# PAAVAI ENGINEERING COLLEGE, NAMAKKAL B.E. MECHANICAL ENGINEERING

# **REGULATIONS 2023**

# (CHOICE BASED CREDIT SYSTEM)

# CURRICULUM & SYLLABUS

# SEMESTER - V

S.No.	Category	Course Code	Course Title	L	T	P	C
Theor	у		and the same safe.				1
1	PC	ME23501	Design of Machine Elements	3	1	0	4
2	PC	ME23502	Dynamics of Machinery	3	1	0	4
3	PC	ME23503	Metrology and Measurements	3	0	0	3
4	PC	ME23504	Additive Manufacturing	3	0	0	3
5	PC	ME23505	Automobile Engineering	3	0	0	3
6	PE	ME2315*	Professional Elective-I	3	0	0	3
Pract	ical		F1 - 1 - 1 - 1 - 2 - 2 - 2 - 2 - 2 - 2 -				
7	PC	ME23506	Metrology and Measurements Laboratory	0	0	2	1
8	PC	ME23507	Dynamics Laboratory	0	0	2	1
9	EE	ME23508	Industrial Training	0	0	2	1
10	EE	GE23501	Professional Development III	0	0	2	1
		Т	OTAL	18	2	8	2

# VERTICAL – IV THERMAL ENGINEERING

S.No.	Category	Course Code	Course Title	L	T	P	C
1	PE	ME23451	Power Plant Engineering	3	0	0	3
2	PE	ME23452	Refrigeration and Air conditioning	3	0	0	3
3	PE	ME23453	Gas Dynamics and Jet Propulsion	3	0	0	3
4	PE	ME23454	Computational Fluid Dynamics	3	0	0	3
5	PE	ME23455	Turbo Machines	3	0	0	3
6	PE	ME23456	Design of Heat Exchangers	3	0	0	3
7	PE	ME23457	Advanced Internal Combustion Engines	3	0	0	3

Approved
BOARD OF STUDIES
Mechanical Engineering

AUTONOMOUS

VERTICAL – V ROBOTICS AND AUTOMATION

S.No.	Category	Course Code	Course Title	L	T	P	C
1	PE	ME23551	Microprocessor and Artificial Intelligence for Industry	3	0	0	3
2	PE	ME23552	Machine Learning in Automation	3	0	0	3
3	PE ·	ME23553	Measurements and Controls	3	0	0	3
4	PE	ME23554	Predictive Analytics in Industry 4.0	3	0	0	3
5	PE	ME23555	Automation in Manufacturing	3	0	0	3
6	PE	ME23556	Real time Embedded Systems	3	0	0	3
7	PE	ME23557	Electrical Drives and Actuators	3	0	0	3

# VERTICAL – VI AUTOMOTIVE ENGINEERING

S.No.	Category	Course Code	Course Title	L	T	P	C
1	PE	ME23651	Vehicle Dynamics and control	3	0	0	3
2	PE	ME23652	Electric Vehicle Technology	3	0	0	3
3	PE	ME23653	Smart Mobility and Vehicle Systems	3	0	0	3
4	PE	ME23654	Thermochemical Energy Systems	3	0	0	3
5	PE	ME23655	Sheet metal and Composite Material design	3	0	0	3
6	PE	ME23656	Automotive Engine and Subsystems	3	0	0	3
7	PE	ME23657	Intelligent vehicle system	3	0	0	3

# MINOR MANUFACTURING TECHNOLOGY

S.No	Category	Course Code	Course Title	L	T	P	C
1	PE	ME23851	Basics of Manufacturing Technology	3	0	0	3
2	PE	ME23852	Fundamentals of Additive Manufacturing	3	0	0	3
3	PE	ME23853	Non-Traditional Manufacturing Processes	3	0	0	3
4	PE	ME23854	Smart Manufacturing and Industry 4.0	3	0	0	3
5	PE	ME23855	Product design and Innovation	3	0	0	3
6	PE	ME23856	Lean and sustainable Manufacturing systems	3	0	0	3



# PAAVAI ENGINEERING COLLEGE, NAMAKKAL B.E. MECHANICAL ENGINEERING REGULATIONS 2023

# (CHOICE BASED CREDIT SYSTEM)

# **CURRICULUM**

# VERTICAL-I

# ENGINEERING DESIGN

S.No.	Category	Course Code	Course Title	L	T	P	C
1	PE	ME23151	Design for Manufacture and Assembly	3	0	0	3
2	PE	ME23152	Design of Jigs, Fixtures and Press Tools	3	0	0	3
3	PE	ME23153	Machine Tool Design	3	0	0	3
4	PE	ME23154	Ergonomics in Design	3	0	0	3
5	PE	ME23155	Geometric Modelling	3	0	0	3
6	PE	ME23156	Engineering Tribology	3	0	0	3
7	PE	ME23157	Failure Analysis and Design	3	0	0	3

# VERTICAL – II MANUFACTURING

S.No.	Category	Course Code	Course Title	L	T	P	C
1	PE	ME23251	Non-Traditional Machining	3	0	0	3
2	PE	ME23252	Welding Technology	3	0	0	3
3	PE	ME23253	Process planning and cost estimation	3 .	0	0	3
4	PE	ME23254	Computer Integrated Manufacturing	3	0	0	3
5	PE	ME23255	Advanced Casting and forming processes	3	0	0	3
6	PE	ME23256	Lean Manufacturing	3	0	0	3
7	PE	ME23257	Industrial Robotics	3	0	0	3

# VERTICAL – III INDUSTRIAL ENGINEERING

S.No.	Category	Course Code	Course Title	L	T	P	C
1	PE	ME23351	Operational Research	3	0	0	3
2	PE	ME23352	Engineering Economics	3	0	0	3
3	PE	ME23353	Industrial Safety	3	0	0	3
4	PE	ME23354	Logistics and Supply Chain Networks	3	0	0	3
5	PE	ME23355	Plant Layout and Materials Handling	3	0	0	3
6	PE	ME23356	Supply Chain Management	3	0	0	3
7	PE	ME23357	Enterprise Resoluce Planning	3	0	0	3

BOARD OF STUDIES

Mechanical Engineering

AUTONOMOUS

ME	23501	DESIGN OF MACHINE ELEMENTS	3	1	0	4
CO	URSE C	DBJECTIVES				
То	enable th	ne students to	- 22-Ti	ed disc	IIA	
1	learn th	e designing of machine elements subjected to static and variable loads.				
2	study a	nd understand the basics of designing shafts and couplings for various application				
3	attain g	ood understanding on design of bolted and welded joints for various kinds of loads	and	appli	catio	ns.
4	acquire	knowledge on designing of helical and torsional springs subjected to constant and	varia	ble lo	oads	
5		and design procedure for bearings and selection of appropriate sliding and rolling on at applications.	conta	ct bea	arings	for
UN	IT I	FUNDAMENTAL CONCEPTS IN DESIGN				12
Ecc brit	entric lo	Preferred numbers- Direct, Bending and torsional loading- Combined loads – ading – curved beams – crane hook and 'C' frame- Factor of safety- theories of farials- Stress concentration - Fluctuating stresses -Endurance limit – design for findle loading – Soderberg, Goodman and Gerber relations - Exposure to standards.	ilure	for d	uctile	and
Sha and		DESIGN OF SHAFT AND COUPLINGS  Axles - Design of solid and hollow shafts based on strength, rigidity and critical specific property of Rigid and flexible couplings - AI-Enabled Material Selection for				
Sha and Ma UN	ofts and A splines nufactur	DESIGN OF SHAFT AND COUPLINGS  Axles - Design of solid and hollow shafts based on strength, rigidity and critical specific property of Rigid and flexible couplings - AI-Enabled Material Selection for	Shaf	t and	coup	Keys pling
Sha and Ma UN Thr	splines nufactur IT III readed fa	DESIGN OF SHAFT AND COUPLINGS  Axles - Design of solid and hollow shafts based on strength, rigidity and critical specific property of Rigid and flexible couplings - AI-Enabled Material Selection for ing.  DESIGN OF TEMPORARY AND PERMANENT JOINTS	Shaf	t and	coup	Keys pling
Sha and Ma UN Thr But	splines nufactur IT III readed fa	DESIGN OF SHAFT AND COUPLINGS  Axles - Design of solid and hollow shafts based on strength, rigidity and critical specific property of Rigid and flexible couplings - AI-Enabled Material Selection for ing.  DESIGN OF TEMPORARY AND PERMANENT JOINTS  asteners - Bolted joints - Simple and eccentrically loaded bolted joints- Cotter joints	Shaf	t and	coup	Keys pling
Sha and Ma UN Thr But	splines nufacturing IT III readed fact, Fillet a	DESIGN OF SHAFT AND COUPLINGS  Axles - Design of solid and hollow shafts based on strength, rigidity and critical specific property of Rigid and flexible couplings - AI-Enabled Material Selection for ing.  DESIGN OF TEMPORARY AND PERMANENT JOINTS  asteners - Bolted joints - Simple and eccentrically loaded bolted joints- Cotter joint and parallel transverse fillet welds - welded joints subjected to combined loads.	Shaf	t and	coup ed joi	Keys pling 12 nts –
Sha and Ma UN Thr But UN	splines nufacturi IT III readed fa att, Fillet a IT IV pes of sp	DESIGN OF SHAFT AND COUPLINGS  Axles - Design of solid and hollow shafts based on strength, rigidity and critical specific property of Rigid and flexible couplings - AI-Enabled Material Selection for ing.  DESIGN OF TEMPORARY AND PERMANENT JOINTS  asteners - Bolted joints - Simple and eccentrically loaded bolted joints - Cotter joint and parallel transverse fillet welds - welded joints subjected to combined loads.  DESIGN OF ENERGY STORING ELEMENTS	Shaf nts, V	Welde	coup ed joi gs, sp	Keys pling  12 nts –  12 pring
Sha and Ma UN Thr But UN Typ des	splines nufacturi IT III readed fa att, Fillet a IT IV pes of sp	DESIGN OF SHAFT AND COUPLINGS  Axles - Design of solid and hollow shafts based on strength, rigidity and critical specific policy of Rigid and flexible couplings - AI-Enabled Material Selection for ing.  DESIGN OF TEMPORARY AND PERMANENT JOINTS  Insteners - Bolted joints - Simple and eccentrically loaded bolted joints - Cotter joint and parallel transverse fillet welds - welded joints subjected to combined loads.  DESIGN OF ENERGY STORING ELEMENTS  Design of helical and concentric springs—surge in springs, Design of lamin static loading - Flywheels considering stresses in rims and arms for engines and	Shaf nts, V	Welde	coup ed joi gs, sp	Keys pling  12 nts –  12 pring
Sha and Ma UN Thr But UN Typ des	splines nufacturi IT III readed fa att, Fillet a IT IV pes of sp ign for s	DESIGN OF SHAFT AND COUPLINGS  Axles - Design of solid and hollow shafts based on strength, rigidity and critical specific policy of Rigid and flexible couplings - AI-Enabled Material Selection for ing.  DESIGN OF TEMPORARY AND PERMANENT JOINTS  Insteners - Bolted joints - Simple and eccentrically loaded bolted joints - Cotter joint and parallel transverse fillet welds - welded joints subjected to combined loads.  DESIGN OF ENERGY STORING ELEMENTS  Design of helical and concentric springs—surge in springs, Design of lamin static loading - Flywheels considering stresses in rims and arms for engines and	Shaf nts, V	Welde	coup ed joi gs, sp	Keys pling  12 nts –  12 pring
Shaand Mar UN Thr But UN Typ des Rim Roll Boy	splines nufacturi IT III readed fa att, Fillet a ign for sign for	DESIGN OF SHAFT AND COUPLINGS  Axles - Design of solid and hollow shafts based on strength, rigidity and critical specific property of Rigid and flexible couplings - AI-Enabled Material Selection for ing.  DESIGN OF TEMPORARY AND PERMANENT JOINTS  Insteners - Bolted joints - Simple and eccentrically loaded bolted joints - Cotter joint and parallel transverse fillet welds - welded joints subjected to combined loads.  DESIGN OF ENERGY STORING ELEMENTS  Derings, design of helical and concentric springs-surge in springs, Design of lamin static loading - Flywheels considering stresses in rims and arms for engines and twheels	shaf nts, V	Weldersprin	coup ed joi gs, s Solice	12 nts – 12 pring l and 12 i and
Shaand Maranda UN Thr But UN Typ des Rim Roll Boy	splines nufacturi IT III readed fa att, Fillet a ign for sign for	Axles - Design of solid and hollow shafts based on strength, rigidity and critical spectrum of Rigid and flexible couplings - AI-Enabled Material Selection for ing.  DESIGN OF TEMPORARY AND PERMANENT JOINTS  Insteners - Bolted joints - Simple and eccentrically loaded bolted joints - Cotter joint and parallel transverse fillet welds - welded joints subjected to combined loads.  DESIGN OF ENERGY STORING ELEMENTS  Derings, design of helical and concentric springs—surge in springs, Design of lamin static loading - Flywheels considering stresses in rims and arms for engines and wheels  DESIGN OF BEARINGS  tact and sliding contact bearings - Hydrodynamic journal bearings, Sommerfeld Number - Application of AI in Analyzing Sommerfeld Number for Hydrodynamic Be f Rolling Contact bearings - Causes and failures of bearings.	nts, V	Weldersprin	gs, spontage of the couple of	12 oring l and l a
Sha and Mai UN Thr But UN Typ des Rin Rol Boy Sel	splines nufacturi IT III readed fa att, Fillet a IT IV pes of sp ign for s nmed fly IT V Illing con yd graph ection of	Axles - Design of solid and hollow shafts based on strength, rigidity and critical special position of Rigid and flexible couplings - AI-Enabled Material Selection for ing.  DESIGN OF TEMPORARY AND PERMANENT JOINTS  Insteners - Bolted joints - Simple and eccentrically loaded bolted joints - Cotter joint and parallel transverse fillet welds - welded joints subjected to combined loads.  DESIGN OF ENERGY STORING ELEMENTS  DESIGN OF ENERGY STORING ELEMENTS  DESIGN OF BEARINGS  Tact and sliding contact bearings - Hydrodynamic journal bearings, Sommerfeld Numbers of AI in Analyzing Sommerfeld Number for Hydrodynamic Bearings Contact bearings - Causes and failures of bearings.	shafents, V	Weldersprin	gs, spontage of the couple of	12 oring l and l a
Shaand Mar UN Thr But UN Typ des Rim UN Roll Boy Sel	splines nufacturi IT III readed fa tt, Fillet a IT IV pes of sp ign for s nmed fly IIT V Illing con yd graph ection of	DESIGN OF SHAFT AND COUPLINGS  Axles - Design of solid and hollow shafts based on strength, rigidity and critical specific position of Rigid and flexible couplings - AI-Enabled Material Selection for ing.  DESIGN OF TEMPORARY AND PERMANENT JOINTS  Insteners - Bolted joints - Simple and eccentrically loaded bolted joints - Cotter joint and parallel transverse fillet welds - welded joints subjected to combined loads.  DESIGN OF ENERGY STORING ELEMENTS  DESIGN OF ENERGY STORING ELEMENTS  DESIGN OF BEARINGS tact and sliding contact bearings - Hydrodynamic journal bearings, Sommerfeld Number of Hydrodynamic Bearings - Causes and failures of bearings.  TOO  DUTCOMES  BT	shafents, Venated pressure aring	Welderspringses -	gs, spondorma	12 oring l and l a
Shaand Mar UN Thr But UN Typ des Rim UN Roll Boy Sel	splines nufacturi IT III readed fa tt, Fillet a IT IV pes of sp ign for s nmed fly IIT V Illing con yd graph ection of the end of	DESIGN OF SHAFT AND COUPLINGS  Axles - Design of solid and hollow shafts based on strength, rigidity and critical specific possible of Rigid and flexible couplings - AI-Enabled Material Selection for ing.  DESIGN OF TEMPORARY AND PERMANENT JOINTS  Insteners - Bolted joints - Simple and eccentrically loaded bolted joints - Cotter joint and parallel transverse fillet welds - welded joints subjected to combined loads.  DESIGN OF ENERGY STORING ELEMENTS  DUTINGS, design of helical and concentric springs-surge in springs, Design of lamin static loading - Flywheels considering stresses in rims and arms for engines and wheels  DESIGN OF BEARINGS  tact and sliding contact bearings - Hydrodynamic journal bearings, Sommerfeld Number of AI in Analyzing Sommerfeld Number for Hydrodynamic Bearing Contact bearings - Causes and failures of bearings.  TOO  OUTCOMES  of the course, the students will be able to	nts, V	Velde sprin ses - PER	gs, spontage of the couple of	12 oring l and l a

CO3	design bolted and welded joints for various kinds of loads and applications	Applying (K3)
CO4	design energy storing elements like helical and leaf springs, flywheels for various applications.	Understanding (K2)
CO5	design different types of bearings and also select sliding and rolling contact bearings appropriately for different applications.	Analysing (K4)

- 1. Bhandari V B, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2017
- Joseph Shigley, Richard G. Budynas and J. Keith Nisbett "Mechanical Engineering Design", 10th Edition, Tata McGraw-Hill, 2015.

# REFERENCES

- Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine component Design",6th Edition, Wiley, 2017.
- 2. R. C. Juvinall and K. M. Marshek, Fundamentals of Machine Component Design, 6th Edition John Wiley and Sons, New Delhi, 2017
- 3. Design Data Hand Book", PSG College of Technology, Coimbatore, 2013
- 4. Norton R.L., "Design of Machinery", 5th Edition, Tata McGraw Hill, New Delhi, 2012.

# CO - PO MAPPING

COs					Progra	amme O	utcome	(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	<b>5.</b>	77.4	1	A.A.		-	2	2	3
CO2	3	3	3	3	-	-	-	1	-		- 1	2	2	3
CO3	3	3	3	3		-	-	1	-	4	-	2	2	3
CO4	3	3	3	3	1020	-	3-0	1	-		-	2	2	3
C05	3	3	3	3	3 3	-	-	1	-	- 7-	-	2	2	3



	23502	DYNAMICS OF MACHINERY	3	1	0	4
CO	URSE O	BJECTIVES				
То	enable the	e students to				
1	understa	and the force-motion relationship in components subjected to external forces	and analys	sis o	star	dard
1	mechani	ism.				
2	familiar	ize the concept of static and dynamic mass balancing				
3	get intro	duced to the approaches and mathematical models used in dynamical analysi	is of free v	brat	ion	
4	know th	e analysis of forced vibrations and vibration transmissibility	¥			
5	learn va	rious control mechanism for governors and gyroscopes				-
UN	ITI	FORCE ANALYSIS AND FLYWHEELS	Page 1	_		12
Stat	ic forces	analysis of mechanism - dynamic force analysis in reciprocating engines -	gas forces	- ine	rtia e	
		g rod - bearing loads - crank shaft torque - engine shaking forces -turn	5///021 II			
flyv	heels of	engines and punch press.				
UN	ITII	BALANCING	Barrier.			12
Stat	ic and dy	namic balancing - balancing of rotating masses - Balancing of single cylinder	er engines	- Ba	lanci	ng of
Mul	ti-cylind	er engines- V-engines - Partial balancing in engines.				
TINI	COLUMN TAX				1	
Bas	ics of vib	FREE VIBRATION  oratory systems - Degrees of freedom - single degree of freedom - free vibrate tency - types of damping - damped free vibration - whirling of shaft and				tion -
Bas natu syst	ics of vib	pratory systems - Degrees of freedom - single degree of freedom - free vibration - types of damping - damped free vibration - whirling of shaft and tural frequency of two and three rotor systems.				sional
Bas natu syst	ics of vib	pratory systems - Degrees of freedom - single degree of freedom - free vibration - types of damping - damped free vibration - whirling of shaft and	critical spe	ed -	- tors	tion - sional
Bas natu syst UN Res	ics of vib	pratory systems - Degrees of freedom - single degree of freedom - free vibrate tency - types of damping - damped free vibration - whirling of shaft and tural frequency of two and three rotor systems.  FORCE VIBRATION  periodic forcing - harmonic forcing - unbalanced forced vibration - supp	critical spe	ed -	- tors	tion - sional
Bas natu syst UN Res dec	ics of vibural frequem – natricem	pratory systems - Degrees of freedom - single degree of freedom - free vibrate tency - types of damping - damped free vibration - whirling of shaft and tural frequency of two and three rotor systems.  FORCE VIBRATION  periodic forcing - harmonic forcing - unbalanced forced vibration - support magnification factor - vibration isolation and transmissibility.	critical spe	ed -	- tors	tion - sional 12 thmic
Bas natu syst UN Res dec	ics of vib	pratory systems - Degrees of freedom - single degree of freedom - free vibrate tency - types of damping - damped free vibration - whirling of shaft and tural frequency of two and three rotor systems.  FORCE VIBRATION  periodic forcing - harmonic forcing - unbalanced forced vibration - supp	critical spe	eed -	tors	tion - sional 12 thmic
Bass natu syst UN Res dec UN Gov	ics of vib	pratory systems - Degrees of freedom - single degree of freedom - free vibrate tency - types of damping - damped free vibration - whirling of shaft and tural frequency of two and three rotor systems.  FORCE VIBRATION  periodic forcing - harmonic forcing - unbalanced forced vibration - suppragnification factor - vibration isolation and transmissibility.  MECHANISM FOR CONTROL	critical special speci	eed -	- tors	12 thmic 12 istics,
Bass natu syst UN Res dec UN Gov	ics of vib	pratory systems - Degrees of freedom - single degree of freedom - free vibrate tency - types of damping - damped free vibration - whirling of shaft and tural frequency of two and three rotor systems.  FORCE VIBRATION  periodic forcing - harmonic forcing - unbalanced forced vibration - suppost magnification factor - vibration isolation and transmissibility.  MECHANISM FOR CONTROL  types - centrifugal governors - watt, porter and proell governors- controlling basic concepts gyroscopic law - gyroscopic couple - gyroscopic stabilization	critical special speci	- lo	ogari	12 thmic 12 istics, ects in
Bass natu syst UN Res decc UN Gov gyr auto	ics of vib	pratory systems - Degrees of freedom - single degree of freedom - free vibrate tency - types of damping - damped free vibration - whirling of shaft and tural frequency of two and three rotor systems.  FORCE VIBRATION  periodic forcing - harmonic forcing - unbalanced forced vibration - suppost magnification factor - vibration isolation and transmissibility.  MECHANISM FOR CONTROL  types - centrifugal governors - watt, porter and proell governors- controlling basic concepts gyroscopic law - gyroscopic couple - gyroscopic stabilization	ort motion ing force- on – gyroso	- lochara	ogari	12 thmic 12 istics, ects in
Bass natu system UN. Ress decount UN. Government of the control of	ics of vib	pratory systems - Degrees of freedom - single degree of freedom - free vibration - types of damping - damped free vibration - whirling of shaft and tural frequency of two and three rotor systems.  FORCE VIBRATION  periodic forcing - harmonic forcing - unbalanced forced vibration - supp magnification factor - vibration isolation and transmissibility.  MECHANISM FOR CONTROL  types - centrifugal governors - watt, porter and proell governors- controllibasic concepts gyroscopic law - gyroscopic couple - gyroscopic stabilization, ships and airplanes.	ort motion	- lo	gari	12 thmic 12 istics, ects in
Bass natu system UN. Ress decount UN. Government of the control of	ics of vib	pratory systems - Degrees of freedom - single degree of freedom - free vibration - types of damping - damped free vibration - whirling of shaft and ural frequency of two and three rotor systems.  FORCE VIBRATION  periodic forcing - harmonic forcing - unbalanced forced vibration - support magnification factor - vibration isolation and transmissibility.  MECHANISM FOR CONTROL  types - centrifugal governors - watt, porter and proell governors- controlled basic concepts gyroscopic law - gyroscopic couple - gyroscopic stabilization, ships and airplanes.  OUTCOMES  f the course, the students will be able to syze forces acting in mechanisms and determine bearing loads and shaking	ort motion ing force- on – gyrose TOTAL BT MAP	- lochara chara PER	ogari	12 thmic 12 istics, ects in
Bass natu syst UN Res dec UN Gov gyre auto	ics of vib	pratory systems - Degrees of freedom - single degree of freedom - free vibration - types of damping - damped free vibration - whirling of shaft and ural frequency of two and three rotor systems.  FORCE VIBRATION  periodic forcing - harmonic forcing - unbalanced forced vibration - support magnification factor - vibration isolation and transmissibility.  MECHANISM FOR CONTROL  types - centrifugal governors - watt, porter and proell governors- controlled basic concepts gyroscopic law - gyroscopic couple - gyroscopic stabilization, ships and airplanes.  OUTCOMES  f the course, the students will be able to syze forces acting in mechanisms and determine bearing loads and shaking	ort motion ing force- on – gyroso TOTAL BT MAP (Highest	characopio	ogari	12 thmic 12 istics, ects in
Bass natu syst UN Res dec UN Gov auto	ics of vib	pratory systems - Degrees of freedom - single degree of freedom - free vibration - types of damping - damped free vibration - whirling of shaft and ural frequency of two and three rotor systems.  FORCE VIBRATION  periodic forcing - harmonic forcing - unbalanced forced vibration - supposagnification factor - vibration isolation and transmissibility.  MECHANISM FOR CONTROL  types - centrifugal governors - watt, porter and proell governors- controllibasic concepts gyroscopic law - gyroscopic couple - gyroscopic stabilization, ships and airplanes.  OUTCOMES  f the course, the students will be able to syze forces acting in mechanisms and determine bearing loads and shaking est.	ort motion ing force- on – gyroso TOTAL BT MAP (Highest Analysin	characopic  PER PED level	ogari	12 thmic 12 istics, ects in

CO5 understand the function and analysis of governors and gyroscopic effects. Understanding (K2)

# TEXT BOOKS

- 1. Rattan, S.S, "Theory of Machines", 5th Edition, Tata McGraw-Hill, 2019
- Uicker, J.J., Pennock, G.R. and Shigley, J.E., "Theory of Machines and Mechanisms", 4th Edition, Oxford University Press, 2014.

### REFERENCES

- 1. J. S. Brar, R. K. Bansal A Text Book of Theory of Machines, Laxmi Publication, 2004
- 2. Bevan Theory of Machines, 3rd Edition, Pearson publishing, 2009
- 3. R.S. KhurmI, "Theory of Machines", S Chand publication, 2020
- 4. Sadhu Singh, Theory of Machines: Kinematics and Dynamics 3rd Edition, 2011

# CO - PO MAPPING

COs					Progr	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1		ne.	- (	- H.	6/-		-	1	2	2
CO2	3	3	3	1	-	-	-	-				1	2	2
CO3	3	3	3	1		-	-	-	-	-	-	1	2	2
CO4	3	3	3	1			-	-		-	A (*)	1	2	2
CO5	3	3	3	1	-	-	-	-	-	-	-	1	2	2



	23503	METROLOGY AND MEASUREMENTS	3	0	0	3
COL	URSE OF	BJECTIVES			YN	
Тое	enable the	students to				
1	understan	nd metrology, measurement systems, and the basics of geometric dimensioning an	d tole	ranc	ing.	
2	learn the	method of linear and angular measurements and provides working skill in suitable	e devi	ces.		
3	provide k	knowledge on form measurements using suitable instruments.	37.0		elle.	
4	learn abo	out techniques and instruments used to measure power, flow and temperature.				
5	know abo	out the laser and advances in metrology.		1 8		
UNI	TIE	BASICS OF METROLOGY				9
Defi	nition of	metrology - units and standards - tolerance analysis - metrological character	istics	of m	easu	ing
pneu	ar measu	LINEAR AND ANGULAR MEASUREMENTS  uring instruments: Vernier, micrometer, slip gauges, height gauge - compar  d electrical comparators - angular measurements: sine bar, sine center, bevel protra				
auto						
		or - applications.				
UNI	T III F	FORM MEASUREMENTS measurements - measurement of screw thread - external thread measurement - mea				jor,
UNI Need mind meas	T III   F	FORM MEASUREMENTS	surem	ent -	- flatı	jor,
UNI Need mind meas Tayl	T III   Fd of form or diameter surement or-Hobson	FORM MEASUREMENTS  measurements - measurement of screw thread - external thread measurement - measurement of Gears: runout, pitch, profile, lead, backlash - straightness measurement - roundness measurement - surface finish measurement - stylus based - tomlinson	surem	ent -	- flatı	jor, ness
UNI Need mind meas Tayl UNI Pow	T III   F   d of form of diameter surement or Hobson T IV   M   er: mecha calibration	FORM MEASUREMENTS  measurements - measurement of screw thread - external thread measurement - measurement of Gears: runout, pitch, profile, lead, backlash - straightness measurement - roundness measurement - surface finish measurement - stylus based - tomlinson Talysurf.	surem n surfa	nent -	- flatineter	and 9 ube
UNI Need mind meas Tayl UNI Pow - AI temp	TIII   For diameter surement   For Hobson   TIV   Mer: mecha   Calibratic serature   TV   L	FORM MEASUREMENTS  measurements - measurement of screw thread - external thread measurement - measurement of Gears: runout, pitch, profile, lead, backlash - straightness measurement - roundness measurement - surface finish measurement - stylus based - tomlinson on Talysurf.  MEASUREMENT OF POWER, FLOW AND TEMPERATURE  mical, pneumatic, hydraulic, electrical type – flow measurement: venture, orifice, roundless for pitot tube-based flow meters - temperature measurement: Met bimetallic strip, thermocouples, pyrometer, resistance temperature detectors.  LASER AND ADVANCES IN METROLOGY	otame	ent -	- flati neter pitot t	jor, ness and 9 ube
UNI Neecemino meass Tayl UNI Pow - AI temp UNI Prec macl	TIII   For diameter surement or Hobson TIV   Market	FORM MEASUREMENTS  measurements - measurement of screw thread - external thread measurement - measurement of Gears: runout, pitch, profile, lead, backlash - straightness measurement - surface finish measurement - stylus based - tomlinson on Talysurf.  MEASUREMENT OF POWER, FLOW AND TEMPERATURE  mical, pneumatic, hydraulic, electrical type – flow measurement: venture, orifice, runon models for pitot tube-based flow meters - temperature measurement: Met bimetallic strip, thermocouples, pyrometer, resistance temperature detectors.	otame hods meass	ment -	- flatineter  pitot traeasurents adap	jor, ness and 9 ube ring 9
UNI Neecemino meass Tayl UNI Pow - AI ttemp UNI Prec macl	TIII   For diameter surement or Hobson TIV   Market	measurements - measurement of screw thread - external thread measurement - measurement of Gears: runout, pitch, profile, lead, backlash - straightness measurement of Gears: runout, pitch, profile, lead, backlash - straightness measurement - surface finish measurement - stylus based - tomlinson Talysurf.  MEASUREMENT OF POWER, FLOW AND TEMPERATURE  Inical, pneumatic, hydraulic, electrical type – flow measurement: venture, orifice, runon models for pitot tube-based flow meters - temperature measurement: Met bimetallic strip, thermocouples, pyrometer, resistance temperature detectors.  LASER AND ADVANCES IN METROLOGY  truments based on laser Principles - laser interferometer- laser application in metrology - coordinate measuring machine (CMM): need, construction, types, flm and applications- computer aided inspection - machine Vision- applications of importance of nano dimension - XRD.	otame hods meass	enent -	ents adap	jor, ness and 9 ube ring 9 and tive
UNI Need mind meass Tayl UNI Pow - AI ttemp UNI Prec macl	TIII   F d of form of diameter surement or Hobso TIV   M er: mecha calibration calibration in the column of the co	measurements - measurement of screw thread - external thread measurement - measurement of Gears: runout, pitch, profile, lead, backlash - straightness measurement - surface finish measurement - stylus based - tomlinson on Talysurf.  MEASUREMENT OF POWER, FLOW AND TEMPERATURE unical, pneumatic, hydraulic, electrical type – flow measurement: venture, orifice, runon models for pitot tube-based flow meters - temperature measurement: Metabimetallic strip, thermocouples, pyrometer, resistance temperature detectors.  LASER AND ADVANCES IN METROLOGY truments based on laser Principles - laser interferometer- laser application in metrology - coordinate measuring machine (CMM): need, construction, types, flow and applications- computer aided inspection - machine Vision- applications of importance of nano dimension - XRD.  TOT	otame hods measure f mac	eter, I with the same of the s	ents adap	jor, ness and 9 ube ring 9 and tive
UNI Need mind meass Tayl UNI Pow - AI temp UNI Prec macl	TIII   For diameter surement or Hobson   TIV   Market   M	measurements - measurement of screw thread - external thread measurement - measurement of Gears: runout, pitch, profile, lead, backlash - straightness measurement of Gears: runout, pitch, profile, lead, backlash - straightness measurement - surface finish measurement - stylus based - tomlinson on Talysurf.  MEASUREMENT OF POWER, FLOW AND TEMPERATURE  Inical, pneumatic, hydraulic, electrical type – flow measurement: venture, orifice, runon models for pitot tube-based flow meters - temperature measurement: Met bimetallic strip, thermocouples, pyrometer, resistance temperature detectors.  LASER AND ADVANCES IN METROLOGY  truments based on laser Principles - laser interferometer- laser application in metrology - coordinate measuring machine (CMM): need, construction, types, flow and applications- computer aided inspection - machine Vision- applications of importance of nano dimension - XRD.  TOT  UTCOMES  TOT	otame hods meass AI-Ba	ent - ace m letter, p of m urem ased hine	ents adap	jor, ness and 9 ube ring 9 and tive

CO2	practice the appropriate linear and angular measurements using precision measuring instruments.	Understanding (K2)
CO3	examine the major terminologies for screw thread, gear and roundness measurement.	Applying (K3)
CO4	have an in-depth knowledge of using appropriate instruments and techniques for the measurements of power, flow and temperature.	Understanding (K2)
CO5	gain knowledge on working principle of laser devices and coordinate measuring machine.	Analysing (K4)

- 1. Jain R.K., "Engineering Metrology", Khanna Publishers, 21st Edition, 2012.
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- 4. Holman.J.P., "Experimental Methods for Engineers" MCGraw-Hill Companies, Inc, 2012.

# CO - PO MAPPING

COs	-	Aller.			Progra	amme O	utcome	s(POs)					PS	Os
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2	-	2	-	-	11005	-	- 1	-	2	-		-	1
CO2	2	-	-1	-	-	-	-		-	2	-	-	-	-
CO3	2	1			2	-	-	-	-	2	-	-	-	-
CO4	2	2	-	-	-	-	-	1	2	1		.1	1	-
CO5	2	2	-	-	2	-	-	1	2	1	-	1	1	-



~~	23504	ADDITIVE MANUFACTURING	3	0	0	3
CO	URSE OB	JECTIVES				
То	enable the	students to				
1	introduce	the fundamentals of Additive Manufacturing and its impact on modern product de	velo	pme	nt.	
2		d the unique capabilities of AM and learn key concepts in design, data processing, and part production.	nd fil	le pre	eparat	ion
3		the principles, materials, processes, advantages, and applications of SLA, DLP, nanufacturing techniques.	LON	M, aı	nd Uz	AM
4		end the principles, processes, materials, and applications of FDM, SLS, SLM, a uring technologies.	nd E	ЕВМ	addi	tive
5		he principles, processes, materials, and applications of Binder Jetting, Material Jonanufacturing techniques.	ettin	g, ar	nd LE	NS
UN	ITI I	NTRODUCTION	17.			9
ben		A, commonly used terms, process chain, 3D modelling, Data Conversion, and transit, Building, Post processing, Classification of AMT process, Applications to various			Check	cing
			S IICI			
UN Con desi - Al Stru	IT II Incepts and ign - Lattice M File form	Objectives - AM Unique Capabilities - Part Consolidation - Topology Optimics Structures - Multi-Material Parts and Graded Materials - Data Processing: CAD Inats: STL-Problems with STL-AMF Design for Part Quality Improvement: Part Oricing - Tool Path Generation - Design rules for Extrusion based AM	zatio Mode	on G	epara	tive tion port
UN Con desi - Al Stru UN	IT II Discepts and ign - Lattice of File formatture - Slice of IT III   V	DESIGN FOR ADDITIVE MANUFACTURING  Objectives - AM Unique Capabilities - Part Consolidation — Topology Optimise Structures - Multi-Material Parts and Graded Materials - Data Processing: CAD In the Capability of Part Quality Improvement: Part Originals: STL-Problems with STL-AMF Design for Part Quality Improvement: Part Originals - Tool Path Generation — Design rules for Extrusion based AM  VAT POLYMERIZATION AND SHEET LAMINATION PROCESSES	zatio Mode ienta	on G el Protion	epara - Sup	tive tion port
UN Cor desi - Al Stru UN Ster Bui Pro Wo	ign - Lattice M File form Incture - Slice IT III   Value Teolithogra Iding and Coessing (Durking Prince	Objectives - AM Unique Capabilities - Part Consolidation - Topology Optimics Structures - Multi-Material Parts and Graded Materials - Data Processing: CAD Inats: STL-Problems with STL-AMF Design for Part Quality Improvement: Part Oricing - Tool Path Generation - Design rules for Extrusion based AM	zatio Mode ienta ild P ons.	on G el Pro tion roces Digi	epara - Sup ss - F tal L g (LO	general street of the street o
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Material Jetting: Multi Jet Modelling (MJM) - Principles - Process - Materials - Advantages and Limitations. Laser Engineered Net Shaping (LENS): Processes- Materials - Advantages - Limitations and Applications.

	Fartyetts 2	TOTAL PERIODS:45
COUL	RSE OUTCOMES	BT MAPPED
At the	end of the course, the students will be able to	(Highest level)
CO1	explain the AM process chain, classify AM technologies, and identify their applications across various industries.	Understanding (K2)
CO2	apply design principles such as part orientation, support structures, and slicing to improve part quality in extrusion-based AM.	Applying (K3)
CO3	describe the working principles, material usage, and benefits of SLA, DLP, LOM, and UAM processes and identify their industrial applications.	Understanding (K2)
CO4	discuss the working principles, material selection, and industrial relevance of FDM, SLS, SLM, and EBM processes.	Remembering (K1)
CO5	differentiate between 3DP, MJM, and LENS processes based on their working principles, material compatibility, and application suitability.	Analysing (K4)

### TEXT BOOKS

- Chua C.K, Leong K.F and Lim C.S, Rapid Prototyping: Principles and Applications, second edition, World Scientific, 2005.
- Ian Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing" Springer - New York, USA, 2nd Edition, 2015

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- 3. Bandyopadhyay, A.& Bose.S. Additive Manufacturing, second edition, CRC Press, 2019
- 4. Milan Brandt. "Laser Additive Manufacturing 1st Edition Materials, Design, Technologies, and Applications", Woodhead Publishing, UK, 2016.

### CO - PO MAPPING

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

COs					Progr	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	2	-		3	iq ent	-	1 2		10 - 11	-	2	2	2
CO2	3	-	3	-	3	1 400	-	T. W.	-	L nt le		-	2	2
CO3	3	-	-	2	2	-	-	-	4		-	-	2	2
CO4	3	2	-	2	3	-	SING C	OLLE		-		-	2	2
CO5	3	-	2	-	3	1.5	Appr	The Late of the la	EN	-	-	2	2	2

Mechanical Engineering

ALTONOMOUS

	3505	AUTOMOBILE ENGINEERING	3	0	0	3
COU	RSE OB	JECTIVES			170	
To er	nable the	students to				
1 l	understan	d the construction and working principles of various parts of an automo	bile	50	800	
2 s	study the	practice for assembling and dismantling of engine parts and transmissio	n system			
3 8	gain know	vledge about different types of transmission systems		THE	733	
4 1	learn the c	concepts and working principles of steering, brakes and suspension syste	ems ·			
5 a	acquire kr	nowledge on alternate energy sources in automobiles		S H	10.7	
UNIT	rı v	EHICLE STRUCTURE AND ENGINES				
Types	s of Autor	mobiles, Types of Chassis layout, with reference to Power Plant drive lo	cation. Types	of F	ames	an
	rchargers	ines – components - functions and materials, variable valve timing - Turbo Lag, Introduction to Electronic Engine Management System.  NGINE AUXILIARY SYSTEMS	(VVI) Iui	700 C	narge	
		nd Simple Carburetor - Electronically controlled gasoline injection	on existence C	e CIT	0=-	
coil i	gnition sy	mization of Fuel Injection Timing in SI and CI Engines - Electronic ignorestem, capacitive discharge ignition system), Engine Emission control by				
coil is syster	gnition sy m, Emissi Г III   Т	estem, capacitive discharge ignition system), Engine Emission control beion norms (Euro and BS).  RANSMISSION SYSTEMS	y 3-Way cata	lytic	conve	rto
coil ig system UNIT Clute	gnition sy m, Emissi FIII T ch – Type	rstem, capacitive discharge ignition system), Engine Emission control between the system (Euro and BS).  RANSMISSION SYSTEMS s and Construction, Gear Boxes - Manual and Automatic, Gear Shift	by 3-Way cata	lytic – Ov	er Dr	ive
coil is system UNIT Clute Trans	gnition sy m, Emissi FIII T ch – Type sfer Box, 1	rstem, capacitive discharge ignition system), Engine Emission control be ion norms (Euro and BS).  RANSMISSION SYSTEMS s and Construction, Gear Boxes - Manual and Automatic, Gear Shift Fluid flywheel, Torque converter, Propeller shaft, Slip Joints, universal	by 3-Way cata	lytic – Ov	er Dr	ive
syster UNIT Clute Trans Axle,	gnition sy m, Emissi FIII T ch – Type sfer Box, I , Hotchkis	rstem, capacitive discharge ignition system), Engine Emission control be ion norms (Euro and BS).  RANSMISSION SYSTEMS s and Construction, Gear Boxes - Manual and Automatic, Gear Shift Fluid flywheel, Torque converter, Propeller shaft, Slip Joints, universal as Drive and Torque Tube Drive.	by 3-Way cata	lytic – Ov	er Dr	ive
system UNITIC Clutce Trans Axle,	gnition sym, Emissing TIII Teh — Type sfer Box, Hotchkis	rstem, capacitive discharge ignition system), Engine Emission control beton norms (Euro and BS).  RANSMISSION SYSTEMS s and Construction, Gear Boxes - Manual and Automatic, Gear Shift Fluid flywheel, Torque converter, Propeller shaft, Slip Joints, universal as Drive and Torque Tube Drive.  TEERING, BRAKES AND SUSPENSION SYSTEMS	Mechanisms joints, Differen	lytic  – Ovential	er Dr	ive
coil is system UNIT Clute Trans Axle, UNIT Steering Types hydra	gnition sym, Emissing FIII The Type of Front	rstem, capacitive discharge ignition system), Engine Emission control be ion norms (Euro and BS).  RANSMISSION SYSTEMS s and Construction, Gear Boxes - Manual and Automatic, Gear Shift Fluid flywheel, Torque converter, Propeller shaft, Slip Joints, universal as Drive and Torque Tube Drive.	Mechanisms joints, Difference of Power Steering	- Ovential	er Dr and R	ive
coil is system UNIT Clute Trans Axle, UNIT Steering Types	gnition sym, Emissing Hotchkish Griv Sing Geometric braking ol.	restem, capacitive discharge ignition system), Engine Emission control beton norms (Euro and BS).  RANSMISSION SYSTEMS  s and Construction, Gear Boxes - Manual and Automatic, Gear Shift Fluid flywheel, Torque converter, Propeller shaft, Slip Joints, universal as Drive and Torque Tube Drive.  RERING, BRAKES AND SUSPENSION SYSTEMS  TEERING, BRAKES AND SUSPENSION SYSTEMS  Tetry and Types of steering gear box - Power Steering - AI-Enhanced Axle, Types of Suspension systems, stabilizer bar, damper, air suspensions	Mechanisms joints, Difference of Power Steering	- Ovential	er Dr and R	ive
coil is system UNIT Clute Trans Axle, UNIT Steering Types hydra control UNIT Electric Autor Gasol	gnition sym, Emissing FIII The Type of Front aulic braking ol.  FV Aric and hymomous Vehol and hymomous Veho	restem, capacitive discharge ignition system), Engine Emission control be ion norms (Euro and BS).  RANSMISSION SYSTEMS  Is and Construction, Gear Boxes - Manual and Automatic, Gear Shift Fluid flywheel, Torque converter, Propeller shaft, Slip Joints, universal as Drive and Torque Tube Drive.  TEERING, BRAKES AND SUSPENSION SYSTEMS  The property and Types of Steering gear box - Power Steering - AI-Enhanced and Axle, Types of Suspension systems, stabilizer bar, damper, air suspensing systems, Antilock braking system (ABS), Electronic brake force discovered to the property of the prope	Mechanisms joints, Difference Power Steerision system - tribution (EB)	- Ovential ng A pneu D) an	er Dr and R ssistar matic d trace	ive tea
coil is system UNIT Clute Trans Axle, UNIT Steering Types hydra control UNIT Electric Autor Gasol	gnition sym, Emissing FIII The Type of Front aulic braking ol.  FV Aric and hymomous Vehol and hymomous Veho	restem, capacitive discharge ignition system), Engine Emission control beton norms (Euro and BS).  RANSMISSION SYSTEMS  s and Construction, Gear Boxes - Manual and Automatic, Gear Shift Fluid flywheel, Torque converter, Propeller shaft, Slip Joints, universal as Drive and Torque Tube Drive.  REERING, BRAKES AND SUSPENSION SYSTEMS  THERING, BRAKES AND SUSPENSION SYSTEMS  THERING, BRAKES AND SUSPENSION SYSTEMS  THE ALICH AND SUSPENSION SYSTEMS  T	Mechanisms joints, Difference Power Steerision system - tribution (EB)	- Ovential ng A pneu D) an	rer Dr and R ssistar matic d trace	ive dea
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CO2	describe the principle and working of CRDI, MPFI, electronic fuel injection system, ignition system and 3-way catalytic converter system	Understanding (K2)
СОЗ	illustrate knowledge on the construction and functionality of clutch, gear box, rear axle drives, fluid flywheel, and torque converter	Applying (K3)
CO4	demonstrate knowledge on parts like the wheels, tyres, steering gear box, suspension system-telescopic, and leaf spring.	Understanding (K2)
CO5	motivated to update knowledge on recent trends in automobile engineering like alternate fuels, and electric vehicles	Analysing (K4)

- 1. Gupta R B, "Automobile Engineering", 1st Edition, Satya Prakashan Publishers, New Delhi, 2016
- 2. Kirpal Singh, "Automobile Engineering Vol I and II", 13th Edition, Standard Publishers, New Delhi, 2017

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- Crouse William H. and Anglin Donald L., "Automotive Mechanism", 10th Edition, Tata McGraw-Hill, New Delhi, 2017
- Ganesan V. "Internal Combustion Engines", Fourth Edition, Tata McGraw-Hill, 2017
- 3. Iqbal Husain, "Electric and Hybrid Vehicles", 3rd Edition, CRC Press, 2021
- 4. Rajput R.K., "A Text book of Automobile Engineering", 2nd Edition, Laxmi Publication, New Delhi, 2017

# CO - PO MAPPING

COs			-Zibi		Progra	amme O	utcome	s(POs)					PS	Os
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	.3	2	3	1	1	-	-	-	-		-	2	3	2
CO2	3	2	3	1	1		-	-	-	-	575	2	3	2
CO3	3	2	3	1	1	-	-	-	-	-		2	3	2
CO4	3	2	3	1	1	-	-	-	-			2	3	2
CO5	3	2	3	1	1	-	-	-	-			2	3	2



506	METROLOGY AND MEASUREMENTS LABORATORY	0	0	2	1
RSE OBJE	CCTIVES	-	-		
able the stu	dents to				
understand	the precision measurement and calibration processes of instruments.				15
familiarize	with different measuring equipment and their usage in industries for measur	rement an	d ins	pect	ion.
practice m	easurement of different parameters like length, angle, torque, pressure and	temperati	ıre.		
carry out f	orm measurements on gear teeth and screw thread and also straightness of	surface.			
	RSE OBJE able the stu understand familiarize practice me	RSE OBJECTIVES able the students to understand the precision measurement and calibration processes of instruments. familiarize with different measuring equipment and their usage in industries for measurement of different parameters like length, angle, torque, pressure and	RSE OBJECTIVES  able the students to  understand the precision measurement and calibration processes of instruments.  familiarize with different measuring equipment and their usage in industries for measurement and practice measurement of different parameters like length, angle, torque, pressure and temperate	RSE OBJECTIVES able the students to understand the precision measurement and calibration processes of instruments.	RSE OBJECTIVES able the students to understand the precision measurement and calibration processes of instruments.  familiarize with different measuring equipment and their usage in industries for measurement and inspect practice measurement of different parameters like length, angle, torque, pressure and temperature.

### LIST OF EXPERIMENTS

- 1. Calibration of precision instrument: Vernier Caliper / Micrometer / Dial Gauge
- 2. Measurements of Gear Tooth Dimensions using optical profile projector
- 3. Measurement of straightness using Autocollimator
- 4. Checking limits of dimensional tolerance using comparators (Mechanical / Electrical)
- 5. Measurement of Temperature using Thermocouple
- 6. Calibration of Linear Variable Differential Transformer (LVDT) using displacement measuring setup
- 7. Measurement of Force using strain gauge
- 8. Measurement of Torque using strain gauge
- 9. Measurement of Vibration
- 10. Measuring screw thread dimensions using Tool Makers Microscope

		<b>TOTAL PERIODS:30</b>
	RSE OUTCOMES  end of the course, the students will be able to	BT MAPPED (Highest level)
CO1	handle different precision measurement tools with appropriate measuring techniques and also carry out calibration processes.	Analyzing (K4)
CO2	study and analyze the characteristics of precision instruments	Analyzing (K4)
CO3	use contact and non-contact measuring instruments, limit gauges and comparators for measurements, checking and inspection	Applying (K3)
CO4	demonstrate practical knowledge on geometrical parameters like straightness, flatness, roundness, parallelism.	Analyzing (K4)

### 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	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO	
CO1	3	2	-	-		-	-	-	1	1		2	2	3	
CO2	3	2	2	-	-	2	-	-	1	1	-	2	2	3	
CO3	3	2	-	-	-	-	-	-	1	1	-	2	2	3	
CO4	3	2		-	-	-	-	-	1	1	-	2	2	3	

Approved
BOARD OF STUDIES
Mechanical Engineering
AUTONOMOUS

ME	23507	DYNAMICS LABORATORY	0	0	2	1
cou	IRSE OBJ	ECTIVES			-	
To er	nable the st	cudents to				
1	familiariz apparatus	ze with mass moment of inertia of Flywheel, axle system and symmetric bodies us.	sing	Tui	n Ta	ible
2	understar	nd the concept of balancing of machinery and mechanisms	33			
3	learn the	working principles and analyze the mechanism of gyroscope, governor and cams				
4	understar	nd the fundamental concepts of various types of vibrating systems and their elemen	nts			
LIST	OF EXP	ERIMENTS		-		

- 1. a) Determination of Mass moment of inertia of Fly wheel and Axle system.
  - b) Determination of Mass Moment of Inertia of axis symmetric bodies using Turn Table apparatus.
- 2. Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
- 3. Governor Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors
- 4. Motorized gyroscope Study of gyroscopic effect and couple.
- Cams Cam profile drawing, Motion curves and study of jump phenomenon
- 6. a) Single degree of freedom Spring Mass System Determination of natural Frequency and verification of Laws of springs - Damping coefficient determination.
  - b) Multi degree freedom suspension system Determination of influence coefficient.
- 7. Vibration of Equivalent Spring mass system undamped and damped vibration.
- 8. Whirling of shafts Determination of critical speeds of shafts with concentrated loads.
- 9. a) Balancing of rotating masses
  - b) Balancing of reciprocating masses
- 10. a) Transverse vibration of Free-Free beam with and without concentrated masses
  - b) Determination of transmissibility ratio using vibrating table.

		TOTAL PERIODS :30
	RSE OUTCOMES end of the course, the students will be able to	BT MAPPED (Highest level)
CO1	determine the mass moment of inertia of flywheel, axle and axis symmetric bodies and internalize the calculations and the elements considered in such tests.	Analyzing (K4)
CO2	practically gain knowledge and demonstrate how Mechanical systems get balanced by design	Analyzing (K4)
CO3	describe the working principles and mechanisms involved in the functioning of gyroscopes, governors and cams	Applying (K3)

CO4	analyze	- 2		associate	ed An	Analyzing (K4)									
CO - F	O MAP	PING													
ong	w. sd									tcomes:	-Weak				
COs		Programme Outcomes(POs)													
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO	
CO1	3	2	1	-	-	-		14.5	1	1	also is	2	2	3	
CO2	3	2	1	-	1 2			-	1	1	TI SECT	2	2	3	
CO3	3	2	1	-	-	122	-	- 12	1	1		2	2	3	
CO4	3	2	1	_	-	( <u>-</u>	-	-	1	1		2	2	3	

Approved
BOARD OF STUDIES
Mechanical Engineering
AUTONOMOUS

COSCIS Jackett

ME2	8 INDUSTRIAL TRAINING 0 0								
COU	RSE OBJECTIVES								
To ena	able the students to		Ī			*			
1	observe the rules and regulation, standards of the industry								
2	appreciate organizational set up from top executive to workmen level								
3	observe the end product, various Components/ materials used in the pro-	oduction and identify th	hei	ir sc	urce	).			
4	develop an Understanding of various stages involved in processing, equipment.	sequential arrangemen	ıt (	of d	liffe	rent			
	CRIPTION	The state of the state of the state of	-			_			

- The objective of the Industrial Training is to enable the students to get practical knowledge towards the handling of various machine and equipment's in a reputed industry or institution. The training involves hands on training of mechanical equipment's in industry, case study in work measurements / arrangements which have been used in industry/Institute and emerging techniques in industry. Groups of not more than four members in a group will carry out the training.
- The students are required to undergo Industrial Training around 2 Weeks / 45 Hrs in a reputed industry or institution. The students who wish to undergo industrial training, the industry chosen for undergoing the training should be at least a private limited company.
- The students shall submit and present the progress report at the Institute at least thrice in this duration for internal assessment. The presentation will be attended by a committee. Alternately, the teacher may visit the Industry to get the feedback of the students.
- The final end semester exam evaluation shall be made based on the report submitted along with the presentation and a Viva voce Examination, conducted internally by a three member Review Committee constituted by the Head of the Institution.
- Assessment of Industrial Training will be based on seminar, viva-voce, report and certificate of Industrial Training or Institutional Project Work obtained by the student from the industry or Institute.
- The student should submit a report describing the profile of the company, Nature of the job assigned to him /her and other details in a standard format duly attested and approved by the head of the industry after two weeks and before Four weeks from the date of joining through e mail. Hard copy of the report may be submitted in person or by post.
- A candidate shall be assessed twice in the spell of industrial training i.e. at the end of third month and finally before he/she completed the industrial training.
- For evaluation of industrial training, a committee consisting following faculty members. (1) Head of Dept. concerned. (2) Industrial Training program co-ordinator (3) any other staff member of department concerned may be formed.

**TOTAL PERIODS:30** 

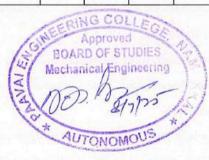
	end of the course, the students will be able to	BT MAPPED (Highest level)
CO1	appreciate the organizational setup and hierarchy	Analysing (K2)
CO2	practice the use of resource optimization techniques	Understanding (K2)
CO3	develop core engineering skills	Applying (K3)
CO4	develop an understanding of solutions for environmental issues in the industry	Understanding (K4)

# 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	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	2	-	-	-	-	-	-		-	-	-	2	1	3	
CO2	1	-	-	-	-	-	-	-	-	-	-	2	1	3	
CO3	2	2	-	-	-	-	-	-	-	-	-	3	2	3	
CO4	3	2	2	2	2	-	-			-	-	3	3	3	



GE23501 PROFESSIONAL DEVELOPMENT III 0 0 2								
COU	RSE OB	JECTIVES						
To en	able stud	ents to						
•	enhan	ce their Resume writing skills and improving corporate vocabularies to	survive in the	ne cor	porat	e world.		
	evalua	te their interview skills and improve their interview presentation.		9				
•	solve	the quantitative aptitude problems and improve their mental ability.				RO		
	impro	ve the critical thinking and reasoning skills.	Harris.					
U	NIT I	RESUME WRITING SKILLS				6		
Update	ed Resum	ne Building III – Self Introduction III – Dressing Etiquette – JAM V – C	orporate Voc	abulai	у	-10.7		
UNI	IT II	INTERVIEW SKILLS				6		
Intervie	ew	- General guidelines - Work Ethics - Group Discussion III - JAM VI - I	Presentation C	Compe	etence			
UNI	TIII	QUANTITATIVE APTITUDE				9		
Cube R	Loot and S	Square Root - Time and Work - Ages - Permutation and Combination -	Probability	- Cale	endar			
UNI	TIV	LOGICAL REASONING				9		
Series	Complet	ion - Blood Relations - Coding and Decoding - Data Sufficiency - S	tatements an	d Ass	umpt	ions		
		то	TAL PERIO	DS:		30		
Wilder of Street or Street		COMES on of the course, the students will be able to	BT MAPI (Highest L					
COI	• exc	el in drafting Resumes and speaking.	Create	e (K6	)			
CO2	• den	nonstrate the participative skills in group discussions and Interviews.	Applyi	ng (K	3)	-81		
CO3	• solv	re problems based on quantitative aptitude.	Applyi	ng (K	3)			
CO4	• enh	ance their logical and verbal reasoning.	Analyz	ring (	K4)			

- Aggarwal, R. S. A Modern Approach to Verbal & Non-Verbal Reasoning. Revised ed., 2024–25, S. Chand & Company Ltd., 2024.
- 2. Aggarwal, R. S. Objective General English: Fully Revised Video Edition. S. Chand & Company Ltd., 2022.

# REFERENCES

- 1. Abhijit Guha, "Quantitative Aptitude ", Tata-Mcgraw Hill.2015.
- 2. Word Power Made Easy By Norman Lewis, Wr.Goyal Publications.2016.
- Johnson, D.W. Reaching out Interpersonal Effectiveness and self- actualisation. Boston: Allyn and Bacon.2019.
- 4. Infosys Campus Connect Program students' guide for soft skills.2015.

CO/PO	MAPP	ING:																			
							Daniel Control			ne Outco -Mediur		Seculated.	10.81	277							
CO's						Progra	amme (	Outcon	nes (PC	)'s)											
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS0							
CO1	3	2	2	3	3	1	aute ji		tsi ke			eav I	3	2							
CO2	-	2	3	-	2	11-22	2	-	- 18	1-179		he - 20	3	2							
CO3	3	2	2	2		-	1	-	-	-		-	2	3							
		5		- 115	130 00		10.7			-3 10 -		RIS CIT									

CO4



	23151	DESIGN FOR MANUFACTURE AND ASSEMBLY	3	0	0	3
CO	URSE O	BJECTIVES			414	
То	enable the	e students to				
1		conomic process selection principles and general design principles for r ment and design of products for various engineering applications.	nanufactu	rabili	ty in	the
2		sign consideration principles of forming in the design of extruded, stamped, a	and forged	prod	ucts.	
3		design consideration principles of machining in the design of turned, drilled and ground products.	, milled, p	laneo	l, sha	ped,
4	explore t	techniques for reducing welding time, improving automation, and optimizing	g material	usage		
5	gain an ı	understanding of the assembly process and its impact on product design.	2511			
UN	IT I	INTRODUCTION AND CASTING				9
		- Economics of process selection - General design principles for mans for: Sand cast - Die cast - Permanent mould cast parts.	anufactura	bility	; De	sign
ACCUPATION.		FORMING	10.00			9
		forming: Working principle, Material, Manufacture, Design - Possible solut	ions - Ma	terial	s choi	ce -
Inf	uence of	materials on form design - form design of welded members, forgings and cas	stings.			
UN	тш	MACHINING .		s, cou	nter s	
UN De scr ma	IT III sign featurews -Reduchinability	MACHINING  ares to facilitate machining - drills - milling cutters - keyways - Doweling pluction of machined area- simplification by separation - simplification by analy.	procedures		19	unk for
UN De scr ma	sign featurews -Reduction	MACHINING  ares to facilitate machining - drills - milling cutters - keyways - Doweling puttion of machined area- simplification by separation - simplification by an area.  WELDING	procedures	on - I	Design	sunk for
UN De ser ma UN Archea	sign featurews -Reductionability	MACHINING  ares to facilitate machining - drills - milling cutters - keyways - Doweling pluction of machined area- simplification by separation - simplification by analy.	procedures nalgamation	on - I	Design	of for 9
UN De scr ma UN Arc hea we	sign features - Reduction ability of the welding at treatment diment.	MACHINING  ares to facilitate machining - drills - milling cutters - keyways - Doweling puttion of machined area- simplification by separation - simplification by an ey.  WELDING  - Design considerations for Cost reduction - Minimizing distortion - Welcomt. Resistance welding - Design considerations for Spot - Seam - Projection - Machine Resistance welding - Design considerations for Spot - Seam - Projection - Machine Resistance welding - Design considerations for Spot - Seam - Projection - Machine Resistance welding - Design considerations for Spot - Seam - Projection - Machine Resistance welding - Design considerations for Spot - Seam - Projection - Machine Resistance welding - Design considerations for Spot - Seam - Projection - Machine Resistance welding - Design considerations for Spot - Seam - Projection - Machine Resistance welding - Design considerations for Spot - Seam - Projection - Machine Resistance welding - Design considerations for Spot - Seam - Projection - Machine Resistance welding - Design considerations for Spot - Seam - Projection - Machine Resistance well - Projection - Machine Resistance - Projection - Projection - Projection - Machine Resistance - Projection -	procedures nalgamation d strength ection —	on - I – We Flash	Design	9 pset
UN De ser ma UN Archea we UN De for	sign featurews -Reductionability of the welding at treatment.  IT V sign for as Rivets —	MACHINING  ares to facilitate machining - drills - milling cutters - keyways - Doweling pluction of machined area- simplification by separation - simplification by an ey.  WELDING  - Design considerations for Cost reduction - Minimizing distortion - Welcomt. Resistance welding - Design considerations for Spot - Seam - Project.	procedures nalgamatic d strength ection —	– We	Design	9 9 pset
UN De ser ma UN Archea we UN De for	sign featurews -Reductionability of the welding at treatment.  IT V sign for as Rivets —	machined area- simplification by separation – simplification by an exp.  WELDING  — Design considerations for Cost reduction – Minimizing distortion – Welcomb. Resistance welding – Design considerations for Spot – Seam – Project. Resistance welding – Design considerations for Spot – Seam – Project. Resistance welding – Design considerations for Spot – Seam – Project. Seembly – General assembly recommendations – Minimizing the no. of parts Screw fasteners – Gasket & Seals – Press fits – Snap fits – Automatic asset	procedures nalgamatic d strength ection —	- We	Design de	9 9 pset
UN De scr ma UN Archea we UN De for ass	sign featurews -Reductionability of welding at treatment.  IT V sign for as Rivets — embly, Depure Ourse Our	MACHINING  Tres to facilitate machining - drills - milling cutters - keyways - Doweling puction of machined area- simplification by separation - simplification by an area.  WELDING  - Design considerations for Cost reduction - Minimizing distortion - Welcont. Resistance welding - Design considerations for Spot - Seam - Project.  ASSEMBLY  ssembly - General assembly recommendations - Minimizing the no. of parts.  Screw fasteners - Gasket & Seals - Press fits - Snap fits - Automatic assembly for manufacture and Computer aided design.	procedures nalgamatic d strength ection — s — Design embly - d	- We Flash cons	ldmer & U	9 9 pset
UN De ser ma UN Archea we UN De for ass	sign featurews -Reductionability of welding at treatment.  IT V sign for as Rivets — embly, Depure Ourse Our	machining - drills - milling cutters - keyways - Doweling puction of machined area- simplification by separation - simplification by an ey.  WELDING  - Design considerations for Cost reduction - Minimizing distortion - Welcont. Resistance welding - Design considerations for Spot - Seam - Project - Seam - Projec	procedures nalgamatic d strength ection — s — Design embly - d	- We Flash cons	ldmer & U	9 9 pset

CO2	design consideration principles of forming in the design of extruded, stamped, and forged products.	Understanding (K2)
CO3	understand the principles of turning operations, including lathe-based processes.	Applying (K3)
CO4	identify the key design considerations for optimizing arc welding processes in terms of cost, quality, and structural integrity.	Understanding (K2)
CO5	know the importance of assembly-oriented design in reducing manufacturing and assembly costs.	Analysing (K4)

- Geoffrey Boothroyd, Petre Dewhurst, Winston A Knight, "Product Design for Manufacture and Assembly", CRC Press, Taylor & Francis Group, 2010.
- 2. P.N. Rao, "Manufacturing Technology Foundry, Forming and Welding", Tata McGraw-Hill, New Delhi, 2013.

### REFERENCES

- 1. A.K. Chitale, R.C. Gupta, Product Design and Manufacturing Prentice Hall of India, 2007.
- David M. Anderson, Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production, CIM Press, 2004
- Erik Tempelman, Hugh Shercliff, Bruno Ninaber van Eyben, Manufacturing and Design: Understanding the Principles of How Things Are Made, Elsevier, 2014.
- 4. S. Kalpakjian, "Manufacturing Engineering and Technology", Pearson Education India Edition, 2014.

# CO - PO MAPPING

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

COs					Progra	amme O	utcome	s(POs)					PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	-	-		-	-		-	1	2	2
CO2	3	3	3	1	m -	- 6	-	•	-	-		1	2	2
CO3	3	3	3	1	-	-	-	-			- L	1	2	2
CO4	3	3	3	1	-	-	-	-	-	-		1	2	2
CO5	3	3	3	1	-		1	-	-	-	2	1	2	2

BOARD OF STUDIES
Mechanical Engineering

\*\*AUTONOMOUS\*\*

ME23	152	DESIGN OF JIGS, FIXTURES AND PRESS TOOLS	3	0	0	3
COUR	RSE OB	JECTIVES				
To ena	able the	students to				
1 st	tudy the f	functions and design principles of Jigs, fixtures and press tools	and the		Kn I	75
2 ga	ain profic	ciency in the development of required views of the final design				
3 fa	amiliarize	e in fundamental press working terminologies				
4 in	ntroduce	the basic principles of bending, forming, and drawing operations				
5 pr	rovide th	e knowledge forming techniques and evaluation				
UNIT	I L	OCATING AND CLAMPING PRINCIPLES				9
Object	tives of t	ool design- Function and advantages of Jigs and fixtures - Basic elements - prin	ciple	s of l	ocatio	on –
Location	ing metho	ods and devices - Redundant Location - Principles of clamping - Mechanical act	uatio	n – p	neum	atic
and hy	draulic a	actuation Standard parts - Drill bushes and Jig buttons - Tolerances and material	s use	d.		
UNIT		GS AND FIXTURES			D 0.5	9
Design	n and dev	velopment of jigs and fixtures for given component- Types of Jigs - Post, Turno	ver, (	hanr	nel, la	-
		ar post jigs - Indexing jigs - General principles of milling, Lathe, boring, broa				350
		mbly, Inspection and Welding fixtures – Modular fixturing systems- Quick char				img
					5.	
UNIT	A	RESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING I			27 -	9
		Terminologies - operations - Types of presses - press accessories - Computation				0.70
– Strip	layout -	- Material Utilization - Shearing action - Clearances - Press Work Materials -	Cente	er of	press	ure-
Design	n of vario	ous elements of dies - Die Block - Punch holder, Die set, guide plates - Stops -	Strip	pers-	– Pilo	ts –
Selecti	ion of St	andard parts - Design and preparation of four standard views of simple blanking,	pierci	ng, c	ompo	und
and pro	rogressiv	e dies.				
UNIT	IV B	ENDING FORMING AND DRAWING DIES				9
Differe	ence bet	ween bending, forming and drawing - Blank development for above operations	– Tyr	es of	Bene	ding
dies –	Press cap	pacity - Spring back - knockouts - direct and indirect - pressure pads - Ejectors -	Vari	ables	affec	ting
Metal	flow in	drawing operations - draw die inserts - draw beads- ironing - Design and devel	opme	ent of	bend	ing,
formin	ng, draw	ing reverse re-drawing and combination dies - Blank development for ax- syn	metr	ic, re	ctang	ular
and ell	liptic par	ts – Single and double action dies.				
UNIT	VF	ORMING TECHNIQUES AND EVALUATION		- di 15	- 18	9
Bulgin	ng, Swag	ing, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, f	ine B	lanki	ng di	es –
recent	trends i	n tool design- computer Aids for sheet metal forming Analysis - basic introd	uctio	n - to	ooling	for
numer	rically co	ntrolled machines- setup reduction for work holding - Single minute exchange of	of die	s – Po	oka Y	oke.
		Color Bonding by America	[AL]			
		TO I			.000	.40

COUI	RSE OUTCOMES	BT MAPPED
At the	end of the course, the students will be able to	(Highest level)
CO1	define the functions and design principles of Jigs, fixtures and press tools	Remembering (K1)
CO2	explain the development of required views for the final design	Understanding (K2)
CO3	apply the principles of various types of presses and various design elements of die.	Applying (K3)
CO4	illustrate the various types of bending dies and drawing dies	Understanding (K2)
CO5	Inference the various forming techniques and evaluation	Analysing (K4)

- 1. Quality Planning and Analysis- JM Juran& FM Gryna. Tata Mc Graw Hill.
- 2. Lean Manufacturing: Principles to Practice by Akhilesh N. Singh, Bibliophile South Asia.

### REFERENCES

- 1. Donaldson, Lecain and Goold "Tool Design", 5th Edition, Tata McGraw Hill, 2017.
- 2. K. Venkataraman, "Design of Jigs Fixtures & Press Tools", Tata McGraw Hill, New Delhi, 2005.
- 3. Joshi, P.H. "Press Tools" Design and Construction", Wheels publishing, 2010.
- 4. Hoffman "Jigs and Fixture Design" Thomson Delmar Learning, Singapore, 2004.

# CO - PO MAPPING

COs	AD SHOW				Progra	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	- 201		-	-	nla-	A THORN	-	1 1	2	2
CO2	3	3	3	1	13 10 10 1	19	eg-da	13 F + 11		lan-anii		1	2	2
CO3	3	3	3	1		-	-	-	457	-1-41		1	2	2
CO4	3	3	3	1	-	14.5	1	-	574	-	-	1	2	2
CO5	3	3	3	1		-	-		-	mc =	-	1	2	2



	23153	MACHINE TOOL DESIGN	3	0	0	3
COI	URSE OBJ	JECTIVES				
То є	enable the s	tudents to				
1	understand	the concepts of machine tool design.	TOWNS IN	7		
2	know the c	concepts of regulation of speeds			Ħ.	
3	apply mac	hine tool structures in design of static and dynamic.	315		161	
4	design the	guide ways and power screws			20	
5	familiarize	the function of spindles and support				
JNI		NTRODUCTION TO MACHINE TOOL DESIGN	S. e 6			9
ntro	duction to	Machine Tool Drives and Mechanisms, Constructional and operational feature	ıres, Aux	iliar	y Mot	ions
n M	achine Too	ols, Kinematics of Machine Tools, Motion Transmission, mechanical, hydra	ulic and	elect	ric dri	ves.
UNI	TII R	EGULATION OF SPEEDS AND FEEDS	•			9
٩im	of Speed a	and Feed Regulation, Layout of Speed Change Gears, Stepped Regulation of	Speeds, N	Multi	ple Sp	eed
Mot	ors, Ray D	iagrams and Design Considerations, Design of Speed Gear Boxes, Feed Dr	ives, Fee	d Bo	x Des	ign,
Digi	tal Twin T	echnology for Speed and Feed Simulation.				
UNI	T III D	ESIGN OF MACHINE TOOL STRUCTURES				9
Fun	ctions of M	fachine Tool Structures and their Requirements, Design for Strength, Design	c n: :			
for	Machine T	ool Structures, Static and Dynamic Stiffness, Machine Tool Construction				
for Hou	Machine T	ool Structures, Static and Dynamic Stiffness, Machine Tool Construction and Tables, Saddles and Carriage.				and
or Hou UNI	Machine T sings, Colu	ool Structures, Static and Dynamic Stiffness, Machine Tool Construction umns and Tables, Saddles and Carriage.  ESIGN OF GUIDEWAYS AND POWER SCREWS	nal Featu	ires,	Beds	and
Fun	Machine T sings, Column TIV D ctions and	cool Structures, Static and Dynamic Stiffness, Machine Tool Construction amns and Tables, Saddles and Carriage.  ESIGN OF GUIDEWAYS AND POWER SCREWS  Types of Guideway s, Design of Guideway s, Clearance adjustment in slide	nal Featu	res,	Beds gn of A	and 9 Aero
for Hou UNI Fun- stati	Machine T sings, Column (T IV Detions and column column column)	cool Structures, Static and Dynamic Stiffness, Machine Tool Construction amns and Tables, Saddles and Carriage.  ESIGN OF GUIDEWAYS AND POWER SCREWS  Types of Guideway s, Design of Guideway s, Clearance adjustment in slide ys, Design of Anti-Friction Guide ways, Combination Guide ways, Design	nal Featu	res,	Beds gn of A	and 9 Aero
for Hou UNI Fundatati Rec	Machine T sings, Column T IV D ctions and c Slide was irculating b	cool Structures, Static and Dynamic Stiffness, Machine Tool Construction amns and Tables, Saddles and Carriage.  ESIGN OF GUIDEWAYS AND POWER SCREWS  Types of Guideway s, Design of Guideway s, Clearance adjustment in slide ys, Design of Anti-Friction Guide ways, Combination Guide ways, Design oall screws.	nal Featu	res,	Beds gn of A	9 Aero and
for Hou UNI Fundatati Rec	Machine T sings, Column TIV D ctions and c Slide was irculating b	cool Structures, Static and Dynamic Stiffness, Machine Tool Construction amns and Tables, Saddles and Carriage.  ESIGN OF GUIDEWAYS AND POWER SCREWS  Types of Guideway s, Design of Guideway s, Clearance adjustment in slide ys, Design of Anti-Friction Guide ways, Combination Guide ways, Design	e ways, I	Desig	Beds gn of A	9 Aero and
for Hou UNI Fundantati Rec UNI	Machine T sings, Column TIV D ctions and c Slide was irculating b ctions of Special CTV D ctions of Sp	cool Structures, Static and Dynamic Stiffness, Machine Tool Construction arms and Tables, Saddles and Carriage.  ESIGN OF GUIDEWAYS AND POWER SCREWS Types of Guideway s, Design of Guideway s, Clearance adjustment in slide ys, Design of Anti-Friction Guide ways, Combination Guide ways, Design of Spindles Screws.  ESIGN OF SPINDLES AND SPINDLE SUPPORT pindles and Requirements, Effect of Machine Tool Compliance on Machinin	e ways, In of Pow	Designer Son	n of A	9 Aero and 9 gn of
for Hou Hou Fundantati Rec UNI Fundantati	Machine T sings, Column CT IV D ctions and c Slide was irrulating b ctions of Spadles, Anti-	cool Structures, Static and Dynamic Stiffness, Machine Tool Construction and Tables, Saddles and Carriage.  ESIGN OF GUIDEWAYS AND POWER SCREWS Types of Guideway s, Design of Guideway s, Clearance adjustment in slide ys, Design of Anti-Friction Guide ways, Combination Guide ways, Design of Spindles Screws.  ESIGN OF SPINDLES AND SPINDLE SUPPORT	e ways, In of Pow	Designer Son	n of A	9 Aero and 9
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CO5 use the design requirements for spindles and bearings. Analyzing (K4)

# TEXT BOOKS

- 1. N.K. Mehta, Machine Tool Design and Numerical Control, TMH, New Delhi, 2010.
- 2. G.C. Sen and A. Bhattacharya, Principles of Machine Tools, New Central Book Agency, 2009.

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- 2. N. S. Acherkhan, "Machine Tool Design", Vol. I, II, III and IV, MIR publications, 2006.
- 3. F. Koenigsberger, Design Principles of Metal-Cutting Machine Tools, Pergamon Press, 2011.
- 4. F. Koenigsberger, Machine Tool Structures, Pergamon Press, 2010.

### CO - PO MAPPING

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

COs					Progra	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1	2	2	- 7	-	-	-		1	2	1
CO2	2	1	2	1	2	2	-	2	W1121 C		20172	1	2	1
CO3	3	3	3	1	2	2		-		- 10	-	1	3	3
CO4	3	3 ·	3	1	2	2	-	1820	-	-		1	3	3
CO5	3	3	3	1	2	2	-	-	7-10	30-24	2-3	1	3	3

Approved
BOARD OF STUDIES
Mechanical Engineering

AUTONOMOUS

-	23154	ERGONOMICS IN DESIGN	3	0	0	3
CO	URSE C	DBJECTIVES		7.1		
То	enable th	ne students to				
1	introduc	ce to industrial design based on ergonomics.				
2	conside	er ergonomics concept in manufacturing	0.00			
3	apply e	rgonomics in design of controls and display.				-
4	apply e	nvironmental factors in ergonomics design.				
5	develop	a aesthetics applicable to manufacturing and product				III.
UN	ITI	INTRODUCTION	3/8	51,0	9 17	•
		n to industrial design, Elements of design structure for industrial design in engine	•	11		
UN	ITII	ERGONOMICS AND PRODUCTION	Walter Street	1157	1113	9
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COUL	RSE OUTCOMES	BT MAPPED
At the	end of the course, the students will be able to	(Highest level)
CO1	identify the need of ergonomics in the industrial design.	Understanding (K2)
CO2	apply ergonomics in creation of manufacturing system	Applying (K3)
CO3	discuss on design of controls and display.	Analyzing (K4)
CO4	consider the environmental factors in ergonomics design.	Applying (K3)
CO5	identify the importance of aesthetics to manufacturing system and product	Understanding (K2)

- 1. Bridger, R.C., Introduction to Ergonomics, 2ndEdition, 2003, McGraw Hill Publications.
- 2. Martin Helander, A Guide to human factors and Ergonomics, Taylor and Francis, 2006.

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- 2. Brain Shakel, "Applied Ergonomics Hand Book", Butterworth Scientific London 2011.
- Ergonomics in Design: Methods and Techniques (Human Factors and Ergonomics) by Marcelo M. Soares
  Francisco Rebelo, 2017.
- 4. Ergonomics in Product Design by Send points Publishing Co. Ltd, 2006.

# CO - PO MAPPING

COs	islail a	33/107	Sile de	NY TA	Progr	amme O	utcome	s(POs)	entropi				PS	Os
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	-	1	3		2	-	3	-	1	-	-	1	1,	3
CO2	-	1	3	-	2	-	3	4.	1	-		1	1	3
CO3	-	1	3	-	2	-	3	-	1	5 -		1	1	3
CO4	-	1	3		2	-	3	-	1	-		1	• 1	3
CO5		1	3	-	2	-	3	-	_1			1	1	3



WIEZ.	3155	GEOMETRIC MODELLING	3	0	0	3
COU	RSE OF	BJECTIVES				
To er	nable the	e students to	- 1-50			74-11-1
1 u	ınderstan	nd the concepts of geometric modelling.	2.1			100
2 k	cnow the	e concepts of surface modelling and volumetric modelling				M
3 a	pply CA	AD data representation and properties of geometric models				
4 d	lesign th	ne graph theoretic models and representation of design	12	31 2		
5 f	amiliariz	ze the function of automated assembly planning				
UNIT	TI (	OVERVIEW OF CAD SYSTEMS AND GRAPHICS TRANSFORMATION				9
static	and dyr	AD workstations; Networking of CAD systems; Generative, cognitive and image properties of graphics data; Graphic standards, generalisplay and viewing, transformations customizing graphics software.				
UNIT	r II I	MATHEMATICAL REPRESENTATION OF CURVES AND SURFACES				9
surfac	ces, para	ves - Cubic spline, Bezier, B-spline, NURBS, curve manipulation; Surface ametric representation of surfaces, design examples.  MATHEMATICAL MODELLING OF SOLIDS	mode	els:		of
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Surface UNIT Prope Analy UNIT Introde config Princ UNIT Defin Exch	r III   III	MATHEMATICAL MODELLING OF SOLIDS  solid model, Solid modelling Techniques - Boundary representation, Constructive olid Modelling, Sweep representation schemes. Solid Manipulation Techniques.  TRANSFORMATION AND PROJECTION TECHNIQUES: to computer graphics, Non-interactive Vs interactive computer graphics, application. 2D and 3D transformation techniques - Translation, Rotation, Scaling and Reconcatenated transformation. Orthographic and Perspective Projections of Geometric GRAPHIC STANDARDS AND MODE OF DATA TRANSFER:  graphics standard, geometrical data, direct and indirect data transfer. Neutral rimat (DXF) and Initial Graphics Exchange Specification (IGES).  TOT UTCOMES  the course, the students will be able to  the different geometric modelling.  Under	ons, geflect	els:  plid Coraphi ion plodel forma  PER PED level inding	Geometric Second	9 9 9 9 Posterny, 9 9 Data

CO4	select the Synthetic Surface modelling.	Applying (K3)
CO5	use the design of Solid Manipulation Techniques	Analyzing (K4)

- 1. Ibrahim Zeid, "CAD/CAM Theory and Practice", 2nd Edition, McGraw Hill Inc, New Delhi, 2009.
- Groover M.P, Zimmers, E.W., "CAD/CAM: Computer Aided Design and Manufacture", Prentice Hall, 2003.

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- Rogers D F, Adams, J. A, "Mathematical Elements for Computer Graphics", 2nd Edition, McGraw Hill Education, New Delhi, 2002.
- 4. Michael E Mortenson, "Geometric Modeling", John Wileyand Sons Inc, 2006.

# CO - PO MAPPING

COs					Progra	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	2	2	-	-			-	1	2	2
CO2	2	1	2	2	2	2		-	-			2	3	2
CO3	3	3	3	1	2	2	-	-	-	-	-	1	3	3
CO4	3	2	3	-2	2	3	112	-	-	1012		3	2	3
CO5	2	3	2	1	3	2	112.0	-	-	-	-	1	3	3



ME	23156	ENGINEERING TRIBOLOGY	3	0	0	3
CO	URSE	OBJECTIVES				
То	enable 1	the students to				
1	measu	ire the different types of surface features associated with the friction of metals and	l non-me	etals		NG.
2	study t	the different types of wear mechanism and surface modification techniques.				
3	analys	se the various types of lubricants and lubrication system in the tribology.				
4	develo	op the methodology for deciding lubricants and lubrication regimes for different of	perating	cond	lition	s.
5	study t	the different types of high-pressure contacts and rolling bearings				
UN	IT I	ENGINEERING SURFACES AND FRICTION		30.5		9
Intro	oductio	on - Measurement methods - Surface Profilometry, Optical and Electron Microsco	py – No	n-co	nform	ing
surf	face con	ntact geometry - Stresses in Non-conforming contacts - Contact of rough surfaces	s – Num	erica	l Sur	ace
Con	ntact Mo	odels - Friction of Metals - Friction of Non-metallic Materials				
UN	IT II	WEAR AND SURFACE TREATMENT				9
Тур	es of w	vear mechanism – Laws of wear –Theoretical wear models- Abrasive wear – Ad	hesive v	vear -	- Fati	
mod	dificatio	etting wear - Cavitation wear - Wear of Metals and Non-metals - Surface ons -Surface coatings - Selection of Surface Treatments and Surface coatings	treatme	iits —	- Sur	ace
mod	dificatio		treatme	uts -	- Sur	ace
	dificatio		treatme		- Sur	9
UN	тш	ons –Surface coatings – Selection of Surface Treatments and Surface coatings				9
UN Lu	IT III bricants	ons –Surface coatings – Selection of Surface Treatments and Surface coatings  LUBRICANTS AND LUBRICATION REGIMES	tives-and	d sel	ection	9 n of
UN Lu Lu	IT III abricants	ons –Surface coatings – Selection of Surface Treatments and Surface coatings  LUBRICANTS AND LUBRICATION REGIMES  s and their physical properties- Viscosity and other properties of oils –Addit	tives-and	d sel	ection	9 n of
UN Lu Lu and	IT III abricants	LUBRICANTS AND LUBRICATION REGIMES  s and their physical properties- Viscosity and other properties of oils –Addit s- Lubricants standards ISO,SAE,AGMA, BIS standards – Lubrication Regimes –	tives-and Solid Lu	d sel	ection	9 of Dry
Lu Lu and	IT III abricants abricants d margi	LUBRICANTS AND LUBRICATION REGIMES  s and their physical properties- Viscosity and other properties of oils –Addit s- Lubricants standards ISO,SAE,AGMA, BIS standards – Lubrication Regimes – inally lubricated contacts- Boundary Lubrication-Hydrodynamic lubrication	tives-and Solid Lu	d sel	ection	9 of Dry
Lu Lu and UN Rey	IT III abricants abricants d margi IT IV molds I	LUBRICANTS AND LUBRICATION REGIMES  s and their physical properties- Viscosity and other properties of oils –Addit s- Lubricants standards ISO,SAE,AGMA, BIS standards – Lubrication Regimes – inally lubricated contacts- Boundary Lubrication-Hydrodynamic lubrication  THEORY OF HYDRODYNAMIC AND HYDROSTATIC LUBRICATION	tives-and Solid Lu N quation	d sel	ectionation-	9 Dry 9 and
Lu Lu and UN Rey Som	IT III abricants abricants d margi IT IV molds I	LUBRICANTS AND LUBRICATION REGIMES  s and their physical properties- Viscosity and other properties of oils –Addit s- Lubricants standards ISO,SAE,AGMA, BIS standards – Lubrication Regimes – inally lubricated contacts- Boundary Lubrication-Hydrodynamic lubrication  THEORY OF HYDRODYNAMIC AND HYDROSTATIC LUBRICATION Equation-Assumptions and limitations-One and two dimensional Reynolds Equation-Assumptions and limitations-One and two dimensional Reynolds Equations-	tives-and Solid Lu N quation	d sel	ectionation-	9 Dry 9 and
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Lu Lu and UNI Rey Som beam UNI Roll	IT III abricants abricants d margi IT IV molds I mmerfel rings-Le IT V ling cor	LUBRICANTS AND LUBRICATION REGIMES s and their physical properties- Viscosity and other properties of oils –Addit s- Lubricants standards ISO,SAE,AGMA, BIS standards – Lubrication Regimes – inally lubricated contacts- Boundary Lubrication-Hydrodynamic lubrication  THEORY OF HYDRODYNAMIC AND HYDROSTATIC LUBRICATION  Equation-Assumptions and limitations-One and two dimensional Reynolds Equation and Service of the Service	Solid Lu N quation ions in I	d sel- abrica Reyn Hydro	ectionation-	9 9 and mic
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CO2	understand the various types of wear mechanism and surface modification techniques	Applying (K2)
СОЗ	familiarize the different types of lubricants and lubrication systems in the tribology	Analysing (K4)
CO4	methodology for deciding lubricants and lubrication regimes for different operating conditions	Understanding (K2)
CO5	ability to understand the different types of high pressure contacts and rolling bearings	Analysing (K4)

- 1. Prasanta Sahoo, "Engineering Tribology", Prentice -Hall of India Pvt Ltd, New Delhi, 2011
- S.K.Basu, S.N.Sengupta & B.B.Ahuja ,"Fundamentals of Tribology", Prentice –Hall of India Pvt Ltd., New Delhi, 2005

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- 1. G.W.Stachowiak& A.W.Batchelor, Engineering Tribology, Butterworth Heinemann, UK, 2005
- 2. Rabinowicz.E, "Friction and Wear of materials", John Willey & Sons, UK, 2010.
- 3. Halling, J. (Editor) "Principles of Tribology", Macmillian 2011.
- 4. Williams J.A. "Engineering Tribology", Oxford Univ. Press, 2003.

# CO - PO MAPPING

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO
CO1	3	3	1	-	2	1	2		-	-		1 -	3	3
CO2	3	2	1	2	2	1	2	-	-	-		1	3	3
CO3	3	2	1	-	2	1	2	-	-	-	NE PER	1	. 3	3
CO4	3	3	1	-	2	1	2	-	-		-	1	3	3
CO5	3	3	1	-	2	1	2	-	-	-	-	1	3	3



WIEZ.	3157	FAILURE ANALYSIS AND DESIGN		3 (	0	0	3
COU	RSE OB	JECTIVES			_		
To er	nable the	students to	an comple	Section 2			
1 p	rovide a	comprehensive understanding of failure analysis, material evaluation techni-	ques	V.	7	75	
2 u	ınderstan	d deformation mechanisms and adopt a general approach to failure analysis		×		T	
3 s	study vari	ous models of SCC mechanisms to comprehend failure processes					
4 k	cnow the	different types of wear and their mechanisms	Hie	FS.			
5 a	apply fail	ure analysis methodologies to identify root causes of material failures in eng	ineerin	g cor	npo	nent	s.
UNIT		NTRODUCTION			Ì	200.000000000	9
Introd	duction,	causes of failures, classification, steps in failure analysis, tools, sample s	selection	and	d tı	eatm	ent,
techn	iques and	ysis, equipments, Metallography, commonly used NDT methods. Machin condition monitoring of gearboxes.	e cond	tion	mo	onito	ing
UNIT		NALYSIS OF FAILURE  nd general approach to analysis of failure; Fracture aspects: Type of frac					9
teete	of failed						
UNIT Basic	r III   F	components.  INVIRONMENT ASSISTED FAILURES  es of aqueous corrosion and high temperature corrosion and oxidation, can an cracking (SCC)- introduction and history of SCC, material/environment c					ies.
UNIT Basic Stress	principles corrosic	INVIRONMENT ASSISTED FAILURES es of aqueous corrosion and high temperature corrosion and oxidation, car					ies.
UNIT Basic Stress occur	principles corrosices, charac	INVIRONMENT ASSISTED FAILURES es of aqueous corrosion and high temperature corrosion and oxidation, can en cracking (SCC)- introduction and history of SCC, material/environment c					ies.
UNITED Basic Stress occur UNITED Types wear	principles corrosices, charace FIV Vs of wear	es of aqueous corrosion and high temperature corrosion and oxidation, can cracking (SCC)- introduction and history of SCC, material/environment cateristics of SCC, introduction to various models of SCC mechanism.	ombina	ed to	wł	eratu	occ 9 res,
UNITED Basic Stress occur UNITED Types wear	principles corrosices, charace V V vs of wear of difference, environment	es of aqueous corrosion and high temperature corrosion and oxidation, can cracking (SCC)- introduction and history of SCC, material/environment cateristics of SCC, introduction to various models of SCC mechanism.  VEAR FAILURES  , different methods of wear measurement, analysis of wear failures, wear agent materials, role of friction on wear, stick slip friction, creep, stress ruptures.	ombina	ed to	wł	eratu	ies.
UNITED Basic Stress occur UNITED Basic Stress occur UNITED Basic UNITE	principles corrosices, charace of IV V V V V V V V V V V V V V V V V V V	es of aqueous corrosion and high temperature corrosion and oxidation, can cracking (SCC)- introduction and history of SCC, material/environment conteristics of SCC, introduction to various models of SCC mechanism.  VEAR FAILURES  , different methods of wear measurement, analysis of wear failures, wear agent materials, role of friction on wear, stick slip friction, creep, stress rupturent induced failure.	ombina at elevat re, elev	ed to	wh	peratu	ies. CCC 9 9 ture
UNITED Basic Stress occur UNITED Basic Stress occur UNITED Basic UNITE	principles corrosices, charace of IV V V V V V V V V V V V V V V V V V V	es of aqueous corrosion and high temperature corrosion and oxidation, can cracking (SCC)- introduction and history of SCC, material/environment cateristics of SCC, introduction to various models of SCC mechanism.  VEAR FAILURES  , different methods of wear measurement, analysis of wear failures, wear a cent materials, role of friction on wear, stick slip friction, creep, stress rupturement induced failure.  EASE STUDIES ON FAILURE ANALYSIS and case studies on Failure analysis: Failures of welded railroad rails, failures failure of broken wire cutters.	ombina at elevat re, elev	ed to	whemp	peratu	geres, ture
UNITED Basic Stress occur UNITED Types wear fatigut UNITED Fan billion	FIII   F. principles corrosices, charace   FIV   V. S. of wear of difference, environment   FV   C. ication and lade and	es of aqueous corrosion and high temperature corrosion and oxidation, can cracking (SCC)- introduction and history of SCC, material/environment conteristics of SCC, introduction to various models of SCC mechanism.  VEAR FAILURES  , different methods of wear measurement, analysis of wear failures, wear agent materials, role of friction on wear, stick slip friction, creep, stress rupturent induced failure.  EASE STUDIES ON FAILURE ANALYSIS and case studies on Failure analysis: Failures of welded railroad rails, failures failure of broken wire cutters.	ombina  nt elevatore, elev  of large	ed to	whempempten	peratu	geres, ture
UNITED Basic Stress occur UNITED Types wear fatigut UNITED Fan birth COU	FIII   F. principles corrosices, charace FIV   V. s of wear of difference, environmental control of the control	es of aqueous corrosion and high temperature corrosion and oxidation, can cracking (SCC)- introduction and history of SCC, material/environment conteristics of SCC, introduction to various models of SCC mechanism.  VEAR FAILURES  , different methods of wear measurement, analysis of wear failures, wear agent materials, role of friction on wear, stick slip friction, creep, stress rupturent induced failure.  EASE STUDIES ON FAILURE ANALYSIS and case studies on Failure analysis: Failures of welded railroad rails, failures failure of broken wire cutters.	ombina at elevat re, elev of large	ed to	when temperature the connection of the connectio	peratu	geres,
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CO4	identify and classify different types of wear mechanisms	Applying (K3)
CO5	analyse the failed engineering components	Analyzing (K4)

- Charlie R. Brooks & Ashok Choudhury, Failure Analysis of Engineering Materials, 1st Edition, McGraw-Hill Education 2002.
- 2. Anderson T L, "Fracture Mechanics: Fundamentals and Applications", 4th Edition, Taylor and Francis, 2017.

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- Surjya Kumar Maiti, "Fracture Mechanics Fundamental and Applications", Cambridge University Press, Delhi 2015.
- 3. Prashant Kumar, "Elements of Fracture Mechanics", Seventh Reprint, Tata Mc Graw Hill publishers, 2014.
- Michael Janssen, Jan Zuidema, Fracture Mechanics: An Engineering Primer 2<sup>nd</sup> Edition 2024.

# 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)													Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	-	-	-	-		-	-	1	2	2
CO2	3	3	3	2	-	-	-	-	-	-	-	1	2	2
CO3	3	3	3	2			-	-	-	-	-	1	2	2
CO4	3	3	3	2	-	-	-	-		-		1	2	2
CO5	3	3	3	2	-	-	-	-	-	16-8-3		1	2	2

Approved
BOARD OF STUDIES
Mechanical Engineering

\* AUTONOMOUS

MI	E23251	NON-TRADITIONAL MACHINING	3	0	0	3
CC	DURSE	OBJECTIVES				
То	enable t	the students to				
1	classif	y non-traditional machining processes and describe mechanical energy based no ses.	n-traditio	nal m	achi	ning
2	differe	entiate chemical and electro chemical energy-based processes.				ŒĮ,
3	describ	be thermo-electric energy-based processes.				
4	explain	n nano finishing processes.				
5	introdu	ace hybrid non-traditional machining processes and differentiate hybrid non-	n-tradition	al m	achii	ning
UN	ITI	INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSE	ES			9
Int	roduction	n - Need for non-traditional machining processes - Classification of non-tradition	nal machir	ning p	roce	sses
Pri	nciples,	equipment's, effect of process parameters, applications, advantages and lin	SSES mitations	of (	Chem	9 ical
ma del	chining, ourring.	Electro-chemical machining, Electro-chemical honing, Electro-chemical grin	mitations			ical
ma det UN	chining, ourring.	Electro-chemical machining, Electro-chemical honing, Electro-chemical grind THERMO-ELECTRIC ENERGY BASED PROCESSES	mitations iding, Ele	ctro	chem	ical ical
ma deb UN Prima	chining, ourring. IT III nciples, o	Electro-chemical machining, Electro-chemical honing, Electro-chemical grin	mitations ding, Elec ons of Elec	tric c	lischa	ical ical 9
ma deb UN Prii ma ma	chining, ourring. IT III nciples, o chining, chining,	THERMO-ELECTRIC ENERGY BASED PROCESSES equipment's, effect of process parameters, applications, advantages and limitation. Wire electric discharge machining, Laser beam machining, Plasma are machining.  NANO FINISHING PROCESSES	mitations ding, Electrical	etric d	lischa	9 urge
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ma det UN Prima ma UN Prima ma rhe	chining, purring.  IT III nciples, chining, chining, nciples, chining	THERMO-ELECTRIC ENERGY BASED PROCESSES equipment's, effect of process parameters, applications, advantages and limitation. Wire electric discharge machining, Laser beam machining, Plasma are machining.  NANO FINISHING PROCESSES equipment's, effect of process parameters, applications, advantages and limitation.  Chemo mechanical polishing, Magnetic abrasive finishing, Magnetor heological abrasive flow finishing.  HYBRID NON-TRADITIONAL MACHINING PROCESSES	ons of Electrical Finish	ctro detric de lectro	lischa on be	9 nrge eam
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CO2	illustrate chemical and electro chemical energy based processes.	Understanding (K2)
CO3	evaluate thermo-electric energy based processes.	Analysing (K4)
CO4	interpret Nano-finishing processes.	Understanding (K2)
CO5	analyse hybrid non-traditional machining processes and differentiate non-traditional machining processes.	Analysing (K4)

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# CO - PO MAPPING

COs	Programme Outcomes(POs)													
	PO1.	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	-	1 -	-	1	-	1	-	1	1		2	2	2
CO2	3		1	-	1	-	1	-	1	1		2	2	2
CO3	3		1	-	1	-	1	-	1	1	-	2	2	2
CO4	3	-	2	-	1	-	1	-	1	1		2	2	2
CO5	3	-	3	-	3	-	1	-	1	1	-	3	• 3	3



LYLL	23252	WELDING TECHNOLOGY	3	0	0	3
CO	URSE (	DBJECTIVES				
То	enable t	ne students to	-december		7	( Land
1	unders	and welding process of gas and arc welding.	gra-w			- 38
2	learn th	e concepts of resistance welding and various resistance welding processes	- 12		a h	
3	gain kr	owledge of solid state welding process for engineering applications				
4	acquire	knowledge on special welding processes and modes of welding				
5	know a	bout different testing methods of weldability and specific materials				É
UN	ITI	GAS AND ARC WELDING PROCESSES				9
Clas	ssification	ons of Welding Processes - Power Sources - characteristics- V-I Gas Welding	: Air Acet	ylene	weld	ing,
Оху	-acetyle	ene welding Arc Welding: Shielded metal arc welding - Submerged arc weldi	ng - TIG v	veldi	ng - N	ИIG
wel	ding - P	asma arc welding - Electro slag welding processes - advantages, limitations and	nd applica	ions		
	IT II	RESISTANCE WELDING PROCESSES	Albur.			9
Spo	t weldir	g - Projection welding - Seam welding - High frequency resistance welding	g processe	s - R	lesista	ance
But	t weldin	g - Flash Butt welding - Percussion welding - advantages, limitations and appl	lications			
UN.	пп	SOLID STATE WELDING PROCESSES				9
For	ge weld	ing - Friction welding - Diffusion bonding - Ultrasonic welding - Explosion	welding -	Cold	pres	sure
wel	ding - a	lvantages, limitations and applications.				
UN.	IT IV	SPECIAL WELDING PROCESSES AND MODES OF WELDING				9
The	rmit we	lding - Electron beam welding - Laser Beam welding- wet under water welding	g-Surfacin	g and	The	rma
Spra	aying Pi	ocesses - Material joining processes - Modes of welding.				
A LEAST SERVICE	IT V	TESTING OF WELDABILITY AND SPECIFIC MATERIALS				9
Des	tructive	Tests: Tensile Test, Toughness Test, And Fatigue Test -Non-Destructive	Test: Vis	ıal Iı	ispec	tion,
Liq	uid Pen	etrant Test, Magnetic Particle Test, Radiographic Test, Ultrasonic Testing	, Weldabi	lity	of S	teel,
Alu	minium	alloys, Copper alloys and other non-ferrous metals.				
			TOTAL	PER	IODS	3:45
CO	URSE	OUTCOMES	BT MAP	PED		
At t	he end	of the course, the students will be able to	(Highest	level)	)	
СО	1 den	nonstrate knowledge on gas and arc welding processes	Applying	(K3)		V.
CO	2 illu	strate the fundamental principles of several resistance welding processes	Understa	nding	(K2)	
CO	3 dise	cuss solid state welding processes and identify their applications	Analysin	g (K4	-)	
CO	4 exp	lain the need for special welding processes and modes of welding	Understa	nding	(K2)	
CO						

different techniques

#### TEXT BOOKS

- 1. Dr.R.S.Parmer, "Welding Processes and Technology", 3rd edition, Khanna Publishers, New Delhi, 2014.
- 2. Baldev Raj, V.Shankar, A.K.Bhaduri, "Welding Technology for Engineers", ASM International, 2006

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- 3. O.P.Khanna, "Welding Technology", DhanpatRai Publications, 2013
- 4. Nadkarni S.V. "Modern Arc Welding Technology", 1st edition, Oxford IBH Publishers, 2005.

### CO - PO MAPPING

COs					Progra	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-		-		2	2	3
CO2	3	3	1 - 1	-	_ = <u>*</u>	2		-	2.2	102	-	2	2	3
CO3	3	3		. <u>.</u>	_	1		-	-			2	2	3
CO4	3	3	-		-	THE MY C	-	-	-	-	-	2	2	3
CO5	3	3	-	-	-	21.10		-	-		-	2	2	3



ME2	3253	PROCESS PLANNING AND COST ESTIMATION	3	4.75	U	3
cou	RSE OB	BJECTIVES				
Тое	nable the	students to	()			
1 :	simplify t	the steps involved in preparing a process plan for a given Product.			×	- 11
2	provide a	n overview for cost estimation of a given product.		(1	77	
3	relate the	allocation of overhead costs in manufacturing.		- 5	d Tr	7
4	understan	d the procedure to estimate the cost of castings and forging products.			graji.	
5	clarify the	e costs involved in machining and estimate the machining cost.	1 11			Ŧ
UNI	ri F	PROCESS PLANNING		-		9
Defin	ning proce	ess planning -Drawing interpretation -Material selection process Factors to be of	conside	red in	selec	ting
		ocess Sequencing; Operation Sequencing; Equipment & Tool Selection; Toolstruments - Computer Aided Process Planning - Retrieval / Variance CAPP are		_		
		Process Planning and methods –Selection of Production Processes from Tables				
		om Tables.	Belee	CIOII	31 1 10	ccss
IINI	гп т				2000 L	0
Conc Estin	ept and nating, T	FUNDAMENTAL OF ESTIMATING AND ELEMENTS OF COST Purpose of Estimating, Functions of Estimating Department, Concept of Corypes of Estimates, Importance of Estimates, Estimating Procedure, Cost	Estima	itors	and	heir
Conc Estin Qual Cost,	cept and nating, T ifications Expense	FUNDAMENTAL OF ESTIMATING AND ELEMENTS OF COST Purpose of Estimating, Functions of Estimating Department, Concept of Cost Types of Estimates, Importance of Estimates, Estimating Procedure, Cost Types of Principal Constituents in a Cost Estimate – Elements of Cost – Introduction, Types and Cost of Product (Ladder Cost).	Estima	itors	and	rsus
Conc Estin Qual Cost, UNI	ept and nating, T ifications, Expense	FUNDAMENTAL OF ESTIMATING AND ELEMENTS OF COST Purpose of Estimating, Functions of Estimating Department, Concept of Company of Estimates, Importance of Estimates, Estimating Procedure, Cost principal Constituents in a Cost Estimate – Elements of Cost – Introduction, as and Cost of Product (Ladder Cost).  OVERHEADS AND DEPRECIATION	Estima Materia	itors	and st, La	rsus their bour
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CO4	estimate cost for casting and forging products.	Analysing (K4)
CO5	analyze the costs for machining a product.	Analysing (K4)

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- Phillip F. Ostwald & Jairo Munoz, "Manufacturing Processes and Systems", 9th Edition, Wiley student edition, 2008.

## CO - PO MAPPING

COs					Progr	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	1	1	1	1	-	1	1	2	2
CO2	3	3	2	2	-	1	1	1	-		1	1	3	3
CO3	3	3	2	2	-	1	1	1	-	-	1	1	3	3
CO4	3	3	2	2		1	1	1	-	TY. 4	1	1	3	3
CO5	3	3	2	2	2	1	1	1	-	-	1	1	3	3



troduction to CAD and CAM- CAD/CAM integration. Concurrent Engineering-CIM concepts — Computerised ements of CIM system —Types of production - Manufacturing models and Metrics — Mathematical models of oduction Performance —Product development cycle-Concurrent engineering ExamplesLean Production and st-In-Time Production. manufacturing automation protocol    PRODUCTION PLANNING AND CONTROL & COMPUTERISED PROCESS   9   PLANNING	ME23254	COMPUTER INTEGRATED MANUFACTURING	3	0	0	3
know the basic concepts and elements in manufacturing process.  understand the production planning and process planning techniques.  familiarize the group technology and cellular manufacturing methodologies.  comprehend the types of FMS and AGVs.  define the various models in CIM and communication methods.  NIT I INTRODUCTION 9  troduction to CAD and CAM- CAD/CAM integration. Concurrent Engineering-CIM concepts — Computerised ements of CIM system —Types of production - Manufacturing models and Metrics — Mathematical models of oduction Performance —Product development cycle-Concurrent engineering ExamplesLean Production and st-In-Time Production. manufacturing automation protocol  NIT II PRODUCTION PLANNING AND CONTROL & COMPUTERISED PROCESS PLANNING  Occess planning — Computer Aided Process Planning (CAPP) — Logical steps in Computer Aided Process Planning Aggregate Production Planning and the Master Production Schedule — Material Requirement planning — Capacity anning- Control Systems-Shop Floor Control-Inventory Control — Brief on Manufacturing Resource Planning-II (RP-II) & Enterprise Resource Planning (ERP) - Simple Problems.  NIT III GROUP TECHNOLOGY & CELLULAR MANUFACTURING 9  froup Technology (GT), Part Families — Parts Classification and coding — DCLASS, MICLASS and OPITZ coding stems. — Facility design using G.T. Cellular Manufacturing — Composite part concept — Machine cell design and yout — Quantitative analysis in Cellular Manufacturing — Rank Order Clustering Method - Arranging Machines a GT cell — Hollier Method — Simple Problems.  NIT IV FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED 9  VEHICLE SYSTEM (AGVS)  VEHICLE SYSTEM (AGVS)  VEHICLE GUIdance technology — Vehicle Management & Safety.  NIT V CIM IMPLEMENTATION AND DATA COMMUNICATION 9  ystem modelling tools- ICAM definition (IDEF) models, The Siemens model of CIM, Activity cycle diagram, IM open system architecture (CIMOSA) — manufacturing enterprise wheel- CIM architecture- Product data anagement, implementation-software. Commun	COURSE	OBJECTIVES				
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NIT V   CIM IMPLEMENTATION AND DATA COMMUNICATION   9	Types of l	lexibility - FMS - FMS Components - FMS Application & Benefits - FMS	S Planning	and	Contr	ol –
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anufacturing-Network file systems-ATM Networks.	CIM open	system architecture (CIMOSA) - manufacturing enterprise wheel- CIM a	rchitecture	- Pro	duct	data
	manageme	nt, implementation-software. Communication fundamentals- local area network	ks (LAN) -	-Netv	vorkir	ng in
TOTAL PERIODS:45	manufactu	ing-Network file systems-ATM Networks.				
	*		TOTAL	PER	IODS	:45

1 - 385 - K

COUI	RSE OUTCOMES	BT MAPPED
At the	end of the course, the students will be able to	(Highest level)
CO1	assess CAD/CAM integration for changing manufacturing and management systems.	Remembering (K1)
CO2	use the planning and control methods in production technology.	Understanding (K2)
CO3	construct a machine cell using the concepts of Group Technology and Cellular manufacturing.	Analysing (K4)
CO4	select the suitable material handling and storage system for Flexible Manufacturing Systems	Understanding (K2)
CO5	choose the suitable CIM implementation and data communication techniques.	Applying (K3)

- Mikell. P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
- Radhakrishnan P, Subramanyan S. and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2008.

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- Singh. N, "Systems Approach to Computer-Integrated Design and Manufacturing", Wiley India Pvt Ltd., 2011.
- Groover. M.P Automation, production system and Computer Integrated Manufacturing System- Prentice Hall, 2014.
- 4. P.N. Rao, CAD/CAM Principles and Applications-Tata McGraw Hill 3rd edition, 2007.

#### CO - PO MAPPING

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

COs					Progra	mme O	utcome	es(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1	3	- 1	-	-	-	-	-	2	2	2
CO2	2	1	2	2	3	-	-	-	-	-	-	2	2	2
CO3	3	1	2	2	3	-	-	-	-		-	2	2	2
CO4	3	1	2	2	3.	-	-	-	-	-	-	2	2	2
CO5	3	2	2	3	3	-		-	-	-	-	2	2	2

Approved
BOARD OF STUDIES
Mechanical Engineering

ME	23255	ADVANCED CASTING AND FORMING PROCESSES	3	0	0	3
CO	URSE OB	JECTIVES				
То	enable the	students to				
1	gain the k	nowledge about principles of foundry				
2	gain the k	nowledge about principles of casting technology				
3	know the	advanced casting technology.				
4	provide o	verview of various sheet metal forming process				07
5	study the	powder metallurgy techniques and Special metal forming processes.				
UN	IT I	PATTERN MAKING, MOULDING AND CORE MAKING		- 12		9
Pat	tern materi	als-Pattern allowances-Pattern layout, pattern making - Moulding sands - Ingredie	ents-	-Spe	cifica	ion
		moulding sands – classification of moulding sands –Sand conditioning –Characterypes of cores	eristic	s of	cores	and
UN	IT II S	SOLIDIFICATION AND GATING				9
Sol	idification	principles - planar and dendritic solidification - constitutional super cooling -	Free	zing	of a p	ure
pro	blems in ri	ser and gating design			lustra	
pro			e il.	l nee		
UN	III II A	ADVANCES IN CASTING		in the		9
UN	IT III A	ADVANCES IN CASTING  Thixo casting - magnetic moulding - Impulse moulding- high pressure mould	-	- Stir	casti	9 1g -
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CO2	evaluate the process parameters involved in casting processes.	Understanding (K2)
CO3	grasp the significance of advanced casting process and its applications.	Analysing (K4)
CO4	understand the conventional sheet metal forming process and various high energy rate forming technique	Understanding (K2)
CO5	understand the powder metallurgy forming technique.	Analysing (K4)

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### CO - PO MAPPING

COs					Progra	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	1	1	1	1	7.0	1 -	1	2	2
CO2	3	3	2	2	-	1	1	1	0-		1	1	3	3
CO3	3	3	2	2		1	1	1	2	2	1	1	3	3
CO4	3	3	2	2	-	1	1	1	-	-	1	1	3	3
CO5	3	3 .	2	2	2	1	1	1	-	-	1	1	3	3



	6 LEAN MANUFACTURING 3 0	0	3
COURS	E OBJECTIVES		
To enab	e the students to		
1 intr	oduce the basics of 6 SIGMA		
2 lear	ning about the lean manufacturing tools		
3 stud	y about the deeper understanding methodologies of Lean manufacturing		
4 stud	y the lean concepts and its elements	10 13	
5 lear	implementation and challenges of lean manufacturing		70.4
UNIT I	BASICS OF 6 SIGMA	16 33	-
Introduc	ion to 6 Sigma, basic tools of six sigma like problem solving approach, standard deviation	n. norr	-
	on, various sigma levels with some examples, value for the enterprise, Variation, and sources of		
	I moving the mean, Various quality costs, cost of poor quality.	· ur iui	OII,
UNIT II	INTRODUCTION TO LEAN MANUFACTURING TOOLS		9
Process (	Capability Indices, Cause and Effect diagram, Control Charts, Introduction to FMEA, APQP and	PPAP	
foundation	nal 6 Sigma methodologies: DMAIC, DMEDI, and Process Management DMEDI for process	creation	on,
foundation DMAIC	nal 6 Sigma methodologies: DMAIC, DMEDI, and Process Management DMEDI for process for process improvement and PDCA for sustaining improvements - Introduction to Value Stream	creation	on,
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COUI	RSE OUTCOMES	BT MAPPED
At the	end of the course, the students will be able to	(Highest level)
CO1	discuss the basics of 6 SIGMA	Applying (K3)
CO2	elaborate the lean manufacturing tools	Understanding (K2)
CO3	illustrate about the deeper understanding methodologies of Lean manufacturing	Analysing (K4)
CO4	discuss lean concepts and its elements	Understanding (K2)
CO5	describe the implementation and challenges of lean manufacturing	Analysing (K4)

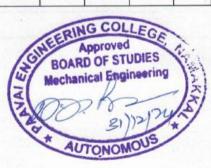
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### CO - PO MAPPING

COs	Programme Outcomes(POs)													PSOs		
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2		
CO1	1	1	2	1	1	-	-	-	1	-	3	1	1	2		
CO2	1	1	2	1	1	-	-	-	1		3	1	1	2		
CO3	1	1	2	1	1	-	-	-	1	-	3	1	1	2		
CO4	1	- 1	2	1	1	- 1	-	-	1	mis-se	3	1	1	2		
CO5	1	1	2	1	1	-		-	1	-	3	1	1	2		



ME23257	INDUSTRIAL ROBOTICS	3	0	0	3
COURSE	OBJECTIVES				
To enable	he students to				
1 under	tand the functions of the basic components of a Robot.	Calarte		elli)	25
2 study	he use of various types of End of Effectors and drives	_ ; ; .		-	Π
3 know	he use of sensors and vision systems in automation systems.			1 2	
4 impar	knowledge in Robot Kinematics and Programming.			Ŧ	
5 gain k	nowledge on the different methods of material handling, robot safety issues and	economi	cs.	T	
UNIT I	FUNDAMENTALS OF ROBOT	10	11.79		9
Robot- Hi	tory of robot, Basic concepts of robotics (Laws of robotics, robotic systems),	, RIA Def	initic	n–Ro	bot
Anatomy-	Co-ordinate Systems, Work Envelope, types and classification-Functions Spec	ecification	s Pit	ch, Y	aw,
Roll, Joint	Notations, Speed of Motion, Pay Load - functions- Need for Robots-Select	tion of ro	oots-	Differ	rent
Applicatio	IS.				
UNIT II	ROBOT DRIVE SYSTEMS AND END EFFECTORS	- Subvituo			9
Pneumatic	Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo M	Iotors, St	epper	Mot	ors,
A.C. Serve	Motors-Salient Features, Applications and Comparison of all these Drives, E	nd Effect	ors - (	Gripp	ers-
Mechanica	Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum	Grippers;	Two	Finge	red
and Three	Fingered Grippers.			WG.	
UNIT III	SENSORS AND MACHINE VISION	* 1-41			9
Requireme	nts of a sensor, Principles and Applications of the following types of sensors – P	osition of	senso	ors (Pi	ezo
Electric Se	nsor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors), Range	e Sensors	(Tria	ngulat	tion
Principle,	Structured, Lighting Approach, Time of Flight Range Finders, Laser Range M	Meters), -	ntrod	uction	n to
	sion - functional block diagram of machine vision system - Sensing and Digiti	35.00			
and analys	s.				
UNIT IV	ROBOT KINEMATICS AND ROBOT PROGRAMMING	-			9
Forward I	inematics, Inverse Kinematics and Differences; Forward Kinematics and	Reverse	Kiner	natics	of
Manipulat	ors with Two, Degrees of Freedom (In 2 Dimensional),- Introduction to DH	Matrices -	Teacl	1 Pend	lant
Programm	ng, Lead through programming, Robot programming Languages - VAL	Programn	ing -	- Mo	tion
Command	, Sensor Commands, End effecter commands, and Simple programs				
UNIT V	IMPLEMENTATION AND ROBOT ECONOMICS	5.7.1			9
RGV, AG	; Implementation of Robots in Industries-Various Steps; Safety Consideration	ns for Rol	ot O	peratio	ons;
Economic	Analysis of Robots- Economic analysis, basic data required methods of Econo	mic analy	sis –	Pay b	ack
Method, E	UAC Method, and Rate of Return Method.	•			
		TOTAL	PER	ODS	:45

COUI	RSE OUTCOMES	BT MAPPED
At the	end of the course, the students will be able to	(Highest level)
CO1	differentiate the various types of Industrial Robots and their architecture.	Understanding (K2)
CO2	apply the working of various robot drive systems and end effectors	Applying (K3)
CO3	describe the working principle of various sensors	Analyzing (K4)
CO4	write robot programming for specific applications	- Creating (K5)
CO5	apply the knowledge of implementation of robotics in industries	Applying (K3)

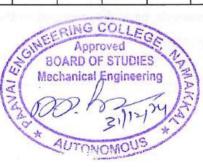
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### CO - PO MAPPING

COs			PSOs											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
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CO2	1	1	2	1	1	- 4	THE T	.40.0	1	-7201	3	1	1	2
CO3	1	1	2	1	1		1 Zeri	AUTE E	1		3	1	1	2
CO4	1	1	2 .	1	1	-	- 1	-	1	-	3	1	1	2
CO5	1	1	2	1	1		112	-	1	hrical h	3	1	1	2



To enable the students to    learn Selecting the constraints on the availability of resources and developing a model and rendering an optin solution for the given circumstances.    study Appraising the challenges in the transportation and production problems and furnishing a ration solution to maximize the benefits   learn Planning the purchase/ manufacturing policies, managing the spares/ stocks and meeting the custor demands.   demands.	Icarn Selecting the constraints on the availability of resources and developing a model and rendering and solution for the given circumstances.    Icarn Selecting the constraints on the availability of resources and developing a model and rendering and solution for the given circumstances.    Icarn Planning the challenges in the transportation and production problems and furnishing a resolution to maximize the benefits   Icarn Planning the purchase/ manufacturing policies, managing the spares/ stocks and meeting the curdemands.    Icarn Planning the purchase/ manufacturing policies, managing the spares/ stocks and meeting the curdemands.    Icarn Planning the purchase/ manufacturing policies, managing the spares/ stocks and meeting the curdemands.    Icarn Planning the purchase/ manufacturing policies, managing the spares/ stocks and meeting the curdemands.    Icarn Planning the purchase/ manufacturing policies, managing the spares/ stocks and meeting the curdemands.    Icarn Planning the purchase/ manufacturing policies, managing the spares/ stocks and meeting the curdemands.    Icarn Planning the purchase/ manufacturing policies, managing the spares/ stocks and meeting the curdemands.    Icarn Planning the purchase/ manufacturing policies, managing the spares/ stocks and meeting the curdemands.    Icarn Planning the purchase/ manufacturing policies, managing the spares/ stocks and meeting the curdemands.    Icarn Planning the purchase/ manufacturing policies, managing the spares/ stocks and meeting the curdemands.    Icarn Planning the purchase/ manufacturing policies, managing the spares/ stocks and meeting the curdemands.    Icarn Planning the purchase/ manufacturing policies, managing the spares/ stocks and meeting the curdemands.    Icarn Planning the purchase/ manufacturing policies, managing the spares/ stocks and meeting the curdemands.    Icarn Planning the purchase/ manufacturing policies, managing the spares/ stocks and meeting the curdemands.    Icarn Planning the purchase/ manufacturing policies	rational ustomer
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	technique.	
Project Management: Introduction; Guidelines for Networking AOA Diagrams - Problems in Critical Path Met	UNIT V PROJECT MANAGEMENT AND REPLACEMENT MODELS	
	Project Management: Introduction; Guidelines for Networking AOA Diagrams - Problems in Critical Path	Metho
(CPM) & Program Evaluation Review Technique (PERT) - Differences of CPM & PERT. Replacement Problem	(CPM) & Program Evaluation Review Technique (PERT) - Differences of CPM & PERT. Replacement Pr	oblems

Types - Problems in: Determination of Economic Life of an Asset - Problems in: Individual and Group Replacement Policies, Apply OR software

		TOTAL PERIODS:45
COUI	RSE OUTCOMES	BT MAPPED
At the	end of the course, the students will be able to	(Highest level)
CO1	discuss the selection of the constraints on the availability of resources, develop a model and render an optimal solution for the given circumstances.	Analysing (K4)
CO2	explain the appraise the challenges in the transportation and production problems and furnish a rational solution to maximize the benefits.	Understanding (K2)
CO3	explain plan the purchase/ manufacturing policies, manage the spares/ stocks, and meet the customer demands	Applying (K3)
CO4	analyze the queue discipline and explore the avenues for better customer service.	Understanding (K2)
CO5	investigate the nature of the project and offer methodical assistance towards decision making in maintenance.	Analysing (K4)

#### TEXT BOOKS

- 1. Pannerselvam R, "Operations Research", 2nd Edition, PHI, 2009
- 2. Hamdy A. Taha, "Operations Research an Introduction", 10th Edition, PHI/Pearson Education, 2017.

### REFERENCES

- Ravindran, Phillips and Solberg, "Operations Research Principles and Practice", 2nd Edition, Wiley India, 2007
- 2. Srinivasan G, "Operations Research Principles and Applications", 3rd Edition EEEPHI, 2017
- 3. Sharma J K, "Operations Research Theory and Applications", 5th Edition, Macmillan India, 2013.
- 4. Premkumar Gupta and D.S.Hira, "Problems in Operations Research", S.Chand, 2009.

## 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	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2		
CO1	2	3	3	2	2	1	1	1	1	1	2	2	2	2		
CO2	2	3	3	2	2	1	1	1	1	1	2	2	2	2		
CO3	2	3	3	2	2	1	1	1	-1	1	2	2	2	2		
CO4	2	3	3	2	2	1	1	1	1	1	2	2	- 2	2		
CO5	2	3	3	2	2	ad co	LLEG	1	1	1	2	2	2	2		

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Mechanical Engineering

ALTRONOUS

methods.  interact the financial metrics, such as present worth, future worth, equivalent annual cost, and rate of return.  comprehend the principles of replacement and maintenance analysis to make informed decisions about asset management.  have an awareness about the business and marketing function  UNIT I FUNDAMENTALS OF ECONOMICS 9  Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics - Engineering efficiency, Economic efficiency, Scope of engineering economics- Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.  UNIT II VALUE ENGINEERING 9  Make or buy decision, Value engineering – Function, aims, and Value engineering procedure. Interest formulae and their applications – Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor-Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.  UNIT III CASH FLOW 9  Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.  UNIT IV REPLACEMENT AND MAINTENANCE ANALYSIS 9  Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.	ME23352	ENGINEERING ECONOMICS	3	0	0	3
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RSE OUTCOMES	BT MAPPED
end of the course, the students will be able to	(Highest level)
appraise analyse complex engineering problems, considering both technical and economic factors	Applying (K3)
analyse the cost-effective engineering solutions based on economic analysis.	Understanding (K2)
formulate the economic and environmental impacts of engineering decisions	Analysing (K4)
assess the replacement and maintenance activities of machine	Understanding (K2)
interpret business and marketing function of management in economics	Analysing (K4)
	economic factors  analyse the cost-effective engineering solutions based on economic analysis.  formulate the economic and environmental impacts of engineering decisions  assess the replacement and maintenance activities of machine

- 1. R. Panneerselvam Engineering Economics ,2<sup>nd</sup> edition PHI Learning 2014
- 2. N.Gregory manikw, Principles of Economics 8th edition Thomson Learning, New Delhi 2017

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- Paul A. Samuelson William D.Nordhaus, Sudip Chaudhuri and Anindya sen, Economics, 19th edition, Tata McGraw Hill, New Delhi 2011
- 3. Richard lipsey and Alec Chrystal Economics, 13th edition, Oxford University Press, New Delhi 2015
- 4. Karl.E Case and Ray C. Fair Principle of Economics .12th edition, Pearson, Education Asia, New Delhi 2017

## CO - PO MAPPING

COs		Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2	
CO1	3	2	-	1.15	-	-	2	-	-	-	-	-	-		
CO2	2	-	100	-	-	3	-	-	2	-	-	-	-	2	
CO3	3	- 5	2	-	-	-	-	-	-	-	-		1	2	
CO4	-		-	2	-		-	-	-	-		HC. Litte	-	1	
CO5	1	- 4	-		-	- 0	_	2	1	1251	10	1000	-	11121	



ME23353	INDUSTRIAL SAFETY	3	0	0	3
COURSE OB	JECTIVES				
To enable the	students to		151 - 51		
1 study the	fundamental concept and principles of industrial safety				
2 study the	principles of maintenance engineering.			6/5	75
3 analyzing	the wear and its reduction.		- 5	Tilegan	
4 study the	faults in various tools, equipment's and machines.				
5 study the	periodic maintenance procedures in preventive maintenance.				- X
UNIT I	NDUSTRIAL SAFETY				9
Accident, cau	ses, types, results and control, mechanical and electrical hazards, types, caus	es ar	nd p	reven	tive
steps/procedur	e, describe salient points of factories act 1948 for health and safety, wash room	ns, d	rinki	ng w	ater
layouts, light,	cleanliness, fire, guarding, pressure vessels, etc, Safety colour codes. Fire prevention	on and	l fire	fight	ing,
equipment and	l methods.				
UNIT II N	MAINTENANCE ENGINEERING				9
Definition and	aim of maintenance engineering, Primary and secondary functions and responsibil	lity o	fmai	intena	nce
department, T	ypes of maintenance, Types and applications of tools used for maintenance, Main	ntena	nce o	cost &	z its
relation with r	eplacement economy, Service life of equipment.				
UNIT III V	VEAR AND CORROSION AND THE IR PREVENTION				9
Wear- types,	causes, effects, wear reduction methods, lubricants-types and applications, Lu	brica	tion	meth	ods,
general sketch	, working and applications, Screw down grease cup, Pressure grease gun, Splash l	ubric	ation	ı, Gra	vity
lubrication, W	rick feed lubrication and Side feed lubrication, Ring lubrication, Definition, pr	incip	le an	d fac	tors
affecting the c	orrosion. Types of corrosion, corrosion prevention methods.				
UNIT IV I	AULT TRACING				9
Fault tracing-	concept and importance, decision tree concept, need and applications, sequen	ice of	fau	lt find	ding
activities, sho	w as decision tree, draw decision tree for problems in machine tools, hyd	Irauli	c, pı	neuma	atic,
automotive, the	nermal and electrical equipment's like, Any one machine tool, Pump, Air co	ompre	ssor	, Inte	rnal
combustion er	igine, Boiler, Electrical motors, Types of faults in machine tools and their genera	l caus	ses.		
UNIT V F	PERIODIC AND PREVENTIVE MAINTENANCE	πĚ		Fa	9
Periodic inspe	ection - concept and need, degreasing, cleaning and repairing schemes, overhau	ling	of m	echan	iical
components, o	overhauling of electrical motor, common troubles and remedies of electric motor,	repai	r con	nplex	ities
and its use, d	efinition, need, steps and advantages of preventive maintenance. Steps/procedu	re fo	r per	iodic	and
preventive ma	tintenance of Machine tools, Pumps, Air compressors, Diesel generating (DG)	sets,	Pro	gram	and
schedule of	preventive maintenance of mechanical and electrical equipment, Advanta	iges	of p	rever	tive
maintenance,	Repair cycle concept and importance.				

	Signal Province Province and State Control Provi	TOTAL PERIODS:45
COUI	RSE OUTCOMES	BT MAPPED
At the	end of the course, the students will be able to	(Highest level)
CO1	explain the fundamental concept and principles of industrial safety	Understanding (K2)
CO2	apply the principles of maintenance engineering.	Applying (K3)
CO3	analyse the wear and its reduction.	Analyzing (K4)
CO4	evaluate faults in various tools, equipment's and machines	Applying (K3)
CO5	apply periodic maintenance procedures in preventive maintenance.	Understanding (K2)

- 1. LM Deshmukh, Industrial Safety Management, Tata Mc Graw -Hill Education, New edition, 2017.
- 2. Charles D. Reese, Occupational Health and Safety Management: A Practical Approach, CRC Press, 2013

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- 2. Garg, HP, Maintenance Engineering, S.Chand Publishing, 2015.
- 3. JMaiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017
- 4. R.Keith Mobley, Maintenance Fundamentals, Elsevier, 2011.

## CO - PO MAPPING

COs					Progr	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	-	-	2	1	-	-	4-1	4.214	1	1	2
CO2	2	1	2	72	-	2	1	12 2	2	_	2	1	1	2
CO3	2	1	2	_		2	1	42.00		da Pr	19211110	1	1	2
CO4	2	1	2	19 20 8	-	2	1	AHTE C	102	0. 200	2	1	1	2
CO5	2	1	2	2.46		2	1		-		-	1	1	2



ME	23354	LOGISTICS AND SUPPLY CHAIN NETWORKS	3	(	)	0	3
CO	URSE OI	BJECTIVES					
To	enable the	e students to			Con a		
1	understa	nd the strategic role of logistics and supply chain management.					
2	compare	and contrast the various modes of logistics operations.	-			T	uv.
3	acquaint	with the functions and techniques of containerization, from the international	perspecti	ve.			
4	ascertain	the role and functions of packaging for domestic and international sales.					
5	familiari	ze with the export logistics and documentation process.				19	-
UN	IT I	INTRODUCTION LOGISTICS AND SUPPLY CHAIN	p. Die		T	6212	9
Sup	ply Chair	- Definition, Evolution Logistics and, Importance. The concepts of logi	stics and	Su	pp	ly C	hain
		Key Drivers of Supply Chain Management and Logistics relationship Supply Chain.	s. Differe	ence	s	Betv	veen
UN	ITII	TRANSPORTATION AND ITS FUNCTIONALITY			T		9
		Transportation, Transportation Functionality and Principles; Multimo					
Cha	racteristic	es; Modal Comparisons; International Air Cargo Transport; Coastal and	d Ocean	trai	ısp	orta	tion,
Cha	racteristic	es of shipping transport- Types of Ships.					
UN	IT III	cs of shipping transport- Types of Ships.  CONCEPT OF LOGISTICS  olution, Objectives, Components and Functions of Logistics Management, D	vistributio	n re	late	ed Is	9 sues
UN Log and	IT III   Gristics: Eve Challenge	CONCEPT OF LOGISTICS					sues
UN Log and and UN	ristics: Eve Challeng Mode; No	CONCEPT OF LOGISTICS olution, Objectives, Components and Functions of Logistics Management, D es; Gaining competitive advantage through Logistics Management, Transpo etwork and Decision, Containerization, Cross docking.  WAREHOUSING	rtation Fu	inct	ion	ns, C	sues osts,
UN Log and and UN Cor	challenge Mode; No IT IV	CONCEPT OF LOGISTICS olution, Objectives, Components and Functions of Logistics Management, D es; Gaining competitive advantage through Logistics Management, Transpo etwork and Decision, Containerization, Cross docking.  WAREHOUSING  types, Warehousing strategy, Warehouse facility location & network de	rtation Fu	vers	ion	logis	sues osts, 9
UN Log and and UN Cor Out	challenge Mode; No IT IV	CONCEPT OF LOGISTICS olution, Objectives, Components and Functions of Logistics Management, D es; Gaining competitive advantage through Logistics Management, Transpo etwork and Decision, Containerization, Cross docking.  WAREHOUSING  types, Warehousing strategy, Warehouse facility location & network de Nature and concept, Strategic decision to Outsourcing, Third party logi	rtation Fu	vers	ion	logis	sues osts, 9
UN Log and and UN Cor Out logi	challenge Mode; Notes and sourcing-istics(4PL	CONCEPT OF LOGISTICS olution, Objectives, Components and Functions of Logistics Management, D es; Gaining competitive advantage through Logistics Management, Transpo etwork and Decision, Containerization, Cross docking.  WAREHOUSING  types, Warehousing strategy, Warehouse facility location & network de Nature and concept, Strategic decision to Outsourcing, Third party logi	rtation Fu	vers	ion	logis	sues osts, 9 stics, party
UN Log and and UN Cor Out logic	Challenge Mode; No IT IV Challenge and sourcing-istics(4PL)	concept of Logistics olution, Objectives, Components and Functions of Logistics Management, D es; Gaining competitive advantage through Logistics Management, Transpo etwork and Decision, Containerization, Cross docking.  WAREHOUSING types, Warehousing strategy, Warehouse facility location & network de Nature and concept, Strategic decision to Outsourcing, Third party logis).	esign, Re	vers	se ou	logis	sues osts, 9 stics, party
UN Log and and UN Cor Out logi UN Sup	Challenge Mode; No IT IV Challenge and sourcing-istics(4PL) oply Chair	CONCEPT OF LOGISTICS  olution, Objectives, Components and Functions of Logistics Management, D es; Gaining competitive advantage through Logistics Management, Transpo etwork and Decision, Containerization, Cross docking.  WAREHOUSING  types, Warehousing strategy, Warehouse facility location & network de Nature and concept, Strategic decision to Outsourcing, Third party logi ).  SUPPLY CHAIN AND CRM	esign, Re	vers	se ou	logis	sues osts, 9 stics, party
UN Log and and UN Cor Out logi UN Sup	Challenge Mode; No IT IV Challenge and sourcing-istics(4PL) oply Chair	concept of Logistics olution, Objectives, Components and Functions of Logistics Management, D es; Gaining competitive advantage through Logistics Management, Transpo etwork and Decision, Containerization, Cross docking.  WAREHOUSING  types, Warehousing strategy, Warehouse facility location & network de Nature and concept, Strategic decision to Outsourcing, Third party logi ).  SUPPLY CHAIN AND CRM In and CRM- Linkage, IT infrastructure used for Supply Chain and CRM, Fu	esign, Re	vers), F	se ou	logis	sues osts,  9 stics, party
UN Log and and UN Cor Out logi UN Sup CR	Challenge Mode; Note and isourcing-istics(4PL) IT V Soply Chair M, Green	concept of Logistics olution, Objectives, Components and Functions of Logistics Management, D es; Gaining competitive advantage through Logistics Management, Transpo etwork and Decision, Containerization, Cross docking.  WAREHOUSING  types, Warehousing strategy, Warehouse facility location & network de Nature and concept, Strategic decision to Outsourcing, Third party logi ).  SUPPLY CHAIN AND CRM In and CRM- Linkage, IT infrastructure used for Supply Chain and CRM, Fu	esign, Restics(3PL	vers), F	se ou	logis	sues osts,  9 stics, party
UN Log and and UN Cor Out logi UN Sup CR	Challenge Mode; No IT IV Challenge Mode; No IT IV Challenge and asourcing-istics(4PL) IT V Challenge Chall	concept of Logistics olution, Objectives, Components and Functions of Logistics Management, D es; Gaining competitive advantage through Logistics Management, Transpo etwork and Decision, Containerization, Cross docking.  WAREHOUSING  types, Warehousing strategy, Warehouse facility location & network de Nature and concept, Strategic decision to Outsourcing, Third party logi ).  SUPPLY CHAIN AND CRM  In and CRM- Linkage, IT infrastructure used for Supply Chain and CRM, Fu supply chain management, Supply Chain Sustainability.	esign, Restics(3PL	vers), F	ion se ou po	logis rrth ponent	sues osts,  9 stics, party
UN Log and and UN Cor Out logi UN Sup CR	Challenge Mode; No IT IV Challenge Mode; No IT IV Challenge and sourcing-stics(4PL) IT V Challenge Challen	concept of Logistics olution, Objectives, Components and Functions of Logistics Management, D es; Gaining competitive advantage through Logistics Management, Transpo etwork and Decision, Containerization, Cross docking.  WAREHOUSING types, Warehousing strategy, Warehouse facility location & network de Nature and concept, Strategic decision to Outsourcing, Third party logi ).  SUPPLY CHAIN AND CRM n and CRM- Linkage, IT infrastructure used for Supply Chain and CRM, Fu supply chain management, Supply Chain Sustainability.  UTCOMES	esign, Restics(3PL	vers ), F	ion se ou po	logis onent	sues osts,  9 stics, party
UN Log and and UN Cor Out logic UN Sup CR CO	Challenge Mode; No Challenge Mode Mode Mode Mode Mode Mode Mode Mod	CONCEPT OF LOGISTICS  olution, Objectives, Components and Functions of Logistics Management, D es; Gaining competitive advantage through Logistics Management, Transpo etwork and Decision, Containerization, Cross docking.  WAREHOUSING  types, Warehousing strategy, Warehouse facility location & network de Nature and concept, Strategic decision to Outsourcing, Third party logi ).  SUPPLY CHAIN AND CRM  In and CRM- Linkage, IT infrastructure used for Supply Chain and CRM, Fu supply chain management, Supply Chain Sustainability.  UTCOMES  the course, the students will be able to estand supply chain based on the participants.  Lise the traditional physical distribution activity against the modern one, for	esign, Restics(3PL	vers ), F  PPE leve	ion se ou po RI D el)	logis arth ponent	sues osts,  9 stics, party  9 s for
UN Log and and UN Corr Out logic UN Sup CR	Challenge Mode; No Challenge Mode Mode Mode Mode Mode Mode Mode Mod	concept of Logistics olution, Objectives, Components and Functions of Logistics Management, D es; Gaining competitive advantage through Logistics Management, Transpo etwork and Decision, Containerization, Cross docking.  WAREHOUSING  types, Warehousing strategy, Warehouse facility location & network de Nature and concept, Strategic decision to Outsourcing, Third party logi ).  SUPPLY CHAIN AND CRM In and CRM- Linkage, IT infrastructure used for Supply Chain and CRM, Fu supply chain management, Supply Chain Sustainability.  UTCOMES The course, the students will be able to estand supply chain based on the participants.	esign, Restics(3PL	vers ), F  PPE leve	ion se ou po RI D el)	logis arth ponent	sues osts,  9 stics, party  9 s for

CO4	examine the effectiveness of the traditional vs modern packaging methods.	Understanding (K2)
CO5	intercept and apply his knowledge in domestic vs export logistics management.	Analysing (K4)

- 1. Ashley McDonough. Operations and Supply Chain Management: Vibrant Publishers,1st Edition, 2020.
- F.Robert Jacobs, Ravi Shankar, Richard. B Chase, Operations and Supply Chain Management, Mc Graw Hill, 17th Edition 2023.

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- 2. Burt, Dobbler, Starling, World Class Supply Management, Tata McGraw-Hill, 2003.
- 3. Donald J Bowersox, David J Closs, Logistical Management, TMH, 2010.
- 4. Pierre David, "International Logistics", Biztantra, 2013.

# CO - PO MAPPING

COs					Progra	amme O	utcome	s(POs)					PS	Os
70,7,3	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2	-	2	-	1	un 2 m			24.0	71-m	-	1 (#S17)	1	2
CO2	-	-	-	-	1	-	-	-	-	2		-	- 7	-
CO3	3	1	f	12.	1 -	2	-	1	19:76		-	-	1	-
CO4	1	16	-	n o <del>s</del> ym	2	cita t <del>a</del> a = 1	2		)	2	a continu	The state of the s	-25/00	2
CO5	-	1	-	-	1	-	2	2	-	-	-	-	15.	1-15-4



WIE 255	355	PLANT LAYOUT AND MATERIALS HANDLING	3	0	0	3
COUR	RSE OB	BJECTIVES				
To ena	able the	students to	V VIII	or and the	nostje	
1 pro	rovided	with the knowledge of the process of analysing and developing information to pro	duce	a pla	nt lay	out
bas	ased on	the locations and working conditions.				
2		he students about the basic things of work conditions which includes ventilation fect based on various nature of work.	, cor	nfort	, light	ing
3 pro	rovide k	knowledge on effective and safe layout design of an industry.	-1,0			
4 lea	arn abo	ut the different types material handling methods, paths equipment's and functions	1			
5 ge	et the ide	lea about the material handling systems.				
UNIT	I P	PLANT LOCATION .				9
treatme	ent and	plant locations, territorial parameters, considerations of land, water, electricity, disposal, further expansions Safe location of chemical storages, LPG, LNG				
	ma, eme	orine, explosives and propellants.				
UNIT I	II Payout, ed	PLANT LAYOUT quipment layout, safety system, fire hydrant locations, fire service rooms, faciliti reatment tanks, site considerations, approach roads, plant railway lines, security				
UNIT I Safe lay disposa for pro- food pr	II Payout, educated and to occess incorocessing	PLANT LAYOUT quipment layout, safety system, fire hydrant locations, fire service rooms, faciliti reatment tanks, site considerations, approach roads, plant railway lines, security a dustries, engineering industry, construction sites, pharmaceuticals, pesticides, fe ng, nuclear power stations, thermal power stations, metal powders manufactur	towe rtiliz	rs. Sa ers, r	ife lay	out ies,
UNIT I Safe lay disposa for pro- food pro- match v	II Payout, educated and to cocess incorocessin works -	PLANT LAYOUT quipment layout, safety system, fire hydrant locations, fire service rooms, faciliti reatment tanks, site considerations, approach roads, plant railway lines, security a dustries, engineering industry, construction sites, pharmaceuticals, pesticides, fe ng, nuclear power stations, thermal power stations, metal powders manufactur – Process Layout.	towe rtiliz	rs. Sa ers, r	ife lay	out ies,
UNIT I	II Payout, education and to cocess in works -	PLANT LAYOUT quipment layout, safety system, fire hydrant locations, fire service rooms, facilitis reatment tanks, site considerations, approach roads, plant railway lines, security adustries, engineering industry, construction sites, pharmaceuticals, pesticides, feing, nuclear power stations, thermal power stations, metal powders manufacture.  Process Layout.  WORKING CONDITIONS	tower ertiliz	rs. Sa ers, r firew	nfe lay refiner rorks	out ies, and
UNIT I	II Payout, education and transcription of grant and gra	PLANT LAYOUT quipment layout, safety system, fire hydrant locations, fire service rooms, facilitis reatment tanks, site considerations, approach roads, plant railway lines, security to dustries, engineering industry, construction sites, pharmaceuticals, pesticides, feng, nuclear power stations, thermal power stations, metal powders manufacture.  Process Layout.  WORKING CONDITIONS good ventilation, purpose, physiological and comfort level types, local and exhause.	ertilizering,	rs. Sa ers, r firew	afe lay efiner orks	ent out ies, and
UNIT I Safe lay disposa for pro- food pri match v UNIT I Princip and due	II Payout, education and to cocess induction works - III Viples of guict design	PLANT LAYOUT quipment layout, safety system, fire hydrant locations, fire service rooms, facilitist reatment tanks, site considerations, approach roads, plant railway lines, security adustries, engineering industry, construction sites, pharmaceuticals, pesticides, feing, nuclear power stations, thermal power stations, metal powders manufacture.  Process Layout.  WORKING CONDITIONS good ventilation, purpose, physiological and comfort level types, local and exhaust, air conditioning, ventilation standards, application. Purpose of lighting, types, and air conditioning, ventilation standards, application.	ertilizing, st ver	rs. Sa ers, r firew ntilat	efiner vorks ion, h	ent out ies, and 9
UNIT I Safe lay disposar for pro- food promatch with the UNIT I Princip and due illumin	II Payout, education and the cocess incorrecessing works— III Viples of good act designation, g	PLANT LAYOUT quipment layout, safety system, fire hydrant locations, fire service rooms, facilitis reatment tanks, site considerations, approach roads, plant railway lines, security to dustries, engineering industry, construction sites, pharmaceuticals, pesticides, feng, nuclear power stations, thermal power stations, metal powders manufacture.  Process Layout.  WORKING CONDITIONS good ventilation, purpose, physiological and comfort level types, local and exhause.	ertilizing, st ver	rs. Sa ers, r firew ntilat	efiner vorks ion, h	ent out ies, and 9
UNIT I Safe lay disposar for pro- food promatch with the UNIT I Princip and due illumin	ayout, education and the cocess incorrects in works - III Vipples of guest designation, gent Environment	PLANT LAYOUT quipment layout, safety system, fire hydrant locations, fire service rooms, facilities reatment tanks, site considerations, approach roads, plant railway lines, security adustries, engineering industry, construction sites, pharmaceuticals, pesticides, feing, nuclear power stations, thermal power stations, metal powders manufacture.  Process Layout.  WORKING CONDITIONS  good ventilation, purpose, physiological and comfort level types, local and exhausin, air conditioning, ventilation standards, application. Purpose of lighting, types, glare and its effect, lighting requirements for various work, standards- Housekeepi	ertilizing, st ver	rs. Sa ers, r firew ntilat	efiner vorks ion, h	ent out ies, and 9
UNIT I Safe lay disposar for pro- food promatch with the control of the control o	ayout, education and transcription of grantion, grant Environ IV	PLANT LAYOUT  quipment layout, safety system, fire hydrant locations, fire service rooms, facilities reatment tanks, site considerations, approach roads, plant railway lines, security and dustries, engineering industry, construction sites, pharmaceuticals, pesticides, feing, nuclear power stations, thermal power stations, metal powders manufacture. Process Layout.  WORKING CONDITIONS  good ventilation, purpose, physiological and comfort level types, local and exhaust, air conditioning, ventilation standards, application. Purpose of lighting, types, aglare and its effect, lighting requirements for various work, standards- Housekeepi conmental Monitoring Systems for Ventilation and Lighting.	st veradvar	rs. Sa ers, r firew ntilat ntage	orks  ion, h s of g	ent rout ies, and 9 ood ood f 5S
UNIT I Safe lay disposar for pro- food pro- match with the UNIT I Princip and due illumin - Smart UNIT Prevent	ayout, education and the cocess incocessing works— III V ples of grantion, grant Environting continuity of the continuit	PLANT LAYOUT  quipment layout, safety system, fire hydrant locations, fire service rooms, facilitist reatment tanks, site considerations, approach roads, plant railway lines, security adustries, engineering industry, construction sites, pharmaceuticals, pesticides, feing, nuclear power stations, thermal power stations, metal powders manufacture. Process Layout.  WORKING CONDITIONS  good ventilation, purpose, physiological and comfort level types, local and exhausen, air conditioning, ventilation standards, application. Purpose of lighting, types, glare and its effect, lighting requirements for various work, standards. Housekeepi commental Monitoring Systems for Ventilation and Lighting.  MANUAL MATERIAL HANDLING AND LIFTING TACKLES	st veradvaring, p	rs. Sa ers, r firew ntilat ntage rincip	efiner vorks ion, h s of g oles o	9 9 000d 000d f 5S
UNIT I Safe lay disposar for pro- food pro- match with the UNIT I Princip and due illumin - Smart UNIT Prevent heavy of	ayout, education and the corocessing works— III V ples of good act designation, good act the corocessing works— IV Noting corocessing works— III v v v v v v v v v v v v v v v v v v	quipment layout, safety system, fire hydrant locations, fire service rooms, facilitis reatment tanks, site considerations, approach roads, plant railway lines, security adustries, engineering industry, construction sites, pharmaceuticals, pesticides, feing, nuclear power stations, thermal power stations, metal powders manufacture. Process Layout.  WORKING CONDITIONS  good ventilation, purpose, physiological and comfort level types, local and exhaustry, air conditioning, ventilation standards, application. Purpose of lighting, types, glare and its effect, lighting requirements for various work, standards- Housekeepi commental Monitoring Systems for Ventilation and Lighting.  MANUAL MATERIAL HANDLING AND LIFTING TACKLES  mmon injuries, lifting by hand, team lifting and carrying, handling specific shape	st veradvaring, p	rs. Sa ers, r firew ntilat ntage rincip	orks  ion, h s of g ples o  and o	9 ood ood f5S
UNIT I Safe lay disposar for pro- food pro- match with the UNIT I Princip and due illumin - Smart UNIT Prevent heavy of specific pro- specific pro- specific pro- for specific pro- spec	ayout, education and the corocessing works— III V ples of good act designation, good act designation, good act corocessing the corocessing works— IV N the corocessing the cor	quipment layout, safety system, fire hydrant locations, fire service rooms, facilitic reatment tanks, site considerations, approach roads, plant railway lines, security to dustries, engineering industry, construction sites, pharmaceuticals, pesticides, feing, nuclear power stations, thermal power stations, metal powders manufacture. Process Layout.  WORKING CONDITIONS  good ventilation, purpose, physiological and comfort level types, local and exhauten, air conditioning, ventilation standards, application. Purpose of lighting, types, glare and its effect, lighting requirements for various work, standards. Housekeepi commental Monitoring Systems for Ventilation and Lighting.  MANUAL MATERIAL HANDLING AND LIFTING TACKLES  mmon injuries, lifting by hand, team lifting and carrying, handling specific shape.  — accessories for manual handling, hand tools, jacks, hand trucks, dollies and when	st veradvaring, properties of crystal structures of crystal struct	ntilat ntage nines rows	ion, h s of g and o storic liq	9 9 000d 000d f5S 9 ther age

### UNIT V MECHANICAL MATERIAL HANDLING

9

Hoisting apparatus, types - cranes, types, design and construction, guards and limit devices, signals, operating rules, maintenance safety rules, inspection and inspection checklist — conveyors, precautions, types, applications - Autonomous Material Handling Systems (AMHS) and Smart Conveyors.

		TOTAL PERIODS:45
	RSE OUTCOMES	BT MAPPED (Highest level)
At the	end of the course, the students will be able to	(Highest level)
CO1	the students will be able to Identify equipment requirements for a specific process and for various locations and working conditions.	Applying (K3)
CO2	the students will be able to Design an efficient material handling system	Understanding (K2)
СОЗ	understand the difficulties during the design and implementation of the plant layout	Analysing (K4)
CO4	know about material handling requirements and methods	Understanding (K2)
CO5	understand the inspection and maintenance techniques.	Analysing (K4)

#### TEXT BOOKS

- 1. "Accident prevention manual for industrial operations" N.S.C., Chicago, 2019.
- 2. Alexandrov. M.P. "Material handling equipment" Mir Publishers, Moscow, 2010.

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- 1. APPLE M. JAMES "Plant layout and material handling", 3rd edition, John Wiley and sons, 2015.
- 2. "Encyclopedia of occupational safety and health", ILO Publication, 2011.
- 3. Facility layout & location an analytical approach /RL FRANCIS /LF Mc Linnis Jr ,White /PHI, 2011.
- 4. Production and operations management / R Panneerselvam /PHI, 2015.

#### CO - PO MAPPING

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

COs					Progr	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	2	-	-	-	-	-	-		2	3	3
CO2	3	1	3	1	-	2	-	1	- /	-	-	2	3	3
CO3	3	1	3	- 18	-	-	13 -	-	-	-	7-1	2	3	3
CO4	3	1	3	0.5	-	-	2	-	-	1-3	11-0	2	3	3
CO5	3	1	3	2	2	-01/02/01/25/03	and a management	-	-	-		2	3	3

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BOARD OF STUDIES
Mechanical Engineering

AUTONOMOUS

ME	23356	SUPPLY CHAIN MANAGEMENT	3	0	0	3
CO	URSE (	OBJECTIVES				
To	enable t	the students to	H. Deviller	THE.	Or THE	
1	unders	tand the fundamentals and strategic importance of supply chain and logistics m	anageme	nt.		
2	analyz	e the design and structure of supply chain networks and their impact on busines	ss perform	ance		
3	evaluar	te logistics components including transportation, distribution, and inventory in	the contex	t of t	he su	pply
4	examir	ne sourcing decisions, supplier relationships, and the importance of coordination	across th	e sup	ply ch	ain.
5	explore	e the role of information technology and emerging trends in enhancing supply	chain effic	cienc	у.	
UN	IT I	INTRODUCTION				9
-	Market Comment	gistics and Supply chain Management: Scope and Importance- Evolution of S	Supply Ch	ain -	Deci	
-	IT II	SUPPLY CHAIN NETWORK DESIGN				9
Rol	e of Di	stribution in Supply Chain - Factors influencing Distribution network design	gn – Desi	on o	ntions	for
Die	tribution	n Naturally Distribution Naturally in Practice Pole of naturally Design in Supply	Chain			
net	work De	n Network Distribution Network in Practice-Role of network Design in Supply ecisions.	/ Chain –			
net	work De	LOGISTICS IN SUPPLY CHAIN	A PERSONAL PROPERTY OF THE PERSONAL PROPERTY O	Fram	eworl	k for
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CO3	analyze the performance drivers and coordination issues in supply chain networks.	Analysing (K4)
CO4	interpret the significance of sourcing strategies and supplier collaboration.	Understanding (K2)
CO5	assess the impact of information technology in supply chain operations.	Analysing (K4)

- Sunil Chopra, Peter Meindl and Kalra, "Supply Chain Management, Strategy, Planning, and Operation", Pearson Education, 2010.
- Simchi-Levi, Kaminsky, and Simchi-Levi, Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies, McGraw-Hill Education, 2007.

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- 2. Srinivasan G.S, "Quantitative models in Operations and Supply Chain Management, PHI, 2010
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- 4. James B.Ayers, "Handbook of Supply Chain Management", St.Lucle press, 2000.

### CO - PO MAPPING

COs					Progra	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	1	1	1	-	2	-	2	2	-	1
CO2	1	1	-	1	2	1	1	-	2	-	2	2	1	-
CO3	1	1	-	1	2	-	1	-	2	-	2	1	1	-
CO4	1	1 ·	-	1	. 2	1	1	-	2	-	2	2	-	2
CO5	1	1	1	1	2	1	1	-	2	- E	2	2		2



ME2	23357	ENTERPRISE RESOURCE PLANNING	3	0	0	3
COL	JRSE O	BJECTIVES				
To e	nable th	e students to				
1	understa	and the risks and benefits of implementing ERP in an organization.				
2	appraise	the worth of ERP software solutions and the various ERP modules.	/Eggs.	- 1/4		
3	interpre	t the implementation of ERP methodology.	Show	9 9		
4	acquain	t with the intricacies in ERP implementation and management.				
5	assess tl	ne latest development in the area of enterprise resource planning.	o long long			
UNI	TI	INTRODUCTION				9
Intro	duction	, Evolution of ERP, need for ERP, ERP Implementation methodology, Bene	efits of an	ERI	Svet	em
		FERP software solutions -ERP Modules -Finance -Manufacturing (Productionance -Materials Management -Quality Management -Sales and Distribution		an R	esoui	ce -
Plan	t iviainte	nance - Materials Management - Quality Management - Sales and Distribution.				
			•			
Plan		ERP IMPLEMENTATION aluation and selection of ERP systems -Implementation life cycle -ERP imple	mentation			
Plan and Emp	Frame voloyee.	ERP IMPLEMENTATION aluation and selection of ERP systems -Implementation life cycle -ERP imple work-Training -Data Migration. People Organization in implementation - C	mentation			logy
Plan and Emp	Frame voloyee.	ERP IMPLEMENTATION  aluation and selection of ERP systems -Implementation life cycle -ERP imple work-Training -Data Migration. People Organization in implementation - C  POST IMPLEMENTATION	mentation	s, Vei	ndors	logy and
Plan and Emp UNI Main	Frame voloyee. T IV	ERP IMPLEMENTATION  aluation and selection of ERP systems -Implementation life cycle -ERP imple work-Training -Data Migration. People Organization in implementation - C  POST IMPLEMENTATION  e of ERP-Organizational and Industrial impact- Success and Failure factors	mentation	s, Vei	ndors	logy and
Plan and Emp UNI Main	Frame voloyee.  T IV ntenance	ERP IMPLEMENTATION  aluation and selection of ERP systems -Implementation life cycle -ERP imple work-Training -Data Migration. People Organization in implementation - C  POST IMPLEMENTATION  of ERP-Organizational and Industrial impact- Success and Failure factors  - Service Recovery Model- Computer Application in Industry.	mentation	s, Vei	ndors	and 9 tion.
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Plan and Emp UNI Main Main Exte Wire sche	Frame volovee.  TIV Intenance intena	aluation and selection of ERP systems -Implementation life cycle -ERP imple work-Training -Data Migration. People Organization in implementation - Corporation - Corporati	of ERP in ER systems al and Stanks.	nplen s -wel te Go	nenta o enal	9 olled,
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Plan and Emp UNI Main Main Exte Wire sche	Frame voloyee.  T IV Intenance intenance of T V Inded ER eless techniques -NO Intenance intenanc	ERP IMPLEMENTATION aluation and selection of ERP systems -Implementation life cycle -ERP imple work-Training -Data Migration. People Organization in implementation - C  POST IMPLEMENTATION of ERP-Organizational and Industrial impact- Success and Failure factors - Service Recovery Model- Computer Application in Industry.  EMERGING TREND ON ERP RP systems and ERP add-ons -CRM, SCM, Business analytic Future trends in Echnologies, cloud computing. Emerging Trends in Startup Funding -Central GO funding -Crowd funding -Angel investors -Hedge funds -Commercial band  OUTCOMES  f the course, the students will be able to  polate the issues in planning and implementation of cross functional	of ERP in ER systems al and Stanks.  TOTAL  BT MAI (Highest	nplen s -wel te Go PER level	nenta p enal po enal po enal	9 solled, ment

CO4	ensure the successful implementation of ERP software's, into the business process system.	Analyzing (K4)
CO5	interfer the awareness of recent developments in ERP.	Analyzing (K4)

- 1. Sinha P. Magal and Jeffery Word, Essentials of Business Process and Information System, Wiley India, 2013.
- 2. Jagan Nathan Vaman, ERP in Practice, Tata McGraw-Hill, 2014.

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- 2. Mahadeo Jaiswal and Ganesh Vanapalli, ERP Macmillan India, 2010.
- 3. Vinod Kumar Grag and N.K. Venkitakrishnan, ERP-Concepts and Practice, Prentice Hall of India, 2016.
- 4. Enterprise Resource Planning, Veena Bansal, 2013 Pearson India.

## CO - PO MAPPING

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

COs					Progra	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO
CO1	1	1	2	1	1	-	-	-	1	-	3	1	1	2
CO2	1	1	2	1	-1	-	-	-	1	-	3	1	1	2
CO3	1	1	2	1	1	-	-	-	1	-	3	1	1	2
CO4	1	1	2	1	1	-	-	-	1	- 1	3	1	1	2
CO5	1	1	2	1.	1	-	-	-	1		3	1	1	2

Approved
BOARD OF STUDIES
Mechanical Engineering

\*\*AUTONOMOUS\*\*

	23451	POWER PLANT ENGINEERING	3	0	0	3
CO	URSE OB	BJECTIVES				
То	enable the	students to		-	200	
1	acquire k	nowledge about steam power plant and its components				
2	get expos	ed to the working principle of nuclear power plant and its elements				
3	understan	d the operation of diesel and gas turbine power plants	W 175			
4	attain kno	owledge about different renewable energy power sources	THE LOT P		-	
5	learn the	concept of power plant economics	1.446	T	П	
UN	TI (	COAL BASED THERMAL POWER PLANTS	al Sentetral		00	9
Flu Equ	dised Bed ipment fo	vpes of Steam Power Plants – Rankine cycle - Boilers -High pressure and Combustion Boiler (FBC) - Mechanical stokers – Pulverizers - Fuel handling r burning coal — Electrostatic precipitator - Ash handling systems – Dra- es, Cooling tower.	ng system	- co	mbus	tior
		NUCLEAR POWER PLANT				9
Nuc		y - Fission, Fusion reaction - Layout of nuclear power plants - Types of rea	ctors, pre	ssuri	zed w	
reac	tor - Boili	ng water reactor - Gas cooled reactor - Fast breeder reactor - Waste disposal	and safet	y.		
UN	тші	DIESEL AND GAS TURBINE POWER PLANT				9
Lay	out and typ	pes of Diesel power plants and components, selection of engine type, applicati	ions. Gas	Turb	ine po	
plai	it – Layou	pes of Diesel power plants and components, selection of engine type, application to Fuels, gas turbine material, types of combustion chambers - reheating, formance calculations.				wei
plan coo	it – Layou ling - Perfe	t - Fuels, gas turbine material, types of combustion chambers - reheating, ormance calculations.  POWER FROM RENEWABLE ENERGY	regenera	tion a	and in	we
plan coo UN Hyo sola	it — Layou ling - Perfo IT IV I lro-electric r thermal	ormance calculations.  POWER FROM RENEWABLE ENERGY  c power plant – components, stand alone and pumped storage, working of so power plants and components, Wind power plant – components, construction	regenera	volta	and in	wei iter-
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UN Hyd sola pov UN Pov and disp	ling - Perfective results thermal ver system  IT V I I Ver tariff to demerits, posal option	ormance calculations.  POWER FROM RENEWABLE ENERGY  power plant – components, stand alone and pumped storage, working of so power plants and components, Wind power plant – components, construction – Magneto Hydro Dynamic (MHD), Geothermal, Fuel cell, Tidal and Bio gas ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS types, Load distribution parameters, load curve, Comparison of site selection capital and operating cost of different power plants. Pollution control techning for coal and nuclear power plants. Application of Artificial Intelligence in Ing., energy demand prediction and emission monitoring	olar photo on and we as power on criteria, nologies in	volta orkin plant relati nclud	ic (P' g of w	99 99 99 erits
UN Hyd sola pov UN Pov and disp	ling - Performance respectively and the second respectively. It is a secon	ormance calculations.  POWER FROM RENEWABLE ENERGY  power plant – components, stand alone and pumped storage, working of so power plants and components, Wind power plant – components, construction – Magneto Hydro Dynamic (MHD), Geothermal, Fuel cell, Tidal and Bio gas ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS types, Load distribution parameters, load curve, Comparison of site selections capital and operating cost of different power plants. Pollution control technical in the property of the power plants and prediction and emission monitoring.	plar photo on and we as power	volta orkin plant relati nclud	ic (P' g of w	y) - yinc
UN Hyd sola pov UN Pov and disp	ling - Performance respectively and the second respectively. It is a secon	ormance calculations.  POWER FROM RENEWABLE ENERGY  power plant – components, stand alone and pumped storage, working of so power plants and components, Wind power plant – components, construction – Magneto Hydro Dynamic (MHD), Geothermal, Fuel cell, Tidal and Bio gas ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS types, Load distribution parameters, load curve, Comparison of site selection capital and operating cost of different power plants. Pollution control technology, energy demand prediction and emission monitoring	olar photo on and we as power on criteria, nologies in	volta orkin plant relati nclud nts —	ic (P' g of w	(V)- vince
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CO2	discuss the construction, types, working, and safety aspects of nuclear power plants and reactors.	Understanding (K2)
CO3	apply the working principles of diesel and gas turbine power plants to analyze their components, cycles, and performance.	Applying (K3)
CO4	explain the basic working principles, components, and operation of various renewable energy sources such as hydro, solar, wind, MHD, tidal, geothermal, fuel cells, and biogas.	Understanding (K2)
CO5	analyze the economic and environmental aspects of power generation, including tariff structures, cost analysis, site selection, and pollution control technologies.	Analyzing (K4)

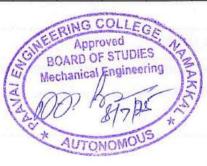
- 1. Arora S.C. and Domkundwar.S, "A Course in Power Plant Engineering", Dhanpat Rai, 2001
- 2. Nag P.K, "Power Plant Engineering", Fourth Edition, Tata-McGraw Hill, 2017.

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- 2. T.Morse Frederick, "Power Plant Engineering", Third Edition, Prentice Hall of India, 2002.
- 3. R.K.Rajput; "Power Plant Engineering", Fifth Edition, Laxmi Publications, 2016.
- 4. G.D.Rai, "Introduction to Power Plant Technology", Reprint, Khanna Publishers, 2010

## CO - PO MAPPING

COs		SWE			Progr	amme O	utcome	s(POs)					PS	SOs
-	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2	1	3	-	-	1	-	1	3	2
CO2	3	2	2	2	2	2	3	1	-	1	-	2	3	2
CO3	3	2	2	2	3	1	2	-		1	. 1	1	3	3
CO4	3	2	3	2	2	2	3	in gree	ille ta	1		2	3	2
CO5	3	3	2	2	2	2	3	1	2 2	2	3	3	3	3



	2 REFRIGERATION AND AIR CONDITIONING	3	0 0	3
COURS	E OBJECTIVES			
To enab	e the students to		7.8	
1	form basic calculations related to the performance of various refrigeration's cycles at the sesses.	nd air c	onditio	oning
2 kno	w about different types of compressors and condensers and expansion devices used in re	efrigera	ion sy	stem
3	y of the thermodynamic properties of moist air (a mixture of dry air and water vaporer varying environmental conditions.	or) and	its beh	avio
4	erstand the controlling the temperature, humidity, purity, and distribution of air to neific environmental requirements of a space.	neet the	comfo	ort o
5	yse the air conditioning load refers to the total amount of heat (sensible + latent) that and to maintain a desired indoor environment.	must be	remov	ed o
UNIT I	REFRIGERATION CYCLE	C'IKUI		9
system -	compression refrigeration cycle - use of P-H charts - multistage and multiple evaporate COP comparison. Ammonia - water systems, three fluid systems. Water - lithium			
Compari	son –Steam jet refrigeration.			
UNIT II	REFRIGERATION SYSTEM COMPONENTS AND REFRIGERANTS			9
UNIT II Compres and evap		s: Capill ndly ref	ary tul	9 poled pe,
UNIT II Compres and evap	REFRIGERATION SYSTEM COMPONENTS AND REFRIGERANTS sors: Types – based on operation and based on arrangement. Condensers: Types-air control orative condensers. Evaporators: Flooded and dry expansion types. Expansion devices ic expansion valve, Thermostatic expansion valve. Refrigerants: Properties, Eco - frience of Refrigerants. Ozone Depletion Potential (ODP) and Global Warming Potential (Grant of Refrigerants).	s: Capill ndly ref	ary tul	9 poled pe,
UNIT II Compress and evap Automat Selection UNIT II Review temperat	REFRIGERATION SYSTEM COMPONENTS AND REFRIGERANTS sors: Types – based on operation and based on arrangement. Condensers: Types-air control or condensers. Evaporators: Flooded and dry expansion types. Expansion devices in expansion valve, Thermostatic expansion valve. Refrigerants: Properties, Eco - frience of Refrigerants. Ozone Depletion Potential (ODP) and Global Warming Potential (Grant of Refrigerants).	s: Capill ndly ref WP). midity,	ary tubrigeran	9 poled pe, ats,  9 poin chart
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UNIT II Compress and evap Automat Selection UNIT II Review temperat temperat UNIT I Air condition Window	REFRIGERATION SYSTEM COMPONENTS AND REFRIGERANTS  sors: Types – based on operation and based on arrangement. Condensers: Types-air control or control of the condensers. Evaporators: Flooded and dry expansion types. Expansion devices it expansion valve, Thermostatic expansion valve. Refrigerants: Properties, Eco - friends of Refrigerants. Ozone Depletion Potential (ODP) and Global Warming Potential (GIT) PSYCHROMETRIC PROPERTIES AND PROCESSES  of fundamental properties of psychrometry, Properties of moist Air-Specific humans, Degree of saturation, Relative humidity, Enthalpy, Wet bulb temperature—Properties calculation—Psychometric processes, Bypass factor, Apparatus ture, mixing of air steams  VAIR CONDITIONING SYSTEMS  ditioning systems – definition, standards of temperature, humidity and air motion, ming systems – effective temperature - comfort conditions. Summer, winter and year-room, Split air conditioners, Central air conditioner systems. Air distribution system. Therefore, systems—applications.	s: Capillindly ref WP).  midity, sychron Dew P	Dew netric oint (annents condition	9 pooled pe, ats,  9 poin chart ADP of air

through building. Solar radiation - infiltration - internal heat sources (sensible and latent) - outside air and fresh air load - estimation of total load - Domestic, commercial and industrial systems.

		TOTAL PERIODS:45
COU	RSE OUTCOMES	BT MAPPED
At the	end of the course, the students will be able to	(Highest level)
CO1	explain the basic concepts of Refrigeration	Understanding (K2)
CO2	explain the Vapor compression Refrigeration systems and to solve problems	Understanding (K2)
CO3	calculate the Psychrometric properties and its use in psychrometric processes	Applying (K3)
CO4	explain the concepts of Air conditioning systems and properties	Understanding (K2)
CO5	explain the concepts of Air conditioning loads and to solve problems	Analysing (K4)

#### TEXT BOOKS

- 1. Manohar Prasad, "Refrigeration and Air Conditioning", New Age International Publishers, 2011.
- 2. Stoecker W F, Jones J W, "Refrigeration and Air Conditioning", McGraw-Hill India, 2014.

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- 2. Carter Stanfield, David Skaves, "Fundamentals of HVACR", Pearson, 2012.
- 3. Roy J Dossat, Thomas J Moran, "Principles of Refrigeration", Pearson, 2001.
- 4. Jones W P, "Air Conditioning Engineering", Butterworth-Heinemann, 2001.

## CO - PO MAPPING

COs					Progra	mme O	utcome	es(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	-	-	1	-	-	-		1	2	2
CO2	3	3	3	1		-	1		-		-	1	2	2
CO3	3	3	3	1	-	-	1	-		-		1	2	2
CO4	3	3	3	1	-	-	1	-	-	-		1	2	2
CO5	3	3	3	1		-	1	-	-	-	-	1	2	2



ME	23453	GAS DYNAMICS AND JET PROPULSION	3	0	0	3
CO	URSE O	BJECTIVES				
То	enable the	e students to				
1	understa	nd the basic difference between incompressible and compressible flow		- 4/1		
2	acquire l	knowledge on Rayleigh and Fanno flow	1-5	1.71	777	
3	know the	e concepts of phenomenon of shock waves and its effect on flow	17,00	JUL T		
4	gain bas	ic knowledge about Jet Propulsion	7.10			
5	learn bas	sic concepts about Rocket Propulsion	and this top	- 74		
UN	IT I	BASIC CONCEPTS AND ISENTROPIC FLOWS		12.7		9
Ene	rgy and n	nomentum equations of compressible fluid flows - Stagnation state - Critica	1 State -	Mach	numb	er –
Ref	erences V	elocities - Various Regions of F low - Mach Cone - Isentropic flow throug	h variabl	e area	Ducts	s: T-
		grams for Nozzle and Diffusers – Use of Gas tables.				
		FLOW THROUGH CONSTANT AREA DUCT				9
Flov	TOTAL CONTRACTOR	h constant area ducts: Flow in constant Area Ducts with Friction - Fanno	Curves a	and Fa	nno F	low
Fan	ation - v	ariation of flow properties - Rayleigh Line and Rayleigh Flow Equation-Flow	w in Con	stant A	rea D	ucts
-44	ation - v	ariation of now proporties – Rayleigh Line and Rayleigh Flow Equation-1 lov				
		1.1	Danier			
with	n Heat Tr	ansfer.	al more			
with	Heat Tr	NORMAL AND OBLIQUE SHOCKS	at acou		arame	9
with UN Way	Heat Tr IT III ve Motio	n - Steep, Non-steep Finite Pressure Waves - Governing equations - Varia	ation of f	low pa		9
with UN Way	Heat Tr IT III   ve Motio	NORMAL AND OBLIQUE SHOCKS  n - Steep, Non-steep Finite Pressure Waves - Governing equations - Variation and oblique shocks - Prandtl - Meyer relations - Use of table and characteristics.	ation of f	low pa		9 ters.
Way Acr	Heat Tr IT III ve Motio oss the no	NORMAL AND OBLIQUE SHOCKS  n - Steep, Non-steep Finite Pressure Waves - Governing equations — Variation and oblique shocks — Prandtl — Meyer relations — Use of table and character propulsion	ntion of f	low pa	ns.	9 ters.
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CO3	apply different types of governing equations of Normal Shock and Oblique Shock and Prandtl- Meyer equation for flow studies	Applying (K3)
CO4	illustrate the concepts of jet propulsion and different types of Jet engines application	Understanding (K2)
CO5	demonstrate knowledge on fundamentals of space propulsion and Indian space systems	Understanding (K2)

- 1. Yahya, S.M. "Fundamentals of Compressible Flow", New Age International (P) Limited, New Delhi, 2016.
- 2. Anderson, J.D., "Modern Compressible flow", McGraw Hill, 3rd Edition, 2013

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- 2. Zucrow. N.J, "Aircraft and Missile Propulsion", vol. Iand II, John Wiley, 2005.
- 3. Balachandran. P, "Fundamentals of Compressible Fluid Dynamics", PHI Learning, New Delhi, 2012
- 4. Sutton G.P, "Rocket Propulsion Elements", John Wiley, New York, 2013

### CO - PO MAPPING

COs					Progra	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	1	. 2	1		-	-	3	-	3	-	3
CO2	3	3	-	1	2	140	-	_	-	1	-	-	1	3
CO3	3	3	and a second	1	2	41.	-	-	-	1	Nie - Pil	EC.	1	3
CO4	3	2	2	-	odjimu	1	109 -	1	112111	1	at Lim	3	1	2
CO5	3	2	2		-	1	-		-	3	- 8	3	-	2



ME	23454	COMPUTATIONAL FLUID DYNAMICS	3	0	0	3
CO	URSE OB	BJECTIVES				
To	enable the	students to		12-7		
1	realize th	e fundamental principles of conservation of mass, momentum, and energy	y in fluid	flow	and 1	neat
2	comprehe	end the basic principles of numerical discretization methods used in fluid flo	w analysi	s.	4-	
3	study the	steady and unsteady state diffusion type problems using finite volume method	od.			
4	impart on	ne dimensional and two dimensional elements in finite element techniques for	or fluid flo	w pr	oblem	s.
5	optimize	CFD models for real-world engineering applications, integrating design con-	straints.			
UN	IT I	GOVERNING EQUATIONS OF FLUID FLOW AND HEAT TRANSFI	ER	-		9
		governing equations of fluid flow: conservation of mass, momentum and ener	2012/2012	nshi	betw	9000
UN	The State of the S	DISCRETIZATION SCHEMES AND METHODS OF FLUID FLOW A				9
Cho	oice of grid	I, finite difference method, finite volume method, forward, backward and cer	ntral diffe	rence	scher	nes,
exp	licit and in	nplicit methods, properties of numerical solution methods, stability analysis,	, error esti	matic	on.	
UN Bas	IT III   F	riplicit methods, properties of numerical solution methods, stability analysis, FINITE VOLUME METHOD  or FV Discretization. Finite Volume (FV) Discretization of one and two or e problems - 1-D convection-diffusion type problem - Unsteady flows – imp	dimension	al ste	ady s	
UN Bas diff	IT III   I sic rules for fusion type additions in	FINITE VOLUME METHOD or FV Discretization. Finite Volume (FV) Discretization of one and two of	dimension dementati	al sto	eady s	tate
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CO3	relate finite volume equations for steady and unsteady state diffusion type problems.	Applying (K3)		
CO4	apply the finite element methods for fluid flow problems.	Understanding (K2)		
CO5	explain the concepts, advantages and limitations of various turbulence models and combustion models.	Analysing (K4)		

- John D Anderson , "Computational Fluid dynamics The Basics with Applications", TATA McGraw Hill, 2016.
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- 4. Subas and V.Patankar "Numerical heat transfer fluid flow", Hemisphere Publishing Corporation, 2012.

#### CO - PO MAPPING

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2		2	-		-	-	-	-	2	-	-	-	- 1
CO2	2	-	1	120	- 4	-	-	-	-	2	-	-	-	-
CO3	2	1	-		2	-	-	-	-	2	1	-	-	-
CO4	2	2	-		-	-	-	1	ż	1		1	1	-
CO5	2	2	- 5	-	2	-	-	1	2	1	-	1	1	-



	TURBO MACHINES 3							
COUI	RSE O	BJECTIVES	6					
To en	able the	e students to	Medic Broke WA	Mare St	PHEN			
1 st	tudy en	ergy transfer mechanisms in rotor and stator parts of turbo machines.	the best de	15.11.5				
2 u	ndersta	nd the roles of different components in centrifugal fans and blowers			H		F5	
3 d	escribe	the function and construction of centrifugal fans and blowers	N V				F	
4 ai	nalyzin	g flow behavior and flow losses in axial flow compressor						
5 e	xamine	various types and the operational behavior of axial and radial flow turbin	ies	mer			Ħ	
UNIT	I	TURBOMACHINERY PRINCIPLES		0.00			9	
Veloc		n of Turbomachines. Energy transfer between fluid and rotor - Euler equalities. Efficiencies in Compressor and Turbine stages. Degree of reaction chines.						
UNIT	п	CENTRIFUGAL FANS AND BLOWERS					9	
CONTRACT OF STREET	am. Stag and no	ge parameters in fans and blowers. Performance characteristic curves – va vise.	rious loss	es. F	an –	bear	ings,	
UNIT	m	CENTRIFUGAL COMPRESSOR					9	
		s - blade types. Velocity triangles - h-s diagram, stage work. Slip fact e characteristics and various losses. Geometry and performance calculati		750				
Perfo	ormanc Flow D	e characteristics and various losses. Geometry and performance calculati eflection.		750		stim	ation	
Perfo and l	Flow D	e characteristics and various losses. Geometry and performance calculati	on. Blade	Ang	gle E	stim	ation 9	
Perfo	Flow D  TIV   ruction	e characteristics and various losses. Geometry and performance calculative flection.  AXIAL FLOW COMPRESSOR  details. Work done factor. Velocity triangles - h-s diagram, stage characteristics, efficiency and stage losses – Stalling and Surging. Free ar	on. Blade	Ang Vork	gle E	stim	9 actor.	
Perfo	Flow D Flow D ruction rmance ing and	e characteristics and various losses. Geometry and performance calculative flection.  AXIAL FLOW COMPRESSOR  details. Work done factor. Velocity triangles - h-s diagram, stage	on. Blade	Ang Vork	gle E	ne fa	9 actor.	
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Performand I UNIT Const Performand Loadi UNIT Axial stages	Flow D Flow D Fruction Fructio	e characteristics and various losses. Geometry and performance calculative flection.  AXIAL FLOW COMPRESSOR  details. Work done factor. Velocity triangles - h-s diagram, stage characteristics, efficiency and stage losses – Stalling and Surging. Free ar Diffusion Factor.  AXIAL AND RADIAL FLOW TURBINES  arbines - Types – Elements - Stage velocity diagrams - h-s diagram, stage pounding of turbines. Performance coefficients and losses. Radial flow to	work. Work - in urbines: T	Vork vorte	dor dor e an	ne fa	9 actor. Blade 9 ction	
Performent of the performance of	Flow D Flow D Truction Tructio	e characteristics and various losses. Geometry and performance calculative effection.  AXIAL FLOW COMPRESSOR  details. Work done factor. Velocity triangles - h-s diagram, stage characteristics, efficiency and stage losses – Stalling and Surging. Free ar Diffusion Factor.  AXIAL AND RADIAL FLOW TURBINES  arbines - Types – Elements - Stage velocity diagrams - h-s diagram, stage bounding of turbines. Performance coefficients and losses. Radial flow try diagrams - h-s diagram, stage work Performance coefficients and losses.	work - in urbines: Tot.  BT M	Vork vorte	dor dor e an e an PER	ne fa	9 actor. Blade 9 ction	
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Performand I UNIT Const Performand Loadi UNIT Axial stages Stage COU At the	Flow D  Flow D  TW  Truction  rmance  Ing and  Flow tu  S. Comp  velocit  RSE O  e end of	e characteristics and various losses. Geometry and performance calculative effection.  AXIAL FLOW COMPRESSOR  details. Work done factor. Velocity triangles - h-s diagram, stage characteristics, efficiency and stage losses – Stalling and Surging. Free ar Diffusion Factor.  AXIAL AND RADIAL FLOW TURBINES  arbines - Types – Elements - Stage velocity diagrams - h-s diagram, stage bounding of turbines. Performance coefficients and losses. Radial flow try diagrams - h-s diagram, stage work Performance coefficients and losses.  OUTCOMES  f the course, the students will be able to	work. Work - in urbines: Tot.  BT M (High	Ang Vork vorte  ppuls ypes  AL I  IAP rstan	dor dor ex flor e an s – E	me fa	9 actor. Blade 9 ction ents -	
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CO5	discuss the types and working of axial and radial flow turbines	Understanding (K2)

- 1. Ganesan, V., "Gas Turbines", 3rd Edition, Tata McGraw Hill, 2011.
- Gopalakrishnan. G and Prithvi Raj. D," A Treatise on Turbomachines", Scitech Publications (India) Pvt. Ltd., 2<sup>nd</sup> Edition, 2008

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### CO - PO MAPPING

COs	Programme Outcomes(POs)											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	1-2	-	-		-		1.2	1	2	2
CO2	3	3	2	2			-	-	-			1	2	2
CO3	3	3	2	2	5 se es	-	-	- (1	-	111-11	( e)	1	2	2
CO4	3	3	2	2	-	-	-	-	-	-	M. Ami	I	.2	2
CO5	3	2	3	2	-	50	11.5	-	-	- 1	-	1	2	2



MIE	23456	DESIGN OF HEAT EXCHANGERS	3	0	0	3
CO	URSE (	OBJECTIVES	**		43	
То	enable t	the students to	e ligações de altinos de la		alery.	
1	know t	the types of heat exchangers and the classification features	Vys. fiz	1 14	151	
2	learn d	lesign consideration principles of heat exchangers.	Taratar.			
3	acquire	e knowledge in double pipe and contact heat exchangers under various arrange	ments.		771	
4	explore	e design techniques in shell and tube heat exchangers.	22 ha		7	
5	gain ar	n understanding on the heat transfer in condensers and evaporators.	St. America			
UN	IT I	INTRODUCTION TO HEAT EXCHANGERS	160	du:	7	9
con	struction	angers—Classification according to transfer process, number of fluids, su in features. Tubular heat exchanger, plate type heat exchangers, extended surfa inerators.				
UN	II II	DESIGN METHODS OF HEAT EXCHANGERS	11. 21.			9
	llysis	ingers, fouling factors, pressure drop calculations, Effectiveness-NTU Meth				9
		T	observations.	_		195-50
UN Film		DOUBLE PIPE AND COMPACT HEAT EXCHANGERS icient for fluids in annulus, fouling factors, calorific temperature, Average fluid toppe exchanger, double pipe exchangers in series parallel arrangements. Tempe	100	. 63		
UN Film of d	n coeffi louble p at Balan	cient for fluids in annulus, fouling factors, calorific temperature, Average fluid pipe exchanger, double pipe exchangers in series parallel arrangements. Temperature in Multi-Pass Exchangers	100	- 63		ion
UN Film of d Hea	n coeffi louble p at Balan IT IV	cient for fluids in annulus, fouling factors, calorific temperature, Average fluid pipe exchanger, double pipe exchangers in series parallel arrangements. Tempe	erature Effe	ective	ness a	ion and
UN Film of d Hea UN She of S	n coefficient Balan  IT IV  Il and T  Shell and	cient for fluids in annulus, fouling factors, calorific temperature, Average fluid pipe exchanger, double pipe exchangers in series parallel arrangements. Temperature in Multi-Pass Exchangers  SHELL AND TUBE HEAT EXCHANGERS	erature Effe	drauli	c des	ion and 9
UN Film of d Hea UN She of S and	n coefficient Balan  IT IV  Il and T  Shell and	cient for fluids in annulus, fouling factors, calorific temperature, Average fluid pipe exchanger, double pipe exchangers in series parallel arrangements. Temperature in Multi-Pass Exchangers  SHELL AND TUBE HEAT EXCHANGERS  Tube heat exchangers – Tinker's, kern's, and Bell Delaware's methods, for there de Tube heat exchangers, Flow-Induced Vibration and Mechanical Design Cons	erature Effe	drauli	c des	ion and 9
UN Film of d Hea UN She of S and UN Typ	n coefficient Balan  IT IV  Ill and T  Shell and its Imp  IT V  Des of aporator	cient for fluids in annulus, fouling factors, calorific temperature, Average fluid pipe exchanger, double pipe exchangers in series parallel arrangements. Temperature in Multi-Pass Exchangers  SHELL AND TUBE HEAT EXCHANGERS  Tube heat exchangers — Tinker's, kern's, and Bell Delaware's methods, for there de Tube heat exchangers, Flow-Induced Vibration and Mechanical Design Construction Heat Transfer and Pressure Drop.	rmal and hysiderations.	drauli Baffle	c des	ion  9 ign ign of
UN Film of d Hea UN She of S and UN Typ	n coefficient Balan  IT IV  Ill and T  Shell and its Imp  IT V  Des of aporator	cient for fluids in annulus, fouling factors, calorific temperature, Average fluid pipe exchanger, double pipe exchangers in series parallel arrangements. Temperature in Multi-Pass Exchangers  SHELL AND TUBE HEAT EXCHANGERS  Tube heat exchangers — Tinker's, kern's, and Bell Delaware's methods, for there are the texchangers, Flow-Induced Vibration and Mechanical Design Construct on Heat Transfer and Pressure Drop.  CONDENSORS AND EVAPORATORS  Condensers-Air cooled condenser —Water-cooled condensers Evaporative rs-Heat transfer in Evaporators, Capacity and Efficiency Calculations for Condensers.	rmal and hysiderations.	drauli Baffle ers, T	c des	ion  9 ign ign of
UN Film of d Hea UN She of S and UN Typ Eva	In coefficient Balan  IT IV  Ill and T  Shell and its Imp  IT V  Des of aporator  erall He	cient for fluids in annulus, fouling factors, calorific temperature, Average fluid pipe exchanger, double pipe exchangers in series parallel arrangements. Temperature in Multi-Pass Exchangers  SHELL AND TUBE HEAT EXCHANGERS  Tube heat exchangers — Tinker's, kern's, and Bell Delaware's methods, for there are the texchangers, Flow-Induced Vibration and Mechanical Design Construct on Heat Transfer and Pressure Drop.  CONDENSORS AND EVAPORATORS  Condensers-Air cooled condenser —Water-cooled condensers Evaporative rs-Heat transfer in Evaporators, Capacity and Efficiency Calculations for Condensers.	rmal and hy siderations.	drauli Baffle ers, T	c des	ion  9 ign ign of
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UN Film of d Hea UN She of S and UN Typ Eva Ove	In coefficient Balan IT IV It and T Shell and its Imp IT V Does of apporator crall He URSE the end	cient for fluids in annulus, fouling factors, calorific temperature, Average fluid pipe exchanger, double pipe exchangers in series parallel arrangements. Temperature in Multi-Pass Exchangers  SHELL AND TUBE HEAT EXCHANGERS  Tube heat exchangers – Tinker's, kern's, and Bell Delaware's methods, for there are the transfer and Pressure Drop.  CONDENSORS AND EVAPORATORS  Condensers-Air cooled condenser –Water-cooled condensers Evaporative rs-Heat transfer in Evaporators, Capacity and Efficiency Calculations for Content Transfer Coefficient in Condensers and Evaporators  OUTCOMES	rmal and hysiderations. e condense densers and	drauli Baffle ers, T d Evap PERIC PED evel)	c des	ion  9 ign ign of
UN Film of d Hea UN She of S and UN Typ Eva Ove	its Important IT Votes of apportator erall He	cient for fluids in annulus, fouling factors, calorific temperature, Average fluid pipe exchanger, double pipe exchangers in series parallel arrangements. Tempo ace in Multi-Pass Exchangers  SHELL AND TUBE HEAT EXCHANGERS  Tube heat exchangers – Tinker's, kern's, and Bell Delaware's methods, for there are the transfer and Pressure Drop.  CONDENSORS AND EVAPORATORS  Condensers-Air cooled condenser –Water-cooled condensers Evaporative res-Heat transfer in Evaporators, Capacity and Efficiency Calculations for Content Transfer Coefficient in Condensers and Evaporators  OUTCOMES  of the course, the students will be able to	rmal and hysiderations.  e condense densers and TOTAL I	drauli Baffle ers, T d Evap PERIO PED evel)	c des	ion  9 ign ign of

CO4	explore various design methods applied to shell and tube heat exchangers.	Analysing (K4)
CO5		Understanding (K2)
	evaporators.	

- Ramesh K. Shah and Dusan P. Sekulic, "Fundamentals of Heat Exchanger Design" John Wiley & sons Inc., 2003.
- 2. A .P. Frass and M.N. Ozisik, "Heat Exchanger Design", McGraw Hill,

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# CO - PO MAPPING

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	1	-	- LA	7.12/1	-	112.11	W 2 13	1	2	2
CO2	3	3	3	2	1	11	-	31.		7-	-	1	2	2
CO3	3	3	3	2	1		und m	11-	-	7-1	o I sill a	1	2	2
CO4	3	3	3	2	1	-	-140		-	(2) PIG	1000	1	2	2
CO5	3	3	3	1	1	-	1(2)	102	-	-	V STV	1	2	2



ME	23457	ADVANCED INTERNAL COMBUSTION ENGINES	3	. 0	0	3
CO	URSE (	OBJECTIVES				
То	enable t	he students to	resterilles	Yell		
1	underst	tand the underlying principles of operation of Spark Ignition Engines and its co	omponents	3		
2	get edu	cated about the principles and operation of Compression Ignition Engines and	its compo	nent	3	
3	gain kr	nowledge on pollutant formation and control methods	2 4 Val			
4	acquire	knowledge on various alternate fuels available to replace non-renewable ener	gy			
5	update	knowledge on recent trends and developments in IC engines		0		
UN	IT I	SPARK IGNITION ENGINES	AT THE			9
Mix	xture req	uirements – Fuel injection systems – Mono point, Multipoint and Direct injection	on - Stages	ofco	mbu	stion
and	Spark T	riming Control	ambers, 1g	nitio	n Sys	
N. O. Chillian	IT II	COMPRESSION IGNITION ENGINES  Injection Systems - Stages of combustion - Knocking - Factors affecting kn	ook Die	ot or	d Inc	. 9
	(140/210210100 <b></b> )	stems - Combustion chambers - Fuel Spray behaviour - Spray structure an	1 2 1			
mo	tion.					9
mot	tion.	POLLUTANT FORMATION AND CONTROL				
UN Pol	IT III lutant –	POLLUTANT FORMATION AND CONTROL  Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides	of Nitrog	en, S	moke	and
UN Pol Par	IT III lutant – ticulate	POLLUTANT FORMATION AND CONTROL	of Nitrogo	en, S	moke	and
UN Pol Par Par	IT III lutant – ticulate	POLLUTANT FORMATION AND CONTROL  Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides matter – Methods of controlling Emissions – Catalytic converters, Selective	of Nitrogo	en, S	moke	and and
UN Pol Par Par	IT III lutant – ticulate ticulate	POLLUTANT FORMATION AND CONTROL  Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides matter – Methods of controlling Emissions – Catalytic converters, Selective Traps – Methods of measurement – BS6 Emission norms -and Driving cycles.	of Nitrog Catalytic	en, S Redu	moke	and and
UN Pol Par Par UN Alc	IT III lutant – ticulate ticulate IT IV cohol, H	POLLUTANT FORMATION AND CONTROL  Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides matter – Methods of controlling Emissions – Catalytic converters, Selective Traps – Methods of measurement – BS6 Emission norms -and Driving cycles.  ALTERNATIVE FUELS  ydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel Demerits - Engine Modifications, Performance and Emission Characterist	of Nitrogo Catalytic	en, S Redu	moke	and and
UN Pol Par Par UN Alc Me	IT III lutant – ticulate ticulate ticulate ticulate and trip ticulate and trip trip trip trip trip trip trip trip	POLLUTANT FORMATION AND CONTROL  Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides matter – Methods of controlling Emissions – Catalytic converters, Selective Traps – Methods of measurement – BS6 Emission norms -and Driving cycles.  ALTERNATIVE FUELS  ydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel Demerits - Engine Modifications, Performance and Emission Characterist Handling of Alternative Fuels.	of Nitrogo Catalytic	en, S Redu	moke	and and
UN Pol Par Par UN Alc Me Sto	IT III lutant – ticulate ticulate TIT IV cohol, Hi	POLLUTANT FORMATION AND CONTROL  Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides matter – Methods of controlling Emissions – Catalytic converters, Selective Traps – Methods of measurement – BS6 Emission norms -and Driving cycles.  ALTERNATIVE FUELS  ydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel Demerits - Engine Modifications, Performance and Emission Characterist Handling of Alternative Fuels.  RECENT TRENDS	of Nitrogo Catalytic - Propertics of Alt	en, S Redu ies, S	moke action Suitab	and and gollity,
UN Pol Par Par UN Alco Me Sto UN Air	lutant – ticulate ticulate ticulate ticulate ticulate and trits and	POLLUTANT FORMATION AND CONTROL  Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides matter – Methods of controlling Emissions – Catalytic converters, Selective Traps – Methods of measurement – BS6 Emission norms -and Driving cycles.  ALTERNATIVE FUELS  ydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel Demerits - Engine Modifications, Performance and Emission Characterist Handling of Alternative Fuels.  RECENT TRENDS  Combustion, Homogeneous charge compression ignition engines – Reactivity	of Nitrogordal Catalytic  - Properties of Altonomy Controlle	en, S Redu ies, S ternat	moke iction Suitablive F	e and gollity, Fuels, ssion
UN Pol Par Par UN Alc Me Sto UN Air Ign	lutant – ticulate tic	POLLUTANT FORMATION AND CONTROL  Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides matter – Methods of controlling Emissions – Catalytic converters, Selective Traps – Methods of measurement – BS6 Emission norms -and Driving cycles.  ALTERNATIVE FUELS  ydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel Demerits - Engine Modifications, Performance and Emission Characterist Handling of Alternative Fuels.  RECENT TRENDS  Combustion, Homogeneous charge compression ignition engines – Reactivity CCI) - Gasoline Compression Ignition - Variable Geometry turbocharger	of Nitrogo Catalytic - Properties of Alto Controlles - Comm	ies, Sternat	moke action Suitablive F	e and gollity, Fuels, ssion
UN Pol Par Par UN Alco Me Sto UN Air Ign	lutant – ticulate tic	POLLUTANT FORMATION AND CONTROL  Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides matter – Methods of controlling Emissions – Catalytic converters, Selective Traps – Methods of measurement – BS6 Emission norms -and Driving cycles.  ALTERNATIVE FUELS  ydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel Demerits - Engine Modifications, Performance and Emission Characterist Handling of Alternative Fuels.  RECENT TRENDS  Combustion, Homogeneous charge compression ignition engines – Reactivity CCI) - Gasoline Compression Ignition - Variable Geometry turbocharger systems - Hybrid Electric Vehicles – Solar Vehicles – Cruise Control –Turb	of Nitrogo Catalytic - Properties of Alto Controlles - Comm	ies, Sternat	moke action Suitablive F	good and good and good good good good good good good go
UN Pol Par Par UN Alco Me Sto UN Air Ign	lutant – ticulate tic	POLLUTANT FORMATION AND CONTROL  Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides matter – Methods of controlling Emissions – Catalytic converters, Selective Traps – Methods of measurement – BS6 Emission norms -and Driving cycles.  ALTERNATIVE FUELS  ydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel Demerits - Engine Modifications, Performance and Emission Characterist Handling of Alternative Fuels.  RECENT TRENDS  Combustion, Homogeneous charge compression ignition engines – Reactivity CCI) - Gasoline Compression Ignition - Variable Geometry turbocharger	of Nitrogo Catalytic  - Properties of Alto Controllers –Common	ies, Sternat	moke action Suitablive F	9 solility. 9 session
UN Pol Par Par UN Alco Me Sto UN Air Ign Inje Ad	lutant – ticulate tic	POLLUTANT FORMATION AND CONTROL  Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides matter – Methods of controlling Emissions – Catalytic converters, Selective Traps – Methods of measurement – BS6 Emission norms -and Driving cycles.  ALTERNATIVE FUELS  ydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel Demerits - Engine Modifications, Performance and Emission Characterist Handling of Alternative Fuels.  RECENT TRENDS  Combustion, Homogeneous charge compression ignition engines – Reactivity CCI) - Gasoline Compression Ignition - Variable Geometry turbocharger ystems - Hybrid Electric Vehicles – Solar Vehicles – Cruise Control –Turb Onboard Diagnostics.	of Nitrogo Catalytic - Properties of Alto Controlles - Comm	ies, Sternat	moke action Suitablive F	9 solility. 9 session
Modern Medical Store Light Address Add	IT III lutant – ticulate ticul	POLLUTANT FORMATION AND CONTROL  Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides matter – Methods of controlling Emissions – Catalytic converters, Selective Traps – Methods of measurement – BS6 Emission norms -and Driving cycles.  ALTERNATIVE FUELS  ydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel Demerits - Engine Modifications, Performance and Emission Characterist Handling of Alternative Fuels.  RECENT TRENDS  Combustion, Homogeneous charge compression ignition engines – Reactivity CCI) - Gasoline Compression Ignition - Variable Geometry turbocharger ystems - Hybrid Electric Vehicles – Solar Vehicles – Cruise Control –Turb - Onboard Diagnostics.	of Nitrogo Catalytic  - Propert ics of Alt Controlle S –Commocharged  TOTAL BT MAI	ies, Sternat	moke action Suitablive I mpre	gand goility, Guels, Sierce NOx
Modern Medical Store Light Address Add	IT III lutant – ticulate ticul	POLLUTANT FORMATION AND CONTROL  Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides matter – Methods of controlling Emissions – Catalytic converters, Selective Traps – Methods of measurement – BS6 Emission norms -and Driving cycles.  ALTERNATIVE FUELS  ydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel Demerits - Engine Modifications, Performance and Emission Characterist Handling of Alternative Fuels.  RECENT TRENDS  Combustion, Homogeneous charge compression ignition engines – Reactivity CCI) - Gasoline Compression Ignition - Variable Geometry turbocharger ystems - Hybrid Electric Vehicles – Solar Vehicles – Cruise Control –Turb Onboard Diagnostics.	of Nitrogo Catalytic  - Propert ics of Alt  Controlle S —Commontarged	ies, Sternat	moke action Suitablive I mpre	gand goility, Guels, Sierce NOx

CO2	discuss in detail the operations of Compression Ignition Engine and its components	Understanding (K2)
CO3	illustrate knowledge about pollutants developed from various fuel sources and apply controlling techniques	Applying (K3)
CO4	demonstrate knowledge on alternate fuels and engine design modifications required to use them	Understanding (K2)
CO5	keep trend with the latest developments in I.C engines like rail direct injection systems, On- board diagnostics and hybrid vehicles.	Analysing (K4)

- 1. Ganesan.V, "Internal Combustion Engines", IV Edition, McGraw-Hill, 2017
- 2. Ramalingam. K.K., "Internal Combustion Engine Fundamentals", III Edition, Scitech Publications, 2018

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- 2. Mathur. R.B. and R.P. Sharma, "Internal Combustion Engines"., Dhanpat Rai and Sons 2007
- 3. Ed May, "Automotive Mechanics", VIII Edition, Tata McGraw-Hill, 2016
- 4. John B. Heywood, "Internal Combustion Engine Fundamentals", I Edition, Mc Graw Hill, 2017

# CO - PO MAPPING

COs		Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2	
CO1	3	2	2	1	1	1	-	-	-	- 1	-	2	3	2	
CO2	3	2	2	1	1	1	1152115	-	-	-		2	3	2	
CO3	3	2	2	1	1	1	- 12.11	-				2	3	2	
CO4	3	2	2	1	1	- 1	-	164	7-0	-	+ 4	2	3	2	
CO5	3	2	2	1	1	1	-	-	-	-	-	2	3	2	



ME	E23551	MICROPROCESSOR AND ARTIFICIAL INTELLIGENCE FOR INDUSTRY	3	0	0	3
CO	URSE O	BJECTIVES			13 10	
То	enable th	e students to				
1	understa	and the architecture and programming basics of microprocessors and microcor	ntrollers	7		
2	learn int	terfacing techniques and communication protocols for industrial device integra	ation.		ØFT.	
3	introduc	te the fundamentals of artificial intelligence and machine learning concepts.			7/15	
4	apply A	I techniques for industrial automation, predictive maintenance, and quality con	ntrol.	i en	air	
5	explore	Industry 4.0 technologies, digital twins, and ethical aspects of AI in industries	S.	mil		
UN	ITI	MICROPROCESSOR AND MICROCONTROLLER ARCHITECTUR	E	917		9
intr	roduction	ning diagram – Interrupts – DMA process – Assembly language programming – 8051 and ARM architecture – Constructional features and comparison with	micropro			
	II TII	INTERFACING OF MICROPROCESSOR WITH INDUSTRIAL DEVI sor interfacing with ADC, DAC, sensors, motors – Input/output int			.0.	9
un De	hitecture  NIT III  finition as	tion protocols: UART, SPI, I2C, CAN – Data transfer methods – Real-time is – SCADA system overview – Applications in automation and process industrical applications in automation and process industrical applications – Supervised and unsuper statements of AI – History and industrial applications – Supervised and unsuper statements of AI – History and industrial applications – Supervised and unsuper statements of AI – History and industrial applications – Supervised and unsuper statements of AI – History and industrial applications – Supervised and unsuper statements of AI – History and industrial applications – Supervised and unsuper statements of AI – History and industrial applications – Supervised and unsuper statements of AI – History and industrial applications – Supervised and unsuper statements of AI – History and industrial applications – Supervised and unsuper statements of AI – History and industrial applications – Supervised and unsuper statements of AI – History and industrial applications – Supervised and unsuper statements of AI – History and Industrial applications – Supervised and Unsupervised an	ies. ervised lea	rning	; – Ne	9 ural
UN Dei	hitecture  VIT III   finition are  tworks – F	- SCADA system overview - Applications in automation and process industri ARTIFICIAL INTELLIGENCE FUNDAMENTALS	ies. ervised lea	rning	; – Ne	9 eural
UN Dei net - R	hitecture  NIT III  finition are  works – F  Role of AI	- SCADA system overview - Applications in automation and process industrial ARTIFICIAL INTELLIGENCE FUNDAMENTALS and scope of AI - History and industrial applications - Supervised and unsuperfuzzy logic systems - AI in sensor data analysis - Machine vision basics - Speed in enhancing industrial decision-making systems.  AI FOR INDUSTRIAL AUTOMATION	ervised lea	rning age p	; – Ne	9 eural sing
UN Definet - R UN Pre vis Au	finition are works – Face of Al MIT IV edictive mation	ARTIFICIAL INTELLIGENCE FUNDAMENTALS  and scope of AI – History and industrial applications – Supervised and unsuperfuzzy logic systems – AI in sensor data analysis – Machine vision basics – Speed in enhancing industrial decision-making systems.  AI FOR INDUSTRIAL AUTOMATION  Taintenance using AI – Data-driven fault detection – AI in robotic arms and CN quality control and defect detection – Integration of AI with IIoT – Smart cousing intelligent systems – Real-time analytics and optimization.	ervised leach and im	rning age p	roces	9 eural sing 9 outer
UN Definet - R UN Pre vis Au	finition are works – Face of All VIT IV edictive methods for quantum tomation	ARTIFICIAL INTELLIGENCE FUNDAMENTALS  and scope of AI – History and industrial applications – Supervised and unsuper Suzzy logic systems – AI in sensor data analysis – Machine vision basics – Speed in enhancing industrial decision-making systems.  AI FOR INDUSTRIAL AUTOMATION  Taintenance using AI – Data-driven fault detection – AI in robotic arms and CN auality control and defect detection – Integration of AI with IIoT – Smart cousing intelligent systems – Real-time analytics and optimization.  INDUSTRY 4.0 FRAMEWORK	ervised leaderch and im	rning age p nes –	; – Ne	9 gural ssing 9 gutter
UN Dei net - R UN Pre vis Au UN Ind	finition are works – Face of All with the dictive mation for quantity and the dictive mation for quantity dustry 4.0 – enabled p	ARTIFICIAL INTELLIGENCE FUNDAMENTALS  and scope of AI – History and industrial applications – Supervised and unsuperfuzzy logic systems – AI in sensor data analysis – Machine vision basics – Speed in enhancing industrial decision-making systems.  AI FOR INDUSTRIAL AUTOMATION  Taintenance using AI – Data-driven fault detection – AI in robotic arms and CN quality control and defect detection – Integration of AI with IIoT – Smart cousing intelligent systems – Real-time analytics and optimization.	ervised leadech and im	rning age p nes – d mo	Comp	9 9 puter ng — 9
UN Dei net - R UN Pre vis Au UN Ind	finition are works – Face of All with the dictive mation for quantity and the dictive mation for quantity dustry 4.0 – enabled p	ARTIFICIAL INTELLIGENCE FUNDAMENTALS  and scope of AI – History and industrial applications – Supervised and unsuper fuzzy logic systems – AI in sensor data analysis – Machine vision basics – Speed in enhancing industrial decision-making systems.  AI FOR INDUSTRIAL AUTOMATION  Taintenance using AI – Data-driven fault detection – AI in robotic arms and CN auality control and defect detection – Integration of AI with IIoT – Smart cousing intelligent systems – Real-time analytics and optimization.  INDUSTRY 4.0 FRAMEWORK  overview – Role of AI in smart manufacturing – Cyber-physical systems – Dig production line, AGV navigation, real-time defect identification – Ethics in AI and s – Legal and regulatory aspects of AI in industries.	ervised leadech and im	rning age p nes — d mod	Comp nitori	9 puter ng — 9 dies:
UN Definet - R UN Pre vis Au UN Ind AI- saf	finition are works – Francisco of Al MIT IV dictive mation for quantion with the dictive mation for quantity 4.0 dictive dicti	ARTIFICIAL INTELLIGENCE FUNDAMENTALS and scope of AI – History and industrial applications – Supervised and unsuper fuzzy logic systems – AI in sensor data analysis – Machine vision basics – Speet in enhancing industrial decision-making systems.  AI FOR INDUSTRIAL AUTOMATION Taintenance using AI – Data-driven fault detection – AI in robotic arms and CN auality control and defect detection – Integration of AI with IIoT – Smart cousing intelligent systems – Real-time analytics and optimization.  INDUSTRY 4.0 FRAMEWORK OVERVIEW – Role of AI in smart manufacturing – Cyber-physical systems – Digoroduction line, AGV navigation, real-time defect identification – Ethics in AI ands – Legal and regulatory aspects of AI in industries.	ervised leadech and im  IC machin control and gital twins	rning age p nes — d mod — Casent — PER	Comp nitori	9 pural sing 9 puter ng - 9 dies:
UN Definet - R UN Pre vis Au UN Ind AI- saf	finition are works – Francisco of Al MIT IV dictive mation for quantion with the district of the end of the en	ARTIFICIAL INTELLIGENCE FUNDAMENTALS and scope of AI – History and industrial applications – Supervised and unsuper fuzzy logic systems – AI in sensor data analysis – Machine vision basics – Speet in enhancing industrial decision-making systems.  AI FOR INDUSTRIAL AUTOMATION Taintenance using AI – Data-driven fault detection – AI in robotic arms and CN auality control and defect detection – Integration of AI with IIoT – Smart cousing intelligent systems – Real-time analytics and optimization.  INDUSTRY 4.0 FRAMEWORK OVERVIEW – Role of AI in smart manufacturing – Cyber-physical systems – Digoroduction line, AGV navigation, real-time defect identification – Ethics in AI ands – Legal and regulatory aspects of AI in industries.	ervised leadech and important	rning age p nes — d mod — Casent — PER PPED level	Comp nitori	9 pural sing 9 puter ng – 9 dies:

CO3	understand AI principles and how they relate to industrial environments.	Understanding (K2)
CO4	implement AI-based automation solutions for predictive control and monitoring.	Analysing (K4)
CO5	analyze real-world AI-integrated systems for industrial transformation.	Analysing (K4)

- 1. Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, PHI.
- 2. Stuart Russell & Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson.

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- 2. David A. Patterson & John L. Hennessy, Computer Organization and Design, Morgan Kaufmann.
- 3. Sutton & Barto, Reinforcement Learning: An Introduction, MIT Press.
- 4. Bhim Singh, Industrial Automation and Robotics, Khanna Publishers.

# 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	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO
CO1	3	2	2	1	2		-	n nemi	12-1-1	- 1	in the state of th	-	3	2
CO2	3	3	3	2	3		-	-		-	-	-	3	3
CO3	2	2	3	2	3	1	-	-	. 1-1	77-000	-	1	2	2
CO4	2	3	3	3	3	p + 5	-	-	1	1.20	ban (5)	2	2	3
CO5	2	2	3	3	3	1	1	1	1	2	1_	3	2	2

	23552	MACHINE LEARNING IN AUTOMATION	3	0	0	3
CO	URSE O	BJECTIVES		N.		
То	enable th	e students to	Complete States			7
1	introduc	e the fundamentals and types of machine learning and their integration with a	automation	syst	ems	П
2	impart k	mowledge on supervised learning models and their role in automation tasks				
3	explore	decision tree learning concepts and their relevance in machine learning work	flows.		ă.	
4	learn ab	out basics of neural networks and neuro fuzzy networks				
5	study th	e concepts and applications of recurrent neural networks and reinforcement le	earning		Y	
UN	ITI	INTRODUCTION TO MACHINE LEARNING AND AUTOMATION				9
		ls of Machine Learning (ML) - Definitions, Types (Supervised, Unsuper	vised, Re	nfor		
		between ML and automation - Applications of ML in industrial automatic				
		L Workflow: Data collection, pre-processing, training, testing.	.,			3
	IT II	SUPERVISED LEARNING TECHNIQUES FOR AUTOMATION				9
		Logistic Regression - Decision Trees and Random Forests - Support Ve	ctor Mack	ines		3
		Metrics - Confusion matrix, precision, recall, F1-Score, ROC - Case Studies -				-
		on in machines, Energy usage prediction.	Trodictiv	o mai	income	1110
		DECISION TREE LEARNING				0
	Annual decision	e representation – Appropriate problems for Decision tree learning – D	ecision tr	90 91		9
		space search- Inductive Bias – Restriction bias and Preference bias - Issues in				
LLY	pouresis s	pace scarcii- inductive Dias – Resulction dias and Freience dias - issues in				
TIN	TT TY		Decision	ucc i		
		NEURAL NETWORKS				9
Ma	thematica	NEURAL NETWORKS al Models of Neurons - ANN architecture, Learning rules - Multi-layer Perce	ptron - Ba	ck pr	opag	9 atio
Ma - In	thematica troductio	NEURAL NETWORKS  al Models of Neurons - ANN architecture, Learning rules - Multi-layer Perce n of Neuro-Fuzzy Systems - Architecture of Neuro Fuzzy Networks - Applicat	ptron - Ba	ck pr	opag	9 atic
Ma - In Ne	thematica troductio tworks in	NEURAL NETWORKS  al Models of Neurons - ANN architecture, Learning rules - Multi-layer Perce n of Neuro-Fuzzy Systems - Architecture of Neuro Fuzzy Networks - Applicat Robotics.	ptron - Ba	ck pr	opag of N	9 atic
Ma - In Ne	thematica troductio tworks in	NEURAL NETWORKS al Models of Neurons - ANN architecture, Learning rules - Multi-layer Perce n of Neuro-Fuzzy Systems - Architecture of Neuro Fuzzy Networks - Applicat Robotics.  REINFORCEMENT LEARNING	ptron - Ba tion Case S	ck pr Study	opag of N	9 atic
Ma - In Net UN	thematical troduction tworks in folding C	NEURAL NETWORKS al Models of Neurons - ANN architecture, Learning rules - Multi-layer Perce n of Neuro-Fuzzy Systems - Architecture of Neuro Fuzzy Networks - Applicat Robotics.  REINFORCEMENT LEARNING computational Graphs - Recurrent neural networks - Application Case Study	ptron - Ba tion Case S	ck pr Study	opag of N	9 atic eur
Ma - In Nei UN Un Ro	thematical troduction tworks in folding C botics - I	NEURAL NETWORKS  al Models of Neurons - ANN architecture, Learning rules - Multi-layer Perce n of Neuro-Fuzzy Systems - Architecture of Neuro Fuzzy Networks - Applicat Robotics.  REINFORCEMENT LEARNING computational Graphs - Recurrent neural networks - Application Case Study Reinforcement learning - Examples for reinforcement learning - Markov of	ptron - Ba tion Case S of recurre decision p	ck pr Study	opag of N	9 atic eur
Ma - In Net UN Un Ro	thematical troduction tworks in folding C botics - I	NEURAL NETWORKS al Models of Neurons - ANN architecture, Learning rules - Multi-layer Perce n of Neuro-Fuzzy Systems - Architecture of Neuro Fuzzy Networks - Applicat Robotics.  REINFORCEMENT LEARNING computational Graphs - Recurrent neural networks - Application Case Study	ptron - Ba tion Case S of recurre decision p	ck pr Study ent ne	opag of N etwor	9 atic eur 9 ks
Ma - In Nei UN Un Roi cor	thematical troduction tworks in ITTV folding Components	NEURAL NETWORKS  al Models of Neurons - ANN architecture, Learning rules - Multi-layer Perce n of Neuro-Fuzzy Systems - Architecture of Neuro Fuzzy Networks - Applicat Robotics.  REINFORCEMENT LEARNING Computational Graphs - Recurrent neural networks - Application Case Study Reinforcement learning - Examples for reinforcement learning - Markov of RL - Q Learning - Application Case Study of reinforcement learning in R	of recurred decision pobotics.	ck pr Study ent ne	opag of N etwor s - N	9 atic eur
Ma - In Net UN Un Ro	thematical troduction tworks in [IT V ] folding C botics - I imponents	NEURAL NETWORKS  al Models of Neurons - ANN architecture, Learning rules - Multi-layer Perce n of Neuro-Fuzzy Systems - Architecture of Neuro Fuzzy Networks - Applicat Robotics.  REINFORCEMENT LEARNING computational Graphs - Recurrent neural networks - Application Case Study Reinforcement learning - Examples for reinforcement learning - Markov of RL - Q Learning - Application Case Study of reinforcement learning in R  OUTCOMES	ptron - Battion Case State of recurred decision probotics.  TOTAL BT MAI	ck pr Study ent ne roces PER	opag of N etwor s - N	9 atic eur 9 ks
Ma - In Net UN Un Ro cor	thematical troduction tworks in [IT V ] folding C botics - I imponents	NEURAL NETWORKS  al Models of Neurons - ANN architecture, Learning rules - Multi-layer Perce n of Neuro-Fuzzy Systems - Architecture of Neuro Fuzzy Networks - Applicat Robotics.  REINFORCEMENT LEARNING Computational Graphs - Recurrent neural networks - Application Case Study Reinforcement learning - Examples for reinforcement learning - Markov of RL - Q Learning - Application Case Study of reinforcement learning in R	of recurred decision pobotics.	ck pr Study ent ne roces PER	opag of N etwor s - N	9 atic eur 9 ks
Ma - In Net UN Un Ro cor	thematical troduction tworks in ITT V folding C botics - I mponents  DURSE C the end of expl	NEURAL NETWORKS  al Models of Neurons - ANN architecture, Learning rules - Multi-layer Perce n of Neuro-Fuzzy Systems - Architecture of Neuro Fuzzy Networks - Applicat Robotics.  REINFORCEMENT LEARNING computational Graphs - Recurrent neural networks - Application Case Study Reinforcement learning - Examples for reinforcement learning - Markov of RL - Q Learning - Application Case Study of reinforcement learning in R  OUTCOMES	ptron - Battion Case State of recurred decision probotics.  TOTAL BT MAI	ck pr Study ent ne roces PER PED level	opag of N etwor s - N	9 atic

CO3	analyze and interpret decision tree structures to support intelligent decision- making in automated systems	Analysing (K4)
CO4	summarize the concepts of neural networks and neuro fuzzy networks	Understanding (K2)
CO5	analyze and implement reinforcement learning algorithms for robotic control tasks and assess their effectiveness through case studies	Analysing (K4)

- 1. Tom M. Mitchell, "Machine Learning", McGraw-Hill Science / Engineering / Math, 1997.
- Micheal Negnevitsky, Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition, Addision Wesley, England, 2011.

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- 2. Timothy J Ross, "Fuzzy Logic with Engineering Applications", 4th Edition, Chichester, 2011, Sussex Wiley.
- 3. Francis X. Govers, "Artificial Intelligence for Robotics", Packt Publishing Ltd, 2018.
- 4. Bruno Siciliano, Oussama Khatib, "Handbook of Robotics", 2nd Edition, Springer, 2016.

## CO - PO MAPPING

COs		Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2	
CO1	3	2	1	2	-	-	- 11		1	-	15 210	2	2	2	
CO2	3	2	1	2	-	3-1	7		-	7		2	2	2	
CO3	3	2	1	2	-	-	-	-	-	-	-	2	2	2	
CO4	3	2	1	2	7 -	-		-	-	-	(C.	2	2	2	
CO5	3	·2	1	2	ŭ.	-	-	-	-	-	-	2	2	2	



	3553	MEASUREMENTS AND CONTROLS	3	0	0	3
COU	RSE OB	JECTIVES				
To e	nable the	students to	CHEST SHA	500	50.1	
1 i	identify m	easurement parameters and analyse errors of measurements.		91 K	ar.	
2 5	select and	apply suitable transducer for a particular measurement.				
3 i	identify m	neasurement parameters and select the appropriate sensor for it.		YW	7	
4 (	explain th	e working of various types of control systems of apply for specific application	ions	01.79	IXI	
5 8	apply the	principle of automatic control systems to control various parameter.	or Title	35	_	7
UNI	ГІ	MEASUREMENTS AND ERROR ANALYSIS	specif la			9
Gene	ral conce	pts – Units and standards – Measuring instruments –sensitivity, readability, ra	ange, accu	racy,	prec	ision
	rimental c	vnamic response – repeatability hysteresis – systematic and random errors lata – Regression analysis – Curve fitting - calibration and Uncertainty.  INSTRUMENTS	s –Statisti	cai a	naiys	9
		egrated Manufacturing (CIM)- Flexible Manufacturing Systems (FMS)-	Industria	l Au	toma	-
	ors, Actua	ntors, Controllers- Robotics in Manufacturing (Types, Kinematics, Cobots)-ry 4.0	CNC Mac	hine	s and	their
UNI	гш	PARAMETERS FOR MEASUREMENT			70	9
Dime	ension, di	splacement, velocity, acceleration, Impact - Force, torque, power- Pressure,	Temperat	ure, l	Heat !	Flux
Heat	Transfer	Coefficients, Humidity - Flow - Velocity - Time, frequency and phase angle	e – noise a	nd so	und l	evel
UNI	T IV	ADVANCED TOOLS AND DATA ANALYTICS	,	(eli		9
Basic	e element	s - feedback principle, implication of measurements - Error detectors - fi	nal actuat	ing e	leme	nts -
	200	multi-position, floating, proportional controls - relays - servo amplifiers - s	servo moto	rs –	Elect	rical
	ietic, elec	tronic control systems.				
UNI	to receive that constitution	APPLICATION OF CONTROL SYSTEMS	1 <u>1                                  </u>	70.5		9
	TV	The control of the co	-thrust an	d flig	ht co	
Gove	T V erning of	APPLICATION OF CONTROL SYSTEMS			tht co	
Gove	T V erning of	APPLICATION OF CONTROL SYSTEMS speed, kinetic and process control – pressure, temperature, fluid level, flow				ntro
Gove – pho	T V erning of oto electri	APPLICATION OF CONTROL SYSTEMS speed, kinetic and process control – pressure, temperature, fluid level, flow	plications.	PER	IOD	ntro
Gove	T V erning of oto electri	APPLICATION OF CONTROL SYSTEMS speed, kinetic and process control – pressure, temperature, fluid level, flow c controls – designing of measurement and control systems for different approximation.	plications.	PER	IOD	ntro
Gove – pho COU	T V erning of oto electrical ordered of the end of the	APPLICATION OF CONTROL SYSTEMS speed, kinetic and process control – pressure, temperature, fluid level, flow c controls – designing of measurement and control systems for different applications.	TOTAL  BT MAP	PER PER	IOD )	S:45
COU	TV erning of oto electrical desired of the end of the identification.	APPLICATION OF CONTROL SYSTEMS speed, kinetic and process control – pressure, temperature, fluid level, flow c controls – designing of measurement and control systems for different applications.  TCOMES the course, the students will be able to	TOTAL  BT MAP (Highest	PER PER level	10D: ) ) g (K2	S:45
COU At the	TV erning of oto electric oto e	APPLICATION OF CONTROL SYSTEMS  speed, kinetic and process control – pressure, temperature, fluid level, flow c controls – designing of measurement and control systems for different applications of the course, the students will be able to by measurement parameters and analyze errors of measurements.	TOTAL  BT MAP (Highest Understa	PER PEE level nding (K3	(K2	S:45
Gove	TV erning of oto electric oto e	APPLICATION OF CONTROL SYSTEMS  speed, kinetic and process control – pressure, temperature, fluid level, flow c controls – designing of measurement and control systems for different apply  TCOMES  the course, the students will be able to  Ty measurement parameters and analyze errors of measurements.  and apply suitable transducer for a particular measurement.	TOTAL  BT MAP (Highest Understa	PER PED level inding (K3	(K2	S:45

- 1. Venkateshan S P, Mechanical Measurements, 2ndEdition, John Wiley & Sons, Ltd, 2015.
- 2. William Bolton, Instrumentation and Control Systems, 2ndEdition, Newnes, 2015.

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- 1. Beckwith, Marangoni and Lienhard, Mechanical Measurements, Pearson, 2013.
- 2. Ernest Doebelin and DhaneshManik, Measurement Systems, McGraw Hill International Edition, 2017.
- 3. Holman J P, "Experimental Methods for Engineers", McGraw Hill-Int. Edition, 7th Ed., 2017.
- 4. Nagrath I J, "Control Systems Engineering", New Age International Publishers, 2018.

# CO - PO MAPPING

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

COs					Progra	amme O	utcome	s(POs)				- PLACE &	PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	-	2	4.586	-	T.	- 1	1 1 T	1	2	2
CO2	3	3	3	1		- 2	te flui.	1.	12 F A	e Tari	m Essi	1	2	2
CO3	3	3	3	1		-		-	-	in Total	-	1	2	2
CO4	3	3	3	1	1.5.0		-		-		-	1	2	2
CO5	3	3	3	1	-	-	-	-	-	-		1	2	2

BOARD OF STUDIES
Mechanical Engineering

AUTONOMOUS

	PREDICTIVE ANALYTICS IN INDUSTRY 4.0 3	0	0	3
COURSE	OBJECTIVES			
To enable	the students to	-	14-	
1 unders makin	stand the fundamental concepts of regression analysis and its application in management.	ent d	lecisi	on-
2 explain	n time series forecasting methods and key machine learning models used for predictive an	alysis	3.	
3	be the components and technologies involved in Industry 4.0, including cyber-physical factories.	l syste	ems	and
4 analyz	e sustainability challenges in supply chain management and the role of smart factories in	Indus	try 4	0.
5 evalua applica	te the concept, architecture, and benefits of digital twins in smart manufacturing and ations.	Indu	stry	4.0
UNIT I	REGRESSION ANALYSIS			9
Simple Reg	gression Analysis: Concept Fundamentals of Regression Analysis - Requirements in Reg	ressio	n Mo	del
Building - 1	Model Diagnostics - Interpretation of Regression results for Management Decision. Multip	ole Re	gress	ion
Analysis: C	Concept - Significance of Multiple Regression Analysis - Structure of Model Estimation	- Test	ing F	ule
	Regression Analysis.			
UNIT II	FORECASTING AND MACHINE LEARNING			
UNITI	TORECASTING AND MACHINE LEARNING			0
Time Serie		nalysi	s - T	9 ime
	s Forecasting: Concept - Forecasting Techniques - Measures of Forecast Error - Trend A			ime
				ime
Series Mod	s Forecasting: Concept - Forecasting Techniques - Measures of Forecast Error - Trend A	ng: C	once	ime
Series Moo Predictive	s Forecasting: Concept - Forecasting Techniques - Measures of Forecast Error - Trend Andels - Auto Regressive Model - Applications of Time Series Models. Machine Learning	ng: C	once	ime
Series Moo Predictive Forest - Mo	s Forecasting: Concept - Forecasting Techniques - Measures of Forecast Error - Trend Andels - Auto Regressive Model - Applications of Time Series Models. Machine Learning Analysis under Machine Learning - Model of Artificial Neural Networks (ANN) - Models - Model of Artificial Neural Networks (ANN) - Model of Artificial Neural N	ng: C	once	ime pt - lom
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Series Mod Predictive Forest - Mod UNIT III Introduction Production Next Gene	s Forecasting: Concept - Forecasting Techniques - Measures of Forecast Error - Trend Andels - Auto Regressive Model - Applications of Time Series Models. Machine Learning Analysis under Machine Learning - Model of Artificial Neural Networks (ANN) - Model of Support Vector Machine - Assumptions under Machine Learning.  INTRODUCTION TO INDUSTRY 4.0  In: Sensing & actuation, Industry 4.0: Globalization and Emerging Issues, The Fourth Revolutions, Systems, Smart and Connected Business Perspective, Smart Factories; Cyber Physical	ng: C	Rancon, LE	pt g AN
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COUL	RSE OUTCOMES	BT MAPPED
At the	end of the course, the students will be able to	(Highest level)
CO1	apply regression analysis techniques to build and interpret models for real-world business data.	Understanding (K2)
CO2	demonstrate the ability to select and use appropriate forecasting and machine learning models for time-dependent data.	Understanding (K2)
СОЗ	identify and explain the emerging technologies and principles underlying Industry 4.0 and smart manufacturing.	Applying (K3)
CO4	assess sustainability factors and ICT integration in supply chain management through case studies of smart factories.	Analyzing (K4)
CO5	implement digital twin concepts to improve predictive maintenance, monitoring, and decision-making in manufacturing processes.	Analysing (K3)

- Introduction to Linear Regression Analysis by Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, Wiley, 2012, 5th Edition.
- 2. Industry 4.0: The Industrial Internet of Things by Alasdair Gilchrist, Apress, 2016, 1st Edition.

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- 2. The Elements of Statistical Learning by Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer, 2009, 2<sup>nd</sup> Edition.
- Artificial Intelligence: A Guide to Intelligent Systems by Michael Negnevitsky, Pearson Education, 2011, 3rd
  Edition.
- Internet of Things: Principles and Paradigms edited by Rajkumar Buyya, Amir Vahid Dastjerdi, Morgan Kaufmann, 2016, 1st Edition.

# CO - PO MAPPING

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

COs					Progra	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	-	1		-	-	-	1	3	2
CO2	3	3	3	3	3	-	-		-		-	2	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	2	3	3
CO4	3	2	3	3	3	-	1	-	-	-	-	2	3	3
CO5	3	3	3	3	3010	G COL	LEE	-	1	1		3	3	- 3

BOARD OF STUDIES
Mechanical Engineering

MIL	23555	AUTOMATION IN MANUFACTURING	3	0	0	3
COL	URSE (	OBJECTIVES				
Тое	enable t	he students to	topic is to	objetic.		
1	illustra	te the basic concepts of automation			ner.	
2	analyz	e single model assembly lines and line balancing algorithms.		psh	is,ta	
3	demon	strate the importance of automated material handling and storage systems.				
4	explair	n the concepts of automated assembly systems.	51.0		υř	
5	describ	be design for manufacturing and just in time production systems.		9 98	hid.	
UNI	ITI	INTRODUCTION	1		00	9
Intro	oduction	n to Automation: Automation in Production Systems-Automated Manufacturing Syst	ems,	Con	pute	ized
an A	Automat	Production Concepts and Mathematical Models. Costs of Manufacturing Operations ted Systems, Advanced Automation Functions, Levels of automation.	, Bas	ic El	emer	ts of
	TII	MANUAL ASSEMBLY LINES AND LINE BALANCING sembly Lines: Fundamentals of manual assembly lines, assembly workstations, man				9
trans algo	sport; l orithms-	d mechanised work transport system: continuous transport, synchronous transpline pacing. Analysis of Single Model Assembly Lines: Line balancing proble Largest candidate rule, Kilbridge and Wester method, Ranked positional weight sing the mentioned algorithms)	m, I	asyı Line	balaı	nous icing
trans algo prob	sport; l orithms- olems u	line pacing. Analysis of Single Model Assembly Lines: Line balancing proble Largest candidate rule, Kilbridge and Wester method, Ranked positional weight sing the mentioned algorithms)	em, I ts me	asyr ine ethoc	balaı	nous acing mple
trans algo prob	sport; l orithms- olems us	line pacing. Analysis of Single Model Assembly Lines: Line balancing proble Largest candidate rule, Kilbridge and Wester method, Ranked positional weight sing the mentioned algorithms)  AUTOMATED PRODUCTION LINES AND ANALYSIS OF TRANSFER L	em, Its me	asyn Line ethod	balaı	nous acing mple
trans algo prob UNI Auto	sport; learning the sport; learning the sport in the spor	Largest candidate rule, Kilbridge and Wester method, Ranked positional weight sing the mentioned algorithms)  AUTOMATED PRODUCTION LINES AND ANALYSIS OF TRANSFER L.  Production Lines: Fundamentals of automated production lines- work part	em, I ts mo	asyncine ethod	balar l. (Si t, sy	nous acing mple
trans algo prob UNI Auto	sport; learning sport; learning sport; learning sport	Largest candidate rule, Kilbridge and Wester method, Ranked positional weight sing the mentioned algorithms)  AUTOMATED PRODUCTION LINES AND ANALYSIS OF TRANSFER L. Production Lines: Fundamentals of automated production lines- work part cons: in-line, segment in-line, rotary; work part transfer mechanisms: linear transfer mechanisms: li	ts mo	asyn Line ethod S nspon syste	balar l. (Si t, sy	nous noing mple 9 stem
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uni Auto conf inde parts and Uni Auto and Insp mac Uni Proc CAI asse	sport; learning sport; learning mated figuration in the storage ideal properties of the sport of	Largest candidate rule, Kilbridge and Wester method, Ranked positional weight sing the mentioned algorithms)  AUTOMATED PRODUCTION LINES AND ANALYSIS OF TRANSFER L. Production Lines: Fundamentals of automated production lines- work part cons: in-line, segment in-line, rotary; work part transfer mechanisms: linear transfer chanisms - Geneva mechanism. Analysis of Transfer Lines: Analysis of flow lines: cycle time analysis, processing time, production time, line frequency; performant roduction rate, line efficiency. (simple problems)  AUTOMATED ASSEMBLY SYSTEMS AND INSPECTION  Assembly Systems: Fundamentals of Automated Assembly Systems, Design for Automative Analysis of Assembly Systems. Inspection: Types of Inspection, Inspection Profiline and Online Inspection, Contact Vs Non-contact Inspection techniques, Committee and Online Inspection and Programming, CMM Applications and Benefits PROCESS PLANNING AND CONCURRENT ENGINEERING	INE transfer mes we need not occide to occide	asyntated Anate tem, urfac man	t, syem, r o intra- a Asser	nous acing mple  9 stem otary ernal ctual ctual aring grative grating grative grating grative grating

kanban, setup time reduction for smaller batch sizes, stable and reliable production operations - stable schedule, ontime delivery, zero defect, work force and supplier base.

	TOTAL PERIODS:45
RSE OUTCOMES	BT MAPPED
end of the course, the students will be able to	(Highest level)
describe automation principles and strategies.	Applying (K3)
analyze single model assembly lines.	Analysing (K4)
design automated production lines.	Analysing (K4)
analyze automated assembly systems.	Applying (K3)
describe concurrent engineering and process planning.	Applying (K3)
	analyze single model assembly lines.  design automated production lines.  analyze automated assembly systems.

#### TEXT BOOKS

- Automation, Production systems and computer integrated manufacturing, Mikel P. Groover/ Pearson Education.
- CAD CAM: Principles, Practice and Manufacturing Management / Chris Mc Mohan, Jimmie Browne / Pearson edu. (LPE)

#### REFERENCES

- Yoram Koren, Computer control of Manufacturing Systems, McGraw-Hill Education, International Edition, 2017.
- P. Radhakrishnan and S. Subramanyam, V. Raju, CAD/CAM/CIM, New Age International Pvt Ltd., 3rd Edition, 2009. Design Data Hand Book", PSG College of Technology, Coimbatore, 2013
- 3. Automation for Productivity, Luke H.D, John Wiley & Sons, New York, 1972.
- Industrial Automation in the Industry 4.0 Era Performance Analysis and Applications , John Soldatos multiple publications in automation, 2019.

#### CO - PO MAPPING

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

COs					Progr	amme O	utcome	(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	2	-	-	-	2	-	-		2	2	3
CO2	2	2	3	2	-	Digini,	-	2	-		gen <u>a</u> lmi	2	2	3
CO3	2	2	3	2	11214	212	-	2	200		-	2	2	3
CO4	2	2	3	2		912	4.2 8	2	m(2 m	1	_	2	2	3
CO5	2	2	3	2	-	or other states	-	2	_	-	) 1 <u>2</u> 1	2	2	3

Approved
BOARD OF STUDIES
Mechanical Engineering

AUTONOMOUS

ME:	23556	REAL TIME EMBEDDED SYSTEMS 3	0	0	3
CO	URSE OF	BJECTIVES			
То	enable the	e students to		All	-
1	understar	nd the concept of embedded system design and analysis.			
2	learn the	architecture of ARM processor			
3	learn the	Programming of ARM processor			
4	expose th	he basic concepts of embedded programming.			
5	learn real	Il time operating systems		SE.	
UNI	IT I	INTRODUCTION TO EMBEDDED SYSTEM DESIGN			9
cont	troller- De	stems and microprocessors— Embedded system design process—Design example esign methodologies—Design flows - Requirement Analysis — Specifications-System design — Quality Assurance techniques - Designing with computing platforms — consumer the construction of the con	n ana	llysis	and
		- platform-level performance analysis.		icon o	,,,,,,
and a second	THE RELEASE DESCRIPTION OF THE PERSON NAMED IN COLUMN TWO IS NOT THE PERSON NAMED IN COLUMN TWO IS	ARM PROCESSOR AND PERIPHERALS ecture Versions – ARM Architecture – Instruction Set – Stacks and Subroutines – Featu			9
and	ARM Co	r – Peripherals – The Timer Unit – Pulse Width Modulation Unit – UART – Block Diag ortex M3 MCU.	gram	of Al	RMS
and UN	ARM Co	ortex M3 MCU.  EMBEDDED PROGRAMMING			9
unl Con tech	ARM Con IT III III Inponents Inniques- P	entex M3 MCU.  EMBEDDED PROGRAMMING  for embedded programs- Models of programs- Assembly, linking and loading Program level performance analysis – Software performance optimization – Program level	– co	mpila	gation and
UNI Con tech pow	ARM Control of the IT III   1   1   1   1   1   1   1   1   1	EMBEDDED PROGRAMMING  for embedded programs- Models of programs- Assembly, linking and loading Program level performance analysis – Software performance optimization – Program lesis and optimization – Analysis and optimization of program size- Program validation as	– co	mpila	gation and
UNI Con tech pow UNI Stru	ARM Control of a sector of a	entex M3 MCU.  EMBEDDED PROGRAMMING  for embedded programs- Models of programs- Assembly, linking and loading Program level performance analysis – Software performance optimization – Program level	– co	mpila nergy sting.	gation and
and UNI Con tech pow UNI Stru Tole UNI	ARM Control of the IT III   1   1   1   1   1   1   1   1   1	EMBEDDED PROGRAMMING  for embedded programs- Models of programs- Assembly, linking and loading Program level performance analysis – Software performance optimization – Program lesis and optimization – Analysis and optimization of program size- Program validation at REAL TIME SYSTEMS  a Real Time System — Estimating program run times – Task Assignment and Scherchniques – Reliability, Evaluation – Clock Synchronisation.  PROCESSES AND OPERATING SYSTEMS	– co evel end te	mpila nergy esting.	9 ation and
and UNI Con tech pow UNI Stru Tole UNI Intro Prio pow Dist	ARM Connection in ponents aniques - Power analysis in true of a grance Team of a grance Team of the point of	EMBEDDED PROGRAMMING  for embedded programs- Models of programs- Assembly, linking and loading Program level performance analysis – Software performance optimization – Program lesis and optimization – Analysis and optimization of program size- Program validation at REAL TIME SYSTEMS  a Real Time System — Estimating program run times – Task Assignment and Scheechniques – Reliability, Evaluation – Clock Synchronisation.	- co vel end te edulin rating	mpila mergy esting. mg – H	gation / and / and / and / grant / gra
and UNI Con tech pow UNI Stru Tole UNI Intro Prio pow Dist	ARM Connection in ponents aniques - Power analysis in true of a grance Team of a grance Team of the point of	EMBEDDED PROGRAMMING  for embedded programs- Models of programs- Assembly, linking and loading Program level performance analysis – Software performance optimization – Program less and optimization – Analysis and optimization of program size- Program validation at REAL TIME SYSTEMS  a Real Time System — Estimating program run times – Task Assignment and Schechniques – Reliability, Evaluation – Clock Synchronisation.  PROCESSES AND OPERATING SYSTEMS  — Multiple tasks and multiple processes – Multirate systems- Pre emptive realtime operated scheduling- Interprocess communication mechanisms – Evaluating operating systems inzation strategies for processes – Example Real time operating systems-POSIX-Weinbedded systems – MPSoCs and shared memory multiprocessors. – Design Example in the systems – MPSoCs and shared memory multiprocessors. – Design Example in the systems – MPSoCs and shared memory multiprocessors. – Design Example in the systems – MPSoCs and shared memory multiprocessors. – Design Example in the systems – MPSoCs and shared memory multiprocessors. – Design Example in the systems – MPSoCs and shared memory multiprocessors. – Design Example in the systems – MPSoCs and shared memory multiprocessors. – Design Example in the systems – MPSoCs and shared memory multiprocessors.	- coovel end te	ompila nergy esting. ng – I	gration / and grant / and grant / gran
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and UNI Con tech pow UNI Stru Toke UNI Intro Prio pow Dist Eng	ARM Control of the property of the print of	EMBEDDED PROGRAMMING  for embedded programs- Models of programs- Assembly, linking and loading Program level performance analysis – Software performance optimization – Program lesis and optimization – Analysis and optimization of program size- Program validation at REAL TIME SYSTEMS  a Real Time System — Estimating program run times – Task Assignment and Scheechniques – Reliability, Evaluation – Clock Synchronisation.  PROCESSES AND OPERATING SYSTEMS  — Multiple tasks and multiple processes – Multirate systems- Pre emptive realtime open discheduling- Interprocess communication mechanisms – Evaluating operating systemization strategies for processes – Example Real time operating systems-POSIX-Weighbedded systems – MPSoCs and shared memory multiprocessors. – Design Example fol unit – Video accelerator.  TOTAL	- coovel end te eduling rating in periodical	mpilanergy sting.  g systematics of the plane of the plan	gration / and grant / and grant / gran
and UNI Con tech pow UNI Stru Toke UNI Intro Prio pow Dist Eng	ARM Control of the end of	EMBEDDED PROGRAMMING  for embedded programs- Models of programs- Assembly, linking and loading Program level performance analysis – Software performance optimization – Program lesis and optimization – Analysis and optimization of program size- Program validation at REAL TIME SYSTEMS  a Real Time System — Estimating program run times – Task Assignment and Scherchniques – Reliability, Evaluation – Clock Synchronisation.  PROCESSES AND OPERATING SYSTEMS  — Multiple tasks and multiple processes – Multirate systems- Pre emptive realtime open discheduling- Interprocess communication mechanisms – Evaluating operating systems inization strategies for processes – Example Real time operating systems-POSIX-Weighbedded systems – MPSoCs and shared memory multiprocessors. – Design Example fol unit – Video accelerator.  TOTAL BUTCOMES  BT MAP	rating rating rating PER PPED level	mpilanergy sting.  g systematics of the plane of the plan	Sation and an arrangement of the sation of t

CO3	analyze various Real Time Operating system is used in Embedded System	Analysing (K4)
CO4	design the flow &Techniques to develop Software for embedded system networks.	Applying (K3)
CO5	analyze Real-time applications using embedded System Products.	Analysing (K4)

- 1. Jane W.S.Liu, Real Time Systems, Pearson Education, Third Indian Reprint, 2003.
- Marilyn Wolf, "Computers as Components Principles of Embedded Computing System Design", Third Edition "Morgan Kaufmann Publisher (An imprint from Elsevier), 2012

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- Jonathan W.Valvano, "Embedded Microcomputer Systems Real Time Interfacing", Third Edition Cengage Learning, 2012
- David. E. Simon, "An Embedded Software Primer", 1st Edition, Fifth Impression, Addison Wesley Professional, 2007
- K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design & Programming", Dream Tech Press, 2005.

# CO - PO MAPPING

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

COs					Progra	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2	- 1	-	-				1	3	2
CO2	3	. 3	3	2 .	2	-	-	-	1	-	-	2	3	3
CO3	3	2	3	2	3	-	-	-	-	-	-	2	3	3
CO4	3	2	3	3	3	-	-	-	1	-	-	2	3	3
CO5	3	2	3	2	3	2	1	1	1	1	2	3	3	3

BOARD OF STUDIES

Mechanical Engineering

ME	23557	ELECTRICAL DRIVES AND ACTUATORS	3		0	0	3
CO	URSE OF	BJECTIVES				-	
То	enable the	students to	de Salvaria		-01		
1	familiariz	ze the different power semiconductor devices and drivers circuits.	Par k		ī	57	
2	get a kno	wledge on electric drive and their characteristics.				7	
3	obtain the	e knowledge on DC motors drives by using power electronics converter.	Jan 1, le	1		-	
4	study abo	out AC motors controlling technique.		1		No.	
5	know abo	out the stepper and switched reluctance motor construction and operation.	State	nó.		T	
UN	IT I	POWER SEMI-CONDUCTOR DEVICES	Tre set	7.77			9
Swi	tching de	vices and V-I characteristics - BJT, SCR, TRIAC, GTO, MOSFET, IGI	BT; Trig	geri	ng	circu	iit -
Intr	oduction to	o driver and snubber circuits.					
UN	тп п	DRIVE CHARACTERISTICS			Т	E F	9
Elec	ctric drive	- Equations governing motor load dynamics, steady state stability; Mu	lti quadr	ant	dy	nami	cs -
Acc	eleration,	deceleration, torque, and direction starting and stopping; Selection of motor					
UN	ІТШ І	DC MOTORS AND DRIVES			П		9
		nent magnet motor, DC servo motor; Starting - Braking; Speed control - Sing OC drives, step down chopper controlled DC drives.	gle phase	full	y c	ontro	lled
			gle phase	full	y c	ontro	lled
rect	ifier fed D	OC drives, step down chopper controlled DC drives.  AC MOTORS AND DRIVES					9
rect UN Thr	ifier fed D  IT IV  A  ee phase in	OC drives, step down chopper controlled DC drives.  AC MOTORS AND DRIVES Induction motor construction, operation and their characteristic; Speed contro	l of three	pha	se i	induc	tion
UN Thr mot	ifier fed D  IT IV  A  ee phase in  or – Staton	OC drives, step down chopper controlled DC drives.  AC MOTORS AND DRIVES  Induction motor construction, operation and their characteristic; Speed control voltage control, stator frequency control, stator voltage and frequency control	l of three	pha	se i	induc	9 tion
UN Thr mot	ifier fed D IT IV A ee phase in or – Staton trol, slip p	OC drives, step down chopper controlled DC drives.  AC MOTORS AND DRIVES  Induction motor construction, operation and their characteristic; Speed control voltage control, stator frequency control, stator voltage and frequency control ower recovery control; Starting-direct online starter, auto transformer starter	l of three	pha	se i	induc	9 tion
UN Thr mot con	ifier fed D IT IV A ee phase in or – Staton trol, slip p	OC drives, step down chopper controlled DC drives.  AC MOTORS AND DRIVES  Induction motor construction, operation and their characteristic; Speed control voltage control, stator frequency control, stator voltage and frequency control ower recovery control; Starting-direct online starter, auto transformer starters and SWITCHED RELUCTANCE MOTOR DRIVES	l of three rol, static	pha rote	se i	induc esista	tion nnce
Thr mot con UN Step	ifier fed D  IT IV  ee phase in  or – Staton  trol, slip p  IT V  sper moto	OC drives, step down chopper controlled DC drives.  AC MOTORS AND DRIVES  Induction motor construction, operation and their characteristic; Speed control voltage control, stator frequency control, stator voltage and frequency control ower recovery control; Starting-direct online starter, auto transformer starter	l of three rol, static r. drive circ	pha rote	se i	induc esista	tion nnce
Thr mot con UN Step	ifier fed D  IT IV  ee phase in  or – Staton  trol, slip p  IT V  sper moto	AC MOTORS AND DRIVES Induction motor construction, operation and their characteristic; Speed control voltage control, stator frequency control, stator voltage and frequency control ower recovery control; Starting-direct online starter, auto transformer starters are strepper AND SWITCHED RELUCTANCE MOTOR DRIVES  Transport of the strepper motor, permanent magnet stepper motor, starters are strepper motor, starters are strepper motor, permanent magnet stepper motor, starters are strepper motor, starters are strepper motor, permanent magnet stepper motor, starters are strepper motor, starters are strepper motor, permanent magnet stepper motor, starters are strepper motor, starters are starters are strepper motor.	l of three rol, static r. drive circ	pha rote	se i	induc esista or ste	tion ance
UN Thr mot con UN Step	ifier fed D IT IV ee phase in or – Staton trol, slip p IT V opper motor cors; Swite	AC MOTORS AND DRIVES Induction motor construction, operation and their characteristic; Speed control voltage control, stator frequency control, stator voltage and frequency control ower recovery control; Starting-direct online starter, auto transformer starters are strepper AND SWITCHED RELUCTANCE MOTOR DRIVES  Transport of the strepper motor, permanent magnet stepper motor, starters are strepper motor, starters are strepper motor, permanent magnet stepper motor, starters are strepper motor, starters are strepper motor, permanent magnet stepper motor, starters are strepper motor, starters are strepper motor, permanent magnet stepper motor, starters are strepper motor, starters are starters are strepper motor.	l of three rol, static	pha rote	se i	induc esista or ste	tion ance
Thr mot con UN Step mot	ifier fed D IT IV ee phase in or – Staton trol, slip p IT V oper moto cors; Swite URSE OI	AC MOTORS AND DRIVES Induction motor construction, operation and their characteristic; Speed control voltage control, stator frequency control, stator voltage and frequency control ower recovery control; Starting-direct online starter, auto transformer starter STEPPER AND SWITCHED RELUCTANCE MOTOR DRIVES  The series of the	l of three rol, static r. drive circon, drive c	pha rote	se i for r	induction of the state of the s	9 ppper
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Thr mot con UN Step mot	ifier fed D IT IV ee phase in or – Staton trol, slip p IT V Sper moto tors; Switce URSE OU	AC MOTORS AND DRIVES Induction motor construction, operation and their characteristic; Speed control voltage control, stator frequency control, stator voltage and frequency control ower recovery control; Starting-direct online starter, auto transformer starter STEPPER AND SWITCHED RELUCTANCE MOTOR DRIVES  IT Is a Variable reluctance stepper motor, permanent magnet stepper motor, wheel reluctance motor — construction and modes of operation, torque equation to the course, the students will be able to	l of three rol, static r. drive circ on, drive of TOTAL BT MA (Highes)	pha rote cuits PPI PPI t lev	se i for r r s for	or ste	stior specification
Thr mot con Step mot CO At 1	ifier fed D IT IV ee phase in or – Stator trol, slip p IT V sper motor tors; Swite URSE OU the end of recog explain	AC MOTORS AND DRIVES Induction motor construction, operation and their characteristic; Speed control voltage control, stator frequency control, stator voltage and frequency control ower recovery control; Starting-direct online starter, auto transformer starter (STEPPER AND SWITCHED RELUCTANCE MOTOR DRIVES)  In a voltage control of the starting of the starter of th	l of three rol, static r. drive circ on, drive o TOTAI  BT MA (Highes:	pha rote cuits PPI PPI t lev	se i for r for se for s	induction of step in the step	gopper
Thr mot con UN Step mot	ifier fed D IT IV ee phase in or – Stator trol, slip p IT V sper motor tors; Swite URSE OU the end of recog explain apply and d	AC MOTORS AND DRIVES Induction motor construction, operation and their characteristic; Speed control voltage control, stator frequency control, stator voltage and frequency control ower recovery control; Starting-direct online starter, auto transformer starter.  STEPPER AND SWITCHED RELUCTANCE MOTOR DRIVES  rs - Variable reluctance stepper motor, permanent magnet stepper motor, sched reluctance motor — construction and modes of operation, torque equation to the course, the students will be able to mize the construction and working power electronics components.  In the working and characteristics of various drives.  The solid state switching circuits to operate various types of DC motors	l of three rol, static r. drive circ on, drive o TOTAI  BT MA (Highes Analysis Underst	pha rote cuits PPI t lev	se i for r for for for for for for for for f	induction of step in the step	9 ppper

- 1. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Pearson, Fourth Edition, 2021.
- 2. Bimbhra B.S., "Power Electronics", Kanna Publishers, New Delhi, Fifth Edition, 2012.

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- Mehta V.K. and Rohit Mehta, "Principles of Electrical Machines", S.Chand & Co. Ltd., New Delhi, Reprint Edition, 2016.

## CO - PO MAPPING

COs		Programme Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2	-	i ingo s			1, 12/219		1	3	2
CO2	3	3	3	2	2	LC	12/7		1		10000	2	3	3
CO3	3	2	3	2	3 .	1.1	740	1 2 11	-	- //	11.	2	3	3
CO4	3	3	3	2	3		-12/41	W. William	1200	7 (4)		2	3	3
CO5	3	2	2	1	2	- /-	11.05 [7]	-		0117 <b>-</b> 37-0	1 102 0	1	3	3



ME2	3651	VEHICLE DYNAMICS AND CONTROL	3	0	0	3
COU	JRSE (	OBJECTIVES				
To e	nable t	he students to	Man V.	- 16.5	Marin -	-
1		p physical and mathematical models that accurately predict the dynamic response operating conditions.	e of v	/ehic	les ur	nder
2		vehicle design performance criteria and utilize these benchmarks effectively to a performance and safety.	issess	and	impi	ove
3		te dynamic analysis methods into the vehicle design process, enhancing the accuracy ability of vehicle behavior predictions.	y of si	mula	itions	and
4		tand the fundamental principles of lateral dynamics, including steering, cornering ved control and maneuverability.	g, and	d sta	bility,	for
5		te the longitudinal dynamics and control systems in automobiles, focusing on accele n control for optimal performance and safety.	ration	ı, bra	king,	and
UNI	TI	CONCEPT OF VIBRATION				9
resis	axis s	TYRES system, tyre forces and moments, tyre marking, tyre structure, hydroplaning, who factors affecting rolling resistance, Longitudinal and Lateral force at various slip a roperty of tire. Performance of tire on wet surface. Ride property of tyres. Various t	angles	s, Tra	active	and
and the same	TIII	VERTICAL DYNAMICS				9
Hum Desi full	an res	ponse to vibration, Sources of Vibration. Suspension requirements – types. State Spanalysis of Passive, Semi active and Active suspension using Quarter car, Bicycle orating model. Influence of suspension stiffness, suspension damping, and tire stigoptimization techniques. Air suspension system and their properties.	Mod	el, ha	ılf car	tion.
UNI	TIV	LONGITUDINAL DYNAMICS AND CONTROL				9
Aero Calc acce Driv	odynan ulatior leratio	nic forces and moments. Equation of motion. Load distribution for three-wheeler of maximum acceleration, tractive effort and reaction forces for different drive vehicle and traction limited acceleration. Estimation of CG location. Stability of vehicle dynamics. Braking and Driving torque. Prediction of Vehicle performance. AB	icles. les re	Pow	er lin	eler. nited lope.
UNI	TV	LATERAL DYNAMICS		-	100	9
Stea	dy sta	te handling characteristics. Steady state response to steering input - Yaw ven gain, curvature response gain. Testing of handling characteristics. Transient response		_		teral

Steering dynamics. Direction control of vehicles. Roll center, Roll axis. Stability of vehicle on banked road, during turn. Effect of suspension on cornering. Minuro Plot for Lateral Transient Response.

		TOTAL PERIODS:45			
COU	RSE OUTCOMES	BT MAPPED			
At the	end of the course, the students will be able to	(Highest level)			
CO1	develop physical and mathematical models to predict the dynamic response of vehicles dynamic response	Understanding (K2)			
CO2	apply vehicle design performance criteria and how to use the criteria to evaluate vehicle	Applying (K3)			
CO3	use dynamic analyses in the design of vehicles.	Applying (K3)			
CO4	understand the principle behind the lateral dynamics.	Understanding (K2)			
CO5	understand the longitudinal dynamics and control in an automobile.	Understanding (K2)			
		35110100			

## TEXT BOOKS

- 1. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics," Society of Automotive Engineers Inc, 2014
- 2. J. Y. Wong, "Theory of Ground Vehicles", Fourth Edition, Wiley-Interscience, 2008.

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- 1. Singiresu S. Rao, "Mechanical Vibrations," Fifth Edition, Prentice Hall, 2010
- 2. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics," Society of Automotive Engineers Inc, 2014.
- 3. Dean Karnopp, "Vehicle Dynamics, Stability, and Control", Second Edition, CRC Press, 2013.
- 4. R. Nakhaie Jazar, "Vehicle Dynamics: Theory and Application", Second edition, Springer, 2013

## 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)												
The state of	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	-	-	-	97 <b>-</b> E	7-1	da-m	mi e in	1	2	2
CO2	3	3	3	1	ut • 23	to 20(1)		00.589	00-0	unt-old	in an	1	2	2
CO3	3	3	3	1	/ - n	lan Z	7.1	. Sm	min.		-	1	2	2
CO4	3	3	3	1	-	-	-	-	-	-	-	1	2	2
CO5	3	3	3	1	-	_		- 2	-	9 <u>18</u> 8	- 52	1	2	2

Approved
BOARD OF STUDIES
Mechanical Engineering

AUTONOMOUS

	23652	ELECTRIC VEHICLE TECHNOLOGY	3	0	0	3
CO	URSE OF	BJECTIVES		•		
То	enable the	students to	A SHOW THE	-		- Tn
1	understar	nd the fundamentals and classifications of electric vehicles.		ac II		
2	learn abo	ut various types of electric propulsion systems and their operation.			_	
3	analyze e	nergy storage systems and battery technologies used in EVs.	lavel.			-
4	study cha	arging infrastructure and power electronics in EVs.	777			
5	explore d	esign considerations, challenges, and emerging trends in electric vehicle tech	nology.			
UN	TI I	NTRODUCTION TO ELECTRIC VEHICLES				9
		volution of electric vehicles - Comparison with IC engine vehicles - Types of	felectric	vehic	les: E	
		FCEV - Vehicle performance parameters - Electric vehicle configuration				
Cha	llenges an	d opportunities in EV adoption.				
UN	IT II I	ELECTRIC PROPULSION SYSTEMS	a land			9
Arc	hitecture o	of EV and HEV - Traction motor characteristics - Types of motors used: DC	motor, In	ducti	on m	otor
BLI	OC, PMSN	M, SRM - Motor control strategies - Transmission systems in electric vehicles	-Regen	erativ	e bral	king
UN	тш 1	ENERGY STORAGE SYSTEMS		17.0		9
		ency, cycle life – Battery management system (BMS) – Thermal managem	ent – Su	perca	pacito	ors -
		anou avala life Dattom management avatem (DMC) Thermal management	ant C		:4	
		ency, cycle life – Battery management system (BMS) – Thermal managemoes, working, and integration in EVs.	ent – Su	perca	pacito	ors -
Fue UN	l cells: typ	pes, working, and integration in EVs.  POWER ELECTRONICS AND CHARGING SYSTEMS				9
Fue UN DC-	l cells: typ  IT IV   1  DC conv	POWER ELECTRONICS AND CHARGING SYSTEMS erters, inverters, and control – Charging methods: slow, fast, wireless –	Charging	stan	dards	s and
Fue UN DC-	l cells: typ  IT IV   1  DC conv	pes, working, and integration in EVs.  POWER ELECTRONICS AND CHARGING SYSTEMS	Charging	stan	dards	s and
Fue UN DC- prot	I cells: typ IT IV 1 DC conv cocols – O	POWER ELECTRONICS AND CHARGING SYSTEMS erters, inverters, and control – Charging methods: slow, fast, wireless – en-board and off-board chargers – Smart charging infrastructure – Grid integral DESIGN, CONTROL, AND FUTURE TRENDS	Charging ation and	stan V2G	dards	and
Fue UN DC- prot	I cells: typ IT IV 1 DC conv cocols – O	POWER ELECTRONICS AND CHARGING SYSTEMS erters, inverters, and control – Charging methods: slow, fast, wireless – en-board and off-board chargers – Smart charging infrastructure – Grid integral	Charging ation and	stan V2G	dards	s and
UN DC- prot UN Veh	I cells: typ  IT IV   1  DC conv  ocols – O  IT V   1  icle desig	POWER ELECTRONICS AND CHARGING SYSTEMS erters, inverters, and control – Charging methods: slow, fast, wireless – en-board and off-board chargers – Smart charging infrastructure – Grid integral DESIGN, CONTROL, AND FUTURE TRENDS	Charging ation and S – Therm	stan V2G al ma	dards	s and cepts men
Fue UN DC- prot UN Veh of H	I cells: typ IT IV   I DC conv cocols - O IT V   I cicle desig	POWER ELECTRONICS AND CHARGING SYSTEMS erters, inverters, and control – Charging methods: slow, fast, wireless – on-board and off-board chargers – Smart charging infrastructure – Grid integral DESIGN, CONTROL, AND FUTURE TRENDS on aspects for EVs – EV modeling and simulation basics – Safety and standards	Charging ation and S – Therm	stan V2G al ma	dards	s and cepts men
Fue UN DC- prot UN Veh of H	I cells: typ IT IV   I DC conv cocols - O IT V   I cicle desig	POWER ELECTRONICS AND CHARGING SYSTEMS erters, inverters, and control – Charging methods: slow, fast, wireless – on-board and off-board chargers – Smart charging infrastructure – Grid integral DESIGN, CONTROL, AND FUTURE TRENDS In aspects for EVs – EV modeling and simulation basics – Safety and standards onents – Autonomous and connected electric vehicles – Trends in EV technitiatives.	Charging ation and S – Therm	stan V2G al ma	dards	s and cepts men men
Fue UNI DC- prot UNI Veh of I	I cells: typ  IT IV   I  DC conv  cocols – O  IT V   I  cicle desig  EV compositions and in	POWER ELECTRONICS AND CHARGING SYSTEMS  erters, inverters, and control – Charging methods: slow, fast, wireless – en-board and off-board chargers – Smart charging infrastructure – Grid integral DESIGN, CONTROL, AND FUTURE TRENDS  In aspects for EVs – EV modeling and simulation basics – Safety and standards onents – Autonomous and connected electric vehicles – Trends in EV technitiatives.	Charging ation and — Therm nologies	stan V2G al ma – Go	dards	s and cepts men men
Fue UNI DC- prot UNI Veh of F	I cells: typ IT IV   I DC conv cocols – O IT V   I dicle desig EV compositions and in	DESIGN, CONTROL, AND FUTURE TRENDS  In aspects for EVs – EV modeling and simulation basics – Safety and standards onents – Autonomous and connected electric vehicles – Trends in EV technitiatives.	Charging ation and — Therm nologies	stan V2G al ma – Go PER	dards	s and cepts men men
Fue UNI DC- prot UNI Veh of I poli	I cells: typ IT IV   I DC convectors - O IT V   I icle design EV composites and in URSE OI he end of	POWER ELECTRONICS AND CHARGING SYSTEMS erters, inverters, and control – Charging methods: slow, fast, wireless – on-board and off-board chargers – Smart charging infrastructure – Grid integral DESIGN, CONTROL, AND FUTURE TRENDS In aspects for EVs – EV modeling and simulation basics – Safety and standards onents – Autonomous and connected electric vehicles – Trends in EV technitiatives.  UTCOMES the course, the students will be able to	Charging ation and — Therm nologies  TOTAL  BT MAI	stan V2G al ma – Go PER PPER level	dards concernance	s and seepts men men
Fue UNI DC- prot UNI Veh of I poli CO At t	I cells: typ IT IV   1 DC conv cocols - O IT V   1 cicle design EV composites and in URSE OI the end of	POWER ELECTRONICS AND CHARGING SYSTEMS  erters, inverters, and control – Charging methods: slow, fast, wireless – en-board and off-board chargers – Smart charging infrastructure – Grid integral DESIGN, CONTROL, AND FUTURE TRENDS  In aspects for EVs – EV modeling and simulation basics – Safety and standards onents – Autonomous and connected electric vehicles – Trends in EV technitiatives.  UTCOMES  the course, the students will be able to gibe the fundamentals, architecture, and types of electric vehicles	Charging ation and — Therm nologies  TOTAL  BT MAI (Highest	stan V2G al ma – Go PER PPER level	dards conc anage overn (IOD)	s and septs men men
Fue UNI DC- prote UNI Veh of I poli CO At t	I cells: typ IT IV   1 DC convocals - O IT V   1 dicle design EV componies and in URSE OI he end of 1   descrip	POWER ELECTRONICS AND CHARGING SYSTEMS erters, inverters, and control – Charging methods: slow, fast, wireless – in-board and off-board chargers – Smart charging infrastructure – Grid integral DESIGN, CONTROL, AND FUTURE TRENDS In aspects for EVs – EV modeling and simulation basics – Safety and standards onents – Autonomous and connected electric vehicles – Trends in EV technitiatives.  UTCOMES the course, the students will be able to libe the fundamentals, architecture, and types of electric vehicles in electric propulsion systems and motor control strategies.	Charging ation and — Therm nologies  TOTAL  BT MAI (Highest Understa	stan V2G al ma – Go PER level anding	dards conc unage overn JODS ) g (K2)	s and septs men men
Fue UNI DC- prot UNI Veh of I poli	I cells: typ  IT IV   1  DC convocos - O  IT V   1  dicle desig  EV composites and in  URSE OI  he end of  descri  expla  analy	POWER ELECTRONICS AND CHARGING SYSTEMS erters, inverters, and control — Charging methods: slow, fast, wireless — in-board and off-board chargers — Smart charging infrastructure — Grid integral DESIGN, CONTROL, AND FUTURE TRENDS In aspects for EVs — EV modeling and simulation basics — Safety and standards onents — Autonomous and connected electric vehicles — Trends in EV technitiatives.  UTCOMES The course, the students will be able to gibe the fundamentals, architecture, and types of electric vehicles in electric propulsion systems and motor control strategies.  Zee the selection, operation, and management of energy storage systems.	Charging ation and s—Therm anologies TOTAL BT MAI (Highest Understa	stan V2G al ma – Go PER level anding anding	dards conc mage overn JODS ) g (K2	s and septs

- 1. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, 2nd Edition, CRC Press, 2011.
- 2. James Larminie and John Lowry, Electric Vehicle Technology Explained, 2nd Edition, Wiley, 2012.

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- John G. Hayes, G. A. Goodarzi, Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, Wiley, 2018.
- 3. Chan, C.C. and Chau, K.T., Modern Electric Vehicle Technology, Oxford University Press, 2001.
- 4. Rui Xiong, Battery Management Algorithm for Electric Vehicles, Springer, 2020.

# CO - PO MAPPING

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

COs	MILE SO	Programme Outcomes(POs)													
Topical	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2	
CO1	3	2	2	-	1	2	2	-	/ - ·	-		2	3	2	
CO2	3	2	2	1	2	4.	IA.	10 - 3	5-0	1-3	-	2	3	3	
CO3	3	3	3	2	3	1	12-16		10-7		- D	2	3	3	
CO4	3	2	2	2	3	_1	1.00	-	0.80	m = 27	gar Wind	2	3	3	
CO5	3	3	3	2	2	2	2	1	1	1	1	3	3	3	

Approved
BOARD OF STUDIES
Mechanical Engineering
AUTONOMOUS

\*\*AUTONOMOUS

MF	E23653	SMART MOBILITY AND VEHICLE SYSTEMS	3	0	0	3
CO	URSE O	BJECTIVES		Tel		7,3
То	enable the	e students to			1	
1	introduc vehicles	e students to the various technologies and systems used to implement smart mobil	lity :	and i	ntelli	gent
2	1000	asics of Radar Technology and Systems, Ultrasonic Sonar Systems, LIDAR Senso and other sensors for automobile vision system.	or Te	echno	ology	and
3	learn Ba	sic Control System Theory applied to Autonomous Automobiles				
4		overall impact of automating like various driving functions, connecting the automation that assist with a task	obile	e to s	ource	es of
5		e automobile to make autonomous intelligent decisions concerning future actions ally impact the safety of the occupants through connected car & autonomous vehicle				that
UN		INTRODUCTION TO AUTOMATED, CONNECTED, AND INTELLIGENT VEHICLES	r			9
Pov	wertrain E	Electronics, Introduction to Automated, Connected, and Intelligent Vehicles. Case st	tudie	es: A	utom	ated,
Co	nnected, a	and Intelligent Vehicles.				
UN	птп	SENSOR TECHNOLOGY FOR SMART MOBILITY	logy	and	Syst	9 ems.
UN Bas Can Da	sics of Ramera Techta to On-E	SENSOR TECHNOLOGY FOR SMART MOBILITY adar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Interest Control Systems.	-			ems,
UN Bas Can Da	sics of Ramera Techta to On-B	SENSOR TECHNOLOGY FOR SMART MOBILITY adar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Interpretational Systems.  CONNECTED AUTONOMOUS VEHICLE	tegra	ition	of Se	ems, ensor
UN Bas Can Da UN B	sics of Ramera Techta to On-E	SENSOR TECHNOLOGY FOR SMART MOBILITY adar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Interest Control Systems.	tegra	Cybe	of Se	ems, ensor 9
UN Bas Can Da UN B Sy	sics of Ramera Techta to On-E	SENSOR TECHNOLOGY FOR SMART MOBILITY  adar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Interpretational Systems.  CONNECTED AUTONOMOUS VEHICLE  rol System Theory applied to Automobiles, Overview of the Operation of ECUs, Bareory and Autonomous Vehicles, Role of Surroundings Sensing Systems and A	tegra	Cybe	of Se	ems, ensor
UN Bas Car Da UN B Sy W	sics of Ramera Techta to On-Basic Contrystem The	SENSOR TECHNOLOGY FOR SMART MOBILITY adar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Interpretational Systems.  CONNECTED AUTONOMOUS VEHICLE rol System Theory applied to Automobiles, Overview of the Operation of ECUs, Base eory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy.	tegra	Cybe	of Se	ems, ensor
UN Bas Car Da UN B Sy W	sics of Ramera Techta to On-Basic Contraction The Vireless Date of Ramera Techta to On-Basic Contraction The Vireless Date of Ramera Technology (NT IV Incless System Syst	SENSOR TECHNOLOGY FOR SMART MOBILITY  adar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Interpretation of Systems.  CONNECTED AUTONOMOUS VEHICLE  rol System Theory applied to Automobiles, Overview of the Operation of ECUs, Bareory and Autonomous Vehicles, Role of Surroundings Sensing Systems and A ata Networks and Autonomy.  VEHICLE WIRELESS TECHNOLOGY & NETWORKING	asic (	Cybe nomy	of Se	ems, ensor  9 rsical le of  9 ding,
UN Bass VW UN Wi Re	sics of Ramera Techta to On-Basic Contract The Vireless Davireless System Syste	SENSOR TECHNOLOGY FOR SMART MOBILITY  adar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Interpretation of Systems.  CONNECTED AUTONOMOUS VEHICLE  rol System Theory applied to Automobiles, Overview of the Operation of ECUs, Base eory and Autonomous Vehicles, Role of Surroundings Sensing Systems and A ata Networks and Autonomy.  VEHICLE WIRELESS TECHNOLOGY & NETWORKING stem Block Diagram and Overview of Components, Transmission Systems – Most	asic (	Cybe nomy	of Se	ems, ensor  9 esical le of  9 ding, hicle
UN Base Car Da UN B Sy W UN Wi Re	sics of Ramera Techta to On-Electronia III asic Contract The Vireless David III III areless System The IIII IIII IIII IIIII IIIII IIIIIIIII IIII	SENSOR TECHNOLOGY FOR SMART MOBILITY  adar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Interpretation of Systems.  CONNECTED AUTONOMOUS VEHICLE  rol System Theory applied to Automobiles, Overview of the Operation of ECUs, Base eory and Autonomous Vehicles, Role of Surroundings Sensing Systems and A ata Networks and Autonomy.  VEHICLE WIRELESS TECHNOLOGY & NETWORKING  stem Block Diagram and Overview of Components, Transmission Systems – Most of Systems Concepts – Demodulation/Decoding, Wireless Networking and Applications.	asic (	Cybe nomy	of Se	ems, ensor  9 esical le of  9 ding, hicle
UN Bas Car UN B Sy W UN Wi Re Au	sics of Ramera Techta to On-Basic Contrystem The Vireless David III III IIII IIII IIIIIIIIIIIIIIIIII	SENSOR TECHNOLOGY FOR SMART MOBILITY adar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Interpretation of Systems.  CONNECTED AUTONOMOUS VEHICLE rol System Theory applied to Automobiles, Overview of the Operation of ECUs, Base eory and Autonomous Vehicles, Role of Surroundings Sensing Systems and A ata Networks and Autonomy.  VEHICLE WIRELESS TECHNOLOGY & NETWORKING stem Block Diagram and Overview of Components, Transmission Systems – Mostystem Concepts— Demodulation/Decoding, Wireless Networking and Applications of Computer Networking – the Internet of Things, Wireless Networking	asic (	Cybe nomy	of Se	ems, ensor  9 esical le of  9 ding, hicle
UN Bass Carl Da UN B Sy W UN Wi Re Au Int UN Co	sics of Ramera Techta to On-Electronia III asic Contraction of the III asic Contraction III asic Contraction III II asic Contraction II II II asic Contraction II II II II asic Contraction II	SENSOR TECHNOLOGY FOR SMART MOBILITY adar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, International Systems.  CONNECTED AUTONOMOUS VEHICLE rol System Theory applied to Automobiles, Overview of the Operation of ECUs, Base eory and Autonomous Vehicles, Role of Surroundings Sensing Systems and A ata Networks and Autonomy.  VEHICLE WIRELESS TECHNOLOGY & NETWORKING stem Block Diagram and Overview of Components, Transmission Systems – Most ystem Concepts – Demodulation/Decoding, Wireless Networking and Applications of Computer Networking – the Internet of Things, Wireless Networking of Wireless Networking and On-Board Vehicle Networks.	dula ation y an	Cybernomy tion/ ns to Func	r-Phy , Ro Enco	ems, ensor  9 rsical le of  ding, hicle ntals,

COUI	RSE OUTCOMES .	BT MAPPED
At the	end of the course, the students will be able to	(Highest level)
CO1	recognize the concept of cyber-physical control systems and their application to collision avoidance and autonomous vehicles	Analysing (K4)
CO2	select the concept of remote sensing and the types of sensor technology needed to implement remote sensing	Understanding (K2)
CO3	familiar with the concept of fully autonomous vehicles	Applying (K3)
CO4	apply the basic concepts of wireless communications and wireless data network	Applying (K3)
CO5	analyze the concept of the connected vehicle and its role in automated vehicles	Analysing (K4)

- "Intelligent Transportation Systems and Connected and Automated Vehicles", 2016, Transportation Research Board
- "Smart Energy and Intelligent Transportation Systems" Albert Y.S. Lam, Boguslaw Lazarz, Grzegorz Perun, MPDI, 2022.

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- "Smart Mobility and Intelligent Transportation Systems for Commercial and Hazardous Vehicles", Naga Swetha Pasupuleti, T. Poongodi, Balamurugan Balusamy, CRC Press, 2023
- 3. "Smart Mobility", Arif Sarwat, Asadullah Khalid, Ahmed Hasnain Jalal, Intech Open, 2023.
- 4. Radovan Miucic, "Connected Vehicles: Intelligent Transportation Systems", 2019, Springer.

#### CO - PO MAPPING

COs		Programme Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	1				-	-	1	2	1
CO2	3	2	1	1	-	1	-	-	-			1	2	1
CO3	3	2	1	1	-	1	-	-	-		7 15	1	2	1
CO4	3	2	1	1	-	1	-		-	-		1	2	1
CO5	3	2	1	1	-	-1	-	-	-	-	1	1	2	1



	23654	THERMOCHEMICAL ENERGY SYSTEMS	3	0	0	3
cot	JRSE OB	JECTIVES	'			
Тое	nable the	students to	TAS TO T		4	
1	evaluvate	the potential and role of biomass in sustainable energy development	- 1			
2	identify ty	pical biomass feedstocks for biogas production				
3	learn the s	significance of the equivalence ratio in combustion systems			2	
4	analyse th	ne governing parameters and yield characteristics of each process	- 1	10	4	
5	explore th	ne engine modifications required for using bio-alcohols as fuels.				
UNI	TIS	OLID FUELS AND RESOURCE ASSESSMENT		13		9
		fuels - Advantages and limitations - Typical fuel characteristics - Proximate	e and ult	imate	e anal	1 6
Conv		echanisms – Densification technologies.  NAEROBIC CONVERSION SYSTEMS	er estác mai pen			
Anae	erobic dig	estion process - Influencing parameters - Common feedstocks - Digester	rs: types	and	desig	n -
Utili	zation sys	stems: burners, lighting, and power generation - Conversion of industrial	effluent	s int	o ene	rgy
Stora	age and di	stribution systems for anaerobic gas.				
		stribution systems for anaerobic gas.  COMBUSTION FUNDAMENTALS	TAMES			9
UNI	тш		t – Equiv	alen	ce rat	1
UNI Type Fixe	T III Coss of com	COMBUSTION FUNDAMENTALS				
UNI Type Fixed syste	TIII Comes of comes dependent and comes.	COMBUSTION FUNDAMENTALS bustion: perfect, complete, and incomplete – Stoichiometric air requirement d fluidized bed combustion systems, Design considerations for small- and l				io -
UNI Type Fixed system UNI	TIII Coss of come do bed and tems.	COMBUSTION FUNDAMENTALS bustion: perfect, complete, and incomplete – Stoichiometric air requirement d fluidized bed combustion systems, Design considerations for small- and l THERMOCHEMICAL CONVERSION METHODS	large-sca	le co	ombus	io -
UNI Type Fixed syste UNI Gasi aspec	T III Coss of coming dispersion community of the cost	bustion: perfect, complete, and incomplete – Stoichiometric air requirement fluidized bed combustion systems, Design considerations for small- and learning the stoichiometric air requirement fluidized bed combustion systems, Design considerations for small- and learning the stoichiometric air requirement fluidized bed combustion systems, Design considerations for small- and learning the stoichiometric air requirement fluidized bed combustion systems, Design considerations for small- and learning the stoichiometric air requirement fluidized bed combustion systems, Design considerations for small- and learning the stoichiometric air requirement fluidized bed combustion systems, Design considerations for small- and learning the stoichiometric air requirement fluidized bed combustion systems, Design considerations for small- and learning the stoichiometric air requirement fluidized bed combustion systems, Design considerations for small- and learning the stoichiometric air requirement fluidized bed combustion systems, Design considerations for small- and learning the stoichiometric air requirement fluidized bed combustion systems, Design considerations for small- and learning the stoichiometric air requirement fluidized bed combustion systems, Design considerations for small- and learning the stoichiometric air requirement fluidized bed combustion systems, Design considerations for small- and learning the stoichiometric air requirement fluidized bed combustion systems.	large-sca	le co	econo	io - tior
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CO4	analyse the influence of process governing parameters in thermochemical conversion of biomass.	Analysing (K4)
CO5	synthesize liquid biofuels for power generation from biomass.	Understanding (K2)

- Biomass for Bioenergy and Biomaterials, by Nidhi Adlakha, Rakesh Bhatnagar, Syed Shams Yazdani, CRC Press; 1st edition (22 October 2021), ISBN-10: 0367745550
- Bioenergy and Biochemical Processing Technologies, by Augustine O. Ayeni, Samuel Eshorame Sanni, Solomon U. Oranusi, Springer (30 June 2022).

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- 3. Khandelwal KC, Mahdi SS, Biogas Technology A Practical Handbook, Tata McGraw Hill, 1986
- 4. Mahaeswari, R.C. Bio Energy for Rural Energisation, Concepts Publication, 1997

## CO - PO MAPPING

COs		Programme Outcomes(POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	2	2		3	10.5	1	14-1	2	2	3	-
CO2	2	2	3	2	la fund	2	2	-	-	cel fishii	2	2	3	V <b>H</b> S
CO3	2	2	3	2	-	-	1	-	-	-	2	2	3	2
CO4	2	2	3	2			- 1	-			2	2	3	1
CO5	2	2	3	2	-	-	1	-	-	-	2	2	3	1



	3655	SHEET METAL AND COMPOSITE MATERIAL DESIGN	3	0	0	3
COU	RSE OB	BJECTIVES				
To er	nable the	students to	unitarion.	Carles .		
1 ι	ınderstan	d the fundamentals and properties of sheet metal and composite materials.		n)		
2 6	explore va	arious forming processes and their applications.	-			
3 1	earn desi	gn considerations specific to sheet metal components.			1	
4 ı	ınderstan	nd composite material selection and manufacturing techniques.	1.7.2			
5 0	develop d	lesign strategies using CAD/CAE for lightweight and high-strength structure	es.	Sm	YS I	
UNI	ri s	SHEET METAL MATERIALS AND PROPERTIES	Ad Jak		9	9
Mate sheet	rial failur metal usa					
UNIT	CONTRACT OF STREET	SHEET METAL FORMING PROCESSES			100	9
		iking, bending, deep drawing – Stretch forming – Roll forming – Hydroform		0	f dies	and
The Control of the Co		cess parameters and formability limits - Safety and quality control in formi	ng operati	ons.		
UNI	IIII   S					200
and j	gn for man	SHEET METAL PART DESIGN AND CAD TECHNIQUES unufacturability – Bend allowance and relief – Tolerances – Hole and featur nethods – CAD modeling for sheet metal (using software like SolidWork	- F	173	Faste	100
and j	gn for man oining m ng strateg	nufacturability – Bend allowance and relief – Tolerances – Hole and feature nethods – CAD modeling for sheet metal (using software like SolidWork	- F	173	Faste	ning
and j nestin UNIT Class and n	gn for man	nufacturability – Bend allowance and relief – Tolerances – Hole and feature nethods – CAD modeling for sheet metal (using software like SolidWork gies.  INTRODUCTION TO COMPOSITE MATERIALS of composites – Matrix and reinforcement types – Properties and selection of chanics – Applications in aerospace, automotive, and consumer products –	s/Creo) –	Flatt	Faste	ening and
and j nestin UNIT Class and n and f	oining many strategrams of IV III in acromec catigue belong.	nufacturability – Bend allowance and relief – Tolerances – Hole and feature nethods – CAD modeling for sheet metal (using software like SolidWork gies.  INTRODUCTION TO COMPOSITE MATERIALS of composites – Matrix and reinforcement types – Properties and selection of chanics – Applications in aerospace, automotive, and consumer products – chaviour.  COMPOSITE MANUFACTURING AND DESIGN PRINCIPLES	eriteria – N	Flatt	Faste	9 anics
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unition and from the control of the	gn for man oining man strategy of IV II sification of macromechatigue belong IV II lay-up, ling and pro/CAE too	nufacturability – Bend allowance and relief – Tolerances – Hole and feature nethods – CAD modeling for sheet metal (using software like SolidWork gies.  INTRODUCTION TO COMPOSITE MATERIALS  of composites – Matrix and reinforcement types – Properties and selection of chanics – Applications in aerospace, automotive, and consumer products – chaviour.  COMPOSITE MANUFACTURING AND DESIGN PRINCIPLES  spray-up, compression molding, RTM, filament winding, pultrusion, a processing requirements – Design guidelines for laminates – Failure theories	eriteria – M Environm nd prepre	Flatt Microrental g tecid cor	Faste ening mecha resist	9 nes - tes -
and j nestin UNIT Class and n and f UNIT Hand Tooli CAD	gn for man oining man strategy of IV II sification of macromechatigue belong the IV II lay-up, ling and pro/CAE too	nufacturability – Bend allowance and relief – Tolerances – Hole and feature nethods – CAD modeling for sheet metal (using software like SolidWork gies.  INTRODUCTION TO COMPOSITE MATERIALS of composites – Matrix and reinforcement types – Properties and selection of chanics – Applications in aerospace, automotive, and consumer products – chaviour.  COMPOSITE MANUFACTURING AND DESIGN PRINCIPLES spray-up, compression molding, RTM, filament winding, pultrusion, a processing requirements – Design guidelines for laminates – Failure theorieols for composite design.	eriteria – N Environm  nd prepre es – Hybri	Flatt ficror ental g teclid cor PER	Faste ening mecha resist hnique mposi	9 nes - tes -
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and j nestin UNIT Class and n and f UNIT Hand Tooli CAD  COU At th	gn for man oining man strateg  FIV II strated in the stratege below the stratege below the stratege below the stratege below the strategy of t	nufacturability — Bend allowance and relief — Tolerances — Hole and feature nethods — CAD modeling for sheet metal (using software like SolidWork gies.  INTRODUCTION TO COMPOSITE MATERIALS of composites — Matrix and reinforcement types — Properties and selection of chanics — Applications in aerospace, automotive, and consumer products — chaviour.  COMPOSITE MANUFACTURING AND DESIGN PRINCIPLES spray-up, compression molding, RTM, filament winding, pultrusion, a processing requirements — Design guidelines for laminates — Failure theoricals for composite design.  UTCOMES the course, the students will be able to attempt to the course of the students of the course of the students of the students will be able to attempt to the course of the students of the studen	riteria – N Environm  nd prepre es – Hybri  TOTAL  BT MAI (Highest  Analyzir  Understa	Flatt ficror ental g tech id cor  PER PPED level ng (K4 anding	Faste ening mecha resist IODS (K2)	9 9 9 ess - s:45

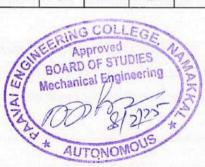
- 1. Paul D. Mathur, Sheet Metal Design and Fabrication, Cengage Learning, 2020.
- Mallick, P.K., Fiber-Reinforced Composites: Materials, Manufacturing, and Design, CRC Press, 4th Edition, 2022.

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- 2. Rao, P.N., Manufacturing Technology Vol. 2, McGraw-Hill Education, 5th Edition, 2018.
- 3. Kalpakjian, S., Manufacturing Engineering and Technology, Pearson Education, 8th Edition, 2021.
- 4. Campbell, F.C., Introduction to Composite Materials, ASM International, 2010.

# CO - PO MAPPING

COs					Progr	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	2	2	1.5	2	-	1	avia e	2	2	3	-
CO2	2	2	3	2	2	1	1	-	120	-	2	2	3	-
CO3	2	2	3	2	3	-	1	-	-	7 - 7	2	2	3	2
CO4	2	2	3	2	2	-	2	-	-	-	2	2	3	2
CO5	2	.2	3	2	3	-	2	-	-	-	2	2	3	2



ME23656	AUTOMOTIVE ENGINES AND SUBSYSTEMS	3	0	0	3
COURSE	OBJECTIVES				
To enable	the students to	- 14	9000	01-150	Ela
1 study	the construction and function of engine components in SI and CI engines.		The		
2 under	stand the combustion process and influencing factors in SI engines.	70.7	9 9)	17/4	
3 exam	ne combustion characteristics and air-fuel interaction in CI engines.			117	7 3
4 learn	the principles and types of engine lubrication and cooling systems.	700			
5 explo	re the impact and methods of supercharging and turbocharging.				
UNITI	ENGINE CONSTRUCTION AND ITS COMPONENT				9
Four strol	e SI and CI engines - Working principle- Constructional details of engine com	pone	ents,	func	tion,
materials,	Intake system components - Discharge coefficient, Pressure drop Air filter, intake ma	nifol	d. C	onnec	cting
	ust system components – Exhaust manifold and exhaust pipe, Spark arresters - Exhau				
operation.	ust system components – Exhaust mannoid and exhaust pipe, spark arresters - Exhau	St III	ume	18, 13	pes,
UNIT II	COMBUSTION IN SI ENGINES				-
	on process in IC engines, Stages of combustion, Flame propagation Flame velocity and				9
	esign. Gasoline injection Systems				
UNIT III	COMBUSTION IN CI ENGINES				9
Importanc	e of air motion - Swirl, squish and turbulence - Swirl ratio. Fuel air mixing - Stag	es of	com	busti	on –
Delay per	od - Factors affecting delay period, Knock in CI engines - methods of controlling dies	el kn	ock,	CI en	gine
combustic	n chambers - Combustion chamber design objectives - open and divided. Induction	on s	wirl,	turb	ulent
combustic	n chambers Air cell chamber - M Combustion chamber, Diesel injection system.				
UNIT IV	LUBRICATION AND COOLING SYSTEM				9
Need for	cooling system - Types of cooling system - Liquid cooled system: Thermosyph	on s	yster	n, Fo	rced
circulation	system, pressure cooling system - properties of coolant, additives for coolants N	eed	for l	ubric	ation
system -	Mist lubrication system, wet sump any dry sump lubrication - Properties of lubricar	ıts, c	onsu	mptio	on of
oil.					
UNIT V	SUPERCHARGING AND TURBOCHARGING				9
Objective	- Effects on engine performance - engine modification required - Thermodynamic	s of	supe	rchai	ging
and Turb	ocharging - Turbo lag- Windage losses- Turbo charging methods - Engine	exh	aust	man	ifold
arrangeme	nts.				
	TOT	'AT.	DED	IOD	0.45
			LLI	IOD	3:43

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COU	RSE OUTCOMES	BT MAPPED
At the	end of the course, the students will be able to	(Highest level)
CO1	outline the various components of the engine and its functions.	Understanding (K2)
CO2	examine the combustion process in SI and CI Engine for understanding the performance and emission characteristics.	Analysing (K4)
CO3	summarize various fuel supply and injection system used in IC engines	Understanding (K2)
CO4	identify various lubricants used in IC engines and assess their properties relevant to engine performance	Analysing (K4)
CO5	explain the concepts of supercharging and turbocharging.	Applying (K3)

- 1. Ganesan V "Internal combustion engines", 4th edition, Tata McGraw Hill Education, 2017.
- 2. Rajput R. K, "A textbook of Internal Combustion Engines, 2<sup>nd</sup> edition Laxmi Publications (P) Ltd, 2017.

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- 6. Edward F, Obert, "Internal Combustion Engines and Air Pollution", Intext Education Publishers, 2023.
- 7. Mathur and Sharma, "A course on Internal combustion Engines", Dhanpat Rai & Sons, 2015
- 8. A.K. Babu and V. Antony Aroul Raj, "Automotive Engines", Khanna Publishing House, 2018

## CO - PO MAPPING

COs		- 1			Progra	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO
CO1	3	2	2	-	-	-	-	-	-	-		1	2	2
CO2	3	3	2	2	-		-	-		-	-	1	2	2
CO3	3	3	2	2		-	-	-	-	-	-	1	2	2
CO4	3	2	2	-	-	-	-	-	-	-	-	1	2	2
CO5	3	2	3	2	2	-	-	-	-	-	-	1	2	2



ME:	23657	INTELLIGENT VEHICLE SYSTEM	3	0	0	3
COI	URSE (	DBJECTIVES				
То	enable t	ne students to	rs venoù	and)	elege.	
1	unders	and the need, benefits, and modern trends in Intelligent Vehicle Systems and expl	ore v	ariou	s AI	AS
1	techno	ogies used to enhance driving safety and comfort.				
2	introdu	ce connected vehicle technologies, including V2V and V2I communications, and	ınder	stand	the	role
_	A PERSON NAMED IN COLUMN	natics and onboard systems in modern vehicles.				
3		e foundational knowledge of autonomous driving technologies, including percention methods, and system architecture.	eptio	n al	gorith	ıms,
4	develo	p an understanding of perception systems, prediction models, and routing technique	s.			
5	unders	and the decision-making and control mechanisms that guide autonomous vehicle m	otion			
UNI	ΙΤΙ	INTRODUCTION TO INTELLIGENT VEHICLE SYSTEM				9
Ben	efits of	Intelligent Vehicles; Enabling Technologies-Environment State - Driver St	ate-;	Roa	d So	ene
Und	lerstand	ing-Road/Lane Tracking-Road Sign Detection-Traffic-Light Detection-Visibility A	ssess	men	t-Veh	icle
Dete	ection;	Advanced Driver Assistance-Collision Avoidance and Mitigation-Adaptive Crui	se C	ontro	l: Di	iver
		-Driver Fatigue, Inattention, and Impairment -Driver and Passenger Protection; A			200	
		gestion-Environmental Factors.			·	
	IT II	WIRELESS VEHICULAR COMMUNICATIONS				9
	Sec. 10.00	and History of Vehicular Networking; Vehicular Networking Approaches;	Vehi	cula	Ad	
		- Vehicle-to-infrastructure Communication- Vehicle-to-vehicle Communication-				
		and Vehicle-to-infrastructure Communication- Hybrid Vehicular Network-				
		s; MAC Solutions for Safety Applications in Vehicular Communications.	LIL	and	ı Lı	quiu
						-
20101	штш	INTRODUCTION TO AUTONOMOUS DRIVING				. 9
		s driving technology overview; Autonomous driving algorithm - Sensing-		*		-
		And Tracking-Action; Autonomous Driving Client System-Robot Operat	and the same			
Har	dware P	latform; Autonomous Driving Cloud Platform- Simulation- HD Map Production- De	eep L	earni	ng M	odel
Trai	ining; A	Autonomous Vehicle Localization- GNSS Error Analysis- Satellite-Based Augmenta	tion S	Syste	ms- F	Real-
Tim	e Kiner	natic and Differential GPS.				
UN	IT IV	PERCEPTION, PREDICTION AND ROUTING IN AUTONOMOUS DRIV	ING			9
Perc	ception	in Autonomous Driving - Datasets- Detection- Stereo, Optical Flow, and Scen	ne Fl	ow-	Track	cing;
Prec	diction	And Routing- Architecture: Planning and Control in a Broader Sense- Traffic Pr	edicti	on -	Beha	vior
Pred	diction a	as Classification- Lane Level Routing- Constructing A Weighted Directed Graph F	or Ro	uting	- Ty	oical
	iting Al	gorithms.				
Rou						
	IT V	DECISION PLANNING AND CONTROL IN AUTONOMOUS DRIVING			an I	9
UN	IT V avioral	DECISION PLANNING AND CONTROL IN AUTONOMOUS DRIVING Decision- Markov Decision Process Approach - Scenario-Based Divide and Conque	r Apr	roac	h; Mo	

Speed Planning; Feedback Control- PID Control; Learning-Based Planning and Control in Autonomous Driving – AI in Autonomous driving.

		TOTAL PERIODS:45
COU	RSE OUTCOMES	BT MAPPED
At the	end of the course, the students will be able to	(Highest level)
CO1	explain the need and advantages of intelligent vehicle systems.	Understanding (K2)
CO2	understand the fundamentals of V2V and V2I communication systems.	Understanding (K2)
CO3	apply localization techniques using GNSS, LIDAR, HD maps	Applying (K3)
CO4	illustrate traffic prediction and lane-level routing mechanisms.	Understanding (K2)
CO5	analyze the interaction between vehicle dynamics, road models, and motion planning algorithms in autonomous driving systems.	Analysing (K4)

#### TEXT BOOKS

- Perallos, U. Hernandez-jayo, E. Onieva and I. Garcia-Zuazola (Eds.), Intelligent Transport Systems: Technologies and Applications, Wiley publications, 2015.
- Shaoshan Liu; Liyun Li; Jie Tang; Shuang Wu; Jean-Luc Gaudiot, —Creating Autonomous Vehicle Systems, Morgan & Claypool, 2017.

## REFERENCES

- Alberto Broggi , Michel Parent , Alexander Zelinsky , Charles E. Thorpe Intelligent Vehicles : Springer Handbook of Robotics, 2008.
- 2. Michael E. McGrath, -Autonomous Vehicles: Opportunities, Strategies, and Disruption, Amazon, 2018
- Andreas Herrmann, Walter Brenner, Rupert Stadler, —Autonomous Driving: How the Driverless Revolution will Change the World Emerald Publishing, 2018
- 4. R. K. Jurgen, Navigation and Intelligent Transportation Systems Progress in Technology, Automotive Electronics Series, Warrendale, PA: SAE International, 2014.

#### CO - PO MAPPING

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

COs					Progra	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	2	-	2/ - 5	-	-	-	-	1	3	2
CO2	2	3	2	1	3	-		11	- 11	711		2	3	3
CO3	3	.3	3	3	3	1			-	1		2	3	3
CO4	3	2	3	3	3	TECT		bea-	1	1	2077 <b>4</b> 01E	3	3	3
CO5	3	3	3	3	3	AING C	OLLE	-	1	1	1	3	3	3

Approved
BOARD OF STUDIES
Mechanical Engineering

ME	23851	BASICS OF MANUFACTURING TECHNOLOGY		3	0	0	3
COUI	RSE OB	JECTIVES					
To en	able the	students to		litera i	No.,	- 1	
1 u	nderstand	d the fundamentals of metal cutting and the mechanics involved in machini	ing pro	cesse	es.		
2 g	ain know	ledge of lathe machines and their operations including machining time cal	culation	ns.			
3 le	earn the v	working principles of shaping, slotting, and planning machines and their pr	actical	appl	icati	ons.	
4 · u	nderstan	d various milling operations and grinding techniques used in finishing proc	esses.		7	-	
5 fa	amiliariz	e with drilling and boring machines, including tools and accessories used.	-	7. 77			
UNIT	'I M	IETAL CUTTING					9
Single	and mul	ti-point machine tools. Orthogonal cutting, various force components, chip	format	tion,	tool	wear	and
tool li	fe, surfac	ee finish and integrity, machinability, cutting tool materials, cutting fluids,	coating	gs.			
UNIT	II L	ATHE AND ITS OPERATIONS					9
Princi	ple of w	orking, specifications, types of lathes, operations performed, work holder	s and t	ool ł	olde	ers. T	aper
turnin	g, thread	turning attachments for lathes. Machining time calculations. Turret and ca	pstan la	athes	- Pr	incip	le of
worki	ng, colle	ct chucks, other work holders - tool holding devices.					
UNIT	III S	HAPING AND SLOTTING MACHINES	, F.				9
Shapi	ng, Slott	ing and planning machines -Principles of working principal parts, specifi	ication,	clas	sific	ation	and
operat	tions per	formed, machining time calculations.					
UNIT	IV N	IILLING OPERATIONS AND GRINDING MACHINES					9
Princi	ple of v	vorking, specifications. Classifications of milling machines, machining	g opera	ation	s. T	ypes	and
geome	etry of m	illing cutters, methods of indexing and accessories to milling machines. Ma	chining	g tim	e cal	culat	ions.
Grind	ing proc	ess, types of grinding machines, grinding process parameters, honing,	lappin	ıg, o	ther	finis	hing
proces	sses.						
UNIT	VD	RILLING AND BORING					9
Drilli	ng: Princ	iple of working, specifications, types and operations performed. Tool holdi	ng devi	ces.	Non	nencl	ature
of twi	st drill. E	Boring: Principle of working, specifications, types, and operations performe	ed - too	l hol	ding	devi	ces -
nome	nclature	of boring tools.					
			TOT	AL I	ER	IOD	S:45
COU	RSE OU	TCOMES	BT M	TADI	orn		
At the	e end of t	he course, the students will be able to	(High				
	explain	n the fundamentals of metal cutting processes, tool life, chip formation,	, ,				
CO1	The state of the s	ol materials.	Unde	rstan	ding	(K2	)
CO2	10.000	knowledge of lathe operations and perform machining time calculations.	Apply	vina	(K3)	`	
	Land of the second		Appl	, mg	(17.)		
CO3	170	e the working principles of shaping, slotting, and planning machines and suitable applications.	Analy	ysing	(K4	1)	
	Scient	barraote apprications.	I				

CO4	understand the working of milling and grinding machines and related accessories.	Understanding (K2)
CO5	demonstrate knowledge on drilling and boring operations, tools, and tool holders.	Understanding (K2)

- 1. R. K. Jain, "Production Technology", Khanna Publishers, 18th Edition, 2021.
- Hajra Choudhury S.K., Hajra Choudhury A.K., Nirjhar Roy S.K., "Elements of Workshop Technology Vol. I & II", Media Promoters & Publishers, 2018.

## REFERENCES

- 1. P.C. Sharma, "A Textbook of Production Engineering", S. Chand Publishing, 2021.
- Kalpakjian S., Schmid S.R., "Manufacturing Engineering and Technology", Pearson Education, 7th Edition, 2014.
- 3. HMT, "Production Technology", Tata McGraw Hill, 2001.
- 4. Mikell P. Groover, "Fundamentals of Modern Manufacturing", Wiley, 6th Edition, 2020.

## CO - PO MAPPING

COs	miz retur				Progra	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	1	-	-	2	2
CO2	3	3	2	2	-		-	- 1		1	563.6		2	3
CO3	3	2	3	2	-			-	0.5	1	-	11.0	3	3
CO4	3	2	2	2	-	-	-	4 -	-	1	-		2	3
CO5	2	2	2	1	-	_2		. =	_	1	-		2	2



	FUNDAMENTALS OF ADDITIVE MANUFAC	TURING		3 0	0	
COUR	SE OBJECTIVES					
To enal	ble the students to	- Yan I - James	eleventeen	and the same		
1 exp	plore the technology used in additive manufacturing.			Lit	77	
2 un	derstand the importance of additive manufacturing in advance manu	facturing pro	cess.		P. IV	
3 acc	quire knowledge, techniques and skills to select relevant additive ma	nufacturing p	process.			
4 exp	plore the techniques and skills in additive manufacturing process					
5 app	ply the enhancing methods in additive manufacturing products.					
UNIT I	INTRODUCTION AND BASIC PRINCIPLES	William Park				
UNIT I Prepara	cturing, Challenges in Additive Manufacturing.  II PRE-PROCESSING IN ADDITIVE MANUFACTURING attion of 3D-CAD model, Reverse engineering, Reconstruction of 3D-centation and support generation, STL Conversion, STL error diagnates.	-CAD model			_	
UNIT I				200		
	lithography apparatus (SLA), Fused deposition modeling (FDM), La ve deposition lamination (SDL), Ultrasonic consolidation, Selective			facturi	ng (L	MO
UNIT I	IV ENERGY BASED ADDITIVE MANUFACTURING PRO	OCESSES				E 7-4
	engineered net shaping (LENS), Electron beam free form fabrica	tion (EBFFF	), Electr	on hea		eltin
(EBM)	, Plasma transferred arc additive manufacturing (PTAAM), Tung M) and Metal inert gas additive manufacturing (MIGAM).		T. C.			
(EBM) (TIGAI UNIT	, Plasma transferred arc additive manufacturing (PTAAM), Tung M) and Metal inert gas additive manufacturing (MIGAM).  V POST-PROCESSING IN ADDITIVE MANUFACTURIN	gsten inert ga	as additiv	ve mai	nufac	turin
(EBM), (TIGAI UNIT Suppor prepara informa	, Plasma transferred arc additive manufacturing (PTAAM), Tung M) and Metal inert gas additive manufacturing (MIGAM).	G mprovement nermal and Applications	aesthet	ic implementation	prove ques,	emen Brie turin
(EBM) (TIGAI UNIT Suppor prepara informa in rapid	, Plasma transferred arc additive manufacturing (PTAAM), Tung M) and Metal inert gas additive manufacturing (MIGAM).  V POST-PROCESSING IN ADDITIVE MANUFACTURING to material removal, surface texture improvement, accuracy in action for use as a pattern, property enhancements using non-thation on characterization techniques used in additive manufacturing, all prototyping, rapid manufacturing, rapid tooling, repairing and coates.	G mprovement nermal and Applications	as additive	ic implementation	prove ques,	emen Brie turin
(EBM), (TIGA! UNIT Suppor prepara informa in rapid	POST-PROCESSING IN ADDITIVE MANUFACTURIN to material removal, surface texture improvement, accuracy intion for use as a pattern, property enhancements using non-thation on characterization techniques used in additive manufacturing, a prototyping, rapid manufacturing, rapid tooling, repairing and coates a second control of the se	G mprovement nermal and Applications	aesthet thermal of additi	ic implementation in the control of	prove ques, nufac	emen Brie turin
(EBM), (TIGAI UNIT Support preparation formation rapid COUR At the country of the	POST-PROCESSING IN ADDITIVE MANUFACTURIN t material removal, surface texture improvement, accuracy intion for use as a pattern, property enhancements using non-thation on characterization techniques used in additive manufacturing, a prototyping, rapid manufacturing, rapid tooling, repairing and coates a set of the course, the students will be able to	G mprovement nermal and Applications	aesthet thermal of additi	ic implementation in the control in	prove ques, nufac	emen Brie turin
(EBM) (TIGAI UNIT Suppor prepara informa in rapid  COUR At the CO1	POST-PROCESSING IN ADDITIVE MANUFACTURIN t material removal, surface texture improvement, accuracy in ation for use as a pattern, property enhancements using non-thation on characterization techniques used in additive manufacturing, all prototyping, rapid manufacturing, rapid tooling, repairing and coates.  SE OUTCOMES  end of the course, the students will be able to apply the technology used in additive manufacturing	G mprovement nermal and Applications ing.	aesthet thermal of additi  TOTA BT M. (Highe	ic implementation in the control of	prove ques, nufac	emen Brie turin
(EBM) (TIGAL UNIT Suppor prepara informa in rapid  COUR At the CO1 CO2	POST-PROCESSING IN ADDITIVE MANUFACTURIN t material removal, surface texture improvement, accuracy intion for use as a pattern, property enhancements using non-thation on characterization techniques used in additive manufacturing, a prototyping, rapid manufacturing, rapid tooling, repairing and coates a set of the course, the students will be able to	G mprovement nermal and Applications ing.	aesthet thermal of additi  TOTA BT M (Highe	ic implementation in the control of	prove ques, nufac	emen Brie turin
(EBM) (TIGAI UNIT Suppor prepara informa in rapid  COUR At the	POST-PROCESSING IN ADDITIVE MANUFACTURIN t material removal, surface texture improvement, accuracy intion for use as a pattern, property enhancements using non-thation on characterization techniques used in additive manufacturing, all prototyping, rapid manufacturing, rapid tooling, repairing and coates.  SE OUTCOMES  end of the course, the students will be able to  apply the technology used in additive manufacturing explain importance of additive manufacturing in advance manufacturing in ad	G mprovement nermal and Applications ing.	aesthet thermal of additi  TOTA BT M (Highe Apply Analys	ic implementation in the control of	prove ques, nufac	emen Brie turin

CO5	utilize the enhancing methods in additive manufacturing products	Applying (K3)
5 55		1100

- Gibson, I, Rosen, D W., and Stucker, B., Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010.
- Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", 3rd Edition, World Scientific Publishers, 2010

#### REFERENCES

- Chee Kai Chua, Kah Fai Leong, 3D Printing and Additive Manufacturing: Principles and Applications: 4 th Edition of Rapid Prototyping, World Scientific Publishers, 2014.
- Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003. Kenneth G. Budinski& Michael K. Budinski, "Engineering Materials: Properties and Selection", 9th Edition, Pearson, 2009.
- 3. Bandyopadhyay, A.& Bose.S. Additive Manufacturing, second edition, CRC Press, 2019
- 4. Milan Brandt. "Laser Additive Manufacturing 1st Edition Materials, Design, Technologies, and Applications", Woodhead Publishing, UK, 2016.

## CO - PO MAPPING

COs					Progra	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	3	-	-	-	-	-	-	2	2	2
CO2	3	-	3	-	3	-	-	-	-	-	-	-	2	2
CO3	3		-	2	3	-	-	-	-	-	-	- 1	2	2
CO4	3	2	-	2	3	-	- 1	-	-	-	10-11	- 1	2	2
CO5	3		2		3	-	-	-	-	H. S. THER		2	2	2



To e  1	classify no illustrate v describe a	JECTIVES students to on-traditional manufacturing processes and describe their advantages over conv	LIKOVO POSL	Gir jord	in the second	
1 2 3 4 5 UNI Intro	classify no	on-traditional manufacturing processes and describe their advantages over conv	M696055	es in part	-635	
2 3 4 5 UNI	illustrate describe a					-1 -
3 4 5 UNI	describe a	VIII - Control Control - C	entiona	al met	hods	
4 5 UNI	Charles San	various non-traditional forming and joining techniques.				
5 UNI Intro		additive manufacturing technologies and their applications.	-	T	7	
UNI Intro	explain na	ano and micro manufacturing techniques.			511	
Intro	introduce systems.	hybrid and intelligent manufacturing processes and compare them with tradit	tional r	nanuf	actur	ing
	TI I	NTRODUCTION TO NON-TRADITIONAL MANUFACTURING			9	
100000	esses – A	Need for non-traditional manufacturing processes – Classification of non-traditions, advantages and limitations – Overview of non-traditional machinifacturing and nano processes.				_
UNI	TII N	ION-TRADITIONAL FORMING AND JOINING PROCESSES	-30.7	30-1	9	,
Intro	oduction -	Need for non-traditional forming and joining - Classification of non-traditional	l formi	ng and	l joir	ing
proc	esses - A	Applications, advantages and limitations - Principles, equipment, effect of	proces	s par	amet	ers,
appli	ications, a	dvantages and limitations of Explosive forming, Electromagnetic forming, Elect	trohydr	aulic	form	ing,
Frict	tion stir w	elding, Ultrasonic welding, Laser beam welding, and Electron beam welding.				
UNI	IT III A	ADDITIVE MANUFACTURING PROCESSES		7	9	)
Intro	oduction	- Need for additive manufacturing - Classification of additive manufa	cturing	proc	esse	s –
App	olications,	advantages and limitations - Overview of Stereolithography (SLA), Fused I	Deposit	ion N	1ode	ling
(FD	M), Selec	tive Laser Sintering (SLS), Direct Metal Laser Sintering (DMLS), and Binder	Jetting	g – Pr	incip	oles,
equi	ipment, ef	fect of process parameters, applications, advantages and limitations.				
UNI	IT IV N	NANO AND MICRO MANUFACTURING PROCESSES			9	)
Intro	oduction -	Need for nano and micro manufacturing - Classification of nano and micro man	nufactu	ring p	roce	sses
- Aj	pplication	s, advantages and limitations - Principles, equipment, effect of process para	meters	, app	icati	ons,
adva	antages an	d limitations of Nano-imprint lithography, Electron beam lithography, Micro-m	illing, l	Micro	-drill	ing,
Ator	mic layer	deposition, and Scanning probe-based techniques.				
UNI	IT V I	IYBRID AND INTELLIGENT MANUFACTURING SYSTEMS			9	)
Intro	oduction -	Need for hybrid and intelligent manufacturing - Classification and overview of	hybrid	manu	factu	ring
proc	cesses — A	Applications, advantages and limitations - Principles, equipment, effect of	proces	ss pai	ame	ters,
appl	lications,	advantages and limitations of processes such as Laser-assisted machining	g, Ultra	sonic	-assi	sted
	hining, ar	nd EDM with USM - Introduction to intelligent manufacturing: smart fact	tories,	cyber	phys	sical
mac	ems, real-	time monitoring, and Industry 4.0.				
						:45

COUI	RSE OUTCOMES	BT MAPPED
At the	end of the course, the students will be able to	(Highest level)
CO1	formulate classifications of non-traditional manufacturing processes and interpret their relevance.	Create (K6)
CO2	illustrate and evaluate non-traditional forming and joining processes.	Applying (K3)
CO3	analyze additive manufacturing techniques and their industrial applicability.	Analyzing (K4)
CO4	describe the principles of nano and micro-manufacturing processes.	Understanding (K2)
CO5	compare hybrid and intelligent manufacturing systems with traditional methods.	Analysing (K4)
	Management 1 and 1	

- 1. G.F. Benedict, Nontraditional Manufacturing Processes, CRC Press, 2018.
- 2. M. Koc, T. Altan, Micro-manufacturing: Design and Manufacturing of Micro-Products, Wiley, 2007.

# REFERENCES

- 1. Kalpakjian & Schmid, Manufacturing Processes for Engineering Materials, Pearson, 2014.
- 2. Mikell P. Groover, Fundamentals of Modern Manufacturing, Wiley, 2020.
- 3. Kapil Gupta, Advanced Manufacturing Technologies, CRC Press, 2018.
- 4. Ian Gibson, David Rosen, Brent Stucker, Additive Manufacturing Technologies, Springer, 2015.

# CO - PO MAPPING

COs					Progra	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 19	PO11	PO12	PSO1	PSO2
CO1	3	2	111211	1	-2	4-11		-2111	ella il	1	10 (42%)	(4)	3	2
CO2	3	3	2	2	2	146	-	75. <b>-</b> 510	kit-or	US BOAR	ul po <del>z</del> enji	111-	3	3
CO3	3	3	3	3	3			-	ani <del>l</del>	in the	7	-	2	3
CO4	2	2	2	2	3	5.0	- T	1	1	1	ā <del>ā</del> a	1		2
CO5	3	3	3	3	- 3		-	1	1	1		1	3	3



-	IE23854					
CO	URSE	OBJECTIVES				
To	enable t	the students to	E PROGRESS	- Contract		774
1	introdu factori	uce the concept of Industry 4.0 and its global significance, including lean materials	nanufac	turing	and	smai
2	familia	arize students with automation technologies such as PLCs, sensors, HMI, and c	yber-ph	ysica	l syste	ems
3	provid	le knowledge on industrial communication protocols and augmented reality in s	smart sy	stems		
4	explor	e the fundamentals and components of IoT platforms and machine-to-cloud co	mmunic	ation		
5	introd	uce foundational concepts in machine learning relevant to smart manufacturing	and Inc	lustry	4.0	7
UN	IT I	INDUSTRY 4.0				9
		listorical development, Globalization and its influence on manufacturing syste	m eme	rging	icens	
	IT II gramma	AUTOMATION able Logic Controller (PLC) and its Programming software, Communication	of diffe	rent d	evice	9 s wi
Pro	gramma		of diffe	rent d	evice	
PL	C, Senso	or, Smart Sensor, HMI design, Cyber Physical System - key components, ISA-	-95 arch	itectu	re, Cl	PS-5
		or, Smart Sensor, HMI design, Cyber Physical System – key components, ISA- e, Concept of Digit Twin.	-95 arch	iitectu	re, Cl	PS-5
arc			-95 arch	itectu	re, Cl	PS-5
arc	hitecture	e, Concept of Digit Twin.	•			9
un Pro	hitecture IT III otocols -	e, Concept of Digit Twin.  COMMUNICATION	MQTT	broke	er, Mo	9 essag
UN Pro	HIT III otocols - es, Qua	e, Concept of Digit Twin.  COMMUNICATION  MQTT, OPC UA, EtherNet/IP, Profinet, EtherCAT, etc; MQTT – History,	MQTT	broke	er, Mo	9 essag
UN Pro typ – F	HIT III otocols - es, Qua	e, Concept of Digit Twin.  COMMUNICATION  MQTT, OPC UA, EtherNet/IP, Profinet, EtherCAT, etc; MQTT – History, lity of Service (QoS), Application; OPC UA – History, Specification, Client, Service (QoS), Application; OPC UA – History, Specification, Client, Service (QoS), Application; OPC UA – History, Specification, Client, Service (QoS), Application; OPC UA – History, Specification, Client, Service (QoS), Application; OPC UA – History, Specification, Client, Service (QoS), Application; OPC UA – History, Specification, Client, Service (QoS), Application; OPC UA – History, Specification, Client, Service (QoS), Application; OPC UA – History, Specification, Client, Service (QoS), Application; OPC UA – History, Specification, Client, Service (QoS), Application; OPC UA – History, Specification, Client, Service (QoS), Application; OPC UA – History, Specification, Client, Service (QoS), Application; OPC UA – History, Specification, Client, Service (QoS), Application; OPC UA – History, Specification, Client, Service (QoS), Application; OPC UA – History, Specification, Client, Service (QoS), Application, Client, Service (QoS), CoS, CoS, CoS, CoS, CoS, CoS, CoS, CoS	MQTT	broke	er, Mo	9 essag
UN Pro typ - F UN	HIT III  otocols - es, Qual ree and	e, Concept of Digit Twin.  COMMUNICATION  MQTT, OPC UA, EtherNet/IP, Profinet, EtherCAT, etc; MQTT – History, lity of Service (QoS), Application; OPC UA – History, Specification, Client, Sopen-source software, Propriety software; Augmented Reality.	MQTT erver, P	broke	er, Me	9 essag g wit
UN Pro typ - F UN Date	IT III  otocols - es, Qual ree and IT IV ta Mode	e, Concept of Digit Twin.  COMMUNICATION  MQTT, OPC UA, EtherNet/IP, Profinet, EtherCAT, etc; MQTT – History, lity of Service (QoS), Application; OPC UA – History, Specification, Client, Sopen-source software, Propriety software; Augmented Reality.  IOT PLATFORM	MQTT erver, P	broke	nmin	9 essag g wir
UN Pro typ - F UN Da Ga	otocols - es, Qual ree and IT IV ta Mode teway,	e, Concept of Digit Twin.  COMMUNICATION  MQTT, OPC UA, EtherNet/IP, Profinet, EtherCAT, etc; MQTT – History, lity of Service (QoS), Application; OPC UA – History, Specification, Client, Sopen-source software, Propriety software; Augmented Reality.  IOT PLATFORM  elling, IoT platforms – Thing, basic functionalities, Abstract definition of Tlient, Machine interfaces – Cloud-based Mosquitto brokers, Programming with	MQTT erver, P	broke	nmin	9 essag g wir
un Pro typ - F UN Da Ga sof	otocols - es, Qual ree and IT IV ta Mode teway, tware, F	e, Concept of Digit Twin.  COMMUNICATION  MQTT, OPC UA, EtherNet/IP, Profinet, EtherCAT, etc; MQTT – History, lity of Service (QoS), Application; OPC UA – History, Specification, Client, Se open-source software, Propriety software; Augmented Reality.  IOT PLATFORM  elling, IoT platforms – Thing, basic functionalities, Abstract definition of The	MQTT erver, P	broke	nmin	9 essag g with  9 e; Io
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CO2	apply automation concepts by utilizing PLCs, sensors, and cyber-physical system architecture in industrial applications	Applying (K3)
CO3	analyze and differentiate between various industrial communication protocols and their applications in smart manufacturing	Analysing (K4)
CO4	understanding of IoT platforms, IoT gateways, and cloud communication through appropriate tools and software	Understanding (K2)
CO5	apply fundamental machine learning algorithms using suitable tools for analysis and decision-making in smart manufacturing environments	Applying (K3)

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- Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", Willy Publications.

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- Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", 2<sup>nd</sup> Edition, Willy Publications.
- Jen-Ruey Jiang, "An improved cyber-physical systems architecture for Industry 4.0 smart factories",
   Advances in Mechanical Engineering, 2018.

## CO - PO MAPPING

COs					Progra	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	1	2	-	-	-		2	2	2
CO2	3	3	3	2	3	-	-	-	-	-		2	2	2
CO3	2	2	2	2	3	-	-	-	-	1-		2	2	2
CO4	2	2	2	2	3	-	-				2	3	2	2
CO5	2	3	3	3	3	-	-	-	-	-	2	3	2	2



	E23855	PRODUCT DESIGN AND INNOVATION	3	1	0	0	3
CO	URSE OB	JECTIVES		-			
То	enable the	students to	Vine raid	0			
1	understan	d fundamental principles of product design and innovation, including need id	entification	on	and	idea	tion
2	gain know	ledge of design thinking and its applications in real-world product develop	ment.				
3	learn crea	tive and systematic approaches to user-centered design.	17.7				
4	understan	d digital prototyping tools and rapid prototyping techniques	7 1	+			-
5	develop e	ntrepreneurship skills through innovation frameworks and case studies.	Section	. 0		sr	
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		Scope of Product Design – Importance of Design in Innovation – Life Cycle	e Thinkin	g –	Us		
fron	Various l		s of Inno	vati	ive	Prod	lucts
CONTRACTOR OF THE PARTY OF THE	Contract in the Contract of th	ESIGN THINKING METHODOLOGY	IS and				9
	576	ng Process: Empathize, Define, and Ideate, Prototype, Test - Human-Cen		-			
		ng – Brainstorming Techniques Storyboarding – Persona Creation – Value I	Propositio	on (	Can	vas.	
UN	TIII E	DESIGN CONCEPTUALIZATION AND EVALUATION				9	9
	RATE IN THE RESERVE	x - Decision Matrices - Product Aesthetics and Ergonomics - Design	for X (	Ma	nuf	actu	ring
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CO4	demonstrate basic digital prototyping using CAD, AR/VR, or IoT tools for product representation	Understanding (K2)
CO5	apply innovation frameworks and entrepreneurial thinking to transform ideas into viable product concepts	Applying (K3)

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- Green, W., & Jordan, P. W. (Eds.).(1999). Human factors in product design: current practice and future trends. CRC Press.

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- Tim Brown, Change by Design: How Design Thinking Creates New Alternatives for Business and Society, Harvard Business Press.
- 4. Jeanne Liedtka, Design Thinking for the Greater Good, Columbia Business School Publishing.

#### CO - PO MAPPING

COs					Progra	amme O	utcome	s(POs)					PS	Os
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	1	2	-	-	2-1	- 1	2	2	2
CO2	3	3	3	2	3	-		112	523	mie_val	21	2	2	2
CO3	2	2	2	2	3	-	-	-2	-		*	2	. 2	2
CO4	2	2	2	2	3	7.00	-	-	-	- 1	2	3	2	2
CO5	2	3	3	3	3	-	7-10	-	-	-	2	3	2	2



ME	23856	LEAN AND SUSTAINABLE MANUFACTURING SYSTEMS		3	0	0	3
COU	RSE C	DBJECTIVES				4	
Тое	nable th	ne students to	e Maria de la composição	-	de.		
1	underst	and the fundamentals and importance of lean thinking in modern industries.	15.00		N.E	-71	
2	learn va	arious tools and techniques to eliminate waste and improve process efficiency					
3	gain ins	sight into sustainable manufacturing practices and environmental impacts.					1
4	analyze	and apply appropriate sustainability metrics and tools like LCA and green V	SM.		I.Y	m	
5	explore	the role of Industry 4.0 and AI in enabling lean and green transformation					
UNI	ГІ	INTRODUCTION TO LEAN MANUFACTURING	1,000	ul-V.			9
Defi	nition –	Evolution of Lean Manufacturing - Toyota Production System (TPS) - Prince	ciples o	of Le	ean –	Туре	es of
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5S, S	tandard	d Work, Visual Management, Kaizen, SMED - Introduction to Value Stream	Mappi	ng (	VSM	D.	
UNI	ГП	LEAN TOOLS AND APPLICATIONS					9
Deta	iled Stu	dy of Lean Tools – Just-in-Time (JIT), Kanban, Cellular Manufacturing, Poka	-Yoke	- H	eijun	ka (L	evel
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CO3	analyze manufacturing systems for sustainability with appropriate tools and	Analysina (VA)
	metrics	Analysing (K4)
CO4	evaluate environmental performance using LCA, SVSM and other sustainability metrics	Understanding (K2)
CO5	explore the role of AI and Industry 4.0 tools in enhancing lean and sustainable practices	Understanding (K2)

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- 2. Beamon, B., Sustainability and Supply Chain Management, OR Journal, 1999.
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- 4. Womack, J.P. & Jones, D.T., Lean Thinking, Free Press, 2003.

## CO - PO MAPPING

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	-	-	-	2	- 2	-	2		2	-	1
CO2	2	1	2	-	1	1 - 0	2	2	120	1		2	-	1
CO3	2	2	2	2		2	3	2	1.0	1		3	2	2
CO4	2	2	2	2	2	2	3	2		2		3	3	3
CO5	2	2	1	2	3	2	3	2	o I guy	2		2	2	3

