting Wear Laws of wear – Theoretical wear models – Wear of metals and non-metals – International standards in friction and wear measurement methods.

UNIT III CORROSION

Introduction – Principle of corrosion – Classification of corrosion – Types of corrosion – Factors influencing corrosion–Testing of corrosion–In-service monitoring, Simulated service, Laboratory testing – Evaluation of corrosion – Prevention of Corrosion – Material selection, Alteration of environment, Design, Cathodic and Anodic Protection, Corrosion inhibitors – Corrosion methods.

UNIT IV SURFACE TREATMENTS

Introduction–Surface properties, Superficial layer–Changing surface metallurgy–Wear resistant coatings and Surface treatments – Techniques – PVD – CVD – Physical CVD – Ion implantation – Surface welding – Thermal spraying – Laser surface hardening and alloying, laser re-melting, and laser cladding. Applications of coatings and surface treatments in wear and friction control – Characteristics of Wear resistant coatings – New trends in coating technology –DLC – CNC – Thick coatings – Nano-engineered coatings – Other coatings, Corrosion resistant coating.

UNIT V ENGINEERING MATERIALS

Introduction-Advanced alloys-Super alloys, Titanium alloys, Magnesium alloys, Aluminium alloys, and Nickel based alloys-Ceramics-Polymers-Biomaterials-Applications-Bio Tribology NanoTribology - Surface texturing, cold spray, short peening, Electroplating.

TOTAL PERIODS: 45

COUF	RSE OUTCOMES		· · · · · · · · · · · · · · · · · · ·		BT	AAPPED
At the	end of the course,	(Hig	hest Level)			
CO1	understand the ba	t types of Unde	erstanding (K2)			
CO2	develop the know	ledge of various w	vear mechanism a	nd its measuremen	t Appl	ying (K3)
CO3	gain knowledge o	on the types of corr	osion and its pre-	ventive measures	Unde	erstanding (K2)
CO4	familiarize the t techniques	ypes of surface p	properties and va	arious surface mo	dification Appl	ying (K3)
CO5	analyze the differ	ent types of materi	als used in the fr	iction and wear app	olications Anal	yzing (K4)
REFE	RENCES					
1. (G.W.Stachowiak &	A.W.Batchelor,"E	Engineering Tribo	ology", Butterworth	-Heinemann, Uk	K, 2005
2. I	Rabinowicz.E,"Fric	tion and Wear of r	naterials",JohnW	illey&Sons,UK,19	95	
3. 1	Williams.J.A. "Eng	ineering Tribology	", OxfordUniv.P	ress,1994		
4. 5	S.K.Basu, S.N.Seng	gupta & B.B.Ahuja	,"Fundamentals	of Tribology", Pre	ntice –Hall of In	dia Pvt. Ltd, New
I	Delhi,2005.					
CO - 1	PO MAPPING					
		Mapping of Cou	irse Outcomes w	th Programme Out	comes:	
	(1/2/	3 indicates streng	th of correlation) 3-Strong, 2-Med	ium , 1-Weak	
COs			Programme (Outcomes(POs)		
	PO1	PO2	PO3	PO4	PO5	PO6
C01	3	1	1	1	1	2
CO2	3	1	1	1	1	2
CO3	3	1	1	1	1	2
CO4	3	1	1	1	1	2
C05	3	1	1	1	1	2

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OPTIMIZATION TECHNIQUES IN DESIGN

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COURSE OBJECTIVES

To enable the students to

1. study the basic concepts of unconstrained optimization techniques.

2. understand the basic concepts of constrained optimization techniques.

3. provide the mathematical foundation of artificial neural networks and swarm intelligence for design problems.

4. implement optimization approaches and to select appropriates solution for design application.

5. demonstrate selected optimization algorithms commonly used in static and dynamic applications.

UNIT I UNCONSTRAINED OPTIMIZATION TECHNIQUES

Introduction to optimum design - General principles of optimization – Problem formulation & their classifications-Single variable and multivariable optimization, Techniques of unconstrained minimization – Golden section, Random, pattern and gradient search methods – Interpolation methods.

UNIT II CONSTRAINED OPTIMIZATION TECHNIQUES

Optimization with equality and inequality constraints-Direct methods-Indirect methods using penalty functions, Lagrange multipliers-Geometric programming.

UNIT III ARTIFICIAL NEURAL NETWORKS AND SWARM INTELLIGENCE

Introduction–Activation functions, types of activation functions, neural network architectures, Single layer feed forward network, multi layer feed forward network, Neural network applications. Swarm intelligence-Various animal behaviors, Ant Colony optimization, Particle Swarm optimization.

UNIT IV ADVANCED OPTIMIZATION TECHNIQUES

Multistage optimization-dynamic programming, stochastic programming Multi objective optimization Genetic algorithms and Simulated Annealing technique - Fuzzy logic.

UNIT V STATIC AND DYNAMIC APPLICATIONS

Structural applications – Design of simple truss members – Design of simple axial, transverse loaded members for minimum cost, weight – Design of shafts and torsionally loaded members –Design of springs. Dynamic Applications – Optimum design of single, two degree of freedom systems, vibration absorbers. Application in Mechanisms– Optimum design of simple linkage mechanisms.

		ΤΟΤΑΙ	PERIODS:	45	
COUR	RSE OUTCOMES		BT MAPPE	D	
At the	end of the course, the students will be able to		(Highest Leve	el)	
CO1	summarize unconstrained optimization techniques in engine application.	ering design	Understandin	g (K2)	
CO2	formulate constrained optimization techniques for various application	ons.	Applying (K3)		
CO3	implement neural network technique to real world design problems.		Understanding (K2)		
CO4	apply genetic algorithms to combinatorial optimization problems.		Applying (K3)		

CO5	evaluate solution	evaluate solutions by various optimization approaches for a design problem. Applying (K3)							
REFERENCES									
1. J	1. Jang, J. S.R, Sun, C. T and Mizutani E., "Neuro-Fuzzy and Soft Computing", Pearson Education.2015,								
2. J	2. JohnsonRay, C., "Optimumdesignofmechanicalelements", Wiley, 2nd Edition 1980.								
3. F	KalyanmoyDeb,"O	ptimizationforEng	ineeringDesign:A	lgorithmsandExan	nples",PHI L	earning Private			
I	Limited, 2 nd Edition	n, 2012.							
4. F	Rao Singiresu S., "	Engineering Optin	nization – Theory	and Practice", Ne	w Age Internati	onal Limited, New			
I	Delhi, 3 rd Edition, 2	2013.							
CO - 1	PO MAPPING								
		Mapping of Co	urse Outcomes wi	th Programme Out	comes:				
	(1/2/	'3 indicates streng	gth of correlation) 3-Strong, 2-Med	lium , 1-Weak				
COs			Programme O	outcomes(POs)		<u></u>			
	PO1	PO2	PO3	PO4	PO5	PO6			
C01	3	3	2	3	3	1			
CO2	3	3	2	3	3	1			
CO3	3	3	2	3	3	1			
CO4	3	3	2	3	3	1			
CO5	3	3	2	3	3	1			



COUD		MECHANICAL MEASUREMENTS AND AT	VALY SIS	3	0 0	
COUR	SE OB	JECTIVES				
To ena	ble the s	students to				
1. un	derstand	d the principle of force and strain measurement.		- 2-31		
2. co	mprehe	nd the vibration measurement and their applications.				
3. ga	in know	ledge on the principle behind acoustics and wind flow measured	urements.			
4. fai	niliarize	e with the distress measurements				
5. rea	lize the	non-destructive testing principle and application				
UNIT I	F	ORCES AND STRAIN MEASUREMENT				
Strain g	gauge, p	rinciple, types, performance and uses. Photo elasticity-Prin	nciple and appl	ications -M	loire	
Hydrau	lic jacks	s and pressure gauges-Electronic load cells-Proving Rings-(Calibration of T	esting Mac	hines	
UNIT I	NIT II VIBRATION MEASUREMENTS					
Charact	eristics	of Structural Vibrations-Linear Variable Differential Tr	ansformer (LV	DT)– Trai	nsduc	
velocity	and ac	cceleration measurements. Vibration meter- Seismographs	- Vibration A	nalyzer –	Displ	
recordin	ng of sig	anals - Cathode Ray Oscilloscope - XY Plotter - Chart Plott	ers–Digital data	a Acquisitio	on sys	
UNIT I	II A	COUSTICS AND WIND FLOW MEASUREMENTS				
Principl	es of P	ressure and flow measurements-pressure transducers-soun	d level meter-	venturimet	ter an	
meters-	wind tu	nnel and its use in structural analysis-structural modeling -d	irect and indire	ect model an	nalysi	
UNIT I	V DI	STRESS MEASUREMENTS				
Diagnos	is of di	stress in structures-crack observation and measurements-co	rrosion of reint	forcement i	n con	
Half-cel	l, consti	ruction and use – damage assessment – controlled blasting for	or demolition.			
UNIT V	/ NO	ON DESTRUCTIVE TESTING METHODS				
Load tes	sting on	structures, buildings, bridges and towers-Rebound Hammer	-acoustice mis	sion –ultras	sonic	
principle	es and a	pplication-Holography-use of laser for structural testing-Br	ittle coating.			
			TOTAL	PERIODS	5:	
COURS	SE OUT	COMES		BT MAPP	'ED	
At the e	nd of the	e course, the students will be able to		(Highest L	evel)	
CO1	01 calculate physical quantities such as forces and strains.				ding (
CO2	evaluate different vibration measurements techniques.				Applying (K3)	
CO3 1	measure physical quantities such as pressure and flow.			Understanding (K)		
CO4 1	utilize techniques involved in crack measurement.				K3)	
CO5 s	select th	ae appropriate nondestructive testing methods for various	engineering	Applying (K3)	
1	applicati	ions.	2 0	11 5 80		
					-	

2. Garas, F.K., Clarke, J.LandArmerGST, "Structural assessment", Butterworths, London, 1987

3. James W. Dally and William Franklin Riley, "Experimental Stress Analysis", McGraw Hill, 3rd Edition, 1991

4. Sadhu Singh, Experimental Stress Analysis, Khanna Publishers, New Delhi, 2009.

CO - PO MAPPING

Mapping of Course Outcomes with Programme Outcomes:

(1/2/3 indicates	strength of correlation) 3-Strong, 2-Medium , 1-Weak
	Programme Outcomes(POs)

COs	Programme Outcomes(105)							
	PO1	PO2	PO3	PO4	PO5	PO6		
C01	3	3	2	1	3	1		
CO2	3	3	2	-	3	1		
CO3	3	3	2	-	3	-		
CO4	3	3	2	1	3	-		
C05	3	3	2	1	3	1		



PED23160

COURSE OBJECTIVES

To enable the students to

1. learn relevant process; apply the general design principles for manufacturability; GD&T

2. study design considerations while designing the formed and machined components

3. gain knowledge on design considerations for assembled systems.

4. get exposure in maintenance systems and reliability based design

5. apply design considerations for environmental issues

UNIT I INTRODUCTION

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric tolerances - Assembly limits - Datum features - Tolerance stacks.-factors influencing form design- working principle, Material, Manufacture, Design- Possible solutions - Materials choice –Influence of materials on form design - form design of welded members, forgings and castings.

UNIT II COMPONENT DESIGN - MACHINING CONSIDERATION

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clampability – Design for accessibility.

UNIT III DESIGN FOR ASSEMBLY

Design for assembly – General assembly recommendations – Minimizing the no. of parts – Design considerations for: Rivets – Screw fasteners – Gasket & Seals – Press fits – Snap fits – Design for assembly – Product design for manual assembly - Product design for automatic assembly – Robotic assembly-Automatic assembly – Computer Application for DFMA -Case studies.

UNIT IV DESIGN FOR RELIABILITY AND MAINTAINABILITY

Reliability design process, system effectiveness, economic analysis and life cycle cost, reliability allocation, design methods, parts and material selection, derating, stress-strength and analysis, failure analysis, identification determination of causes, assessments of effects, computation of criticality index, corrective action, system safety – analysis of down-time – the repair time distribution, stochastic point processes system repair time, reliability under preventive maintenance state dependent system with repair. MTTR – mean system down time, repair vs replacement, replacement models, proactive, preventive, predictive maintenance maintainability and availability, optimization techniques for system reliability with redundancy heuristic methods applied to optimal system reliability.

UNIT V SUSTAINABLE DESIGN

Industrial ecology, multiple life cycle design, principles of design, green engineering, cradle to cradle design, The Natural Step, biomimicry, design for reuse, dematerialization, modularization, Design to minimize material usage

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- Design for disassembly - Design for recyclability - design for flexibility, design for disassembly, design for inverse manufacturing, design for the environment, - Design for energy efficiency - Design to regulations and standards etc.

		PERIODS:	45					
COUR	RSE OUTCOMES		BT MAPPED					
At the	end of the course, the students will be able to		(Highest Level)					
CO1	select relevant process; apply the general design principles for man GD&T	Understanding (K2)						
CO2	apply design considerations while designing the formed an components	Applying (K3)						
CO3	utilize design considerations for assembled systems.	Understanding (K2)						
CO4	be exposed to maintenance systems and reliability based design		Applying (K3)					
CO5	apply design considerations for environmental issues		Applying (K3)					
REFE	RENCES							
1. I	Boothroyd, G, 2006 Design for Assembly Automation and Product D	esign. New Yo	rk, Marcel Dek	ker.				
2. I	Bralla, Design for Manufacture handbook, McGraw hill, 2010.							
3. I	Dickson, John. R, and Corroda Poly, Engineering Design and D	esign for Man	ufacture and	Structural				
	Approach, Field Stone Publisher, USA, 2006.							

"Maintenance Engineering and Management": K.Venkataraman-PHI Learning - 2007 2. David J. Smith,
 "Reliability and Maintainability in Perspective", McMillan, 2nd Edition, 2002.

CO - PO MAPPING

Mapping of Course Outcomes with Programme Outcomes:

	(1/2	/3 indicates streng	gth of correlation) 3-Strong, 2-Mee	lium , 1-Weak						
60		Programme Outcomes(POs)									
CUS	PO1	PO2	PO3	PO4	PO5	PO6					
C01	3	3	2	1	3	1					
CO2	3	3	2	-	3	1					
CO3	3	3	2	-	3	endue et					
CO4	3	3	2	1	3	N. T. ST.					
C05	3	3	2	1	3	1					



PED	23161	VEHICLE DYNAMICS		3	3 0	0	3
COL	JRSE C	DBJECTIVES					
To e	nable th	he students to			-		
1.	develop	mathematical model of a system			-		
2.	gain kn	owledge on vehicular vibrations and response of vehicle					
3.	learn at	tire model based on required performance.					1
4.	study va	arious vehicle performance, control methodologies to ensure s	tability and rid	e comfort			
5.	comprel	hend the principles vertical, longitudinal and lateral dynamics	vehicle design				
UNI	ГІ	BASIS OF VIBRATION				1	9
Defir	nitions,	Modeling and Simulation, Global and Vehicle Coordinate	System, Free,	Forced, I	Undar	mped	and
Dam	ped Vi	bration, Response Analysis of Single DOF, Two DOI	F, Multi DOF	, Magnif	icatio	on fac	ctor,
Trans	smissibi	lity, Vibration absorber, Vibration measuring instruments, To	rsional vibratio	on, Critical	spee	d	
UNIT	ГП	TYRES			-		9
Tyre	forces a	and moments, Tyre structure, Longitudinal and Lateral force	at various lip a	ingles, rol	ling r	esista	nce.
Tract	ive and	cornering property of tyre. Performance of tyre on wet surface	. Ride property	of tyres. N	Aagic	form	ulae
tyre n	nodel, E	estimation of tyre road friction. Teston Various road surfaces.	Tyre vibration.		ngio	Torm	ulae
UNIT	III	VERTICAL DYNAMICS			-		9
Huma	in respo	nse to vibration, Sources of Vibration. Design, analysis and	computer simu	lation of	Passi	ve Se	mi
active	and A	ctive suspension using Quarter car, half car and full car me	odel Influence	of susper	sion	etiffn	
suspe	nsion da	amping, and tyre stiffness. Control law for LOR. H Infinite SI	whook dampin	of Susper	onsic	stilling	tom
and th	neir prop	perties.	ij nook damping	g. An susp	CHSIC	ni sys	tem
UNIT		LONGITUDINAL DYNAMICS AND CONTROL				_	
Aerod	lynamic	forces and moments Equation of motion. Two forces calling		1 1			9
wheel	er and f	our wheeler Calculation of Maximum accolonation D	g resistance, Lo	bad distrib	ution	for th	ree
Drivir	or and r	e. Prediction of Wakiela performance ADC 1111	forces for Diffe	erent drive	s. Bra	king a	and
		A TED AL DIVISION	Traction contro	ol. Case St	udies.		
		LATERAL DYNAMICS					9
Steady	y state h	andling characteristics. Steady state response to steering inp	ut. Testing of l	handling c	harac	teristi	ics.
Transi	ent resp	ponse characteristics, Direction control of vehicles. Rollcente	er, Rollaxis, Ve	hicle und	er sid	e forc	es.
Stabili	ity of ve	hicle on banked road and during turn. Effect of suspension or	n cornering.				
			TOTAI	PERIO	DS:	45	;
COUI	RSE OU	JTCOMES		BT MAI	PED)	
At the	end of	the course, the students will be able to		(Highest	Leve	1)	
201	unders equipt	stand the basics of finding vibration in vehicle components a nent	nd measuring	Understa	nding	g (K2)	,
02	D2 develop the knowledge of various tyres model and their parameters				Applying (K3)		

CO3	design analysis and computer simulation of vertical dynamics in vehicles. Understanding (K2)								
CO4	acquire knowledg	mics and Apply	ving (K3)						
CO5	summarize the co	Apply	ving (K3)						
REFE	RENCES								
1.]	homas D. Gillespi	e, "Fundamentals	of Vehicle Dynam	nics", Society of A	utomotive Engine	ers Inc, 1992			
2. I	Ians B Pacejka, "T	ire and Vehicle D	ynamics", 2nd edi	tion, SAE Internat	ional, 2005				
3. I	Rajesh Rajamani, "	Vehicle Dynamic	s and Control", 1st	edition, Springer,	2005				
4. 1	Wong. J. Y., "Theo	ry of Ground Veh	icles", 3rd Edition	, Wiley-Interscien	ce, 2001				
CO -]	PO MAPPING			a na angarta	an an an an an				
		Mapping of Co	ourse Outcomes wi	th Programme Out	tcomes:				
	(1/2/	3 indicates stren	gth of correlation) 3-Strong, 2-Med	lium , 1-Weak				
CO 2			Programme C	utcomes(POs)					
COS	PO1	PO2	PO3	PO4	PO5	PO6			
C01	3	3	2	1	3	1			
CO2	3	3	2	-	3	1			
CO3	3	3	2	-	3	-			
CO4	3	3	2	1	3	-			
C05	3	3	2	1	3	1			



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COURSE OBJECTIVES

To enable the students to

acquaint the students with evolution of Solid Freeform Manufacturing (SFM) / Additive Manufacturing (AM), 1. proliferation into various fields and its effects on supply chain.

2. design for Additive Manufacturing (DFAM) and its importance in quality improvement of fabricated parts.

3. gain knowledge on polymerization and sheet lamination processes and their applications.

4. get expose with material extrusion and powder bed fusion processes.

5. learn jetting and direct energy deposition processes and their applications.

UNIT I INTRODUCTION

Need - Development of SFM systems - Hierarchical structure of SFM - SFM process chain - Classification -Applications. Case studies: Bio printing- Food Printing- Electronics printing - Rapid Tooling - Building printing. AM Supply chain. Economics aspect: Strategic aspect- Operative aspect.

UNIT II DESIGN FOR ADDITIVE MANUFACTURING

Concepts and Objectives - AM Unique Capabilities - Part Consolidation - Topology Optimization - Lightweight Structures - DFAM for Part Quality Improvement - CAD Modeling - Model Reconstruction - Data Processing for AM - Data Formats - Data Interfacing - Part Orientation - Support Structure Design and Support Structure Generation - Model Slicing - Tool Path Generation. Design Requirements of Additive Manufacturing: For Part Production, For Mass Production, For Series Production. Case Studies.

VAT POLYMERIZATION AND SHEET LAMINATION PROCESSES **UNIT III**

Stereolithography Apparatus (SLA): Principles - Photo Polymerization of SL Resins - Pre Build Process - Part-Building and Post-Build Processes - Part Quality and Process Planning, Recoating Issues - Materials - Advantages - Limitations and Applications. Digital Light Processing (DLP) - Materials - Process - Advantages and Applications. Laminated Object Manufacturing (LOM): Working Principles - Process - Materials, Advantages, Limitations and Applications. Ultrasonic Additive Manufacturing (UAM) - Process - Parameters - Applications. Case Studies.

MATERIAL EXTRUSION AND POWDER BED FUSION PROCESSES **UNIT IV**

Fused deposition Modeling (FDM): Working Principles - Process - Materials and Applications. Design Rules for FDM. Selective Laser Sintering (SLS): Principles - Process - Indirect and Direct SLS - Powder Structure - Materials - Surface Deviation and Accuracy - Applications. Multijet Fusion. Selective Laser Melting (SLM) and Electron Beam Melting (EBM): Principles - Processes - Materials - Advantages - Limitations and Applications. Case Studies.

UNIT V

JETTING AND DIRECT ENERGY DEPOSITION PROCESSES

Binder Jetting: Three dimensional Printing (3DP): Principles - Process - Physics of 3DP - Types of printing: Continuous mode - Drop on Demand mode - Process - Materials - Advantages - Limitations - Applications. Material Jetting: Multi Jet Modelling (MJM) - Principles - Process - Materials - Advantages and Limitations. Laser

Engine	ered Net Shaping	(LENS): Processes	s- Materials- Adva	intages - Limitatio	ons and App	lications. Case	Studies.	
					TOTAL	PERIODS:	45	
COUR	RSE OUTCOMES	5				BT MAPPEI	D	
At the	end of the course,	the students will b	e able to			(Highest Leve	el)	
CO1	relate the importa	ance in the evoluti	on of SFM/AM, p	roliferation into t	he various	Understandin	g (K2)	
COI	fields					Chatristanan	5(1-2)	
CO2 analyze the design for AM and its importance in the quality of fabricated parts. Analyzing (K4)								
CO3	build knowledge	on principles ar	nd applications of	polymerization	and sheet	Understandin	g (K2)	
COS	lamination proces	sses with case stud	lies.			Churchan	8()	
CO1	explain the princi	iples of material ex	xtrusion and powd	er bed fusion pro	cesses and	Applying (K3	3)	
04	design guidelines	3 .				rippijing (in	,	
CO5	elaborate jetting a	and direct energy of	leposition process	es and their applie	cations.	Applying (K3	3)	
REFE	RENCES							
1. A	Andreas Gebhardt	and Jan-Steffen	Hotter, "Additive	e Manufacturing	3D Printin	g for Prototy	ping and	
N	Manufacturing", Ha	anser publications	Munchen, German	ny, 2016.				
2. E	Ben Redwood, Bria	an Garret, Filemon	Schöffer, and Ton	y Fadel, "The 3D	Printing Ha	andbook: Tech	nologies,	
I	Design and Applica	ations", 3D Hubs H	3.V., Netherland, 2	2017.				
3. I	an Gibson, David	W. Rosen and Bre	ent Stucker, "Addi	tive Manufacturin	g Technolo	gies: Rapid Pro	ototyping	
t	o Direct Digital M	anufacturing" Spri	inger - New York,	USA, 2nd Edition	n, 2015			
4. N	Milan Brandt. "I	Laser Additive M	Manufacturing 1s	t Edition Mater	ials, Desig	gn, Technolog	gies, and	
A	Applications", Woo	odhead Publishing	, UK, 2016.					
CO - I	PO MAPPING							
		Mapping of Co	urse Outcomes wit	th Programme Ou	tcomes:			
	(1/2/	3 indicates streng	th of correlation	3-Strong, 2-Me	dium , 1-W	eak		
COs	PO1	PO2	Programme O PO3	PO4	PO5	;]	PO6	
C01	3	1	2	1	2		-	
CO2	3	1	2	1	2		2	
CO3	3	-	2	1	2		2	
CO4	3	1	2	-	2		2	
C05	3	1	2	1	2		2	



PEI	023165	ADVANCED FINITE ELEMENT ANAL	LYSIS	3	0	0	3
CO	URSE	OBJECTIVES		1			
To	enable t	he students to		X			
1.	get exp	posure to solve problems involving plate and shell elements	to be to be and				
2.	learn c	oncept of problems involving geometric and material non-linea	urity	Distance Inter-			
3.	study s	olution techniques to solve dynamic problems	n and the short	S. A. Seed			
4.	familia	rize with fluid mechanics and heat transfer problems	New Princes	S. Sandhar			
5.	gain kr	nowledge on error norms, convergence rates and refinement.		a desine a			
UNI	TI	BENDING OF PLATES AND SHELLS	e Bauty				
Revi	iew of I	Elasticity Equations – Bending of Plates and Shells – Finite E	Element Formu	lation of P	late a	and S	She
Elen	nents -	Conforming and Non-Conforming Elements - C0 and C1 C	ontinuity Elem	ents –Dege	enera	ated s	she
elem	ents-Aj	oplication and Examples.					
UNI	тп	NON-LINEAR PROBLEMS					
Intro	duction	- Iterative Techniques - Material non-linearity - Elasto Pla	sticity - Plastic	city – Visc	o Pl;	astici	ty ·
Geor	netric 1	Non linearity - large displacement Formulation -Solution pro	cedure- Applic	cation in M	letal	Form	ning
Proc	ess and	Contact Problems.					
UNI	тш	DYNAMIC PROBLEM					-
Dire	ct Form	ulation - Free, Transient and Forced Response - Solution Pr	rocedures - Ei	gen solutio	n- S	ub sr	bace
Iterat	tive Teo	chnique – Response analysis - Houbolt, Wilson, Newmark–M	lethods – Expl	icit & Imp	ict N	Neth	ods
Lanc	hzos, R	educed method for large size system equations.					
UNI	T IV	FLUID MECHANICS AND HEAT TRANSFER					
Gove	erning I	Equations of Fluid Mechanics – Solid structure interaction -	Inviscid and	Incompres	sible	Flor	w -
Poter	ntial Fo	rmulations – Slow Non-Newtonian Flow – Metal and Polym	er Forming_N	lavier Stok	es E	anati	0n-
Stead	ly and 7	ransient Solution.	in ronning r	arrer stor	55 L	quatr	511
UNI		ERROR ESTIMATES AND ADAPTIVE REFINEMENT					
Error	norms	and Convergence rates-h-refinement with adaptivity-Adaptive	refinement				,
				DEDIOD	C.	41	_
COU	RSE O	UTCOMES	IUIAI	DTMAD	DED	43	,
At the	e end of	The course, the students will be able to		(Highest)	Leve	1)	
201	solve	problems involving plate and shell elements		Understar	ding	(K2)
CO2	desci	ibe problems involving geometric and material non-linearity		Applying	(K3))	
CO3	form	ulate solution techniques to solve dynamic problems		Understan	ding	(K2))
204	apply	concepts of Finite Element Analysis to solve fluid mechan	nics and heat	Applying	(K3)		
205	inves	tigate error norms, convergence rates and refinement		Applying	(V_2)		-
		c		тррушд	(12)	1	

1.

REFERENCES

1. Logan. D. L.,"A first course in Finite Element Method", Cengage Learning, 2012

2. Reddy, J.N. "An Introduction to Non linear Finite Element Analysis", 2nd Edition, Oxford, 2015

- Robert D.Cook, David S.Malkus, Michael E.Plesha, Robert J.Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2004.
- 4. Tirupathi R. Chandrupatla and Ashok D.Belegundu, "Introduction to Finite Elements in Engineering", International Edition, Pearson Education Limited, 2014.

CO - PO MAPPING

	(1/2	Mapping of Co /3 indicates streng	urse Outcomes wi gth of correlation	th Programme Out) 3-Strong, 2-Me o	tcomes: lium , 1-Weak						
co.	Programme Outcomes(POs)										
	PO1	PO2	PO3	PO4	PO5	PO6					
CO1	3	3	2	2	3	2					
CO2	3	3	2	1	2	2					
CO3	3	3	2	2	3	2					
CO4	3	3	2	1	3	2					
CO5	3	3	2	1	3	2					

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2.	underst	and	the p	roper	ties o	of ba	atteries	s and its	s type	es.									
3.	gain kn	owle	edge	about	t desi	ign c	of serie	es hybri	id ele	ectric ve	hicles.								
4.	compre	hend	l des	ign of	f para	allel	hybric	d electr	ric veh	hicles.							11.3		
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Moto Desi Cons UNI Cont Moto UNI EV chara grada grada COU At th CO1 CO2 CO3 CO3	or Size - gn of H sumption T IV trol Strat or Drive T V Transm acteristic ability URSE O te end of expla funct choos desig provi	Des Engin PAI tegie Pow ELI iissic cs-EV UTC `the iin ha ion. se pr n see de d	RAL s of er C COM cours ow a oper ries h	ontro of the enerat LEL Paral apacin RIC Sonfig otor ES se, the hybr energ ybrid	I Stra e Gea tor S HYI llel H ty-Tr VEH gurati sizin e stud id ve gy sto I eleco parall	ategi ar Ra Size BRII Hybri ransi HICL ions- ng-in dents ehicl orage ctric lel h	es-Siz atio-V - Des D ELI id Dri nissio E DR -Trans itial a s will l e worl e syste vehicl ybrid o	ing of t erificat sign of ECTRI ve Trai n Desig EIVE T smissio accelera be able ks and ems for es. electric	to to vehic	ajor Co of Accel Power RIVE T Drive T nergy S N ompone -rated v ribe its	empone leration Capac TRAIN Train Pa torage ents-Ide vehicle main c	nts -D Perfo city- I DESI aramet Design eal g veloc	esign orman Design (GN ers – n. ear bity–	of peal ceVe n of th Engin Dox-Ge maxim TOT	king erific he E e Po ear num FAL	power ation nergy wer C ratio veloc PERI BT M (High Under Apply Under	sour of gra Capa Capa capaci torq ity – ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODSODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS ODS OD	ce- T ade a acity ty- E ue- max ED evel) ing (1 <3)	racti bility –Fu llectr spec timu 45 K2)

CO5	describe the tra vehicles	nsmission compo	nents and their	configurations for	electric Appl	ying (K3)
REFE	RENCES					
1. E	Ehsani,M, "Mode	rn Electric, Hybr	rid Electric and	Fuel Cell Vehicle	s: Fundament	als, Theory and
Ľ	Design",CRC Press	s, 2005				
2. I	qbal Hussain, "Ele	ctric & Hybrid Ve	hicles–Design Fu	ndamentals", Second	Edition, CRC	Press, 2011.
3. J	ames Larminie, "H	Electric Vehicle Te	chnology Explain	ed", John Wiley&Sor	ns, 2003.	
4. S	Sandeep Dhameja,	"Electric Vehicle	Battery Systems",	Newnes, 2000.		
CO - I	PO MAPPING					
		Mapping of Co	urse Outcomes wi	th Programme Outco	mes:	
	(1/2/	3 indicates streng	th of correlation) 3-Strong, 2-Mediu	m, 1-Weak	
COs			Programme O	utcomes(POs)		
003	PO1	PO2	PO3	PO4	PO5	PO6
C01	3	2	3	2	1	2
CO2	3	2	3	2	1	2
CO3	3	2	3	2	1	2
CO4	3	2	3	2	1	2
C05	3	2	3	2	1	2



PE	D23168	MATERIAL HANDLING SYSTEMS AND (Use of Approved Data Book is Permi	DESIGN		3 (0	3	
CO	URSE OB	JECTIVES						
То	enable the	students to						
1.	understan	d the fundamental concepts of design of hoists						
2.	explore de	esign of various drives for hoisting gears		-		-		
3.	learn abou	t conveyer systems for material flow in different industrial	production syst					
4.	get exposi	re to design of elevators for various manufacturing and ser	vice application		-	-	-	
5.	study integ	grated mechanical system design for machine tools		13.				
UNI	TII	NTRODUCTIONS AND DESIGN OF HOISTS			-	1	9	
Тур	es, selectio	n and applications, Design of hoisting elements: Welded a	nd roller chains	s-Hemn	and w	ire ro	nes	
Desi	gn of ropes	s, pulleys, pulley systems, sprockets and drums, Load handl	ing attachments	Design	of fo	aed h	pes -	
and	eye hooks -	- crane grabs - lifting magnets – Grabbing attachments-Desi	on of arresting	gear -B	akas	geu I	hand	
and	cone types.		Shortaresting	gear -Di	ares.	snoe,	Danu	
UNI	TII D	RIVES OF HOISTING GEAR				-		
Hand	and powe	er drives - Traveling gear - Rail traveling mechanism - can	tilever and mar				9	
band	luffing ge	ar-cog wheel drive-selecting the motor ratings			ranes-	siewii	1g, ji	
UNI		ONVEYORS			_	1		
Type	s-descripti	on-design and applications of Belt conveyors apron conveyo	and accelete	na Deces			9	
Screv	v conveyor	s and vibratory conveyors	ors and escarato	rs Pneur	natic c	onvey	ors,	
UNI		EVATORS						
Buck	et elevator	s: design - loading and bucket arrangements. Computer the	1.0				9	
hoist	ing machin	e safety devices Design of fork lift trucks	rs - shaft way,	guides, o	counte	r weig	ghts,	
UNIT		NAMICS OF DOTODS MOUNTED ON UNDER DUR						
Integ	rated Desig	m of systems Welve Com Mala in David and	NAMIC BEAR	INGS			9	
Mach	ine Power	Sarous Coor Device Gear Mechanisms, Portable Air Con	pressor, Hay-I	Bale lifte	er, Ca	n Tes	ting	
Iviaci.	inic, i owei	Screws, Gear Box Design more than six speed.						
COL	DEE OUT	COME	TOTAI	PERIC	DDS:	4	5	
	RSE OUT	COMES		BT MA	APPE	D		
At the	e end of the		(Highe	st Lev	el)			
	of design of hoists.					g (K2)	
CO2	D2 design various drives for hoisting gears)		
CO3	describe systems	conveyer systems for material flow in different industri	al production	Unders	tandin	g (K2)	
	1		and the second sec					

CO5	integrate mechan	ical system design	for machine tools	with different con	nponents App	lying (K3)
REFEF	RENCES					
1. A	lexandrov,M.,Ma	terials Handling E	quipments,MIRPu	blishers,1981.		
2. N	orton.L Robert. "	Machine Design-	An Integrated App	roach" Pearson Ed	ucation, 2nd Edit	ion, 2005.
3. R	udenko,N, Materi	als handling equip	oment,ELnveePubl	ishers,1970.		
4. Sj	pivakovsy, A.O.a	nd Dyachkov,V.K	., Conveying Macl	nines, Volumes I a	nd II, MIR Publi	shers,1985.
CO - P	O MAPPING					
		Mapping of Co	ourse Outcomes with	th Programme Out	comes:	
	(1/2)					
	(112)	3 indicates stren	gth of correlation) 3-Strong, 2-Med	lium, 1-Weak	
COs	(1/2/	3 indicates stren	gth of correlation Programme O) 3-Strong, 2-Med outcomes(POs)	lium , 1-Weak	
COs	PO1	PO2	gth of correlation Programme O PO3) 3-Strong, 2-Med utcomes(POs) PO4	lium , 1-Weak PO5	PO6
COs CO1	PO1 3	PO2 2	gth of correlation Programme O PO3 3) 3-Strong, 2-Med putcomes(POs) PO4 1	PO5 2	PO6
COs CO1 CO2	PO1 3 3	PO2 2 2	Programme O PO3 3 3) 3-Strong, 2-Med putcomes(POs) PO4 1 1	PO5 2 2 2	PO6 1 1
COs CO1 CO2 CO3	PO1 3 3 3	PO2 2 2 2 2	Programme O PO3 3 3 3 3 3) 3-Strong, 2-Med putcomes(POs) PO4 1 1 1	PO5 2 2 2 2 2	PO6 1 1 1 1
COs CO1 CO2 CO3 CO4	PO1 3 3 3 3 3	PO2 2 2 2 2 2 2 2	Programme O PO3 3 3 3 3 3 3 3 3) 3-Strong, 2-Med putcomes(POs) PO4 1 1 1 1 1	PO5 2 2 2 2 2 2 2 2 2 2 2 2 2	PO6 1 1 1 1 1 1 1

RING COLLEGA Approved BOARD OF STUDIES (N) NAL 317/27 0 AUTONOMOU

PED23169 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING 3 0	0 3
COURSE OBJECTIVES	
To enable the students to	Sec.
1. gain knowledge on artificial intelligence.	
2. understand the concepts of Machine Learning.	
3. appreciate supervised learning and their applications.	
4. learn the concepts and algorithms of unsupervised learning.	
5. explore the theoretical and practical aspects of Probabilistic Graphical Models.	
UNIT I ARTIFICIAL INTELLIGENCE	9
Artificial intelligence - Basics - Goals of artificial intelligence - AI techniques-problem representation	in AI –
Problem reduction and solution techniques - Application of AI and KBES in Robots.	
UNIT II INTRODUCTION TO MACHINE LEARNING	9
Machine Learning-Types of Machine Learning -Machine Learning process- preliminaries, testing	Machine
Learning algorithms, turning data into Probabilities, and Statistics for Machine Learning- Probability	theory -
Probability Distributions – Decision Theory.	
UNIT III SUPERVISED LEARNING	9
Linear Models for Regression – Linear Models for Classification- Discriminant Functions, Probabilistic Ge	enerative
Back propagation - Support Vector Machines.	k, Error
Clustering- K-means – FM Algorithm- Mixtures of Gaussians, Dimonsionality Reduction Line Di	9
Analysis, Factor Analysis, Principal Components Analysis, Independent Components Analysis.	iminant
JNIT V PROBABILISTIC GRAPHICAL MODELS	9
Graphical Models – Undirected Graphical Models – Markov Random Fields – Directed Graphical M	lodels –
Bayesian Networks – Conditional Independence properties – Markov Random Fields - Hidden Markov M	lodels –
Conditional Random Fields (CRFs).	
TOTAL PERIODS:	45
COURSE OUTCOMES BT MAPPED	
At the end of the course, the students will be able to (Highest Level))
CO1 optimize the robots using Artificial Intelligence. Understanding	(K2)
CO2design a learning model appropriate to the application.Applying (K3)	
2O3 implement Probabilistic Discriminative and Generative algorithms for an application of your choice and analyze the results. Understanding	(K2)
use a tool to implement typical Clustering algorithms for different types of Applying (K3)	

	applications.					
CO5	identify applicati justification.	ons suitable for dif	ferent types of Ma	chine Learning wi	th suitable App	lying (K3)
REFE	RENCES					
1. (Christopher Bishop	o, "Pattern Recogn	ition and Machine	Learning" Spring	er, 2007.	
2. 5	Stephen Marsland,	"Machine Learn	ing – An Algorith	mic Perspective"	, Chapman and	Hall, CRC Press,
5	Second Edition, 20	14.				
3. I	Kevin P. Murphy, '	"Machine Learnin	g: A Probabilistic	Perspective", MIT	Press, 2012.	
4. I	Ethem Alpaydin, "	Introduction to Ma	achine Learning", 1	MIT Press, Third	Edition, 2014.	
CO - 1	PO MAPPING					
	-	Mapping of Co	urse Outcomes wi	th Programme Ou	tcomes:	
	(1/2	/3 indicates stren	gth of correlation) 3-Strong, 2-Mee	dium , 1-Weak	
COs			Programme C	utcomes(POs)		
COS	PO1	PO2	PO3	PO4	PO5	PO6
C01	3	2	3	1	2	1
CO2	3	2	3	1	2	1
C03	3	2	3	1	2	1
CO4	3	2	3	1	2	1
C05	3	2	3	1	2	1



PED	023170	INDUSTRIAL INTERNET OF THIN	GS	3	0	0	3
COL	URSE OB	JECTIVES	A				_
To e	enable the	students to					
1.	understand	the fundamentals of Internet of Things			_		_
2.	learn abou	t the basics of IOT protocols					
3.	gain know	ledge on bigdata analytics and software defined networks					
4.	get expose	d to the concept of IOT security					
5. 0	explore In	dustrial IOT case studies in different domains	Y21	1	3		
UNI		TRODUCTION AND ARCHITECTURE OF IOT					9
Intro	duction – I	Definition and characteristics of IoT - Physical and Logical	Design of IoT - C	ommun	icatic	on mo	dels
and A Funct	APIs – Cha tional Stac	Illenges in IoT - Evolution of IoT- Components of IoT – A k.	Simplified IoT A	rchitect	ıre –	Core	IoT
UNIT	TII IN	DUSTRIAL IOT					9
IoT-	Introductio	on, Industrial IoT: Business Model and Reference Architec	ture: IIoT-Busine	ess Mod	els 1	ndus	trial
loT- I	Layers: IIc	T Sensing, IIoT Processing, IIoT Communication, IIoT Ne	tworking.			naus	
UNIT	гш пе	OT ANALYTICS				_	0
Big D	ata Analyi	ics and Software Defined Networks. Machine Learning and	Data Science Jul	ia Progr	0,000	ing T	y Jota
Mana	gement wi	th Hadoop.	Data Science, Jul	la i logi	amm	ing, L	Jala
JNIT	TIV IO	T SECURITY					9
ndust	trial IoT: S	ecurity and Fog Computing - Cloud Computing in IIoT, Fo	g Computing in I	IoT. Sec	curity	in II	oT
JNIT	V CA	SE STUDY					0
ndust	trial IOT-	Application Domains: Oil, chemical and pharmaceutica	l industry Appli	cations	ofI	IAV	in
ndust	tries, Real	case studies: Milk Processing and Packaging Industries. Ma	mufacturing Indu	stries	or c	AVS	m
			TOTAL P	PERIOT	1.20	15	
OUI	RSE OUT	COMES	B	TMAP	PPFD		
t the	end of the	course, the students will be able to		Highest		1)	
01	describe	the fundamentals of Internet of Things		ndersta	ndino	(K2))
02	apply the	e basics of IOT protocols	A	pplving	(K3)	(112)	,
O3	illustrate	bigdata analytics and software defined networks	U	ndersta	nding	(K2)	,
O4	impleme	nt the concepts of IOT security	A	pplying	(K3)		
05	investiga	te case studies in different domains of industrial IOT	A	pplying	(K3)		
EFE	RENCES			-			
1. I	ndustry 4.): The Industrial Internet of Things", by Alasdair Gilchrist ((Apress), 2017				
2. "	Industrial	Internet of Things: Cyber manufacturing Systems "by Sabin	a Jeschke, Christi	an Brec	her, F	loubi	ng
S	Song, Danc	a B. Rawat (Springer), 2017					0
201 202 203 204 205 REFE 1. In 2. "	describe apply the illustrate impleme investiga RENCES ndustry 4.0	the fundamentals of Internet of Things e basics of IOT protocols bigdata analytics and software defined networks nt the concepts of IOT security te case studies in different domains of industrial IOT D: The Industrial Internet of Things", by Alasdair Gilchrist (Internet of Things: Cyber manufacturing Systems "by Sabin la B. Rawat (Springer), 2017	(I U A U A (Apress), 2017 a Jeschke, Christi	Tighest Inderstan pplying pplying pplying an Brec	Level nding (K3) nding (K3) (K3)	l) (K2) (K2) Houbi)

 The Industrial Internet of Things (IIoT): Intelligent Analytics for Predictive Maintenance by R. Anandan, Suseendran Gopalakrishnan, Souvik Pal, Noor Zaman, Scrivener Publishing LLC, February 2022.

4. "Internet of Things", Greg Dunko, Joydeep Misra, Josh Robertson, Tom Snyder, Bridgera LLC, 2017.

CO - PO MAPPING

	(1/2)	Mapping of Co /3 indicates streng	urse Outcomes wi gth of correlation	th Programme Out) 3-Strong, 2-Mec	tcomes: lium , 1-Weak						
60	Programme Outcomes(POs)										
COs	PO1	PO2	PO3	PO4	PO5	PO6					
CO1	3	3	3	2	3	1					
CO2	3	3	3	2	3	1					
CO3	3	3	3	2	3	1					
CO4	3	3	3	2	3	1					
CO5	3	3	3	2	3	1					



PED23171MATERIALS CHARACTERIZATION TECHNIQUES30								
COU	JRSE (DBJECTIVES						
To e	nable th	ne students to						
1.	analyze	the different spectroscopic methods and fundamentals of Vibra	tional Spectrosco	ру				
2.	apply th	ne effects of X-Ray techniques and chemical analysis						
3.	underst	and the Electron Microscopy and Transmission Electron Micros	scopy					
4.	study tł	he thermal analysis and learn basic theory of Instrumentation						
5.	acquire	knowledge on Electrical Characterization and Non-destructive	testing					
UNI	TI	SPECTROSCOPIC METHODS					9	
Aton	nic abs	orption spectrometry (AAS), Atomic fluorescence spectro	metry (AFS) an	nd Ator	nic	emi	ssion	
spect	trometr	y (AES) - Fundamentals and instrumentation, Vibrational	spectroscopy - F	Raman	and	Infr	ared,	
Princ	ciples of	f Vibrational spectroscopy, Infrared and Raman activity, Applic	ations.					
UNI	TII	X-RAY TECHNIQUES					9	
X-ra	y diffra	ction- Generation and characteristics of x-ray, Lattice planes a	nd Bragg's law, 7	Theory of	of di	ffrac	tion,	
Wide	e angle	XRD; X-ray fluorescence spectroscopy- Fundamental princip	ples, Chemical a	nalysis,	Way	ve le	ngth	
dispe	ersive sj	pectroscopy and energy dispersive spectroscopy, Applications.						
UNI	TIII	ELECTRON MICROSCOPY					9	
Scan	ning ele	ectron microscopy (SEM), Instrumentation, Electron beam-speci	men interaction, S	Specime	n pre	epara	tion,	
Ener	gy disp	ersive spectroscopy (EDS) in electron microscopes; Transmissio	on electron micros	сору (Т	ΈM) - B	asics	
of TI	EM, Ele	ctron sources, Specimen preparation, Image modes, Image contr	ast, Electron diffr	action, u	ınde	rstar	ıding	
diffra	action p	attern, High resolution TEM, FESEM.						
UNI	T IV	THERMAL ANALYSIS					9	
Ther	mo grav	vimetric analysis (TGA), Differential thermal analysis (DTA), D	ifferential scannin	ıg calori	meti	y (D	SC),	
Dyna	amic m	echanical analysis (DMA), Thermo-mechanical analysis (TM	A) and Dynamic	mecha	nica	l the	rmal	
analy	ysis (DN	MTA), Basic theory, Instrumentation and applications.						
UNI	ΤV	ELECTRICAL AND MAGNETIC PROPERTIES					9	
Two	probe	and four probe methods for electrical characterization, Vibrat	ting sample magr	netomet	er (V	/SM) for	
magr	netic pr	operty analysis, Applications. Non-destructive testing: Radiog	graphy, Ultrasonic	e, Acou	stic	emis	sion,	
Ther	mograp	hy, Holography, Basic principles, Applications.						
			TOTAL P	PERIOI	DS:	4	1 5	
COL	JRSE (DUTCOMES	В	ST MAI	PPE	D		
At th	At the end of the course, the students will be able to (Highest Level)							
COL	CO1 learn the different spectroscopic methods and fundamentals of Vibrational Understanding (K2)							
	Spectroscopy Childerstanding (K2)							
CO2know the effects of X-Ray techniques and chemical analysisApplying (K3)								

CO3	analyze the Electron Microscopy and Transmission Electron Microscopy	Analyzing (K4)
CO4	develop the thermal analysis and learn basic theory of Instrumentation	Applying (K3)
CO5	understand Electrical Characterization and Non-destructive testing	Understanding (K2)
REFE	RENCES	
1. S	. Zhang, Lin Li, A. Kumar, Materials Characterisation Techniques, CRC press, 200	8.
2. Y	Leng, Materials Characterisation: Introduction to Microscopic and Spectroscopic	Methods, John Wiley &
S	ons (Asia), 2008.	
3. R	.M. Silverstein, Spectrometric identification of organic compounds, 7th ed., John W	viley and Sons, 2007.
4. B	8. Raj, T. Jayakumar, M. Thavasimuthu, Practical Non-Destructive Testing, 2nd	ed., Narosa Publishing
H	Iouse, 2002.	
CO - P	O MAPPING	
	Mapping of Course Outcomes with Programme Outcomes:	
	(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-We	eak
COs	Programme Outcomes(POs)	

COs	Programme Outcomes(POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	
CO1	3	2	2	-	-	-	
CO2	3	2	3	-	-	-	
CO3	3	1	3	-	-	-	
CO4	3	2	2	-	-	-	
CO5	3	2	3	-	-	-	



PE	D23172	COMPOSITE MATERIALS AND TEST	ING	3	0	0	3
CO	URSE O	BJECTIVES		I			
То	enable the	e students to					
1.	learn the	types of composites, FRP and Particulate composites					
2.	acquire	knowledge on types of Reinforcement and fibres					
3.	understa	nd the characteristics of Metal Matrix Composites					
4.	study the	e Ceramic Metal Matrix, properties and various types of CMC					
5.	demonst	rate the different types of testing of composites, Electrical and	Thermal conduc	ctivity tes	st		
UN	IT I	TYPES OF COMPOSITES					9
Fun	damental	s of composites - need for composites -Types, Polymer mate	rix composites (PMC), C	Carbo	n m	atrix
Cor	nposites o	or Carbon-Carbon Composites, Metal matrix composites (MMC	C), Ceramic mat	rix comp	osite	s (Cl	MC).
Fib	er Reinfor	ced Composites, Fiber Reinforced Polymer (FRP) Composites	, Particulate Co	mposites	Ap	olica	tions
of v	various typ	bes of composites.					
UN	IT II	TYPES OF REINFORCEMENTS/FIBERS					9
Rol	e and Sel	ection of reinforcement materials. Types of fibres: Glass fiber	s, Carbon fibers	, Aramid	fibe	rs, N	/letal
fibe	ers, Alumi	na fibers, Boron Fibers, Silicon carbide fibers, Quartz and Sili	ca fibers, Multip	hase fibe	ers, V	Whis	kers,
Fla	kes.						
UN	IT III	METAL MATRIX COMPOSITES					9
Cha	racteristic	es of MMC, Various types of Metal matrix composites Al	loy vs. MMC, A	Advantag	ges o	of M	MC,
Lin	nitations o	f MMC, Metal Matrix, Processing of MMC - Powder metall	urgy process - d	iffusion	bond	ing -	- stir
cast	ting – squ	eeze casting.					
UN	IT IV	CERAMIC MATRIX COMPOSITES					9
Eng	gineering	ceramic materials – properties – advantages – limitations – M	Ionolithic ceram	ics - Nee	ed fo	r CN	1C –
Cer	amic mat	rix - Various types of Ceramic Matrix composites- oxide ceram	nics – non oxide	ceramics	s - al	umii	nium
oxi	de – silico	n nitride –Sintering - Hot pressing – Cold isostatic pressing (CI	Ping) – Hot isost	atic press	sing	HIP	ing).
UN	IT V	TESTING OF COMPOSITES					9
Me	chanical t	esting of composites: tensile, compressive, Flexural, Impact and	d Hardness, elect	trical con	duct	ivity	test,
The	ermal prop	perties tests: Coefficient of Thermal Expansion and Thermal-C	onductivity - Te	nsile hol	e tes	ing,	high
tem	perature t	esting and wear test.					
			TOTAL	PERIOI	DS:	4	15
CO	URSE O	UTCOMES		BT MAI	PPE	D	
At t	he end of	the course, the students will be able to		(Highest	Leve	el)	
CO	1 unde	rstand the the types of composites, FRP and Particulate compo	sites	Understa	ndin	g (K	2)
CO	2 know	the types of Reinforcement and fibres		Applying	g (K3	3)	
CO	CO3 analyze the characteristics of Metal Matrix Composites Analyzing (K4)						

CO4	learn the Cerami	c Metal Matrix, pr	operties and vario	us types of CMC	Ap	plying (K3)		
CO5	do the differen conductivity test	t types of testir	ng of composites	s, Electrical and	Thermal Ap	Applying (K3)		
REFE	RENCES							
1. N	Mechanical Metall	urgy, G. Dieter, 3r	d Edition, McGrav	w Hill, 1986.				
2.	Engineering Mech	anics and Compos	site Materials, Isaa	ac M Daniels and	Ori Ishai, Seco	nd Edition, Oxford		
τ	University Press, 2	005						
3. I	Engineering Mater	ials: Polymers, Ce	eramics and Comp	osites, Second Ed	ition, A.K.Bha	gava, Prentice Hall		
I	India, 2012.							
4. N	Materials character	ization, Vol. 10, A	SM hand book, 20	019.				
CO - 1	PO MAPPING							
		Mapping of Co	urse Outcomes wi	th Programme Out	comes:			
	(1/2/	3 indicates streng	gth of correlation) 3-Strong, 2-Med	lium , 1-Weak			
COs			Programme O	outcomes(POs)				
	PO1	PO2	PO3	PO4	PO5	PO6		
C01	3	2	2	-	2	2		
CO2	3	2	3	-	1	1		
CO3	3	1	3	3	2	2		
CO4	3	2	2	2	3	3		
CO5	3	2	3	-	2	2		



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COURSE OBJECTIVES

To enable the students to

- 1. classify the various soft computing frame works
- 2. familiarize with the design of neural networks, fuzzy logic and fuzzy systems
- 3. learn mathematical background for optimized genetic programming
- 4. get exposed to neuro-fuzzy hybrid systems and its applications

5. understand various hybrid soft computing techniques and apply in real time problems

INTRODUCTION TO SOFT COMPUTING **UNIT I**

Soft Computing Constituents-From Conventional AI to Computational Intelligence- Artificial neural network: Introduction, characteristics- learning methods - taxonomy - Evolution of neural networks - basic models important technologies - applications. Fuzzy logic: Introduction - crisp sets- fuzzy sets - crisp relations and fuzzy relations: cartesian product of relation - classical relation, fuzzy relations, tolerance and equivalence relations, noniterative fuzzy sets. Genetic algorithm Introduction - biological background - traditional optimization and search techniques - Genetic basic concepts.

UNIT II NEURAL NETWORKS

Supervised learning network: perceptron networks - adaptive linear neuron, multiple adaptive linear neuron, BPN, RBF, associative memory network: auto-associative memory network, hetero-associative memory network, BAM, hopfield networks, unsupervised learning networks: Kohonen self-organizing feature maps, LVQ – CP networks.

UNIT III **FUZZY LOGIC**

Membership functions: features, fuzzification, methods of membership value assignments Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems overview of fuzzy expert system-fuzzy decision making.

UNIT IV GENETIC ALGORITHM

Genetic algorithm- Introduction - biological background - traditional optimization and search techniques - Genetic basic concepts - operators - Encoding scheme - Fitness evaluation - crossover - mutation - genetic programming - multilevel optimization - real life problem- advances in GA.

UNIT V HYBRID SOFT COMPUTING TECHNIQUES AND APPLICATIONS

Neuro-fuzzy hybrid systems - genetic neuro hybrid systems - genetic fuzzy hybrid and fuzzy genetic hybrid systems - Applications: optimization of traveling salesman problem using genetic algorithm approach, hybrid systems in image processing, soft computing based hybrid fuzzy controllers.

> **TOTAL PERIODS:** 45

COUR	RSE OUTCOMES	5			BT N	IAPPED		
At the end of the course, the students will be able to					(High	(Highest Level)		
CO1	apply various soft computing concepts for practical applications					Applying (K3)		
CO2	choose and desig	n suitable neural r	network for real tir	ne problems	Appl	ying (K3)		
CO3	use fuzzy rules a	nd reasoning to de	velop decision ma	king and expert sy	stem Unde	rstanding (K2)		
CO4	explain the impo	rtance of optimiza	tion techniques an	d genetic program	ming Apply	ying (K3)		
CO5	review the various hybrid soft computing techniques and apply in real time Applying (K3) problems							
REFE	RENCES							
1. J	.S.R.Jang, C.T. Su	ın and E.Mizutani,	"Neuro-Fuzzy and	d Soft Computing'	', PHI / Pearson E	ducation 2004.		
2. 8	S.N.Sivanandam ar	nd S.N.Deepa, "Pri	inciples of Soft Co	mputing", Wiley I	ndia Pvt Ltd, 201	1.		
3. George J. Klir, Ute St. Clair, Bo Yuan, "Fuzzy Set Theory: Foundations and Applications" Prentice Hall,								
1	.997.							
4. I	David E. Goldberg	, "Genetic Algorit	hm in Search Opt	mization and Mac	hine Learning" P	earson Education		
Ι	ndia, 2013.							
CO - I	PO MAPPING							
	(4.10	Mapping of Co	urse Outcomes wi	th Programme Out	comes:			
	(1/2/	3 indicates streng	th of correlation) 3-Strong, 2-Med	lium, 1-Weak			
COs	PO1	PO2	PO3	PO4	PO5	PO6		
CO1	3	2	2	2	2	2		
CO2	3	2	3	1	3	1		
CO3	3	1	3	2	2	2		
CO4	3	2	2	2	3	3		
CO5	3	2	3	1	2	2		

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