PAAVAI ENGINEERNG COLLEGE (Autonomous) M.E. - ENGINEERING DESIGN REGULATIONS 2023

(CHOICE BASED CREDIT SYSTEM)

CURRICULUM

(For the candidates admitted during the Academic Year 2023-24) SEMESTER - I

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory	y						
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	English for Research Paper Writing (Audit Course I)	2	0	0	0
Practic	cal						
1	PC	PED23105	Computer Aided Design Laboratory	0	0	4	2
		Te	OTAL	20	1	4	21

SEMESTER-I

S.No.	Category	Course Code	Course Title	L	T	P	C
Theor	у						
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	cal						
1	PC	PED23205	Simulation and Analysis Laboratory	0	0	4	2
			TOTAL	20	2	4	22

BOARD OF STUDIES
Mechanical Engineering
AUTONOMOUS

SEMESTER - III

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory	•	L				1	
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
Practic	al						
1	EE	PED23302	Project Work (Phase I)	0	0	12	6
			TOTAL	12	0	12	18

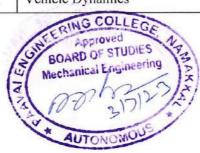
SEMESTER - IV

S.No.	Category	Course Code	Course Title	L	T	P	C
Practic	al).			
1	EE	PED23401	Project Work (Phase II)	0	0	24	12
			TOTAL	0	Ö	24	12

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

PROFESSIONAL ELECTIVE COURSES

S.No.	Category	Course Code	Course Title	L	T	P	C
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



S.No	Category	Course Code	Course Title	L	T	P	С
12.	PE	PED23162	Wearable Technologies	3	0	0	3
13.	PE	PED23163	Solid Freeform Manufacturing	3	0	0	3
14.	PE	PED23164	Bio Materials	3	0	0	3
15.	PE	PED23165	Advanced Finite Element Analysis	3	0	0	3
16.	PE	PED23166	Design of Hybrid and Electric Vehicles	3	0	0	3
17.	PE	PED23167	Bearing Design and Rotor Dynamics	3	0	0	3
18.	PE	PED23168	Material Handling Systems and Design	3	0	0	3
19.	PE	PED23169	Artificial Intelligence and Machine Learning	3	0	0	3
20.	PE	PED23170	Industrial Internet of Things	3	0	0	3

OPEN ELECTIVE COURSES

S. No	Category	Course Code	Course Title	L	T	P	С
1	OE	PED23901	Industrial Safety	3	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

SPECIAL ELECTIVE COURSES

S. No	Category	Course Code	Course Title	L	T	P	C
1	SPE	PMR23001	Materials Characterization Techniques	3	0	0	3
2	SPE	PMR23002	Composite Materials and Testing	3	0	0	3
3	SPE	PMR23003	Soft Computing	3	0	0	3



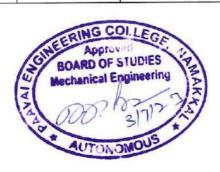
PF	ED2310	ADVANCED ENGINEERING MATERIAL	S	3	0	0	3
CO	DURSE	E OBJECTIVES					T
To	enable	e the students to					
1.	under	rstand the structure of various materials and its behaviors in the engin	neering field.				
2.	learn	imperfection, deformation, diffusion, dislocation and strengthening r	nechanisms.		100		
3.	create	e phase diagram in iron carbon system to improve and enhance their	research activ	rities.			Ħ
4.	acqui	ire the knowledge of various failures of metals.					
5.	famil	iarize the processing of metals like ceramics, polymers and composit	es.				т
UN	ITI	STRUCTURE OF MATERIALS					9
Pro	perties	of materials - Classification of materials. Advanced Materials, Futu	re materials	and mod	lern 1	nater	ials
Ato	omic str	ructure. Atomic bonding in solids, Crystal structures, Crystalline an	nd non-crysta	lline ma	teria	ls. M	ille
ind	ices. A	nisotropic elasticity. Elastic behavior of composites. Structure and pr	operties of p	olymers.	Stru	cture	and
pro	perties	of ceramics.					
UN	IT II	IMPERFECTIONS IN SOLIDS, DIFFUSION, DISLOCATION STRENGTHENING MECHANISMS	ONS AND				9
Poi	nt defe	cts. Theoretical yield point. Line defects and dislocations. Interfacia	al defects. Bu	ılk or vo	lume	defe	ects.
		ects. Theoretical yield point. Line defects and dislocations. Interfacia vibrations; Elastic deformation. Plastic deformation. Diffusion					
Ato	omic v	vibrations; Elastic deformation. Plastic deformation. Diffusion	n mechanisi	ms. No	n-eq	uilibr	ium
Atc trar	omic v nsforma	vibrations; Elastic deformation. Plastic deformation. Diffusion and microstructure, Dislocation and plastic deformation. Mech	n mechanisi anisms of str	ms. No	n-equing in	uilibr n mei	ium tals.
Ato trar Rec	omic v nsforma covery,	vibrations; Elastic deformation. Plastic deformation. Diffusion ation and microstructure, Dislocation and plastic deformation. Mech re-crystallization and grain growth. Strengthening by second phase	n mechanisi anisms of str	ms. No	n-equing in	uilibr n mei	ium tals.
Atc trar Rec	omic v nsforma covery,	vibrations; Elastic deformation. Plastic deformation. Diffusion and microstructure, Dislocation and plastic deformation. Mech re-crystallization and grain growth. Strengthening by second phase Lattice resistance to dislocation motion.	n mechanisi anisms of str	ms. No	n-equing in	uilibr n mei	ium tals.
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SE OUTCOMES	BT MAPPED
end of the course, the students will be able to	(Highest Level)
demonstrate an understanding of physical properties of materials including metals, ceramics and polymers	Understanding (K2)
understand existence of imperfections and their cause of failure	Understanding (K2)
demonstrate understanding of phase diagrams and their use in predicting phase transformation and microstructure	Understanding (K2)
understand and predict various types of failures using concept of fracture mechanics, creep and effect of impact	Understanding (K2)
know the processing of metals, ceramics, polymers and composites	Applying (K3)
	metals, ceramics and polymers understand existence of imperfections and their cause of failure demonstrate understanding of phase diagrams and their use in predicting phase transformation and microstructure understand and predict various types of failures using concept of fracture mechanics, creep and effect of impact

- 1. Materials Science and Engineering, William D. Callister, Jr, John Wiley & sons, 2007
- Advanced Engineering Materials and Modeling, Ashutosh Tiwari, N. Arul Murugan, Rajeev Ahujar, Hardcover, 2016.
- Advanced Engineering Materials, M N Avadhanulu, Dr. Shilpa A. Pande, Dr. Arti R. Golhar, Dr. Mohan Giriya, S Chand And Company Ltd. 2019.
- 4. Introduction to Materials Science for Engineers, James F Shackelford, Pearson; 7th edition, 2008.

CO - PO MAPPING

co.			Programme (Outcomes(POs)		
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



	D23102	CONCEPTS OF ENGINEERING DESIGN		3 0	0	3
CO	URSE OB	TECTIVES		_		
То	enable the	tudents to				
1.	impart the	fundamentals designing cost effective, preservation and productive.				
2.	familiarize	with the customer-oriented design and societal considerations.				
3.	understand	reinforces the knowledge being learned and shortens the overall learning	g of design	meth	ods.	
4.	know the	oncepts of materials for the design process.				
5.	acquire the	knowledge in the design of reliability of failure mode effect analysis an	d probabili	ty cor	cepts	
UN	IT I D	ESIGN FUNDAMENTALS				
for and	design-Co	esign- The design process-Considerations of Good Design – Morpholographer Aided Engineering –Designing to codes and standards – Concurrates – Technological Forecasting – Market Identification – Competition I	rent Engine Bench marl	ering		duc
		JSTOMER ORIENTED DESIGN AND SOCIETAL CONSIDERAT				9
		of customer needs- customer requirements- Quality Function Depl				_
		Human Factors in Design - Ergonomics and Aesthetics. Societal co				
		- Protecting intellectual property - Legal and ethical domains - Codes of		∃thica	l conf	lict
		responsible design-future trends in interaction of engineering with societ	y.			
	ACC. 145-145-15	CSIGN METHODS				9
Crea	ativity and l	roblem Solving -Creativity Methods-Theory of Inventive Problem Sol-	ving (TRIZ	() – C	oncep	tua
deco	omposition-	Generating design concepts-Axiomatic Design – Evaluation methods- En	nbodiment	Desig	n-Proc	duc
Arcl	hitecture- C	onfiguration Design- Parametric Design. Role of models in design-N	Mathematic	al M	odelin	g -
Sim	ulation – G	ometric Modeling -Rapid prototyping.				
IINI	IT IV M	ATERIAL SELECTION PROCESSING AND DESIGN				9
0111						
0.03400000	erial Select	on Process - Economics - Cost Vs Performance - Weighted property	Index – Va	ılue A	nalys	is –
Mat		on Process - Economics - Cost Vs Performance - Weighted property ing in Design - Classification of Manufacturing Process - Design for				
Mate Role	e of Process		Manufactu	re – D	esign	for
Mate Role Asse	e of Process	ing in Design – Classification of Manufacturing Process – Design for Ingring for castings, Forging, Metal Forming, Machining and Welding – R	Manufactu	re – D	esign	for
Mate Role Asse Frac	e of Process embly –Des eture and Fa	ing in Design – Classification of Manufacturing Process – Design for Ingring for castings, Forging, Metal Forming, Machining and Welding – R	Manufactu	re – D	esign	for
Mate Role Asse Frac UNI	e of Process embly –Des sture and Fa	ing in Design – Classification of Manufacturing Process – Design for I gning for castings, Forging, Metal Forming, Machining and Welding – R lure. OBABILITY CONCEPTS IN DESIGN FOR RELIABILITY	Manufactu esidual Str	re – D	esign - Fatig	for gue,
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:

CO2	familiarize the product design specifications, ergonomics and aesthetics.	Applying (K3)
CO3	identify the suitable design methods for problem solving.	Understanding (K2)
CO4	understand the proper material selection processing	Understanding (K2)
CO5	apply the probability concepts in design foe reliability	Applying (K3)

- George E.Dieter and Linda C.Schmidt, Engineering Design, McGraw Hill, 5th International Editions, 2012.
- 2. Pahl, G, and Beitz. W, Engineering Design, Springer Verlag, London, 2007.
- 3. Suh, N.P., —The principles of Design, Oxford University Press, NY.1990.
- 4. Karl T. Ulrich and Steven D. Eppinger, Product Design and Development, McGraw Hill, 5th Edition 2011.

CO - PO MAPPING

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



	03	COMPUTER APPLICATIONS IN DESIGN		3 (0 0	
COURS	E OB.	TECTIVES				_
To enab	le the s	tudents to				
1. und	erstanc	fundamental concepts of computer graphics and its tools in a generic frame	work.			
2. imp		parametric fundamentals to create and manipulate geometric models using	ig curv	es, s	urface	S
3. imp	art the	parametric fundamentals to create and manipulate geometric models using N	NURB	S and	solid	3.
4. pro	vide cle	ear understanding of CAD systems for 3D modeling and viewing.				
	D syste		er of a	stand	lards i	1
UNIT I	IN	TRODUCTION TO COMPUTER GRAPHICS FUNDAMENTAL				
Circle A	Algorith	ithm - DDA, Bresenham's and Parallel Line Algorithm. Circle generating m. Geometric Transformations: Coordinate Transformations, Windowir formations - Translation, Scaling, Shearing, Rotation and Reflection, Compose.	ng an	d Cl	ipping	,
UNIT II		URVES AND SURFACES MODELLING				
	4706000	SKYES AND SURFACES MODELLING				
Introduc			ite cub	ic snl	ine- B	e
	tion to	curves - Analytical curves: line, circle and conics - synthetic curves: Hermit				
curve an	tion to	curves - Analytical curves: line, circle and conics - synthetic curves: Hermitine curve - curve manipulations. Introduction to surfaces - Analytical surface	es: Pla	ne su	rface,	rı
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	COURSE OUTCOMES At the end of the course, the students will be able to					
CO1	solve 2D and 3D transformations for the basic entities like line and circle.	Understanding (K2)				
CO2	formulate the basic mathematics fundamental to CAD system.	Applying (K3)				
CO3	use the different geometric modeling techniques like feature based modeling, surface modeling and solid modeling.	Understanding (K2)				
CO4	create geometric models through animation and transform them into real world systems	Applying (K3)				
CO5	simulate assembly of parts using Computer-Aided Design software.	Applying (K3)				

- 1. Ibrahim Zeid, "Mastering CAD/CAM", McGraw Hill, 2nd Edition, 2006.
- 2. Boothroyd, G, "Assembly Automation and Product Design" Marcel Dekker, New York, 1997.
- Chitale A.K and Gupta R.C "Product design and manufacturing "PHI learning private limited, 6th Edition, 2015.
- David Rogers, James Alan Adams "Mathematical Elements for Computer Graphics" 2nd Edition, Tata McGraw-Hill edition.2003

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					
CO1	3	3	3	2	3	1					
CO2	3	2	3	2	3	1					
C03	3	2	3	2	3	1					
CO4	3	2	3	-	3	1					
CO5	3	3	3		3	1					



PED2	23104		VIBRA	TION ANALY	SIS AND CONT	ROL	3	1	0	4
COU	RSE (OBJECTI	VES							
To en	able t	he students	sto							
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2. c	alcula	te the natu	ral frequencies an	d mode shapes o	of the two degree	freedom system	ıs	-		
			ural frequencies a					syste	ms	
4. le	earn th	ne fundame	entals of control te	chniques of vibr	ration and noise le	evels				
5. u	se the	instrumen	ts for the measuring	ng and analyzing	g the vibration lev	els in a body				
UNIT	I	FUNDA	MENTALS OF V	IBRATION				T		1
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Single	Degr	ee Freedon	n Systems -Vibrat	ion isolation Vib	brometers and acc	elerometers - R	Response to	Arbi	trary	ar
non- h	armoi	nic Excitati	ions – Transient V	ibration –Impul	se loads, Critical	Speed of Shaft-	-Rotor syste	ms.		
UNIT	II	TWO DI	GREE FREEDO	OM SYSTEM						1
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UNIT										
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CO2	determine the natural frequencies and mode shapes of the two degree freedom systems.	Applying (K3)
CO3	calculate the natural frequencies and mode shapes of the multi degree freedom and continuous systems	Understanding (K2)
CO4	control the vibration and noise levels in a body	Applying (K3)
CO5	measure and analyze the vibration levels in a body	Applying (K3)
DEEE	DENCES	

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CO - PO MAPPING

CO	Programme Outcomes(POs)										
COs _	PO1	PO2	PO3	PO4	PO5	PO6					
CO1	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					
CO5	3	3	3	2	1	÷					



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2. b	e fami	liar with	data c	ollec	ction	and l	iteratu	ire sui	rvey p	rocess	į.									
3. k	now th	e statis	ical co	ncep	ts in	expe	iment	ation												
4. ac	cquire	knowle	dge in	writii	ng re	searc	h prop	osal												
5. le	earn ab	out pate	nt righ	ts an	d its	impo	rtance	;												
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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)											
cos –	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	3	3	3	1	_	(<u>a</u>						
CO2	3	3	-	1	2	-						
CO3	3	3	3	2	2	720						
CO4	3	3	-	=	1	1						
CO5	3	_	-	2	2	3						



PAC	220101	ENGLISH FOR RESEARCH PAPER WRITING		2 (0	(
COL	URSE (OBJECTIVES				ī
То е	enable tl	he students to				ī
1.	improv	e the writing skills and level of readability.				ī
2.	learn al	bout what to write in each section and to understand the skills required to develo	p a tit	le.		
3.	choose guidelii	a topic of interest and paraphrase, summarize, using correct attribution and foll nes.	lowing	doc	ument	ati
4.	craft a	research paper in their discipline.				
5.	ensure	the good quality of a research paper at first-time submission				Ī
UNI	TI	PLANNING AND PREPARATION				
Reme		f Words; Breaking up long sentences; Structuring Paragraphs and Sentences Redundancy, Avoiding Ambiguity and Vagueness. Expressing independent thou				
UNI	923 - 25 27 20	LITERATURE REVIEWS AND CITATIONS				
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		view of all current research in their field; Review of the Literature; Methods; Review of the Literature; Review of the L	,	2150	abbion	a
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CO ₂	understand the basics of citations, avoiding plagiarism and literature reviews	Applying (K3)
CO3	write paraphrase, results and conclusions.	Understanding (K2)
CO4	culminate the actual crafting and revising of a research paper	Applying (K3)
CO5	use suitable vocabulary, grammar and punctuation to write flawless piece of writing	Applying (K3)

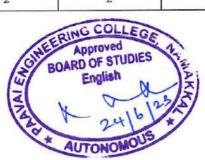
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 2011

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	
CO1	(6)	-	=	2	7 4 0	1	
CO2		3	-	2	2	2	
CO3	-	1	-	(4)			
CO4		-	-	3	-	-	
CO5	4	2	2	3	-	-	



PED	23105	COMPUTER AIDED DESIGN LABORATORY	0	0	4	2
COU	RSE OBJECT	TIVES				
To er	nable the studer	ats to				
1. l	understand sket	ches for given mechanical component				
2.]	learn features of	f the software for solid modeling and surface modeling with the help of	software	tools		
3. 1	model and asser	nble mechanical components like couplings, joints, Engine parts and mis	scellaneou	ıs co	mpoi	nents
4. 1	gain knowledge	on drafting and form layouts for assembled components				
CID	INTEROPTION	TON.		_		

CAD INTRODUCTION

- 1. Sketcher
- 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.

100	TOTA	AL PERIODS:			
	SE OUTCOMES end of the course, the students will be able to	BT MAPPED (Highest Level)			
CO1	create sketches for given mechanical component	Understanding (K			
CO2	use features of the software to develop solid modeling and surface modeling	Applying (K3)			
CO3	modeling and assembling of mechanical components like couplings, joints. Engine parts and miscellaneous components	Understanding (K			
CO4					

CO - PO MAPPING

COs	Programme Outcomes(POs)								
cos	PO1	PO2	PO3	PO4	PO5	PO6			
CO1	3	T-E	3	2	3				
CO2	3	1.6	3	2	3	-			
CO3	3	-	3	2	3	-			
CO4	3	:-	3	2	3	_			



PE	D23201	FINITE ELEMENT METHODS IN MECHANICAL DESIGN	3	1	0	4
CO	URSE (OBJECTIVES				
То	enable t	ne students to		-		
1.	learn m	athematical models for one dimensional problems and their numerical solution	ns			
2.	learn tv	vo dimensional scalar and vector variable problems to determine field variable	S			
3.	learn is	oparametric transformation and numerical integration for evaluation of elemen	nt matrices			-
4.	study v	arious solution techniques to solve Eigen value problems				Ī
5.	learn so	olution techniques to solve non-linear problems				
UN	ITI	FINITE ELEMENT ANALYSIS OF ONE DIMENSIONAL PROBLEM	S		П	12
His	torical B	ackground – Weighted Residual Methods - Basic Concept of FEM – Variationa	al Formula	tion o	of B.	V.P.
		od – Finite Element Modelling – Element Equations – Linear and Higher order ents – Applications to Heat Transfer problems.	r Shape fur	nctio	ns —]	Bar,
UN	II II	FINITE ELEMENT ANALYSIS OF TWO DIMENSIONAL PROBLEM	1S			12
Bas	ic Bound	lary Value Problems in two-dimensions - Linear and higher order Triangular,	quadrilater	al ele	emen	ts –
Poi	sson's ar	d Laplace's Equation - Weak Formulation - Element Matrices and Vectors	- Applica	tion	to sc	alar
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CO3	apply iso-parametric transformation and numerical integration for evaluation of element matrices	Applying (K3)
CO4	apply various solution techniques to solve Eigen value problems	Applying (K3)
CO5	formulate solution techniques to solve non-linear problems	Applying (K3)

- 1. Bathe K.J., "Finite Element Procedures in Engineering Analysis", Prentice Hall, 1990
- 2. David Hutton, "Fundamentals of Finite Element Analysis", Tata McGrawHill, 2005
- 3. Rao, S.S., "The Finite Element Method in Engineering", 6th Edition, Butterworth Heinemann, 2018.
- 4. Reddy, J.N. "Introduction to the Finite Element Method", 4th Edition, Tata McGrawHill, 2018

CO - PO MAPPING

COs	Programme Outcomes(POs)					
cos	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



	D2320	22 INTEGRATED PRODUCT DEVELOPMENT	3	0	0	3
CC	URSE	E OBJECTIVES				- 816
То	enable	e the students to				
1.	unde	rstand the principles of development process, product planning and customer nee	ed analysi	s		
2.	enhar	nce the understanding of product specifications, generate, screen and test concept	ts			
3.	apply	the principles of product architecture and the importance of industrial design pri	inciples			
4.	expos	se the different Prototyping techniques for developing robust design				
5.	learn	the concepts of economics principles and project management practices				
UN	IT I	INTRODUCTION TO PRODUCT DESIGN	.vie			9
Cha	aracteri	istics of Successful Product development -Duration and Cost of Product Development	opment –	Cha	lleng	es of
Pro	duct D	Development - Product Development Processes and Organizations - Product Plan	nning Pro	ocess	- Pro	cess
of I	dentify	ying Customer Needs.				
UN	IT II	PRODUCT SPECIFICATIONS, CONCEPT GENERATION, SELECTI	ON ANI)	Г	9
		TESTING				
Est	ablish '	Target and Final product specifications – Activities of Concept Generation –	Concept	Scre	l ening	and
		Concept Testing Methodologies.	•			
	1,000					
UN	III III	PRODUCT ARCHITECTURE AND INDUSTRIAL DESIGN				9
			ion – Plat	form	Plan	9 ning
Pro	duct A	rchitecture – Implications and establishing the architecture – Delayed Differentiat				ning
Pro – R	duct A	rchitecture – Implications and establishing the architecture – Delayed Differentiat system level design issues - Need and impact of industrial design - Industrial design				ning
Pro – R	duct Arelated s	rchitecture – Implications and establishing the architecture – Delayed Differentiat system level design issues - Need and impact of industrial design - Industrial design ustrial design process - assessing the quality of industrial design.	n process			ning
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CO5	exhibit knowledge on the	e concepts	of economics	principles	and project	Applying (K3)
	management practices					

- Karl T.Ulrich, Steven D.Eppinger, Anita Goyal, "Product Design and Development", McGraw -Hill Education (India) Pvt. Ltd, 4th Edition, 2012.
- Kenneth Crow, "Concurrent Engineering/Integrated Product Development". DRM Associates, 6/3, Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book
- Kevin N Otto, Kristin L Wood, "Product Design Techniques in Reverse Engineering and New Product Development", Pearson Education, Inc, 2016.
- 4. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin Homewood, 1992.

CO - PO MAPPING

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



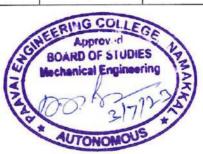
0 0 3	3	D23203 MECHANICAL BEHAVIOR OF MATERIALS
		URSE OBJECTIVES
		enable the students to
		learn different strengthening and failure mechanism of the metals
		understand the behavior of materials under different types of loads
		know various aspects of selection of materials and processing
		get exposed to modern metallic materials and their composition
		gain knowledge on non-metallic materials for engineering applications
		IT I BASIC CONCEPTS OF MATERIAL BEHAVIOR
Strengthenin	properties, S	ineering Design process and the role of materials; materials classification and their
trengthening	boundary st	hanisms-grain size reduction, solid solution strengthening, strain hardening, grain
ate on plasti	and strain ra	cipitation, particle, fibre and dispersion strengthening, Effect of temperature, strain a
		avior-Super plasticity-Failure of metals.
	ES	IT II BEHAVIOUR UNDER CYCLIC LOADS AND DESIGN APPROACH
hanisms and	fracture mec	ss intensity factor and fracture toughness-Fatigue low and high cycle fatigue test, f
		s lawEffect of surface and metallurgical parameters on fatigue- Safe life, Stress-life
	e, strain-life	s lawEffect of surface and metandigical parameters on rangue— safe file, stress-file
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and fail-saf		gn approaches-Fracture of non-metallic Materials-Failure analysis, sources of failure,
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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)

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CO - PO MAPPING

-			Programme (Outcomes(POs)		
COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	2	1
CO2	3	2	1	1	2	1
CO3	3	2	1	1 -	2	1
CO4	3	2	1	1	2	1
C05	3	2	1	1	2	1



	D23204	ADVANCED MECHANICS OF MATERI	ALS	3	1	0	4
CC	URSE O	BJECTIVES					
То	enable th	e students to				-37	
1.	learn the	e concepts of theory of elasticity in three-dimensional stress sys	tem.				
2.	study th	e shear center of various cross-sections and deflections in beam	s subjected to	unsymme	trica	l ben	ding
3.	acquire	knowledge on the stresses in flat plates and curved members.					
4.	understa	and torsional stress of non-circular sections.					
5.	know th	e stresses in rotating members, contact stresses in point and line	e contact appl	ications.			
UN	ITI	ELASTICITY					12
Stre	ess-Strain	relations and general equations of elasticity in Cartesian, Polar a	and curvilinea	r coordinat	es, d	iffere	entia
equ	ations of	equilibrium - compatibility - boundary conditions - representa	ntion of three	- dimensio	nal:	stress	of a
tens	sion gener	ralized hook's law - St. Venant's principle - plane stress - Airy's	stress function	on. Energy	met	hods.	
UN	II II	SHEAR CENTRE AND UNSYMMETRICAL BENDING					12
Loc	ation of	shear center for various thin sections - shear flows. Stresses a	nd Deflection	ns in beam	s su	biect	ed to
		al loading-kern of a section.				J	
ULI		STRESSES IN FLAT PLATES AND CURVED MEMBER	es				12
		STRESSES IN FLAT PLATES AND CURVED MEMBER see and radial stresses – deflections - curved beam with restre		closed rin	a cul	niecto	12
Circ	cumference	ce and radial stresses - deflections - curved beam with restre	ained ends -		_		ed to
Circ	cumference centrated	ce and radial stresses - deflections - curved beam with restra load and uniform load - chain links and crane hooks. Solution of	ained ends -		_		ed to
Circ con plat	cumference centrated es – defle	ce and radial stresses – deflections - curved beam with restra load and uniform load - chain links and crane hooks. Solution of action – uniformly distributed load – various end conditions.	ained ends -		_		ed to
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- 2. Hibbeler. R.C., "Mechanics of Materials", Prentice-Hall, 2018.
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CO - PO MAPPING

COs			Programme (Outcomes(POs)		
cos	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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CO	URSE	OBJECTIVES			
То	enable	the students to			
1.	unders	stand the aims, objectives and educational philosophies of education.			
2.	acquir	te the knowledge of Instructional objectives of teaching and teaching skills.			
3.		the knowledge of methods and strategies of teaching in real classroom situation.			-
4.	utilize	the instructional aids and tools for effective classroom teaching.	-	-	
5.	acquai	int with the knowledge of professional development of teachers.			7
UNI	TI	EDUCATION AND ITS PHILOSOPHY		T	
Educ	cation-	Definition, Aims, Objectives, Scope, Educational philosophy of Swami Vivekananda, I	Mahatr	na Ga	ndh
		th Tagore, Sri Aurobindo and J.Krishnamoorthy, Montessori, Jean - Jacques Rou			
		d John Dewey. Current trends and issues in Education - Educational reforms and No			
		1968 and 1986 - its objectives and features.		•	. (21.4)
UNI	TII	INSTRUCTIONAL OBJECTIVES AND DESIGN		T	_
Instr	uctiona	ol Objectives: Taxonomy of Educational objectives - Writing of general and specific	ecific	object	ives
		design. I laming and designing the lesson, writing of lesson plan; meaning its need	and in	nnorts	nce
		al design: Planning and designing the lesson, Writing of lesson plan: meaning, its need			
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PRACTICUM

- Writing of three lesson plans
- Practice teaching for 15 days
- Preparation of one teaching aid
- A seminar on one educational philosophy
- · Assignment on any of these five units

RSE OUTCOMES	BT MAPPED
end of the course, the students will be able to	(Highest Level)
explain the educational philosophies of education.	Understanding (K2)
write instructional and specific objectives in lesson plan.	Applying (K3)
utilize the teaching skills and methods effectively.	Understanding (K2)
use instructional media efficiently.	Applying (K3)
update themselves in the area of professional development.	Applying (K3)
	write instructional and specific objectives in lesson plan. utilize the teaching skills and methods effectively. use instructional media efficiently.

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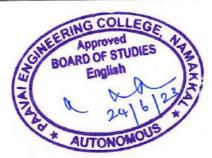
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CO - PO MAPPING

Mapping of Course Outcomes with Programme Outcomes:

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

COs			utcomes(POs)			
COs _	PO1	PO2	PO3	PO4	PO5	PO6
CO1	, -	2	-	3	-	-
CO2	-	-		-	Œ	_
CO3	-	-	-	3	2	3
CO4	1	-	-	-	3	3
CO5	-	-	-	3	. 3	3



PEL	023205	SIMULATION AND ANALYSIS LABORATORY	0	0	4	2
COI	URSE OBJEC	TIVES				
То	enable the stude	nts to				
1.	learn behaviou	r of machine elements under static loads				
2.	gain knowledg	e on the analysis of mechanical systems under thermal loads				
3.	use commercia	software packages to simulate stress analysis of axis-symmetric comp	onents			
4.	study response	of different mechanisms using kinematics and dynamics simulation so	ftware			
LIS	COF EXPERI	MENTS		-		

Analysis of Mechanical Components - Use of commercial FEA Packages

Exercises shall include analysis of

- 1. Machine elements under Static loads
- 2. Thermal Analysis of mechanical systems
- 3. Modal Analysis
- 4. Stress Analysis of an Axis -Symmetric Component
- 5. Machine elements under Dynamic loads
- 6. Harmonic Response Analysis
- 7. Non-linear systems
- 8. Use of kinematics and dynamics simulation software
- 9. Analysis of velocity and acceleration for mechanical linkages of different mechanisms.

	. T	OTAL PERIODS:	60
COU	RSE OUTCOMES	BT MAPPED	
At the	end of the course, the students will be able to	(Highest Level)
CO1	analyze behavior of machine elements under static loads	Analyzing (K4)
CO2	demonstrate the analysis of the mechanical systems under thermal loads	Applying (K3)	
CO3	simulate and study the stress analysis of axis-symmetric components	Understanding	(K2)
CO4	use kinematics and dynamics simulation software to study response of diff mechanisms	Perent Applying (K3)	

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 C	outcomes(POs)	20	
COS	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	3	2
CO2	3	3	3	2	3	2
CO3	3	3	3	2	3	2
CO4	3	3	3	2	3	2



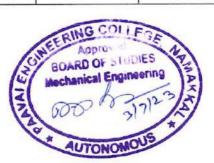
PE	D23151	DESIGN FOR SUSTAINABILITY 3	0 0	T	3
CC	URSE	OBJECTIVES			
To	enable t	the students to			
1.	identif	by the relevant process; applying the general design principles for manufacturability; GD &	T.		Ŧ
2.	learn t	he design considerations while designing the cast and welded components.			
3.	know t	the design considerations while designing the formed and machined components.			
4.	apply o	design considerations for assembled systems.			Т
5.	gain kı	nowledge design considerations for environmental issues.			
UN	TTI	INTRODUCTION			9
syn	ation to bols.	cast and weller components design	pplem	enta	
STREETS	2000000000	siderations for: Sand cast – Die cast – Permanent mold parts. Arc welding – Design consid			9
Cos	t reduct				
for:		ion – Minimizing distortion – Weld strength – Weldment. Resistance welding–Design co eam–Projection–Flash and Upset weldment. FORMED AND MACHINED COMPONENTS DESIGN			ns
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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)

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CO - PO MAPPING

COs			Programme (Outcomes(POs)		
cos	PO1	PO2	PO3	PO4	PO5	PO6
CO1	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



	023152	MECHANICS OF COMPOSITE MATERIALS	3	0	0	3
CO	URSE	OBJECTIVES		_		
То	enable t	he students to		Т		Ť
1.	learn t	he significance and future enhancements in composite materials.				
2.	analyz	e the geometric and physical properties of typical composite materials.				T
3.	unders	tand the concepts of mathematical relations and mechanical properties.				
4.	get kno	owledge in failure theories and strength parameters.				
5.	design	and analyze the structure and various laminates of composite materials.				
UNI	TI	INTRODUCTION				9
		tics, Overview of advantage and limitations of composite materials, Significanterials, Science and technology, current status and future prospectus.	cance and	obj	ective	es of
	TII	BASIC CONCEPTS AND CHARACTERISTICS				9
Stru	ctural	l performance of conventional material, Geometric and physical definition	on, Mater	ial	respo	onse
		on of composite materials, Scale of analysis; Micromechanics, Basic lamina and properties, Properties of typical composite materials.	properties	s, C	onstit	tuent
	TIII	ELASTIC BEHAVIOR OF UNIDIRECTIONAL LAMINA				9
V-000000000000000000000000000000000000		relations, Relation between mathematical and engineering constants, transfo	ation of	F admi		- 3
ouc.	33-3tran	relations, relation between mathematical and engineering constants, transfo	THINKHH (1)	SILE	255. S	
and	elastic p	parameters.	mation of		.,.	пап
	elastic _I	STRENGTH OF UNIDIRECTIONAL LAMINA				
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UNI Mici	T IV	STRENGTH OF UNIDIRECTIONAL LAMINA				9
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UNI Microtheon UNI Basi mon struc COI At the	T IV romecharies, Ap T V c assument resetural co	STRENGTH OF UNIDIRECTIONAL LAMINA anics of failure; failure mechanisms, Macro-mechanical strength parameters, Macro-mechanical strength parameter	a laminates PERIOD BT MAP (Highest	e, F PPEI Leve	cal fa Corce esign 4 D el)	9 and for
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CO - PO MAPPING

COs	Programme Outcomes(POs)					
cos	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	-	2	
CO2	3	3	2	-	2	(a)
CO3	3	3	2	-	2	1.00
CO4	3	3	2	9	2	-
CO5	3	3	2	-	2	1 2



PE	D23153	DESIGN OF HYDRAULIC AND PNEUMAT	TIC SYSTEMS	3	0	0	3
CC	OURSE	OBJECTIVES					
То	enable	the students to					
1.	familia	arize the students with various hydraulic systems and hydrau	ic actuators.				
2.	unders	stand the control elements and actuation systems.					
3.	learn t	o design Hydraulic circuits effectively.					
4.	acquir	e knowledge to design the pneumatic systems and circuits.					
5.	know	about pneumatic equipment's, design calculation and use of i	nicroprocessors				
UN	IT I	OIL HYDRAULIC SYSTEMS AND HYDRAULIC AC	TUATORS				9
Ну	draulic	Power Generators - Selection and specification of pumps,	pump characteri	stics. Line	ar an	d Ro	otary
Act	tuators –	- selection, specification and characteristics.					
UN	II II	CONTROL AND REGULATION ELEMENTS					9
Pre	ssure - c	direction and flow control valves - relief valves, non-return a	nd safety valves -	actuation	syste	ms.	
UN	III TII	HYDRAULIC SYSTEMS AND CIRCUITS					9
Rec	ciprocati	ion, quick return, sequencing, synchronizing circuits - accum	ulator circuits - i	ndustrial c	ircui	ts — J	press
circ	cuits - h	ydraulic milling machine - grinding, planning, copying, -	forklift, earth mo	ver circuit	s- de	esign	and
sele	ection of	f components - safety and emergency mandrels.					
UN	IT IV	PNEUMATIC SYSTEMS AND CIRCUITS					9
Pne	umatic	fundamentals - FRL unit - control elements, position and pro	essure sensing – l	ogic circui	ts – s	wite	hing
circ	uits - fri	inge conditions modules and these integration -sequential circ	uits - cascade met	thods - map	ping	met	hods
– st	ep coun	ter method -compound circuit design - combination circuit de	esign.				
UN	IT V	INSTALLATION, MAINTENANCE AND SPECIAL C	IRCUITS				9
Pne	eumatic	equipment's- selection of components - design calculation	ns - application	-fault fin	ding	- h	ydro
pne	umatic o	circuits - use of microprocessors for sequencing -PLC, Low of	ost automation -F	Robotic circ	uits.		
		<u> </u>	ТОТА	L PERIOI	S:	4	15
CO	URSE (OUTCOMES		BT MAI	PEI)	
At 1	the end o	of the course, the students will be able to		(Highest	Leve	el)	
СО	1 de	emonstrate knowledge on hydraulic power generator, pur	nps and various	Understa	ndin	σ (K'	2)
	ac	ctuators.			-		-,
CO	10	entify proper control and regulation elements.		Applying	(100 to 1		
CO		esign appropriate hydraulic circuits for various Engineering a	pplications.	Understa			2)
CO		escribe design procedure for pneumatic circuits.		Applying		(C)	
CO.		elect suitable components for designing hydro pneumatic circ	uits.	Applying	(K3)	
RE.	FEREN	ICES					
1.	Anton	y Espossito, "Fluid Power with Applications", Prentice Hall,	2013				

- 2. Bolton. W., "Pneumatic and Hydraulic Systems", Butterworth Heinemann, 1997
- 3. Andrew Parr, "Hydraulic and Pneumatics" (HB), Jaico Publishing House, 2011.
- K.Shanmuga Sundaram, "Hydraulic and Pneumatic Controls: Understanding made Easy" S.Chand & Co Book publishers, New Delhi, 2006 (Reprint 2009).

CO - PO MAPPING

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



PED:	23154	TRIBOLOGY IN DESIGN		3	0	0
COU	RSE	OBJECTIVES				
To er	nable	he students to				
1. i	mpart	the knowledge in friction and surface measurement				
2. ι	ınders	tand the basics of theories of wear and wear prevention				
3. 1	earn t	he bearing material properties which influence the tribological characteristics	of surfa	ces a	nd lu	brica
4. k	now a	about the design of bearings and its types				
5. g	gain ki	nowledge on the analytical behavior and design of bearings based on analytic	al/theore	tical	appro	oach
UNIT	ΓI	FRICTION AND SURFACE MEASUREMENT				-
stick-	slip m	eories of friction, Friction control, Surface texture and measurement, genesis cotion. WEAR	of friction	i, ins	tabili	ties a
2000		s of wear, theories of wear, wear prevention.				
UNIT		BEARING MATERIALS AND LUBRICANTS			_	
		DEARING MALERIALS AND LUBRICANTS			- 1	
Who can constitution of						
Tribo UNIT	logica `IV	l properties of bearing materials and lubricants. BEARINGS				
Tribo UNIT Lubric show	logica IV cation slider	l properties of bearing materials and lubricants. BEARINGS , Reynolds's equation and its limitations, idealized bearings, infinitely longs, infinitely long and infinitely short (narrow) journal bearings, lightly loads				
Tribo UNIT Lubric show	Iogical IV cation slider	l properties of bearing materials and lubricants. BEARINGS , Reynolds's equation and its limitations, idealized bearings, infinitely long	ed infin			d fix journ
Tribo UNIT Lubric show bearin UNIT Hydro applic	cation slider Y v estatic estatic estatic estatic	l properties of bearing materials and lubricants. BEARINGS Reynolds's equation and its limitations, idealized bearings, infinitely long s, infinitely long and infinitely short (narrow) journal bearings, lightly load troff's solution), Finite Bearings, Design of hydrodynamic journal bearings.	FION ds, pistor	itely	long	journ
Tribo UNIT Lubric show bearin UNIT Hydro applic	cation slider Y v estatic estatic estatic estatic	I properties of bearing materials and lubricants. BEARINGS Reynolds's equation and its limitations, idealized bearings, infinitely long s, infinitely long and infinitely short (narrow) journal bearings, lightly load troff's solution), Finite Bearings, Design of hydrodynamic journal bearings. THEORY OF HYDROSTATIC AND HYDRODYNAMIC LUBRICAT squeeze film Circular and rectangular flat plates, variable and alternating load to journal bearings. Elasto-hydrodynamic lubrication – pressure viscosity terry, lubrication of spheres, gear teeth, Air lubricated bearings.	FION ds, pistor	n pin	long lubric	journ
Tribo UNIT Lubric show bearin UNIT Hydro applic Hertz	cation slider (Per V estation theory) theory	I properties of bearing materials and lubricants. BEARINGS Reynolds's equation and its limitations, idealized bearings, infinitely long s, infinitely long and infinitely short (narrow) journal bearings, lightly load troff's solution), Finite Bearings, Design of hydrodynamic journal bearings. THEORY OF HYDROSTATIC AND HYDRODYNAMIC LUBRICAT squeeze film Circular and rectangular flat plates, variable and alternating load to journal bearings. Elasto-hydrodynamic lubrication – pressure viscosity terry, lubrication of spheres, gear teeth, Air lubricated bearings.	FION ds, pistor m in Rey	n pin	lubric s's eq	jourr
Tribo UNIT Lubric show bearin UNIT Hydro applic Hertz	cation slider og (Pe V vostation theorem)	I properties of bearing materials and lubricants. BEARINGS , Reynolds's equation and its limitations, idealized bearings, infinitely long s, infinitely long and infinitely short (narrow) journal bearings, lightly load troff's solution), Finite Bearings, Design of hydrodynamic journal bearings. THEORY OF HYDROSTATIC AND HYDRODYNAMIC LUBRICAT squeeze film Circular and rectangular flat plates, variable and alternating load to journal bearings. Elasto-hydrodynamic lubrication – pressure viscosity termy, lubrication of spheres, gear teeth, Air lubricated bearings. TOTA	FION ds, pistor in Rey	n pin mold:	lubric s's eq	d fix journ cation quatic
Tribo UNIT Lubric show bearin UNIT Hydro applic Hertz	cation slider of V vostation theorem	I properties of bearing materials and lubricants. BEARINGS Reynolds's equation and its limitations, idealized bearings, infinitely long s, infinitely long and infinitely short (narrow) journal bearings, lightly load troff's solution), Finite Bearings, Design of hydrodynamic journal bearings. THEORY OF HYDROSTATIC AND HYDRODYNAMIC LUBRICAT squeeze film Circular and rectangular flat plates, variable and alternating load to journal bearings. Elasto-hydrodynamic lubrication – pressure viscosity termy, lubrication of spheres, gear teeth, Air lubricated bearings. TOTA	TION ds, pistor m in Rey AL PERI	n pin mold:	lubric s's eq S: PED Level)	journ cation quatic
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Tribo UNIT Lubric show bearin UNIT Hydro applic Hertz COUL At the	cation slider by V ostation theorem RSE (und acquapp a pa	I properties of bearing materials and lubricants. BEARINGS , Reynolds's equation and its limitations, idealized bearings, infinitely long as, infinitely long and infinitely short (narrow) journal bearings, lightly load troff's solution), Finite Bearings, Design of hydrodynamic journal bearings. THEORY OF HYDROSTATIC AND HYDRODYNAMIC LUBRICAT squeeze film Circular and rectangular flat plates, variable and alternating load to journal bearings. Elasto-hydrodynamic lubrication – pressure viscosity termy, lubrication of spheres, gear teeth, Air lubricated bearings. TOTA OUTCOMES of the course, the students will be able to erstand theories of friction and surface measurement uire knowledge on the theories of wear and prevention of wear repriately select materials and lubricants and suggest a tribological solution to	TION ds, pistor m in Rey AL PERI (High Unde	IODS IODS IVING	lubric s's eq S: PED Level) ding (K3)	cation 45

- 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

COs	Programme Outcomes(POs)						
cos _	PO1	PO2	PO3	PO4	PO5	PO6	
CO1	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	
CO5	3	3	3	3	1 -	1	



PED	23155	ADVANCED MECHANISMS IN DESI	GN	3	0	0	3
COU	URSE (DBJECTIVES					
To e	enable tl	he students to	7				
1.	learn the	he concepts of gross motion capability and develop multi- nisms	loop kinematic	chains a	nd e	quiva	alent
2.	study c	omplex mechanisms to determine velocity and acceleration of o	output links.				
3.	locate i	inflection points and to draw the inflection circle					
4.	gain kn	owledge on the synthesis of planar mechanisms					
5.	compre	hend design of six bar coupler driven mechanisms and cam me	chanisms				
UNI	TI	INTRODUCTION					9
analy	ysis – fo	fundamentals of kinematics-classifications of mechanisms-contraction of one D.O.F. multi loop kinematic chains, Network furctures of serial and parallel robot manipulators-Compliant me	ormula – Gross 1	motion c	once	pts-B	asic
UNIT	TII	KINEMATIC ANALYSIS		100			9
hor 1	inkanga	Analytical methods for valority and application Analysis	four hon linker	a iaula aa	1	.:- D	1
comp	olex me	s. Analytical methods for velocity and acceleration Analysis- chanisms-auxiliary point method. Spatial RSSR mechanism-De- kinematics of robot manipulators.		and the second of the second	occupant.		
comp	olex me	chanisms-auxiliary point method. Spatial RSSR mechanism-De		and the second of the second	occupant.		vard
comp and in	nverse	chanisms-auxiliary point method. Spatial RSSR mechanism-Denkinematics of robot manipulators.	navit-Hartenberg	Paramet	ers-	- Forv	vard 9
and in UNIT	nverse in T III d and m	chanisms-auxiliary point method. Spatial RSSR mechanism-Dekinematics of robot manipulators. PATH CURVATURE THEORY, COUPLER CURVE	navit-Hartenberg	Paramet	ers -	Forv	yard 9
comp and in UNIT Fixed – cub	nverse in T III d and m	chanisms-auxiliary point method. Spatial RSSR mechanism-Deckinematics of robot manipulators. PATH CURVATURE THEORY, COUPLER CURVE avoing centrodes, inflection points and inflection circle. Euler Stationary curvature. Four bar coupler curve-cusp -crunode - couplements and couplements are coupled at the couplements of the couplements are coupled at the couplements are c	navit-Hartenberg	Paramet	ers -	Forv	yard 9
and in UNITE Fixed — cub line n	nverse in the inverse	chanisms-auxiliary point method. Spatial RSSR mechanism-Deckinematics of robot manipulators. PATH CURVATURE THEORY, COUPLER CURVE avoing centrodes, inflection points and inflection circle. Euler Stationary curvature. Four bar coupler curve-cusp -crunode - couplements and couplements are coupled at the couplements of the couplements are coupled at the couplements are c	navit-Hartenberg	Paramet	ers -	Forv	9 ions ight
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and in UNIT Fixed — cub line n UNIT Type path	T III d and moic of stancehants	chanisms-auxiliary point method. Spatial RSSR mechanism-Deckinematics of robot manipulators. PATH CURVATURE THEORY, COUPLER CURVE doving centrodes, inflection points and inflection circle. Euler Stationary curvature. Four bar coupler curve-cusp -crunode - couplisms. SYNTHESIS OF FOUR BAR MECHANISMS sis – Number synthesis – Associated Linkage Concept. Dimen	avary equation, goler driven six-ba	graphical ar mechan — function	consismon ge	struct s-stra	9 9 ions ight
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compand in UNIT Fixed – cub line in UNIT Type path reduct Equat UNIT	T III d and m oic of sta mechan T IV synthe genera ction-tw tion-Ble T V	chanisms-auxiliary point method. Spatial RSSR mechanism-Deckinematics of robot manipulators. PATH CURVATURE THEORY, COUPLER CURVE doving centrodes, inflection points and inflection circle. Euler Stationary curvature. Four bar coupler curve-cusp -crunode - couplisms. SYNTHESIS OF FOUR BAR MECHANISMS sis – Number synthesis – Associated Linkage Concept. Dimentation, motion generation. Graphical methods-Pole technique to, three and four position synthesis of four- bar mechanism och's Synthesis. SYNTHESIS OF COUPLER CURVE BASED MECHANISMS MECHANISMS	avary equation, goler driven six-basional synthesis e inversion techs. Analytical me	graphical ar mechan — function hnique-pethods- F	consismon geoint	struct s-stra enerat posi lenste	99 ions, sons,
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compand in UNIT Fixed – cub line n UNIT Type path reduct Equat UNIT Hydro applic Hertz	T III d and m oic of sta mechan T IV synthe genera ction-tw tion-Blo T V costatic, cation to z' theory	chanisms-auxiliary point method. Spatial RSSR mechanism-Deckinematics of robot manipulators. PATH CURVATURE THEORY, COUPLER CURVE ationary curvature. Four bar coupler curve-cusp -crunode - couplisms. SYNTHESIS OF FOUR BAR MECHANISMS sis – Number synthesis – Associated Linkage Concept. Dimention, motion generation. Graphical methods-Pole technique, three and four position synthesis of four- bar mechanism och's Synthesis. SYNTHESIS OF COUPLER CURVE BASED MECHANISMS squeeze film Circular and rectangular flat plates, variable and also journal bearings. Elasto-hydrodynamic lubrication – pressure	avary equation, goler driven six-basional synthesis e inversion techs. Analytical message SMS & CAM eternating loads, possessity term in the total lateral possessity term in total la	graphical ar mechan — function hnique-pethods- F	consistence of the constant of	struct s-stra enerat posi lenste	9 ions ight 9 ion, tion in's

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)

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- 4. Uicker, J.J., Pennock, G. R. and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2017.

CO - PO MAPPING

Mapping of Course Outcomes with Programme Outcomes:

COs	Programme Outcomes(POs)										
cos	PO1	PO2	PO3	PO4	PO5	PO6					
CO1	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					



			PRODUC	T LIFE	CYCLE	SMANA	GEME	ENT		3	0	0	3
COURSE	OBJECTIV	/ES											Т
To enable	the students	to					and the second						
1. study l	history, cond	cepts and	terminolo	gy of PL	M								T
2. learn f	unctions and	d features	of PLM/F	PDM									
3. unders	stand differen	nt module	es offered	in comm	ercial Pl	LM/PDN	A tools						
4. demon	strate PLM/	PDM app	roaches fo	or indust	rial appl	lications							
5. use PL	M/PDM wit	th legacy	data bases	, CAx &	ERP sy	stems				da ni			
UNIT I	HISTOR	Y, CONC	CEPTS AN	ND TER	MINOI	LOGY (F PLM						12
Introduction	n to PLM,	Need for	PLM, o	pportuni	ties of	PLM, D	ifferent	views of	PLM -	Engir	neer	ing 1	Data
Managemen	nt (EDM), P	roduct Da	ata Manag	gement (I	PDM), C	Collabora	tive Pro	duct Defin	nition Ma	nagem	ent	(cPI	m)
	ve Product												
	d Communi												
UNIT II	PLM/PDN												10
User Functi	ions – Data	Vault and	Documen	t Manag	ement, V	Workflo	w and P	rocess Mai	nagement	Produ	uct	Struc	
	II. Product	Classifica	ation and	Progran	nme Ma	anageme	nt I Itil	ity Functi	one (A 133 133 134	2100		
					nme Ma								
Notification	n, data transp	oort, data	translation	i, image	services,	, system	adminis						
Notification UNIT III	n, data transp	oort, data	translation	n, image :	services, M/PLM	, system	adminis						
Notification UNIT III Case studies	DETAILS s based on to	oort, data	translation DULES I mmercial	n, image : N APDN PLM/PD	services, M/PLM	, system	adminis						
Notification UNIT III Case studies UNIT IV	DETAILS s based on to	oort, data of OF MO op few con	translation DULES I mmercial	n, image s N APDN PLM/PD TRIES	services, M/PLM OM tools	SOFTV	adminis VARE	stration and	d applicat	ion int	egr	ation.	5
Notification UNIT III Case studies UNIT IV	DETAILS s based on to	oort, data of OF MO op few con	translation DULES I mmercial	n, image s N APDN PLM/PD TRIES	services, M/PLM OM tools	SOFTV	adminis VARE	stration and	d applicat	ion int	egr	ation.	5
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Notification UNIT III Case studies UNIT IV Case studies visioning, P barriers to I	DETAILS s based on to ROLE OF s on PLM s PLM strategy	oort, data of SOF MO op few construction of PLM IN the selection of the se	DULES I mmercial in INDUST and imple ceasibility	N APDM PLM/PD TRIES ementation study, cl	M/PLM OM tools on (like	softv softv auto, ae	vARE ro, elec	tration and tronic) - o	d applicate	sible so	ecto	ors, P	12 LM
Notification UNIT III Case studies UNIT IV Case studies visioning, P barriers to I	DETAILS s based on to ROLE OF s on PLM s PLM strategy	oort, data and oort,	DULES I mmercial N INDUST and imple easibility ten step	N APDN PLM/PD TRIES ementation study, clapproach	M/PLM OM tools on (like hange m	softv softv auto, ae nanagem M, benef	vARE ro, electent for	tronic) - o PLM, fina	other possurcial jus	sible so	ecto	ors, P	12 LM LM, ers,
Notification UNIT III Case studies UNIT IV Case studies visioning, P barriers to I product or se	DETAILS s based on to ROLE OF s on PLM s PLM strategy PLM implementation	oort, data of OF MO op few construction of PLM IN selection of PLM for the period of PLM CUST	DULES I mmercial NINDUST and imple leasibility ten step mance. COMISAT	N APDM PLM/PD TRIES ementation study, clarapproach	M/PLM OM tools on (like hange m to PLM	auto, ae nanagem	ro, electent for PDI	tronic) - copplete PLM, fina	other possuncial justiness, of	sible so tification	ecto	ors, Pof PL	12 LM LM, ers,
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CO - PO MAPPING

Mapping of Course Outcomes with Programme Outcomes:

COs _	Programme Outcomes(POs)										
cos –	PO1	PO2	PO3	PO4	PO5	PO6					
CO1	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					
CO5	3	3	1	3	3	2					



		SURFACE ENGINEERING	3 (0	3
To	URSE	OBJECTIVES			
	enable	the students to			
1.	learn t	he basics of surface features and different types of friction in metals and	d nonmetals.		
2.		e the different types of wear mechanism and international stands	ard used in friction	and	wear
3.	unders	tand the different types of corrosion and its preventive measures.			
4.	study 1	he different types of surface treatments and surface modification techni-	ques.	-	+
5.	compr	ehend different types of materials used in the friction and wear applicat	ions		
UN	ITI	FRICTION			7
of S	liding I	of Surfaces—Surface features — Properties and measurement—Surface Priction—Rolling Friction- Friction properties of metallic and nonmetallic Thermal considerations in sliding contact.			
UN	II TI	WEAR			6
		nt methods.	- 5		
	TIII	CORROSION		,	10
		n - Principle of corrosion - Classification of corrosion - Types of c	orrasion Fasters :	.f	10
			orrosion – raciois i	much	CHIE
COLL	osion-1	esting of corrosion-In-service monitoring. Simulated service Labor	ratory testing - Eva		-
		esting of corrosion–In-service monitoring, Simulated service, Labor Prevention of Corrosion – Material selection, Alteration of environmen		luatio	n of
corr	osion –	Prevention of Corrosion – Material selection, Alteration of environment Corrosion inhibitors – Corrosion methods.		luatio	n of
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corre Prote UNI	osion – ection, T IV	Prevention of Corrosion – Material selection, Alteration of environmen Corrosion inhibitors – Corrosion methods. SURFACE TREATMENTS	t, Design, Cathodic a	luation An	n of odic
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Prote UNI Intro	osion – ection, or T IV oduction ace trea	Prevention of Corrosion – Material selection, Alteration of environment Corrosion inhibitors – Corrosion methods. SURFACE TREATMENTS -Surface properties, Superficial layer–Changing surface metallurgy tments – Techniques – PVD – CVD – Physical CVD – Ion implantation	t, Design, Cathodic a -Wear resistant coan - Surface welding	luation and An artings	n of odic 12 and
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COUI	RSE OUTCOMES	BT MAPPED
At the	end of the course, the students will be able to	(Highest Level)
CO1	understand the basics of surface features, laws of friction and different types of friction	Understanding (K2)
CO2	develop the knowledge of various wear mechanism and its measurement	Applying (K3)
CO3	gain knowledge on the types of corrosion and its preventive measures	Understanding (K2)
CO4	familiarize the types of surface properties and various surface modification techniques	Applying (K3)
CO5	analyze the different types of materials used in the friction and wear applications	Analyzing (K4)
	The state of the s	

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CO - PO MAPPING

Mapping of Course Outcomes with Programme Outcomes:

COs	Programme Outcomes(POs)									
cos –	PO1	PO2	PO3	PO4	PO5	PO6				
CO1	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				
CO5	3	1	1	1	1	2				



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CO	URSE	OB.	ECTIV	ES								-					
То	enable	the s	tudents	to													
1.	study	the b	asic co	ncepts	of un	constrai	ined op	otimizatio	on tech	niques.							
2.	under	stanc	the bas	ic con	cepts	of cons	strained	doptimiz	zation te	chnique	es.						
3.	provid	le the	mathe	matical	l foun	dation o	of artifi	icial neur	ral netw	orks an	d swarı	n intellig	gence for	r desi	ign p	orob	lems
4.	imple	ment	optimiz	zation a	appro	aches a	and to se	elect app	propriate	es soluti	ion for	design ap	pplicatio	n.			
5.	demor	ıstra	e select	ed opti	imiza	tion alg	gorithm	s commo	only use	ed in sta	tic and	dynamic	applica	tions			
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CO5	evaluate solutions by various optimization approaches for a design problem.	Applying (K3)
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COs	Programme Outcomes(POs)										
COS	PO1	PO2	PO3	PO4	PO5	PO6					
CO1	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					



1050000	D23159		L MEASUREMENTS AND AN	VALISIS	3	0	0
		BJECTIVES	ar				
То		e students to					
1.		nd the principle of force and					
2.	41-	end the vibration measureme					
3.			nd acoustics and wind flow measu	urements.			
4.	familia	ze with the distress measurer	nents				
5.	realize	ne non-destructive testing pri					
UN	ITI	FORCES AND STRAIN M	EASUREMENT				
Stra	ain gaug	principle, types, performance	ce and uses. Photo elasticity-Prin	nciple and app	lications -N	Moire	Fı
Ну	draulic ja	ks and pressure gauges-Elec	tronic load cells-Proving Rings-C	Calibration of	Testing Ma	chines	
UN	IT II	VIBRATION MEASUREM	IENTS				
Cha	racterist	s of Structural Vibrations-	Linear Variable Differential Tr	ansformer (LV	VDT)– Tra	nsduc	er
velo	ocity and	acceleration measurements.	Vibration meter- Seismographs	- Vibration	Analyzer –	Displ	av
			oscope – XY Plotter – Chart Plott				
	тш		FLOW MEASUREMENTS		· · · · · · ·	J. 57.5	_
D :							
Prir	ciples o	Pressure and flow measurer		d laval mater			
			ments-pressure transducers-soun				
met	ers-win	tunnel and its use in structura	nents-pressure transducers-sound al analysis-structural modeling -d				
met UN	ers–wind	tunnel and its use in structura DISTRESS MEASUREME	ments-pressure transducers-sound all analysis-structural modeling -d	lirect and indir	ect model a	nalysi	S
met UN Dia	ers-wind IT IV gnosis o	tunnel and its use in structural DISTRESS MEASUREME. distress in structures—crack o	ments—pressure transducers—sound analysis—structural modeling—d NTS bservation and measurements—co	lirect and indirect	ect model a	nalysi	S
UN Dia Hal	ers-wind IT IV gnosis o f-cell, co	DISTRESS MEASUREME distress in structures—crack o struction and use – damage a	ments—pressure transducers—sound analysis—structural modeling—d NTS bservation and measurements—co ssessment—controlled blasting for	lirect and indirect	ect model a	nalysi	S
UN Dia Hal	ers-wind IT IV gnosis o f-cell, co	DISTRESS MEASUREME distress in structures—crack o struction and use — damage a NON DESTRUCTIVE TES	nents—pressure transducers—sound analysis—structural modeling—d NTS bservation and measurements—co ssessment—controlled blasting for	rrosion of rein	ect model a	inalysi in con	cr
UN Dia Hal UN Loa	ers-wind IT IV gnosis of-cell, con IT V d testing	DISTRESS MEASUREME distress in structures—crack o struction and use — damage a NON DESTRUCTIVE TES in structures, buildings, bridge	nents—pressure transducers—sound analysis—structural modeling—d NTS bservation and measurements—consessment—controlled blasting for the transducers—Rebound Hammer	prosion of reinor demolition. -acoustice mi	ect model a	inalysi in con	cr
UN Dia Hal UN Loa	ers-wind IT IV gnosis of-cell, con IT V d testing	DISTRESS MEASUREME distress in structures—crack o struction and use — damage a NON DESTRUCTIVE TES in structures, buildings, bridge	nents—pressure transducers—sound analysis—structural modeling—d NTS bservation and measurements—co ssessment—controlled blasting for	prosion of reinor demolition. -acoustice mi	ect model a	inalysi in con	cr
UN Dia Hal UN Loa	ers-wind IT IV gnosis of-cell, con IT V d testing	DISTRESS MEASUREME distress in structures—crack o struction and use — damage a NON DESTRUCTIVE TES in structures, buildings, bridge	nents—pressure transducers—sound analysis—structural modeling—d NTS bservation and measurements—consessment—controlled blasting for the transducers—Rebound Hammer	orrosion of rein or demolition. -acoustice ministrate coating.	ect model a	in con	s cr te
met UN Dia Hal UN Loa prin	ers-wind IT IV gnosis o f-cell, co IT V d testing ciples ar	DISTRESS MEASUREME distress in structures—crack o struction and use — damage a NON DESTRUCTIVE TES in structures, buildings, bridge	nents—pressure transducers—sound analysis—structural modeling—d NTS bservation and measurements—consessment—controlled blasting for the transducers—Rebound Hammer	orrosion of rein or demolition. -acoustice ministrate coating.	rect model a	in con	cr
met UN Dia Hal UN Loa prin	ers-wind IT IV gnosis of-cell, co IT V d testing ciples ar	DISTRESS MEASUREME distress in structures—crack o struction and use — damage a NON DESTRUCTIVE TES in structures, buildings, bridg application—Holography—use	nents—pressure transducers—sound analysis—structural modeling—dents NTS bservation and measurements—conssessment—controlled blasting for the transfer of the	orrosion of rein or demolition. -acoustice ministrate coating.	rect model and a second	in con sonic S:	cr
met UN Dia Hal UN Loa prin	ers-wind IT IV gnosis of-cell, co IT V d testing ciples ar URSE Co he end o	DISTRESS MEASUREME distress in structures—crack of struction and use — damage a NON DESTRUCTIVE TES in structures, buildings, bridge application—Holography—use	nents—pressure transducers—sound analysis—structural modeling—dents NTS bservation and measurements—conssessment—controlled blasting for the transfer of the transfer of the transfer of laser for structural testing—Brown able to	orrosion of rein or demolition. -acoustice ministrate coating.	rect model and an arrangement and arrangement arrangem	in con sonic S: PED Level)	cr
met UN Dia, Hali UN Loa prin CO At the	ers-wind IT IV gnosis o f-cell, co IT V d testing ciples ar URSE C he end o	DISTRESS MEASUREME distress in structures—crack of struction and use — damage a NON DESTRUCTIVE TES In structures, buildings, bridge application—Holography—use DTCOMES the course, the students will be	ments—pressure transducers—sound analysis—structural modeling—dents—of the servation and measurements—conssessment—controlled blasting for the servation and towers—Rebound Hammer erof laser for structural testing—Broke able to servations.	orrosion of rein or demolition. -acoustice ministrate coating.	rect model and an arrangement and arrangement arrangem	in con sonic S: PED Level)	cr
met UN Dia Hal UN Loa prin CO At ti	ers-wine IT IV gnosis o f-cell, co IT V d testing ciples ar URSE C he end o calcu	DISTRESS MEASUREME distress in structures—crack o struction and use — damage a NON DESTRUCTIVE TES in structures, buildings, bridg application—Holography—use DTCOMES the course, the students will be ate physical quantities such a	nents—pressure transducers—sound analysis—structural modeling—dints NTS bservation and measurements—conssessment—controlled blasting for the second towers—Rebound Hammer and towers—Rebound Hammer are of laser for structural testing—Brown able to see able to see forces and strains. ements techniques.	orrosion of rein or demolition. -acoustice ministrate coating.	rect model and an arrangement of the sector	in con sonic S: PED Level) ding ((K3)	s cr te
met UN Dia Hali UN Loa prin CO At th	gnosis o f-cell, co IT V d testing ciples ar URSE C he end o calculate evaluation	DISTRESS MEASUREME distress in structures—crack o struction and use — damage a NON DESTRUCTIVE TES in structures, buildings, bridg application—Holography—use DTCOMES the course, the students will be ate physical quantities such a te different vibration measur	nents—pressure transducers—sound analysis—structural modeling—donts NTS bservation and measurements—conssessment—controlled blasting for the transfer of the	orrosion of rein or demolition. -acoustice ministrate coating.	rect model and an afforcement and a sistem of the sistem o	in con sonic S: PED ding ((K3) ding (s cr te
met UN Dia Hal UN Loa prin CO	ers-wine IT IV gnosis o f-cell, co IT V d testing ciples ar URSE C he end o calce evaluation utilizion selection	DISTRESS MEASUREME distress in structures—crack o struction and use — damage a NON DESTRUCTIVE TES in structures, buildings, bridg application—Holography—use TCOMES the course, the students will be ate physical quantities such a te different vibration measur re physical quantities such as techniques involved in crack	nents—pressure transducers—sound analysis—structural modeling—donts NTS bservation and measurements—conssessment—controlled blasting for the transfer of the	orrosion of rein or demolition. -acoustice minittle coating. TOTAL	rect model and an arrangement of the sector	in con isonic S: PED Level) ding ((K3) ding ((K3)	s cr te

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- 3. James W. Dally and William Franklin Riley, "Experimental Stress Analysis", McGraw Hill, 3rd Edition, 1991
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Mapping of Course Outcomes with Programme Outcomes:

co.	Programme Outcomes(POs)											
COs	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	3	3	2	1	3	1						
CO2	3	3	2	-	3	1						
СОЗ	3	3	2	2	3	48						
CO4	3	3	2	1	3							
CO5	3	3	2	1	3	1						



PED2316	0 DESIGN FOR X	3	0 0	3
COURSE	OBJECTIVES			
To enable	the students to			
1. learn	relevant process; apply the general design principles for manufacturability; GD&T			
707	design considerations while designing the formed and machined components			_
3. gain l	knowledge on design considerations for assembled systems.			
4. get ex	posure in maintenance systems and reliability based design			
5. apply	design considerations for environmental issues			
UNIT I	INTRODUCTION			9
General de	sign principles for manufacturability - strength and mechanical factors, mechanisms sel	ection	, evalu	ation
method, P	rocess capability - Feature tolerances Geometric tolerances - Assembly limits - I	Datum	ı featu	res -
	stacksfactors influencing form design- working principle, Material, Manufacture,			
	Materials choice -Influence of materials on form design - form design of welded meml	oers, f	orging	s and
castings.				
UNIT II	COMPONENT DESIGN - MACHINING CONSIDERATION			9
Design fea	tures to facilitate machining - drills - milling cutters - keyways - Doweling procedu	res, co	ounter	sunk
screws - R	eduction of machined area- simplification by separation - simplification by amalgama	tion -	Desig	n for
machinabil	ity - Design for economy - Design for clampability - Design for accessibility.			
UNIT III	DESIGN FOR ASSEMBLY			9
Design for	assembly - General assembly recommendations - Minimizing the no. of parts - Design	gn cor	ısidera	ions
	 Screw fasteners – Gasket & Seals – Press fits – Snap fits – Design for assembly – Press fits – Snap fits – Design for assembly – Press fits – Snap fits – Design for assembly – Press fits – Snap fits – Design for assembly – Press fits – Snap fits – Design for assembly – Press fits – Snap fits – Design for assembly – Press fits – Snap fits – Design for assembly – Press fits – Snap fits – Design for assembly – Press fits – Snap fits – Design for assembly – Press fits – Snap fits – Design for assembly – Press fits – Snap fits – Design for assembly – Press fits – Snap fits – Design for assembly – Press fits – Snap fits – Design for assembly – Press fits – Snap fits – Design for assembly – Press fits – Snap fits – Design for assembly – Press fits – Snap fits – Design for assembly – Press fits – Snap fits – Design for assembly – Press fits – Snap fits			
	embly - Product design for automatic assembly - Robotic assembly-Automatic assen			
	for DFMA -Case studies.	1,75.0		
UNIT IV	DESIGN FOR RELIABILITY AND MAINTAINABILITY			9
Reliability	design process, system effectiveness, economic analysis and life cycle cost, reliability a	llocat	ion, de	sign
methods, p	arts and material selection, derating, stress-strength and analysis, failure analysis	is, ide	entifica	tion
determinati	on of causes, assessments of effects, computation of criticality index, corrective action	, syste	m safe	ty –
	down-time - the repair time distribution, stochastic point processes system repair time,			
	maintenance state dependent system with repair. MTTR - mean system down			
	t, replacement models, proactive, preventive, predictive maintenance maintainability			
	n techniques for system reliability with redundancy heuristic methods applied to			
reliability.	(2)	_		
UNIT V	SUSTAINABLE DESIGN		T	9
Industrial e	cology, multiple life cycle design, principles of design, green engineering, cradle to cra	adle d	esign.	3200
	o, biomimicry, design for reuse, dematerialization, modularization, Design to minimize			CATALON DEPOSIT
				-8-

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.

	TOTAL	L PERIODS: 45
COUF	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 manufacturability; GD&T	Understanding (K2)
CO2	apply design considerations while designing the formed and machined 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)

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 "Reliability and Maintainability in Perspective", McMillan, 2nd Edition, 2002.

CO - PO MAPPING

Mapping of Course Outcomes with Programme Outcomes:

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



PED23161		VEHICLE DYNAMICS	3	0 0	3
	DBJECTIVES			-	
To enable t	ne students to				-
1. develo	mathematical model of a sys	tem			
2. gain kr	owledge on vehicular vibration	ns and response of vehicle			
3. learn a	tire model based on required p	performance.			
4. study v	arious vehicle performance, co	ontrol methodologies to ensure stability and ride	comfort		
5. compre	hend the principles vertical, lo	ngitudinal and lateral dynamics vehicle design			Ħ
UNIT I	BASIS OF VIBRATION			T	
Definitions,	Modeling and Simulation, C	Global and Vehicle Coordinate System, Free,	Forced, Uno	lamped	an
Damped V	bration, Response Analysis	of Single DOF, Two DOF, Multi DOF,	Magnifica	tion fa	cto
		ation measuring instruments, Torsional vibration			
UNIT II	TYRES				
Tyre forces	and moments, Tyre structure,	Longitudinal and Lateral force at various lip ar	nales rolling	reciete	
		formance of tyre on wet surface. Ride property of			
tvre model	Stimation of twe road friction	. Teston Various road surfaces. Tyre vibration.	or tyres. Mag	ic form	ula
UNIT III	VERTICAL DYNAMICS	. Teston various road surfaces. Tyre vibration.			
OTHE III	TENTICAL DINAMICS				
		Vibration. Design, analysis and computer simul			emi
active and A suspension d	ctive suspension using Quart amping, and tyre stiffness. Co.	Vibration. Design, analysis and computer simuler car, half car and full car model. Influence of trol law for LQR, H Infinite, Skyhook damping	of suspensio	n stiffn	ess
active and A suspension d and their pro	ctive suspension using Quart amping, and tyre stiffness. Concerties.	er car, half car and full car model .Influence of ntrol law for LQR, H Infinite, Skyhook damping	of suspensio	n stiffn	emi
active and A suspension d and their pro	ctive suspension using Quart amping, and tyre stiffness. Con perties. LONGITUDINAL DYNAM	er car, half car and full car model .Influence of the control law for LQR, H Infinite, Skyhook damping ICS AND CONTROL	of suspension. Air suspension.	n stiffn	emi
active and A suspension d and their pro UNIT IV Aerodynamic	ctive suspension using Quart amping, and tyre stiffness. Concerties. LONGITUDINAL DYNAM forces and moments. Equation	er car, half car and full car model .Influence of the control law for LQR, H Infinite, Skyhook damping ICS AND CONTROL on of motion. Tyre forces, rolling resistance, Loan	of suspensions. Air suspensions	n stiffn sion sys	emi
active and A suspension d and their pro UNIT IV Aerodynamic	ctive suspension using Quart amping, and tyre stiffness. Concerties. LONGITUDINAL DYNAM forces and moments. Equation	er car, half car and full car model .Influence of the control law for LQR, H Infinite, Skyhook damping ICS AND CONTROL on of motion. Tyre forces, rolling resistance, Loan	of suspensions. Air suspensions	n stiffn sion sys	emi ness sten
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active and A suspension d and their pro UNIT IV Aerodynamic wheeler and Driving torqu	ctive suspension using Quart amping, and tyre stiffness. Concerties. LONGITUDINAL DYNAM forces and moments. Equation	er car, half car and full car model .Influence of the control law for LQR, H Infinite, Skyhook damping ICS AND CONTROL on of motion. Tyre forces, rolling resistance, Loan	of suspensions. Air suspensions ad distribution of the contraction of	n stiffn sion sys	emi ness sten
active and Asuspension dand their pro UNIT IV Aerodynamic wheeler and Driving torqu	ctive suspension using Quart amping, and tyre stiffness. Concerties. LONGITUDINAL DYNAM forces and moments. Equation four wheeler. Calculation of Management of Management of Vehicle performance. LATERAL DYNAMICS	er car, half car and full car model .Influence of the control law for LQR, H Infinite, Skyhook damping ICS AND CONTROL on of motion. Tyre forces, rolling resistance, Loa aximum acceleration, Reaction forces for Differ rmance. ABS, stability control, Traction control	of suspensions. Air suspensions distributions distributions distributions. Etc. Case Studio	on stiffing sion system for the straking ses.	emi ess ess ess ess ess enree
active and Asuspension dand their pro UNIT IV Aerodynamic wheeler and Driving torqu UNIT V Steady state	ctive suspension using Quart amping, and tyre stiffness. Concerties. LONGITUDINAL DYNAM forces and moments. Equation four wheeler. Calculation of Me. Prediction of Vehicle performance. LATERAL DYNAMICS handling characteristics. Stead	aximum acceleration, Reaction forces for Differ rmance. ABS, stability control, Traction control by state response to steering input. Testing of heads of the control of th	of suspensions. Air suspensions ad distribution of the suspensions of	on stiffing sion system for the straking eas.	emi ness sten g
active and Asuspension dand their pro UNIT IV Aerodynamic wheeler and Driving torqu UNIT V Steady state Fransient res	ctive suspension using Quart amping, and tyre stiffness. Concerties. LONGITUDINAL DYNAM forces and moments. Equation of Modern wheeler. Calculation of Modern Prediction of Vehicle performandling characteristics. Stead poinse characteristics, Direction of Course Charac	er car, half car and full car model .Influence of atrol law for LQR, H Infinite, Skyhook damping ICS AND CONTROL on of motion. Tyre forces, rolling resistance, Los aximum acceleration, Reaction forces for Differ rmance. ABS, stability control, Traction control by state response to steering input. Testing of half of control of vehicles. Rollcenter, Rollaxis, Vehicles. Rollcenter, Rollaxis, Vehicles.	of suspensions. Air suspensions ad distribution of the suspensions of	on stiffing sion system for the straking eas.	emi ness sten
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suspension dand their pro UNIT IV Aerodynamic wheeler and Driving torqu UNIT V Steady state Fransient res Stability of v	ctive suspension using Quart amping, and tyre stiffness. Concerties. LONGITUDINAL DYNAM forces and moments. Equation four wheeler. Calculation of Management of Vehicle performanding characteristics. Stead poonse characteristics, Direction of banked road and duri	aximum acceleration, Reaction forces for Differ rmance. ABS, stability control, Traction control by state response to steering input. Testing of he in control of vehicles. Rollcenter, Rollaxis, Vehing turn. Effect of suspension on cornering.	of suspensions. Air suspensions. Air suspensions ad distribution rent drives. Etc. Case Studies and ling characteristic under suppersions.	on stiffn sion sys	garage and garage specifics.
suspension de and their pro UNIT IV Aerodynamic wheeler and Driving torque UNIT V Steady state Fransient restability of v	ctive suspension using Quart amping, and tyre stiffness. Concerties. LONGITUDINAL DYNAM forces and moments. Equation four wheeler. Calculation of Me. Prediction of Vehicle performandling characteristics. Stead conse characteristics, Direction of Cartesian Consecutive C	aximum acceleration, Reaction forces for Differ rmance. ABS, stability control, Traction control by state response to steering input. Testing of he in control of vehicles. Rollcenter, Rollaxis, Vehing turn. Effect of suspension on cornering.	of suspensions. Air suspensions. Air suspensions ad distribution and distributions. Each of the control of the	on stiffn sion sys	gessance and gessa
suspension described and their prospension described and their prospension described and their prospension described and the control of the color of	ctive suspension using Quart amping, and tyre stiffness. Concerties. LONGITUDINAL DYNAM forces and moments. Equation four wheeler. Calculation of Me. Prediction of Vehicle performandling characteristics. Stead conse characteristics, Direction of the course characteristics, Direction of the course characteristics and durent the course, the students will be course, the students will be	are car, half car and full car model .Influence of the control law for LQR, H Infinite, Skyhook damping ICS AND CONTROL on of motion. Tyre forces, rolling resistance, Loa aximum acceleration, Reaction forces for Differ rmance. ABS, stability control, Traction control by state response to steering input. Testing of his in control of vehicles. Rollcenter, Rollaxis, Vehing turn. Effect of suspension on cornering. TOTAL	of suspensions. Air suspensions. Air suspensions ad distribution rent drives. Etc. Case Studionandling characteristics under suppersions.	on stiffn sion system on for the graking es.	and grics
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CO3	design analysis a	nd computer simu	lation of vertical d	ynamics in vehicle	s. Und	erstanding (K2)
CO4	acquire knowled		namic concepts in	longitudinal dyna	mics and App	lying (K3)
CO5	summarize the co	oncepts in lateral d	ynamics of vehicl	es	App	lying (K3)
REFE	CRENCES	31.			•	
1.	Thomas D. Gillesp	ie, "Fundamentals	of Vehicle Dynan	nics", Society of A	utomotive Engin	eers Inc, 1992
	Hans B Pacejka, "T					
	Rajesh Rajamani, "					
	Wong. J. Y., "Theo					
1955	PO MAPPING			•	*	
				th Programme Out) 3-Strong, 2-Med		
CO-				outcomes(POs)		
COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	1	3	1
CO2	3	3	2	-	3	1
CO3	3	3	2	9	3	
CO4	3	3	2	1	3	



C05

	D23162	WEARABLE T	ECHNOLOGIES		3	0 0	3
CO	URSE	DBJECTIVES					
To	enable	ne students to					
1.	identi	the guiding principles and challenges of V	Wearable Computing.				T
2.	learn l	sics of different types of wearable sensors					
3.	study	indamental concepts and components requ	ired for flexible electro	onics			Т
4.	introd	ce the concept of energy harvesting system	s from different source	es			
5.	acquir	knowledge on monitoring physiological pa	arameters using weara	ble sensors			Т
UN	ITI	INTRODUCTION					- 9
Attr	ibutes	wearables, Meta-wearable, Challenges a	and opportunities, Fut	ure of wearab	les - Soci	al aspec	ets c
		and interaction: Social interpretation of Aes haptic devices - Categories of wearable ha				-15)	
	II II	WEARABLE SENSORS					9
Che	mical a	d Biochemical sensors, System design, C	Challenges in chemica	l Bio-chemica	al sensing,	Applic	atio
area	s - Iner	a sensors, Parameters from inertia sensors	- Applications for wea	arable motion :	sensors - N	Aeasure	men
of e	nergy e	penditure by body worn heat flow sensors.					
UNI	TIII	FLEXIBLE ELECTRONICS					9
Intro	oductio w-pow	Thin-film transistors: Materials and Techn Integrated Circuit Design for Bio-potenti	al sensing: Analog cir	cuit design tec	hniques -	Low- p	onics
Intro - Lo desi Prac	oduction w-pow gn for A tical co	Thin-film transistors: Materials and Techn Integrated Circuit Design for Bio-potenti DCs - Digital circuit design techniques - A siderations.	al sensing: Analog cir	cuit design tec	hniques -	Low- p	onics ower
Intro Lo desig Prac	oduction w-pow gn for A tical co	Thin-film transistors: Materials and Techn Integrated Circuit Design for Bio-potenti DCs - Digital circuit design techniques - A siderations. ENERGY HARVESTING SYSTEMS	al sensing: Analog circ	cuit design tec	chniques - o-potentia	Low- p	onic
Intro Lo desi Prac UNI	w-pow gn for A tical co	Thin-film transistors: Materials and Technology Integrated Circuit Design for Bio-potential DCs - Digital circuit design techniques - A siderations. ENERGY HARVESTING SYSTEMS esting from human body: Temperature grades	al sensing: Analog circhitectural design for	cuit design tec	chniques - co-potential transmiss	Low- p	onics owe ition
Intro Lo desig Prac UNI Ener	w-pow gn for A tical co T IV gy hard esting f	Thin-film transistors: Materials and Technology Integrated Circuit Design for Bio-potential DCs - Digital circuit design techniques - A siderations. ENERGY HARVESTING SYSTEMS esting from human body: Temperature gracom light and RF energy - Energy and power	al sensing: Analog circ rehitectural design for dient, Foot motion - Wer consumption issues,	cuit design tec low-power bid fireless energy	chniques - co-potential transmiss	Low- p	onics owe ition
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	electronics	
CO4	familiarize the concept of energy harvesting systems from different sources	Applying (K3)
CO5	explain aspects of monitoring physiological parameters using wearable sensors	Applying (K3)

- Edward Sazonov, Michael R Neuman, "Wearable Sensors: Fundamentals, Implementation and Applications", Academic Press, USA, 2014.
- Tom Bruno, "Wearable Technology: Smart Watches to Google Glass for Libraries", Rowman & Littlefield Publishers, Lanham, Maryland, 2015.
- 3. Raymond Tong, "Wearable Technology in Medicine and Health Care", Academic Press, USA, 2018.
- 4. Haider Raad, "The Wearable Technology Handbook", United Scholars Publication, USA, 2017.

CO - PO MAPPING

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



PED23163	SOLID FREEFORM MANUFACTURING 3	0	0	3
COURSE OB	JECTIVES			
To enable the	students to			
	ne students with evolution of Solid Freeform Manufacturing (SFM) / Additive Manufacturing (SF	cturi	ng (A	M),
2. design for	Additive Manufacturing (DFAM) and its importance in quality improvement of fabri	cated	part	s.
3. gain know	ledge on polymerization and sheet lamination processes and their applications.			
4. get expose	with material extrusion and powder bed fusion processes.			
5. learn jettir	ng and direct energy deposition processes and their applications.			
UNIT I	NTRODUCTION			9
Need - Develo	pment of SFM systems - Hierarchical structure of SFM - SFM process chain -C	assif	icatio	on –
Applications. (Case studies: Bio printing- Food Printing- Electronics printing - Rapid Tooling - Buil	ding	print	ting.
AM Supply cha	ain. Economics aspect: Strategic aspect- Operative aspect.			
UNIT II D	ESIGN FOR ADDITIVE MANUFACTURING			9
Concepts and (Objectives - AM Unique Capabilities - Part Consolidation - Topology Optimization	- Lig	htwe	ight
Structures - DF	AM for Part Quality Improvement - CAD Modeling - Model Reconstruction - Data I	roce	ssing	g for
AM - Data Fo	rmats - Data Interfacing - Part Orientation - Support Structure Design and Supp	ort S	Struc	ture
Generation - M	lodel Slicing - Tool Path Generation. Design Requirements of Additive Manufactur	ring:	For !	Part
Production, For	Mass Production, For Series Production. Case Studies.			
UNIT III V	AT POLYMERIZATION AND SHEET LAMINATION PROCESSES		-	9
Stereolithograp	hy Apparatus (SLA): Principles - Photo Polymerization of SL Resins - Pre Build Principles	roces	s – P	art-
Building and Po	ost-Build Processes - Part Quality and Process Planning, Recoating Issues - Materials	- Ad	vanta	iges
- Limitations an	d Applications. Digital Light Processing (DLP) - Materials - Process - Advantages and	Appl	icatio	ons.
Laminated Obje	ect Manufacturing (LOM): Working Principles - Process - Materials, Advantages, Li	mitat	ions	and
Applications. U	Itrasonic Additive Manufacturing (UAM) - Process - Parameters - Applications. Case	Stuc	lies.	
UNIT IV M	ATERIAL EXTRUSION AND POWDER BED FUSION PROCESSES			9
Fused deposition	n Modeling (FDM): Working Principles - Process - Materials and Applications. Des	ign F	tules	for
FDM. Selective	Laser Sintering (SLS): Principles - Process - Indirect and Direct SLS - Powder Structure	re – N	later	ials
- Surface Devia	tion and Accuracy - Applications. Multijet Fusion. Selective Laser Melting (SLM)	and	Elect	ron
Beam Melting	(EBM): Principles - Processes - Materials - Advantages - Limitations and Applic	cation	ıs. C	ase
Studies.				
UNIT V JE	TTING AND DIRECT ENERGY DEPOSITION PROCESSES			9
Binder Jetting:	Three dimensional Printing (3DP): Principles - Process - Physics of 3DP - Types	of	orinti	ng:
Continuous mo	de - Drop on Demand mode - Process - Materials - Advantages - Limitations -	Appl	icatio	ons.
Material Jetting	Multi Jet Modelling (MJM) - Principles - Process - Materials - Advantages and Limit	ation	s. La	iser

	TOTAL	PERIODS: 45
COUL	RSE OUTCOMES	BT MAPPED
At the	end of the course, the students will be able to	(Highest Level)
CO1	relate the importance in the evolution of SFM/AM, proliferation into the various fields	Understanding (K2)
CO2	analyze the design for AM and its importance in the quality of fabricated parts.	Analyzing (K4)
CO3	build knowledge on principles and applications of polymerization and sheet lamination processes with case studies.	Understanding (K2)
CO4	explain the principles of material extrusion and powder bed fusion processes and design guidelines.	Applying (K3)
CO5	elaborate jetting and direct energy deposition processes and their applications.	Applying (K3)

- Andreas Gebhardt and Jan-Steffen Hotter, "Additive Manufacturing:3D Printing for Prototyping and Manufacturing", Hanser publications Munchen, Germany, 2016.
- Ben Redwood, Brian Garret, FilemonSchöffer, and Tony Fadel, "The 3D Printing Handbook: Technologies, Design and Applications", 3D Hubs B.V., Netherland, 2017.
- Ian Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing" Springer - New York, USA, 2nd Edition, 2015
- 4. Milan Brandt. "Laser Additive Manufacturing 1st Edition Materials, Design, Technologies, and Applications", Woodhead Publishing, UK, 2016.

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



PED2	3164	BIO MATERIALS		3	0	0	3
COUF	RSE OB	BJECTIVES					
To ena	able the	students to					
1. st	tudy diff	erent concepts in selecting bio and smart materials					
2. le	arn abou	ut dental material and its classifications					
3. kn	now the	orthopaedic materials and its properties					
4. un	nderstan	d wound dressing materials and surgical aids					
5. ga	ain know	vledge on materials for cardiovascular and ophthalmology					-
UNIT	I II	NTRODUCTION					9
Human	n anaton	ny- tissues- organs- repair- regeneration- Wolff's Law - bior	material – compatil	oility –	clas	sifica	tion
friction	n and w	 Material response: swelling and leaching, corrosion and ear – host response: the inflammatory process – coagulation coagulation coagulation coagulatory 	n and hemolysis-				
UNIT	II D	ENTAL MATERIALS					9
		tion, formation and properties - temporary fixation devices -c					
and allo		ings and restoration materials - oral and maxillofacial surgery					
and allo	oys- Fill al adhesi III O	ings and restoration materials - oral and maxillofacial surgery	– dental cements a	and der	ntal a	malg	ams
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CO3	illustrate knowledge on orthopaedic materials and its properties	Understanding (K2)
CO4	comprehend wound dressing materials and surgical aids	Applying (K3)
CO5	select appropriate materials for cardiovascular and ophthalmology	Applying (K3)

- M. V. Gandhi and B. S. Thompson, "Smart Materials and Structures", Chapman and Hall, London, First Edition, 1992.
- 2. Sujata V., Bhat., "Biomaterials", Narosa Publication House, New Delhi, 2002.
- Buddy D. Ratner (Editor), Allan S. Hoffman (Editor), Frederick J. Schoen (Editor), Jack E. Lemons, "Biomaterials Science: An Introduction to Materials in Medicine", Academic Press,2nd edition, 2004.
- 4. Mohsen Shahinpoor and Hans-Jorg Schneider "Intelligent Materials", RSC Publishing, 2008.

CO - PO MAPPING

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



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		OBJECTIVES						ī
То		the students to						T
1.		posure to solve problems involving plate and shell elements						T
2.	learn c	concept of problems involving geometric and material non-linearit	ty					
3.	study s	solution techniques to solve dynamic problems						
4.	familia	arize with fluid mechanics and heat transfer problems						Ť
5.	gain kı	nowledge on error norms, convergence rates and refinement.						Ť
UN	TI	BENDING OF PLATES AND SHELLS			-			-
Rev	iew of	Elasticity Equations - Bending of Plates and Shells - Finite Ele	ment Form	ulation	of P	late	and S	She
elen	nents-A	Conforming and Non-Conforming Elements – C0 and C1 Compplication and Examples.	tinuity Elei	ments –	-Deg	enera	ited s	she
	ТП	NON-LINEAR PROBLEMS						4
		n - Iterative Techniques - Material non-linearity - Elasto Plastic						
Geo	metric 1	Non linearity - large displacement Formulation -Solution proce	dure- Appl	ication	in N	letal	Forn	nin
Droo	ess and	Contact Problems.						
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CO - PO MAPPING

		Programme Outcomes(POs)						
COs _	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		



PED		DESIGN OF HYBRID AND ELECTRIC VI	MICLES	3 (0 0	
		BJECTIVES				
То е	enable the	students to				
	learn fun	damental concepts of electric and hybrid vehicle operation				
_	understar	d the properties of batteries and its types.				
3.	gain knov	vledge about design of series hybrid electric vehicles.				
4.	comprehe	and design of parallel hybrid electric vehicles.				
5.	familiariz	e with electric vehicle drive train.				
UNI	TI I	NTRODUCTION TO ELECTRIC VEHICLES			T	
Elect	tric Vehic	eles (EV) system- EV History - EV advantages - EV i	market – vehi	cle mechanics	: road	lw
	leration-p	law of motion-vehicle kinetics- dynamics of vehicle moropulsion system design. ENERGY SOURCE	tion – propuls	sion power–ve	elocity	a
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		lead acid battery-alternative batteries-battery parameters-te		eteristics— batte	ery po	ve
		rgy sources: Fuel cells-Fuel Cell characteristics-Fuel cell typ	oes.			
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CO5	describe	the	transmission	components	and	their	configurations	for	electric	Applying (K3)
CO3	vehicles									1.146.7.1.2 (1.1.2)
REFE	RENCES									

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COs	Programme Outcomes(POs)						
Cos	PO1	PO2	PO3	PO4	PO5	PO6	
CO1	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	
CO5	3	2	3	2	1	2	



	D23167	BEARING DESIGN AND ROTOR DYN	AMICS 3 0	0
CO	URSE O	BJECTIVES		
То	enable th	e students to		
1.	understa	nd classification and selection of bearings		
2.	gain kno	wledge on design of fluid film bearings		
3.	learn abo	out rolling contacts selection of rolling bearings		***
4.	familiari	ze with rotor dynamics for rigid and flexible supports		
5.	study dy	namics of rotors mounted on hydro dynamic bearings		
UNI	IT I	CLASSIFICATION AND SELECTION OF BEARINGS		
Sele	ection crit	eria - Dry and Boundary Lubrication Bearings-Hydrody	namic and Hydrostatic bearing	s-Elect
		rings - Dry bearings - Rolling Element bearings-Bearings for		
		ngs- Selection of plain Bearing materials - Metallic and No		
	ings.			
UNI	TII	DESIGN OF FLUID FILM BEARINGS		
Desi	ign and po	erformance analysis of Thrust and Journal bearings - Full, p	artial fixed and pivoted journal	hooring
		lure-Minimum film thickness – lubricant flow and delive		
		alculations- Design based on Charts & Tables Design of H		
		ideration-flow regulators and pump design in hydrostatic be		
		ERIES HYBRID ELECTRIC DRIVE TRAIN DESIGN		gs ———
	AND THE WATER	ses in Rolling bearings – Centrifugal stresses – Elasto h		
				1,571
		Bearing operating temperature - Lubrication- Selection of I		
	selection	Mounting arrangements. Manufacturing methods-Ceramic	bearings-Rolling bearing cages	-bearin
		Property and the second		
UNI		OTOR DYNAMICS		
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		haft in the bearing-Rotor supported on rigid and flexible sup		
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(Highest Level)
Understanding (K2)
Applying (K3)
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Applying (K3)
Applying (K3)

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- 2. Cameron, A. "Basic Lubrication Theory", Ellis Herward Ltd., UK, 1981
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CO - PO MAPPING

00		Programme Outcomes(POs)						
COs _	PO1	PO2	PO3	PO4	PO5	PO6		
CO1	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		
CO5	3	2	3	2 -	1	2		



PE	D23168	MATERIAL HANDLING SYSTEMS AND DESIGN (Use of Approved Data Book is Permitted)		3	0	0	3
CC	URSE	OBJECTIVES				_	
To	enable	the students to			-		-
1.	unders	stand the fundamental concepts of design of hoists.					
2.		e design of various drives for hoisting gears					
3.	learn a	bout conveyer systems for material flow in different industrial production syst	tems				
4.		posure to design of elevators for various manufacturing and service application					+
5.		ntegrated mechanical system design for machine tools					+
	ITI	INTRODUCTIONS AND DESIGN OF HOISTS					-
Тур	es, sele	ction and applications, Design of hoisting elements: Welded and roller chains	s-Hemp	and	wi	re ro	pes
Des	ign of r	opes, pulleys, pulley systems, sprockets and drums, Load handling attachments	. Design	of	forg	ged h	ook:
and	eye hoo	sks - crane grabs - lifting magnets - Grabbing attachments-Design of arresting	gear -Br	ake	s: s	hoe.	band
	cone ty					,	5-550.00
UN	ITII	DRIVES OF HOISTING GEAR					-
Han	d and p	ower drives - Traveling gear - Rail traveling mechanism - cantilever and mor	no rail ci	rane	S-S	ewir	
oano	d luffing	gear-cog wheel drive-selecting the motor ratings.		·	5 51	CVIII	6, J
	ПП	CONVEYORS					9
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Scre	w conv	eyors and vibratory conveyors.	is i neun	iativ	200	nvey	015,
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Rucl	ket elev	ators: design - loading and bucket arrangements - Cage elevators - shaft way,	anides c	OUE	tor	maia	
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JNI Integ	TV grated D	DYNAMICS OF ROTORS MOUNTED ON HYDRO DYNAMIC BEAR esign of systems - Valve Gear Mechanisms, Portable Air Compressor, Hay-Fewer Screws, Gear Box Design more than six speed. TOTAL	Bale lifte			Test	ting
JNI nteg //ac/	TV grated Dhine, Po	DYNAMICS OF ROTORS MOUNTED ON HYDRO DYNAMIC BEAR esign of systems - Valve Gear Mechanisms, Portable Air Compressor, Hay-Fewer Screws, Gear Box Design more than six speed. TOTAL UTCOMES	Bale lifte	DDS	S:	45	ting
JNI nteg Mac	TV grated Dhine, Po	DYNAMICS OF ROTORS MOUNTED ON HYDRO DYNAMIC BEAR esign of systems - Valve Gear Mechanisms, Portable Air Compressor, Hay-Fewer Screws, Gear Box Design more than six speed. TOTAL UTCOMES The course, the students will be able to	Bale lifte	DDS APP	: ED	45	ting
UNI Integrated Machinery COU At the	TV grated Dhine, Po	DYNAMICS OF ROTORS MOUNTED ON HYDRO DYNAMIC BEAR esign of systems - Valve Gear Mechanisms, Portable Air Compressor, Hay-I wer Screws, Gear Box Design more than six speed. TOTAL UTCOMES The course, the students will be able to ain the fundamental concepts of design of hoists.	Bale lifte PERIC BT MA	DDS APP st Le	S: ED	45 l)	ting 5
UNI Integrated Machinery COU At the	TV grated Dhine, Po	DYNAMICS OF ROTORS MOUNTED ON HYDRO DYNAMIC BEAR esign of systems - Valve Gear Mechanisms, Portable Air Compressor, Hay-H wer Screws, Gear Box Design more than six speed. TOTAL UTCOMES The course, the students will be able to ain the fundamental concepts of design of hoists. In various drives for hoisting gears	PERIO BT MA	ODS APP st Le	ED evel	45 l)	ting 5
UNI nteg Mac	TV grated Dhine, Po	esign of systems - Valve Gear Mechanisms, Portable Air Compressor, Hay-Fewer Screws, Gear Box Design more than six speed. TOTAL UTCOMES The course, the students will be able to ain the fundamental concepts of design of hoists. In various drives for hoisting gears ribe conveyer systems for material flow in different industrial production	PERIO BT MA (Highes	DDS APP st Le tand	EPED evel ling K3)	45 l) ; (K2	ting 5

CO5 integrate mechanical system design for machine tools with different components Applying (K3)

REFERENCES

- 1. Alexandrov, M., Materials Handling Equipments, MIRPublishers, 1981.
- 2. Norton.L Robert. "Machine Design-An Integrated Approach" Pearson Education, 2nd Edition, 2005.
- 3. Rudenko, N, Materials handling equipment, ELnveePublishers, 1970.
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CO - PO MAPPING

			Programme O	outcomes(POs)		
COs _	PO1	PO2	PO3	PO4	PO5	PO6
COI	3	2	3	1	2	1
CO2	3	2	3	1	2	1
CO3	3	2	3	1	2	1
CO4	3	2	3	1	2	1
CO5	3	2	3	1	2	1



	023169	ARTIFICIAL INTELLIGENCE AND MACHIN	E LEARNING	G 3 0	0	1
COI	URSE OF	BJECTIVES				
Тое	enable the	students to				
	gain know	vledge on artificial intelligence.				
2.	understan	d the concepts of Machine Learning.				
3.	appreciate	e supervised learning and their applications.				
4.	learn the	concepts and algorithms of unsupervised learning.				
5.	explore th	ne theoretical and practical aspects of Probabilistic Graphica	l Models.			
UNI		RTIFICIAL INTELLIGENCE				
Artif	icial intel	ligence - Basics - Goals of artificial intelligence- AI tech	niques-proble	m representation	n in	ΑI
Prob	lem reduc	tion and solution techniques - Application of AI and KBES	in Robots.			
UNI	TII II	NTRODUCTION TO MACHINE LEARNING			1	-
Macl	nine Lear	ning-Types of Machine Learning -Machine Learning pr	ocess- prelim	inaries, testing	Mac	hir
		rithms, turning data into Probabilities, and Statistics for M				
		stributions – Decision Theory.				
UNIT	r III S	UPERVISED LEARNING				
Linea	ar Models	for Regression - Linear Models for Classification - Discrimin	nant Functions	Probabilistic C	Pener	otis
		bilistic Discriminative Models - Decision Tree Learning				
		hods, Bagging, Boosting, Neural Networks, Multilayer Pere				
		on - Support Vector Machines.		Torrida Tierri	ork, L	111
UNIT		NSUPERVISED LEARNING				
Clusto	ering- K-1	neans - EM Algorithm- Mixtures of Gaussians -Dimension	mality Reducti	on Linear Dia	onim i	
		r Analysis, Principal Components Analysis, Independent Co			CHIIIII	Idi
UNIT		ROBABILISTIC GRAPHICAL MODELS	imponents / tha	uysis.		
Graph		els - Undirected Graphical Models - Markov Random F	ields — Direct	ad Granhiaal 1	M - J -	1
		orks – Conditional Independence properties – Markov Rand				
		ndom Fields (CRFs).	ioni i icius - 11	iddeli iviarkov	wode	1S -
			TOTAL	L PERIODS:	45	5
COU	RSE OUT	COMES		BT MAPPEI		_
At the	end of th	e course, the students will be able to		(Highest Leve		
001	optimiz	e the robots using Artificial Intelligence.		Understandin)
002		a learning model appropriate to the application.		Applying (K3		_
		ent Probabilistic Discriminative and Generative algorit	hms for an	rippijing (K)	,	
CO3		ion of your choice and analyze the results.	inns for all	Understanding	g (K2)
CO4		ool to implement typical Clustering algorithms for differ	ent types of	Applying (K3)	-
			.,	-11-2 mg (163	,	

	applications.	
CO5	identify applications suitable for different types of Machine Learning with suitable justification.	Applying (K3)

- Christopher Bishop, "Pattern Recognition and Machine Learning" Springer, 2007.
- Stephen Marsland, "Machine Learning An Algorithmic Perspective", Chapman and Hall, CRC Press, Second Edition, 2014.
- 3. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
- 4. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Third Edition, 2014.

CO - PO MAPPING

Mapping of Course Outcomes with Programme Outcomes:

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



PED23170	INDUSTRIAL INTERNET OF THINGS		3	0	0	3
COURSE (DBJECTIVES					1000
To enable the	ne students to					+
1. underst	and the fundamentals of Internet of Things					
2. learn al	out the basics of IOT protocols					
3. gain kn	owledge on bigdata analytics and software defined networks					_
	osed to the concept of IOT security			T		
	Industrial IOT case studies in different domains					Т
UNIT I	INTRODUCTION AND ARCHITECTURE OF IOT					9
ntroduction	 Definition and characteristics of IoT – Physical and Logical Design of 	loT - Comr	nunic	atio	n mo	del
	Challenges in IoT - Evolution of IoT- Components of IoT - A Simplified	d IoT Archi	tectur	e –	Core	IoI
Functional S	tack.					
	INDUSTRIAL IOT					9
IoT-Introdu	ction, Industrial IoT: Business Model and Reference Architecture: IIo7	Γ-Business 1	Mode	ls, I	ndust	rial
	HoT Sensing, HoT Processing, HoT Communication, HoT Networking.					
JNIT III	HOT ANALYTICS			T		9
Big Data Ana	lytics and Software Defined Networks, Machine Learning and Data Scie					
	5 The Data Scientific Learning and Data Scien	nce, Julia Pi	rograi	nmi	ng. D	ata
	with Hadoop.	ence, Julia Pi	rograi	nmi	ng, D	ata
/Ianagement		ence, Julia Pi	rograi	nmi	ng, D	
Management NIT IV	with Hadoop. IOT SECURITY	-		1		9
Management INIT IV Industrial IoT	with Hadoop.	-		1		9 oT.
Management UNIT IV Industrial IoT UNIT V	with Hadoop. IOT SECURITY Security and Fog Computing - Cloud Computing in HoT, Fog Computation CASE STUDY	ting in IIoT,	, Secu	ırity	in IId	9 oT.
Management JNIT IV Industrial IoT JNIT V Industrial IO	with Hadoop. IOT SECURITY Security and Fog Computing - Cloud Computing in IIoT, Fog Computation CASE STUDY T- Application Domains: Oil, chemical and pharmaceutical industry	ting in IIoT,	, Secu	ırity	in IId	9 oT.
Management NIT IV Industrial Io I NIT V Industrial IO	with Hadoop. IOT SECURITY Security and Fog Computing - Cloud Computing in IIoT, Fog Computation CASE STUDY T- Application Domains: Oil, chemical and pharmaceutical industry all case studies: Milk Processing and Packaging Industries, Manufacturi	ting in IIoT,	ons c	urity of U	in IIo	9 oT. 9 in
Management INIT IV Industrial IoT INIT V Industrial IO Industrial IO Industries, Re	with Hadoop. IOT SECURITY The Security and Fog Computing - Cloud Computing in HoT, Fog Computing CASE STUDY The Application Domains: Oil, chemical and pharmaceutical industry and case studies: Milk Processing and Packaging Industries, Manufacturing To	ting in IIoT,	ons ons ons ons ons ons	urity of U	in IId	9 oT. 9 in
Management INIT IV Industrial Io I INIT V Industrial IO I Industries, Ref	With Hadoop. IOT SECURITY Security and Fog Computing - Cloud Computing in HoT, Fog Computation CASE STUDY T- Application Domains: Oil, chemical and pharmaceutical industry all case studies: Milk Processing and Packaging Industries, Manufacturi TOUTCOMES	ting in HoT,	ons ces.	urity of U	in IId	9 oT. 9 in
Management INIT IV Industrial Io I INIT V Industrial IO Industrial IO Industries, Ref	with Hadoop. IOT SECURITY Security and Fog Computing - Cloud Computing in IIoT, Fog Computation CASE STUDY T- Application Domains: Oil, chemical and pharmaceutical industry cal case studies: Milk Processing and Packaging Industries, Manufacturi TOUTCOMES the course, the students will be able to	ting in HoT, Applicati ng Industrie DTAL PER BT M (High	ons	of U	in IId AVs 45	9 DT. 9 in
Management INIT IV Industrial IoT INIT V Industrial IO Industries, Reserved OURSE OURSE OURSE OURSE OURSE OI I description	with Hadoop. IOT SECURITY E: Security and Fog Computing - Cloud Computing in IIoT, Fog Computation CASE STUDY T- Application Domains: Oil, chemical and pharmaceutical industry cal case studies: Milk Processing and Packaging Industries, Manufacturi TOUTCOMES the course, the students will be able to be the fundamentals of Internet of Things	ting in HoT, Applicati ng Industrie OTAL PER BT M (High	ons	of U	in IId AVs 45	9 DT. 9 in
Management INIT IV Industrial IoT INIT V Industrial IO Industrial IO Industries, Ref OURSE OURSE OURSE OU	with Hadoop. IOT SECURITY The Security and Fog Computing - Cloud Computing in HoT, Fog Computation Case Study The Application Domains: Oil, chemical and pharmaceutical industry and case studies: Milk Processing and Packaging Industries, Manufacturiation Towns and Case Studies: Milk Processing and Packaging Industries, Manufacturiation Towns and Case Studies: Milk Processing and Packaging Industries, Manufacturiation Towns and Packaging Industries of Towns and Packaging Indus	ting in HoT, y, Applicati ng Industrie DTAL PER BT M (High Unde	ons	of U S: PED evel ding K3)	AVs 45 (K2)	9 oT. 9 in
Management NIT IV Industrial IoT NIT V Industrial IO Industrial IO Industries, Ref OURSE OF It the end of Industrial IO Industries IO Indus	With Hadoop. IOT SECURITY Security and Fog Computing - Cloud Computing in IIoT, Fog Computation CASE STUDY T- Application Domains: Oil, chemical and pharmaceutical industry cal case studies: Milk Processing and Packaging Industries, Manufacturiation TOUTCOMES the course, the students will be able to be the fundamentals of Internet of Things the basics of IOT protocols ate bigdata analytics and software defined networks	ting in HoT, y, Applicati ng Industrie DTAL PER BT M (High Unde Apply Unde	ons	of U S: PED evel ding K3)	AVs 45 (K2)	9 oT. 9 in
Management NIT IV Industrial IoT NIT V Industrial IO Industrial IO Industries, Ref OURSE OF It the end of Industrial IO Industries IO Indus	With Hadoop. IOT SECURITY Security and Fog Computing - Cloud Computing in IIoT, Fog Computation CASE STUDY T- Application Domains: Oil, chemical and pharmaceutical industry cal case studies: Milk Processing and Packaging Industries, Manufacturiation TOUTCOMES the course, the students will be able to be the fundamentals of Internet of Things the basics of IOT protocols ate bigdata analytics and software defined networks ment the concepts of IOT security	ting in HoT, y, Applicati ng Industrie DTAL PER BT M (High Unde Apply Unde	ons costs. IODS IAPP mest L rstance ying (of U S: PED evel ding K3) K3)	AVs 45 (K2)	9 oT. 9 in
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- 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.

Mapping of Course Outcomes with Programme Outcomes:

COs _		Programme Out		outcomes(POs)		
	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



	R23001	MATERIALS CHARACTERIZATION TECHNIQUES		3	0 0	3
CO	URSE (DBJECTIVES				
То	enable t	ne students to				-
1.	analyze	the different spectroscopic methods and fundamentals of Vibrational Spectro	oscopy			
2.	apply t	ne effects of X-Ray techniques and chemical analysis				
3.	underst	and the Electron Microscopy and Transmission Electron Microscopy				
4.	study tl	e thermal analysis and learn basic theory of Instrumentation				
5.	acquire	knowledge on Electrical Characterization and Non-destructive testing				
UNI	TI	SPECTROSCOPIC METHODS				9
Ator	mic abs	orption spectrometry (AAS), Atomic fluorescence spectrometry (AFS)	and A	Atomi	c emis	sior
spec	trometry	(AES) - Fundamentals and instrumentation, Vibrational spectroscopy	- Ram	an ar	d Infr	ared
Prin	ciples of	Vibrational spectroscopy, Infrared and Raman activity, Applications.				
UNI	TII	X-RAY TECHNIQUES				9
X-ra	y diffra	ction- Generation and characteristics of x-ray, Lattice planes and Bragg's lav	w, Thec	ory of	diffrac	tion,
Wid	e angle	XRD; X-ray fluorescence spectroscopy- Fundamental principles, Chemica	l analy:	sis, W	ave le	ngth
lispo	ersive sp	ectroscopy and energy dispersive spectroscopy, Applications.				
JNI	тшт	ELECTRON MICROSCOPY				9
Scan	ning ele	etron microscopy (SEM), Instrumentation, Electron beam-specimen interaction	n, Speci	imen į	reparat	ion,
		rsive spectroscopy (EDS) in electron microscopes; Transmission electron mic		(7)	-	
		tron sources, Specimen preparation, Image modes, Image contrast, Electron d				
		ttern, High resolution TEM, FESEM.				umg
JNI	TIV	mern, riigh resolution rew, resew.				ung
	0.100	THERMAL ANALYSIS				
her	mo grav	THERMAL ANALYSIS	ning ca	lorimo	etry (DS	9
		THERMAL ANALYSIS metric analysis (TGA), Differential thermal analysis (DTA), Differential scan				9 SC),
)yna	mic me	THERMAL ANALYSIS				9 SC),
)yna naly	mic me	THERMAL ANALYSIS metric analysis (TGA), Differential thermal analysis (DTA), Differential scan chanical analysis (DMA), Thermo-mechanical analysis (TMA) and Dynar				9 SC), mal
yna naly I NI	mic me	THERMAL ANALYSIS metric analysis (TGA), Differential thermal analysis (DTA), Differential scan chanical analysis (DMA), Thermo-mechanical analysis (TMA) and Dynar TA), Basic theory, Instrumentation and applications. ELECTRICAL AND MAGNETIC PROPERTIES	nic me	chanio	cal ther	9 SC), mal
Dyna naly J NI Wo	r V probe a	THERMAL ANALYSIS metric analysis (TGA), Differential thermal analysis (DTA), Differential scan chanical analysis (DMA), Thermo-mechanical analysis (TMA) and Dynar TA), Basic theory, Instrumentation and applications. ELECTRICAL AND MAGNETIC PROPERTIES nd four probe methods for electrical characterization, Vibrating sample magnetic analysis (DTA), Differential scan	nic med	chanic	cal ther	9 for
Dyna naly NI wo	rsis (DM) rV probe a setic pro	THERMAL ANALYSIS metric analysis (TGA), Differential thermal analysis (DTA), Differential scan chanical analysis (DMA), Thermo-mechanical analysis (TMA) and Dynar TA), Basic theory, Instrumentation and applications. ELECTRICAL AND MAGNETIC PROPERTIES	nic med	chanic	cal ther	9 for
ynaly naly Wo nagn	rsis (DM) rV probe a setic pro	THERMAL ANALYSIS metric analysis (TGA), Differential thermal analysis (DTA), Differential scan chanical analysis (DMA), Thermo-mechanical analysis (TMA) and Dynar TA), Basic theory, Instrumentation and applications. ELECTRICAL AND MAGNETIC PROPERTIES nd four probe methods for electrical characterization, Vibrating sample maperty analysis, Applications. Non-destructive testing: Radiography, Ultrasory, Holography, Basic principles, Applications.	agneton	neter	(VSM)	9 (SC), mal (SC) for for for,
Oyna naly NI wo nagn	r V probe a netic pro	THERMAL ANALYSIS metric analysis (TGA), Differential thermal analysis (DTA), Differential scan chanical analysis (DMA), Thermo-mechanical analysis (TMA) and Dynar TA), Basic theory, Instrumentation and applications. ELECTRICAL AND MAGNETIC PROPERTIES nd four probe methods for electrical characterization, Vibrating sample may perty analysis, Applications. Non-destructive testing: Radiography, Ultraso	agneton	neter coustic	(VSM) emiss	9 (SC), mal (SC) for for for,
Oyna naly INI Two nagn	r V probe a netic promograph	THERMAL ANALYSIS metric analysis (TGA), Differential thermal analysis (DTA), Differential scan chanical analysis (DMA), Thermo-mechanical analysis (TMA) and Dynar TA), Basic theory, Instrumentation and applications. ELECTRICAL AND MAGNETIC PROPERTIES and four probe methods for electrical characterization, Vibrating sample maperty analysis, Applications. Non-destructive testing: Radiography, Ultrasory, Holography, Basic principles, Applications. TOTAL TOTAL	agneton onic, Ac	neter coustic	(VSM) e emiss	9 (SC), mal (SC) for for for,
Dyna naly UNIT wo nagn there	rv probe a setic promograph	THERMAL ANALYSIS metric analysis (TGA), Differential thermal analysis (DTA), Differential scan chanical analysis (DMA), Thermo-mechanical analysis (TMA) and Dynar TA), Basic theory, Instrumentation and applications. ELECTRICAL AND MAGNETIC PROPERTIES and four probe methods for electrical characterization, Vibrating sample maperty analysis, Applications. Non-destructive testing: Radiography, Ultrasory, Holography, Basic principles, Applications. TOTAL UTCOMES the course, the students will be able to	agneton	neter coustic	(VSM) e emiss	9 (SC), mal (SC) for for for,
Dyna naly UNIT wo nagn there	rv probe a setic promograph	THERMAL ANALYSIS metric analysis (TGA), Differential thermal analysis (DTA), Differential scan chanical analysis (DMA), Thermo-mechanical analysis (TMA) and Dynar TA), Basic theory, Instrumentation and applications. ELECTRICAL AND MAGNETIC PROPERTIES and four probe methods for electrical characterization, Vibrating sample maperty analysis, Applications. Non-destructive testing: Radiography, Ultrasory, Holography, Basic principles, Applications. TOTAL TOTAL	agneton nic, Ac PERI BT M (Highe	neter coustice ODS: APPI	(VSM) e emiss	9 for for,
Dyna unaly UNI Two nagn Therr	rv probe a letic promograph RSE Of learn Spect	THERMAL ANALYSIS metric analysis (TGA), Differential thermal analysis (DTA), Differential scan chanical analysis (DMA), Thermo-mechanical analysis (TMA) and Dynar TA), Basic theory, Instrumentation and applications. ELECTRICAL AND MAGNETIC PROPERTIES Ind four probe methods for electrical characterization, Vibrating sample may perty analysis, Applications. Non-destructive testing: Radiography, Ultraso y, Holography, Basic principles, Applications. TOTAL JTCOMES the course, the students will be able to the different spectroscopic methods and fundamentals of Vibrational	agneton nic, Ac PERI BT M (Highe	neter oustice APPI est Le	(VSM) e emiss 45 ED vel)	9 for for,

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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)

- 1. S. Zhang, Lin Li, A. Kumar, Materials Characterisation Techniques, CRC press, 2008.
- Y. Leng, Materials Characterisation: Introduction to Microscopic and Spectroscopic Methods, John Wiley & Sons (Asia), 2008.
- 3. R.M. Silverstein, Spectrometric identification of organic compounds, 7th ed., John Wiley and Sons, 2007.
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CO - PO MAPPING

60-			Programme Outcomes(POs)			
COs _	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	_	-	
CO2	3	2	3	-	Ĭ.	-
CO3	3	1	3	-	=	1+3
CO4	3	2	2	-	-	•
CO5	3	2	3	-	-	-



PM	IR23002	COMPOSITE MATERIALS AND TESTING 3 0	0 0	3
CC	OURSE (OBJECTIVES		
To	enable t	he students to		
1.	learn th	ne types of composites, FRP and Particulate composites		
2.	acquire	knowledge on types of Reinforcement and fibres		
3.	underst	tand the characteristics of Metal Matrix Composites		
4.	study tl	he Ceramic Metal Matrix, properties and various types of CMC		
5.	demons	strate the different types of testing of composites, Electrical and Thermal conductivity test		
UN	ITI	TYPES OF COMPOSITES	-	9
Fun	idamenta	als of composites - need for composites -Types, Polymer matrix composites (PMC), Carl	bon m	atrix
Fib	er Reinfo	or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramic matrix composite corced Composites, Fiber Reinforced Polymer (FRP) Composites, Particulate Composites. Appes of composites.	- 2	
UN	IT II	TYPES OF REINFORCEMENTS/FIBERS		9
Rol	e and Se	election of reinforcement materials. Types of fibres: Glass fibers, Carbon fibers, Aramid fib	hers N	[eta]
		nina fibers, Boron Fibers, Silicon carbide fibers, Quartz and Silica fibers, Multiphase fibers,	Whish	ers,
Flal	kes. IT III	METAL MATRIX COMPOSITES		9
Flal UN Cha Lim	IT III racterist		of M	9 MC,
Cha Lim cast	IT III aracterist nitations ing – squ	METAL MATRIX COMPOSITES ics of MMC, Various types of Metal matrix composites Alloy vs. MMC, Advantages of MMC, Metal Matrix, Processing of MMC – Powder metallurgy process - diffusion bon neeze casting. CERAMIC MATRIX COMPOSITES	of M	9 MC, stir
Flah UN Cha Lim cast UN Eng Cera oxic	IT III aracterist aitations aing – squ IT IV cineering amic mat	METAL MATRIX COMPOSITES ics of MMC, Various types of Metal matrix composites Alloy vs. MMC, Advantages of MMC, Metal Matrix, Processing of MMC – Powder metallurgy process - diffusion bon are casting. CERAMIC MATRIX COMPOSITES ceramic materials – properties – advantages – limitations – Monolithic ceramics – Need for ix - Various types of Ceramic Matrix composites- oxide ceramics – non oxide ceramics – and nitride – Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing	of Minding -	9 MC, stir 9 C –
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CO4	learn the Ceramic Metal Matrix, properties and various types of CMC	Applying (K3)
CO5	do the different types of testing of composites, Electrical and Thermal	Applying (K3)
COS	conductivity test	rippi) ing (125)

- 1. Mechanical Metallurgy, G. Dieter, 3rd Edition, McGraw Hill, 1986.
- Engineering Mechanics and Composite Materials, Isaac M Daniels and Ori Ishai, Second Edition, Oxford University Press, 2005
- Engineering Materials: Polymers, Ceramics and Composites, Second Edition, A.K.Bhargava, Prentice Hall India, 2012.
- 4. Materials characterization, Vol. 10, ASM hand book, 2019.

CO - PO MAPPING

Mapping of Course Outcomes with Programme Outcomes:

COs			Programme O	utcomes(POs)		
Cos	PO1	PO2	PO3	PO4	PO5	PO6
CO1	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



	R23003		3	0	0	3
CO	URSE (DBJECTIVES			-	
То	enable tl	ne students to				
1.	classify	the various soft computing frame works				
2.	familia	rize with the design of neural networks, fuzzy logic and fuzzy systems				
3.	learn m	athematical background for optimized genetic programming			The	
4.	get exp	osed to neuro-fuzzy hybrid systems and its applications				-
5.	underst	and various hybrid soft computing techniques and apply in real time problems				
UNI	TI	INTRODUCTION TO SOFT COMPUTING				
Soft	Compu	ting Constituents-From Conventional AI to Computational Intelligence- Artificia	ıl net	ıral	netv	ork
relat	ions: car	chnologies - applications. Fuzzy logic: Introduction - crisp sets- fuzzy sets - crisp retesian product of relation - classical relation, fuzzy relations, tolerance and equivalency sets. Genetic algorithm Introduction - biological background - traditional optim Genetic basic concepts.	nce re	elati	ons,	non
UNI		NEURAL NETWORKS				9
						- 3
Supe	rvised l	earning network: perceptron networks - adaptive linear neuron, multiple adaptive lin	near n	eur	on, E	PN
RBF hopf	, associa	tive memory network: auto-associative memory network, hetero-associative memory orks, unsupervised learning networks: Kohonen self-organizing feature maps, LVC	y net	woi	k, B	4M
RBF hopfi UNI	, associa ield netv	tive memory network: auto-associative memory network, hetero-associative memory vorks, unsupervised learning networks: Kohonen self-organizing feature maps, LVC FUZZY LOGIC	y net () – Cl	wor	rk, Ba	AM ks.
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COU	RSE OUTCOMES	BT MAPPED
At the	end of the course, the students will be able to	(Highest Level)
COI	apply various soft computing concepts for practical applications	Applying (K3)
CO2	choose and design suitable neural network for real time problems	Applying (K3)
CO3	use fuzzy rules and reasoning to develop decision making and expert system	Understanding (K2)
CO4	explain the importance of optimization techniques and genetic programming	Applying (K3)
CO5	review the various hybrid soft computing techniques and apply in real time problems	Applying (K3)

- 1. J.S.R.Jang, C.T. Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI / Pearson Education 2004.
- 2. S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt Ltd, 2011.
- 3. George J. Klir, Ute St. Clair, Bo Yuan, "Fuzzy Set Theory: Foundations and Applications" Prentice Hall,
- 4. David E. Goldberg, "Genetic Algorithm in Search Optimization and Machine Learning" Pearson Education India, 2013.

CO - PO MAPPING

	Programme Outcomes(POs)						
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	

