

B. TECH. MECHATRONICS

(Duration: 4 Years)

CURRICULUM and SYLLABUS

(Applicable for Students admitted from Academic Year 2018-19)

DEPARTMENT OF MECHATRONICS ENGINEERING SCHOOL OF MECHANICAL SCIENCES HINDUSTAN INSTITUTE OF TECHNOLOGY AND SCIENCE

HINDUSTAN INSTITUTE OF TECHNOLOGY AND SCIENCE

Motto:

To Make Every Man a Success and No Man a Failure

Vision:

To be an International Institute of Excellence, providing a conducive environment for education with a strong emphasis on innovation, quality, research and strategic partnership blended with values and commitment to society.

Mission:

- To create an ecosystem that promotes learning and world class research.
- To nurture creativity and innovation.
- To instill highest ethical standards and values.
- To pursue activities for the development of the Society.
- To develop national and international collaborations with institutes and industries of eminence.
- To enable graduates to become future leaders and innovators.

Value Statement:

Integrity, Innovation, Internationalization.

DEPARTMENT OF MECHATRONICS ENGINEERING

Vision:

To be recognized internationally in providing Mechatronics education, nurturing professional engineers with outstanding competencies for innovation, research and entrepreneurial skills.

Mission:

The Mechatronics Engineering department continuously strives

M1. To provide a conducive academic environment with state of art laboratory infrastructure

M2. To promote collaborative research and innovation with global institutions and industries

M3. To offer interdisciplinary curricula and learning practices to meet the dynamic global demands

M4. To impart technical, managerial and lifelong learning skills, embedded with ethical values and social relevance.

PROGRAMME'S EDUCATIONAL OBJECTIVES (PEO'S):

PEO1- Successful career and adaptability to industry: Graduates will exhibit knowledge and skills to apply Mechatronics engineering to address real world problems.

PEO2 - Graduates shall demonstrate practical and innovative skills in integrating various Mechatronics elements through group design and project work in an industry, research or academia.

PEO3 - Graduates shall conduct research in interdisciplinary topics and contribute to scientific community/ society/ industries

PROGRAMME OUTCOMES (PO'S):

PO-1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO-2. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO-3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO-4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO-5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO-6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO-7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO-8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO-9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO-10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO-11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

PROGRAMME SPECIFIC OUTCOMES (PSO'S):

PSO-1: Design, develop and evaluate the elements of mechatronics systems.

PSO-2: Interface and integrate Mechatronics systems to align with global industrial standards satisfying the societal needs.

	B.TECH – MECHATRONICS ENGINEERING												
	(165 - CREDIT STRUCTURE)												
SEMESTER- I													
SL. NO	COURSE CATEGORY	COURSE	NAME OF THE COURSE	L	т	Р	С	S	тсн				
1	BS	MEA4101 / ELA4101	Engineering Graphics and Computer aided Design / Professional English and soft skills	1	1	2	3	1	4				
2	BS	MAA4101	Matrices and calculus	3	0	2	4	1	5				
3	BS	PHA4101/ CYA4101	Engineering Physics / Engineering Materials	3	0	0	3	1	3				
4	PC	CSA4101/ GEA4102	Problem Solving Using C*/ Sustainable Engineering Systems	2	0	2*/ 0	3/2	1	4/3				
5	РС	MHB4102/ MHB4101	Introduction to Digital Systems* / Engineering and Design	2/3	0	2*/ 0	3	1	3				
	PRACTICAL												
6	BS	GEA4131	Engineering Immersion Lab	0	0	2	0.5	2	2				
7	BS	PHA4131/ CYA4131	Engineering Physics Lab/ Materials Chemistry Lab	0	0	2	1	0	2				
			Total	11/ 12	1	12/ 10	17. 5/1 6.5	7	23/2 2				
			SEMESTER- II	1		1			1				
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	т	Р	с	S	тсн				
1	BS	MAA4117	Analytical Mathematics	3	0	2	4	0	5				
2	BS	PHA4101 / CYA4101	Engineering Physics / Engineering Materials	3	0	0	3	1	3				
3	BS	ELA4101 / MEA410 1	Professional English and soft skills / Engineering Graphics and Computer Aided Design		1	2	3	1	4				
4	PC	CSA4101/ GEA4102	Problem Solving Using C*/ Sustainable Engineering Systems	2	0	2*/ 0	3/2	1	4/3				
5	PC	MHB4102 / MHB4101	Introduction to Digital Systems* / Engineering and Design	2/3	0	2*/ 0	3	1	3				

6	РС	MEB4116	Engineering Mechanics	3	1	0		4	1	4		
7	РС	MHB4117	Basics of Mechatronics	2	0	2		3	1	3		
			PRACTICAL				1			I		
8	РС	MHB4141	Floor Shop Training	0	0	2		1	2	1		
9	BS	GEA4131	Engineering Immersion Lab	0	0	2	C).5	2	2		
10	BS	PHA4131/ CYA4131	 Engineering Physics Lab/ Materials Chemistry Lab 	0	0	2		1	0	2		
			Total	16/1 7	2	16	25.5	/24.5	10	31/3 0		
SEMESTER-III												
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	т	Р		С	S	тсн		
1	BS	MAA42 01	Partial Differential Equations and Transforms31040							5		
2	РС	MHB42 01	Manufacturing Processes3003							3		
3	РС	MHB42 02	Mechanics of Machines	3	0	2		4	1	5		
4	РС	MHB42 03	Embedded Systems	3	0	2		4	1	5		
5	DE		Department Elective-I	3	0	0		3	0	3		
6	NE		Non Department Elective- I	2	0	0		2	0	2		
			PRACTICAL		•							
7	РС	MHB42 31	Computer Aided Design Lab	0	0	2	1	0	2	2		
8	РС	MHB42 32	Manufacturing Processes Lab	0	0	3	1	0	3	}		
9	РС	MHB42 33	Design Project I	0	0	2	1	0	2	2		
			Total	17	1	11	23	2	3	0		
	[MINORS		1			,				
1	Μ	MHM42 61	Digital Manufacturing	3	0	0	3	2	3	1		

			SEMESTER- IV						
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	т	Р	С	s	тсн
1	РС	MHB4218	B Electrical Machines and Drives	3	0	0	3	1	3
2	РС	GEA4216	Professional ethics and life skills	2	0	0	2	1	2
3	РС	MHB4219	 Solid and Fluid Mechanics 	3	0	0	3	2	3
4	РС	MHB4220	D Statistics and Data Analytics	3	0	2	4	0	5
5	DE		Department Elective-II	3	0	0	3	0	3
6	NE		Non Department Elective–II	2	0	0	2	0	2
			PRACTICAL		•	•			
7	PC	MHB424 2	Electrical Machines and Drives lab	0	0	2	1	0	2
8	РС	MHB424 3	Solid and Fluid Mechanics Lab	0	0	3	2	0	3
9	РС	MHB424 4	Design Project II	0	0	2	1	0	2
			Total	16	0	9	21	4	25
	-		MINORS		I				
1	M	MHM427 6	Intelligent Machining	3	0	0	3	2	3
			SEMESTER- V						
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	т	Ρ	С	S	тсн
1	РС	MHB430 1	Metrology and Measurements	3	0	2	4	0	5
2	РС	MHB430 4	Control Systems	2	1	2	4	2	5
3	PC	MHB430 5	Hydraulics and Pneumatics	3	0	0	3	1	3
4	HS	GEA430 4	Business Economics	3	0	0	3	1	3
L									-
5	DE		Department Elective-III	3	0	0	3	3	

			PRACTICAL									
7	PC	MHB433 4	Hydraulics and Pneumatics Lab	0	0	2	1	0	2			
8	PC	MHB433 5	Virtual Instrumentation Lab	0	1	3	3	2	4			
9	PC	MHB433 6	Design Project III	0	0	2	1	0	2			
			Total	16	2	11	24	6	29			
MINORS												
1MMHM43 61Mechatronics System Design30032												
			SEMESTER- VI									
SL. NO	COURSE CATEGOR Y	COURSE CODE	NAME OF THE COURSE	L	т	Ρ	с	S	тсн			
1	PC	MHB432 1	Sensors and Motion Control	3	0	0	3	2	3			
2	PC	MHB432 2	Design of Mechatronics System	3	0	2	4	3	5			
3	PC	MHB432 3	CNC Technology	3	0	2	4	3	5			
4	PC	MHB432 4	Industrial Electronics	3	0	0	3	3	3			
5	DE		Department Elective-IV	3	0	0	3	0	3			
6	NE		Non Department Elective– IV	2	0	0	2	0	2			
			PRACTICAL					1				
7	РС	MHB434 5	Sensors and Motion Control Lab	0	0	3	2	0	3			
8	PC	MHB434 6	Design Project IV	0	0	2	1	0	2			
9	PC	MHB434 7	Comprehension	1	0	0	1	0	1			
			Total	18	0	9	23	11	27			
		-	HONOURS			-	-	<u> </u>				

1	Н	MHH437 6	Automation in Manufacturing	3	0	0	3	2	3		
2	Н	MHH437 7	Engineering Project Management - I	3	0	0	3	2	3		
			SEMESTER- VI	1							
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	т	Ρ	С	S	тсн		
1	PC	MHB440 7	NDT and Condition Monitoring	3	0	0	3	2	3		
2	PC	MHB440 8	Robotics and Machine Vision	3	1	0	4	3	4		
3	PC	MHB440 9	Artificial Intelligence for Mechatronics	3	0	2	4	3	5		
4	PC	MHB441 0	Fundamentals of Signal Processing	3	0	2	4	0	5		
5	DE		Department Elective - V	3	0	0	3	0	3		
6	NE		Non Department Elective –20020V								
PRACTICAL											
7	РС	MHB443 7	Robotics and Machine Vision Lab	0	0	2	1	0	2		
8	РС	MHB443 8	NDT and Condition Monitoring Lab	0	0	3	2	0	3		
9	РС	MHB443 9	Design Project V	0	0	2	1	0	2		
			Total	17	1	11	24	8	29		
			HONOURS								
1	н	MHH446 1	Advanced Manufacturing	3	0	0	3	2	3		
2	Н	MHH446 2	Engineering Project Management –II	3	0	0	3	2	3		
	L – Lecture	; T – Tutori	al; P – Practical; C – Credit; S	S- Self S	Study;	тсн-	Total Co	ontac	t Hours		
			SEMESTER- VII	I							
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	т	Р	С	S	тсн		

1	PC	MHB444 8	Project	0	0	24	8	0	24
			Total	0	0	24	8	0	24
			TOTAL CREDITS				165		

		LIST OF DEP	RTMENTAL ELECTIVES WITH GROUPIN	NG - S	EME	STER	WISE		
SEM	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	т	Р	с	s	тсн
Electiv	ve l					·		-	
3	DE	MHC4251	Basics of Robotics	3	0	0	3	1	3
3	DE	MHC4252	Mechatronics System Applications	3	0	0	3	1	3
3	DE	MHC4253	Mobile Robots	3	0	0	3	1	3
3	DE	MAA4301	Optimization Techniques	3	0	0	3	1	3
Electiv	ve II					•		-	
4	DE	MHC426 6	Industrial Robots	3	0	0	3	1	3
4	DE	MHC426 7	Machining Technology	3	0	0	3	1	3
4	DE	MHC426 9	Product Development 3 0 0 3					1	3
Electiv	ve III							_	
5	DE	MHC435 5	Building Automation	3	0	0	3	1	3
5	DE	MHC435 6	Electronic Devices And Circuits	3	0	0	3	1	3
5	DE	MHC435 7	Industrial Instrumentation	3	0	0	3	1	3
Electiv	ve IV								
6	DE	MHC437 0	Analog Electronics	3	0	0	3	1	3
6	DE	MHC437 1	Operational Research	3	0	0	3	1	3
6	DE	MHC437 2	Robotic Operating System	3	0	0	3	1	3
6	DE	MHC437 3	Virtual Reality	3	0	0	3	1	3

Electi	ve V								
7	DE	MHC445 9	Robotic Process Automation	3	0	0	З	1	3
7	DE	MHC446 0	Industrial Engineering	3	0	0	3	1	3
7	DE	MHC446 1	Total Quality Management	3	0	0	3	1	3
7	DE	MHC446 2	Finite Element Analysis	3	0	0	3	1	3

LIST	LIST OF NON DEPARTMENTAL ELECTIVES OFFERED BY MECHATRONICS WITH GROUPING - SEMESTER WISE											
SEM	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	т	Р	c	s	тсн			
Elect	ive I											
3	NE	MHD4281	Building of Mobile Robots	2	0	0	2	1	2			
Elect	ive II											
4	NE	MHD4292	AI in Robotics	2	0	0	2	1	2			
Elect	ive III											
5	NE	MHD4382	Building of Under Water Robots	2	0	0	2	1	2			
Elect	ive IV											
6	NE	2	0	0	2	1	2					

SEMESTER – I

COURSE	ENGINE	UTER AIDED	CREDITS	3		
TITLE			DESIGN		CREDITS	5
COURSE		101	COURSE	PC		1 1 2 1
CODE	IVIEA4	101	CATEGORY	DS	L-1-P-3	1-1-2-1
Varsian	1.0	n	Anneval Dataila	24 ACM,	LEARNING	DTI 2
version	1.0	J	Approval Details	30.05.2021	LEVEL	DIL-3
ASSESSMENT	SCHEME					
First Peri	odical	Se	cond Periodical	Practical Co	mnonent	FSF
Assessm	nent		Assessment		mponent	LJL
15%			15%	20	%	50%

Course Description	This course broadly introduces the mechanical design using computer aided design tools and fundamentals of free hand sketching. It prepares the students to learn the basic concepts involved in technical drawing skills and computer graphics. It also emphasis on the principles and basic understanding of projections and visualizations aspects of component designing.
Course Objective	 The course should enable the student to 1. Understand the basics of Engineering graphics and plane curvatures using AutoCAD tool 2. Visualize the free hand sketch and orthographic projections and to solve simple problems 3. Comprehend the various geometrical models and its developments 4. Understand the transformation of 2D drafting to 3D models using CAD tools 5. Generate associated views of 3D models and related geometric dimensioning and tolerencing.
Course Outcome	 Upon completion of this course, the students will be able to Use the AutoCAD commands to generate simple drawings and understand drafting techniques. Apply the acquired knowledge to solve simple problems involving straight planes and solids. Visualize solid objects and apply AutoCAD commands to generate the models. Recognize and use 3D model commands in AutoCAD tool to generate solid objects. Generate the various views of the geometrical solid model manually and using AutoCAD as well.
Prerequisites: N	lil

СО, Р	CO, PO AND PSO MAPPING													
6	РО	РО	РО	PO	РО	РО	РО	РО	РО	РО	РО	PO-	PSO	PSO
	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	12	-1	-2
CO1	2	1	-	-	3	-	-	-	-	-	-	-	-	-
CO2	2	1	2	-	3	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	3	1	-	-	-	-	-	-	-	-
CO4	2	1	-	-	3	-	-	-	-	-	1	-	-	-
CO5	2	1	3	-	3	-	-	-	-	-	-	1	-	-
	1: Weakly related, 2: Moderately related and 3: Strongly related													
MOD	ULE 1	: BASIO	CS OF I	ENGIN	EERIN	g gra	PHICS	AND	PLANE	CURVES	6	(3L+ 3	8T+6P=1	2)
Importance of graphics - BIS conventions and specifications - drawing sheet sizes -														
Lettering – Dimensioning - Scales. Drafting methods - introduction to Computer												ло-т ті 2		
Aided	Draf	ting -	- Com	nputer	Hard	ware	– Wo	orksta	tion –	Printe	r and	Plotter	-	16-2

Introduction to software for Computer Aided Design and Drafting – Exposure to Solid	
Modelling software – Geometrical Construction-Coordinate Systems/Basic Entities – 3D	
printer.	
Practical component:	
AutoCAD – Solid modelling tool - Basics.	
Suggested Readings:	
Basics of drafting and dimensioning	
MODULE 2: VISUALIZATION, ORTHOGRAPHIC PROJECTIONS AND FREE HAND SKETCHING	G
(3L+3T+6P=12)	
 Visualization concepts and Free Hand sketching: Visualization principles — Representation of Three Dimensional objects — Pictorial Projection methods - Layout of views- Free hand sketching of multiple views from pictorial views of objects. Drafting of simple Geometric Objects/Editing General principles of presentation of technical drawings as per BIS - Introduction to Orthographic projections - Naming views as per BIS - First angle projection method. Conversion to orthographic views from given pictorial views of objects, including dimensioning – Drafting of Orthographic views from Pictorial views. Practical component: 2D drafting, Orthographic projections Suggested Readings: AutoCAD tool – Commands for sketching Projections 	CO-2 BTL-2
AutoCAD tool – Commands for sketching , Projections	
(3L+3T+6P=12)	
Principles of isometric projection and solid modelling. Isometric drawing – IsoPlanes and 3D Modelling commands. Projections of Principal Views from 3-D Models. Solid Modeling – Types of modelling - Wire frame model, Surface Model and Solid Model – Introduction to graphic software for solid modelling. Development of Surfaces Practical component: 3D modelling and surface development Suggested Readings: Surface modelling and solid modelling	CO-3 BTL-3
MODULE 4: COMPUTER AIDED DESIGN AND DRAFTING (3L+3T	+6P=12)
Preparation of solid models of machine components like slide block, solid bearing	
block, bushed bearing, gland, wall bracket, guide bracket, shaft bracket, jig plate, shaft support (open type), vertical shaft support etc using appropriate modelling software. 2D views and sectional view, computer aided drafting and dimensioning. Generate 2D drawing from the 3D models – generate and develop the lateral surfaces of the objects. Presentation Techniques of Engineering Drawings – Title Blocks – Printing/Plotting the 2D/3D drawing using printer and printing solid object using 3D printer. Practical component:	CO-4 BTL-2
2D to 3D transformation plotting of drawings	

Suggested Readings:											
3D mo	delling – view gener	rations and comman	ds								
				N (21.2	T: (D-12)						
NIUDU		in PROJECTS – COIVII	PUTER AIDED DESIG		1+6P=12)						
Erame	Creation of engineering models and their presentation in standard 2D form, 3D Wire-										
genera	ation for componen	t manufacture, geon	netric dimensioning	and tolerencing. Use							
of sol	id-modelling softwa	are for creating asso	ociative models at t	he components and							
assem	bly levels in their re	espective branch of	engineering like bui	ding floor plans that							
includ	e: windows, doors,	fixtures such as WC	, Sink, shower, slide	block, etc. Applying							
color o	coding according to	drawing practice.			DIL-3						
	cal component:										
SD SOI	solid meshed topology, geometrical dimensioning, simple components										
Sugge	Suggested Readings:										
	AD dimensioning, a	ssembly of solid com	iponents								
TEXT BOOKS											
Jeyapoovan, T. (2016). <i>Engineering Drawing and Graphics Using AutoCAD</i> , 7 ¹¹¹ Edition, Vikas											
DEEED	Publishing House P	vt Ltd., New Deini.									
REFER					. .						
1.	Warren J. Luzadde	er and Jon. M. Du	ff. (2016). Fundame Edition	entals of Engineerin	g Drawing,						
	lensen ID Helsel	D R Short (2012)	Eution. Engineering Drawing	and Design McGra	w-Hill Sixth						
2.	Edition.										
E BOO	KS										
1.	http://keralatechno	ologicaluniversity.blo	gspot.in/2015/06/e	ngineering-graphics-j	-benjamin-						
	pentex-freeebook-	odf-download.html									
2.	http://keralatechno	ologicaluniversity.blo	gspot.in/2015/06/e	ngineering-graphics-)-i-						
MOOO	vargnese.ntm										
1	, http://nptel.ac.in/c	ourses/112103019/									
2	http://nptel.ac.in/c	ourses/112103013/									
		.001303/103104146/									
SE	N		ILLIS	CREDITS	4						
TITLE	141										
COU											
RSF	MAA4101	COURSE	BS	L-T-P-S	3-0-2-1						
CODE		CATEGORY	_								

Versi on	1.0	Appr	oroval Details 24 30 th M		1 2018 LEARNING LEVE		BTL-4		
ASSESS	MENT SCHEME								
First Periodical Assessment			Second F Asses	Periodical sment	Pra	actical component	ESE		
15%			15	5%		20%	50%		
с	ourse Description	I	To make the and calculus	e student und using MATLA	erstand B	the basic concepts	of matrices		
Course Objective			 The course should enable the student to, Know how to perform some simple operations on matrices Understand effectively the basic concepts of differentiation and partial differentiation and their applications. Perform integration and other operations for certain types of functions and carry out the computation fluently. Classify ordinary differential equations 						
	Course Outcome		Upon co to, 1. Apply th 2. Apply th 3. Apply th 4. Apply th	e concept of r e concept of r e concept of f e concept of I e concept of o	this co natrice eature ntegral ordinar	ourse, the students as and Eigen Values. s in Differential Calcu l Calculus y differential equatic	will be able ulus		

СО, РО	CO, PO AND PSO MAPPING													
со	Р О- 1	РО- 2	РО- 3	РО- 4	РО- 5	РО- 6	РО- 7	РО- 8	РО- 9	PO- 10	РО- 11	PO- 12	PSO -1	PS O-2
CO-1	2	2	1	-	-	-	-	-	-	-	-	-	3	2
CO-2	2	1	1	-	-	-	-	-	-	-	-	-	3	2
СО-3	2	1	1	1	-	-	-	-	-	-	-	-	3	2
CO-4	2	1	-	-	1	1	1	-	-	-	-	-	3	2
		1:	Weakl	y relate	ed, 2: N	Aodera	itely re	lated a	nd 3: S	strongl	y relate	ed		
MODU (13L+2I	MODULE 1:MATRICES (13L+2P)													

Characteristic equi Hamilton theorem Cayley Hamilton transformation. Practical Compone • Lab1: Eigen Hamilton the Suggested Reading	ation – Eigen values and Eigenvectors – Properties – Cayley (Statement only) – Verification and inverse of the matrix using theorem- Diagonalization of matrices using similarity ent: n values and Eigenvectors, Verification and inverse using Cayley neorem- Diagonalization g: Basics of Matrices	CO-1 BTL-4						
MODULE 2: DIFFER	ENTIAL CALCULUS	(13L+2P)						
Methods of differentiation of functions – Product and Quotient rules – Inverse trigonometric functions – Implicit function – parametric form. Partial differentiation – Total differentiation- Taylor's series – Maxima and minima of functions of two variables Practical Component: • Lab2: Taylor's series – Maxima and minima of functions of two variables Suggested Reading: Basics of Differentiation								
MODULE 3:INTEGR	AL CALCULUS	(13L+2P)						
Integration – Methods of integration – Substitution method – Integration by parts – Integration using partial fraction – Bernoulli's formula. Applications of Integral Calculus: Area, Surface and Volume. Practical Component: Lab3: Applications of Integral Calculus: Area, Surface area and Volume. Suggested Reading: Basics of Integrations								
MODULE 4: ORDIN	IARY DIFFERENTIAL EQUATIONS	(13L+2P)						
Second order differential equations with constant coefficients – Particular integrals – e^{ax} , $Sinax$, $Cosax$, x^m , e^{ax} Cos bx, e^{ax} Sin bx. Solutions of homogeneous differential equations with variable coefficients – Variation of parameters. Practical Component: Lab 4: Solution of Second order differential equations. Suggested Reading: Basics of Differential Equations.								
TEXT BOOKS								
1.	Grewal B.S.(2014). <i>Higher Engineering Mathematics,</i> Khanna Pub Delhi, 43rd Edition.	lishers, New						
2.	2. Bali N. P and Manish Goyal. (2011). A Text book of Engineering Mathematics Eighth Edition, Laxmi Publications Pvt Ltd.							
3. Chandrasekaran A(2010), A Text book of Engineering Mathematics Publications, Chennai								
REFERENCE BOOKS								
1.	1.Srimantha Pal and Bhunia, S.C. (2015). Engineering Mathematics, Oxford University Press.							

2.	Weir, M.D and Joel Hass. (2015). <i>Thomas' Calculus</i> , 12th Edition, Pearson India.								
3.	Dean G. Duffy .(2011). Advanced Engineering Mathematics With Matlab, Third Edition, by CRC Press.								
E BOOKS									
1.	http://nptel.ac.in/courses/111105035/ https://www.edx.org//introduction-engineering-mathematics-utarlingtonx- engr3								
моос									
1.	https://www.mooc-list.com/tags/engineering-mathematics								

COURSE TITLE	N	/IATRIC	ES AND CALCUL	US		CREDITS	4		
COURSE CODE	MAA4101	COUF	RSE CATEGORY	BS		L-T-P-S	3-0-2-1		
Version	1.0	Арр	oroval Details	24 30 th ا	4 ACM May 2018	LEARNING LEVEL	BTL-4		
ASSESSM	ENT SCHEME								
First P	eriodical Assessme	nt	Second Perio Assessme	dical nt	Practi	cal component	ESE		
	15%		15%			20%	50%		
Co	urse Description		To make the student understand the basic concepts of matrices and calculus using MATLAB						
Ca	ourse Objective	 5. Know how to perform some simple operations on matrices 6. Understand effectively the basic concepts of differentiation and partial differentiation and their applications. 7. Perform integration and other operations for certain types of functions and carry out the computation fluently. 8. Classify ordinary differential equations 							
C	ourse Outcome	 Upon completion of this course, the students will be able to, 5. Apply the concept of matrices and Eigen Values. 6. Apply the concept of features in Differential Calculus 7. Apply the concept of Integral Calculus 8. Apply the concept of ordinary differential equation 							
Prerequisi	tes: Nil								

CO, PO AND PSO MAPPING

	PO	PO	ΡO	PO-	ΡO	PO	PO	ΡO	ΡO	PO-	PO-	PO-	PSO	PSO-
СО	-1	-2	-3	4	-5	-6	-7	-8	-9	10	11	12	-1	2
CO-1	2	2	1	-	-	-	-	-	-	-	-	-	3	2
CO-2	2	1	1	-	-	-	-	-	-	-	-	-	3	2
CO-3	2	1	1	1	-	-	-	-	-	-	-	-	3	2
CO-4	2	1	-	-	1	1	1	-	-	-	-	-	3	2
		1: We	eakly	related	, 2: M	odera	tely r	elated	and	B: Stron	gly rela	ated		
MODULE													1:MA	RICES
(13L+2P)														
Characteristic equation – Eigen values and Eigenvectors – Properties – Cayley Hamilton														
theorem (Statement only) – Verification and inverse of the matrix using Cayley												ey 🛛		
Hamilton theorem- Diagonalization of matrices using similarity transformation.												0_1		
Practical Component:													.0-1 TI 4	
 Lab1: Eigen values and Eigenvectors, Verification and inverse using Cavlev 												y B	1L-4	
Hamilton theorem- Diagonalization														
Suggested Reading: Basics of Matrices														
MODULE 2: DIFFERENTIAL CALCULUS											(13	L+2P)		
Methods of differentiation of functions – Product and Quotient rules – Inverse											e			
trigonometric functions – Implicit function – parametric form. Partial differentiation –												-		
Total differentiation- Taylor's series – Maxima and minima of functions of two variables											es C	0-2		
Practical Component:											B	STL-4		
• La	b2: Ta	ylor's	series	s – Max	ima a	nd mir	nima c	of fund	ctions	of two	variable	es		
Suggested	Readi	ng: Ba	sics o	f Differ	entiat	ion								
MODULE 3	B:INTE	GRAL	CALCI	JLUS									(13	L+2P)
Integratio	n – M	ethod	s of i	ntegrat	ion –	Subst	itutior	n met	hod –	Integra	ation b	y parts	-	
Integratio	n usir	ng pa	rtial	fraction) — В	Bernou	ılli's f	ormu	la. Ap	oplicatio	ons of	Integr	al	
Calculus: A	Area, S	urface	e and '	Volume									0	0-3
Practical (Compo	onent:											B	STL-4
Lab3: App	licatio	ns of I	ntegr	al Calcu	ılus: A	rea, S	urface	e area	and V	olume.				
Suggested	l Read	ing: B	asics o	of Integ	ration	IS								
MODULE	4: OR[DINAR	Y DIF	FERENT	IAL EC	QUATI	ONS						(13	L+2P)
Second or	rder di	ifferer	ntial e	quatior	ns witl	h cons	stant o	coeffic	cients	– Parti	cular in	tegrals	-	
e^{ax} , Sinax	,Cosax	x, x^m ,	e ^{ax} C	Cos bx,	e ^{ax} S	in bx.	Solut	tions	of hoi	nogene	eous di	fferenti	al	
equations	with v	ariabl	e coet	fficients	s – Vai	riation	of pa	ramet	ters.				C	20-4
Practical (Compo	onent:											BTI	1,2,3
Lab 4: Sol	ution o	of Seco	ond o	rder dif	ferent	ial eq	uation	IS.						
Suggested	d Read	ing: B	asics o	of Diffe	rentia	l Equa	tions.							
TEXT BOO	KS													
			Gre	wal B.S	.(2014	4). <i>Hig</i>	gher E	ngine	ering	Mathe	matics,	Khann	a Publ	ishers,
	L.		New	Delhi,	43rd E	ditior	ı							
	,		Bali	N. P	and	Mani	sh G	oyal.	(2011). A	Text b	ook of	Engin	eering
2	<u>.</u> .		Mat	hemati	cs, Eig	hth Ec	lition,	Laxm	i Publi	cations	Pvt Lto	ł.		

3.	Chandrasekaran A(2010), A Text book of Engineering Mathematics I, Dhanam Publications, Chennai
REFERENCE BOOKS	
1.	Srimantha Pal and Bhunia, S.C. (2015). <i>Engineering Mathematics,</i> Oxford University Press.
2.	Weir, M.D and Joel Hass. (2015). <i>Thomas' Calculus</i> , 12th Edition, Pearson India.
3.	Dean G. Duffy .(2011). Advanced Engineering Mathematics With Matlab, Third Edition, by CRC Press.
E BOOKS	
1.	http://nptel.ac.in/courses/111105035/ https://www.edx.org//introduction-engineering-mathematics-utarlingtonx- engr3
MOOC	
1.	https://www.mooc-list.com/tags/engineering-mathematics

COURSE TITLE		IN	ITRODUCTION TO DIGITAL	SYSTEMS	CREDITS	3				
COURSE CODE	МНВ	4102	COURSE CATEGORY	PC	L-T-P-S	2-0-2-1				
Version	1.0		Approval Details	24 th ACM 30.05.2018	LEARNING LEVEL	BTL-3				
ASSESSMENT SCHEME										
First Perio Assessme	dical ent	Seco	nd Periodical Assessment	Practical component	E	SE				
15%			15%	20%	50%					
Course Description		Introduction to digital system is concerned with the design, selection, analysis of digital circuits as well as the various electronics components to be used in a Mechatronics system								
Course Obje	ective	The 1. Pr 2. D 3. A ci 4. D in 5. Ce 6. Sy	e course should enable the ractice the different nu echniques esign of adders, subtractors pply the underlying princ rcuits esign of asynchronous cir iterfacing concepts and its a omprehend the principle of ynergetic combination of all	student to, imber systems, Lo s and other combina ciple and applicatio cuits and the vario application. f various electronic d pove in the design of	ogic gates, tional circuits ins of variou us issues in i evices Mechatronic	Minimization s sequential it. Real time systems.				

	Upon completion of this course, the students will be able to									
	1. Simplify mathematical expressions using Boolean functions									
Course Outcome	2. Design combinational circuits									
	3. Design sequential circuits and Asynchronous circuits for simple problems									
	4. Select appropriate electronic devices for mechatronic systems									

CO, PO AND PSO MAPPING

c0	PO_1	PO_2	-2 PO-3		PO-5	PO-6	PO-7	DU-8	PO-9	PO-	PO-	PO-	PSO-	PSO-
co	F0-1	10-2		r 0-4				FU-0	FO-5	10	11	12	1	2
CO-	2	2						2	2			2	2	1
1	3	5	5 -	-	-	-	-	2	2	_	-	2	2	L
CO-	2	2	2	2	2			2	2			•	2	4
2	3	3 3	5 5	5 5	5	-	-	2	2	-	-	Z	2	1
CO-	2	2						2	2			2	2	1
3	5	5	-	-	-	-	-	2	2	-	-	2	2	1
CO-	2	2						2	2			2	2	1
4	5	5	-	-	-	-	-	2	2	-	-	2	2	L

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: INTRODUCTION TO DIGITAL SYSTEMS (61+6P)	
Introduction to Digital systems – Number systems - Binary, Hexadecimal - Boolean theorems – Basic Logic Gates, Minimization – Minterm, Maxterm, Karnaugh Map, K map up to 4 variables. Simplification of logic functions with K-map, tabular minimization procedures Practical component: (<i>To be done in Simulation environment</i>) Implementation of Boolean Expressions using Basic Logic Gates Suggested Readings: Basics of number systems.	CO-1 BTL-2
MODULE 2: COMBINATIONAL CIRCUITS	(6L+6P)
Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, De-multiplexer, Magnitude Comparator, Decoder, Encoder. Practical component: (<i>To be done in Simulation environment</i>) 1. Implementation of Boolean Relations using Digital Comparators 2. Implementation of Arithmetic Expressions using Adders / Subtractors 3. Implementation of BCD-TO-7-segment Decoder / Driver and Operation of 7- segment LED Display Suggested Readings: Priority Encoder.	CO-2 BTL-2
MODULE 3: SEQUENTIAL CIRCUITS	(6L+6P)

Flip f of FF, mode Count Pract 1. Im 2. Imp Sugge Best	lops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering , Analysis and design of clocked sequential circuits – Design – Moore/Mealy els, state minimization, state assignment, circuit implementation – Design of ters- Ripple Counters, Ring Counters, Shift registers. ical component: - (<i>To be done in Simulation environment</i>) plementation of Sequential Circuits using Basic Flip-Flops olementation of Multi-bit Sequential Circuits using Shift Registers ested Readings:	CO-3 BTL-3
MOD	ULE 4: ASYNCHRONOUS SEQUENTIAL CIRCUITS	(6L+6P)
Asynd cycles Pract 1. Im 2. Imp Sugge ASM	chronous sequential circuits- fundamental mode pulse mode sequential circuits. s and races, Race free assignments, hazards ical component: - (<i>To be done in Simulation environment</i>) plementation of Logic Functions using Multiplexers plementation of Logic Functions using Decoders ested Readings: chart	CO-3 BTL-2
MOD	ULE 5: BASIC ELECTRONIC DEVICES	(6L+6P)
Volta Diode Practi V-I ch Sugge	ge – Current – Ohms Law – introduction to electronic devices – PN Junction e, V-I characteristics, Transistors, Rectifiers. cal component: aracteristics of PN junction diode, transistors ested Readings: ters, Converters and Voltage regulators	CO-4 BTL-2
TEXT	BOOKS	
1.	Thomas I. Floyd. (2014). <i>Digital Fundamentals</i> , 11 th edition, Pearson.	
REFER	RENCE BOOKS	
1.	M. Morris Mano. (2016). Digital Logic and Computer Design, Prentice-Hall.	
2.	W.H.Gothmann. (1992). Digital Electronics-Introduction Theory and Practice, PH.	
3.	S. Salivahanan and S. Arivazhagan. (2006). <i>Digital Circuits and Design</i> , 3 rd Edition. Publishing House Pvt. Ltd, New Delhi.	, Vikas
MOO	2	
1.	http://nptel.ac.in/courses/106108099/Digital%20Systems.pdf	
2.	https://onlinecourses.nptel.ac.in/noc18_ee33/preview	

COURSE TITLE		ENGINEERING PHYSICS		CREDITS	3
COURSE CODE	PHA4101	COURSE CATEGORY	BS	L-T-P-S	3-0-0-0
Version	1.0	Approval Details	24 ACM 30.05.201	LEARNING LEVEL	BTL-3

							1	8					
ASSE	SSMEN	T SCHEME											
Fin Perio Assess	rst odical sment	Second Periodica Assessmer	Sen	ninar/ A Pro	ssignm ject	ents/	Surı Test /	prise / Quiz	Attendance			E	SE
15	5%	15%		10)%		5	%		5%		50)%
Cou Desci r	urse riptio 1	This course deals with fundamental principles of physics, using mathematical derivations, for first year B. Tech students; the principles and applications of elasticity, acoustics, ultrasonics, quantum physics, crystal physics, lasers and fiber optics are dealt in this course. Intended for Aeronautical, Automobile, Bio tech., Chemical, Civil and Mechanical branches											
Cou Obje	urse ctive	The construction 1. Explai problec 2. Apply engine 3. Explai apply 4. Identi mater 5. Discus	purse sho n stress, principle eering to n particle it to infin fy crysta ials and h s the prin	es of ac ol e natur ite pote al strue nysteres	able th and el coustice e of ra ential v ctures sis base workir	e stude astic n s to so adiation vell and ed on c ng and	ent to, noduli lve bas n, comp crystal oncept applica	and ap sic prol pute So planes of ferr tions o	oply the blems chrodir s; des omagn of lasers	e conce and us nger's w cribe o etic do s and fil	epts to e ultra wave e differei mains. ber opt	o solve sonics equation nt mag	basic as an n and gnetic
Cou Outc	urse come	Upon 1. Solve 2. Apply ultras 3. Use m 4. Identi explai 5. Famili	completing the basic the know onic as an athemat fy the cr n the fer arize with	ion of t proble vledge n engine ical der ystal la romagn n the pr	his cou ms in e of acou eering ivation ttice p etic do inciple	Irse, th lasticit ustics in tool. s to so planes, omain. s, worl	e stude y and e n design lve qua disting king and	ents wi explain ning ac ntum p uish di d applie	II be ab the pro coustica problen ifferent cations	operties operties al build ns. magn of lase	s of ma ings an etic m ers and	itter id empl aterials fiber o	loying s, and ptics.
Preree	quisite	s: Knowled	ge in fun	dament	als of F	Physics	at high	er seco	ondary	level			
CO , 1	PO AN	D PSO M	APPING										
со	РО- 1	PO- PC 2 3	- PO-	РО- 5	РО- 6	РО- 7	РО- 8	РО- 9	РО- 10	РО- 11	РО- 12	PSO -1	PSO -2
CO- 1	3	2 1	1	1	1	1	1	1	1	1	1	1	1

CO-

CO-

3														
CO- 4	3	2	1	1	2	1	1	1	1	1	1	1	1	1
CO- 5	3	2	1	1	3	1	1	1	1	1	1	1	1	1
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: PROPERTIES OF MATTER AND HEAT)			
Elasticity - Hooke's law- Elastic Moduli - Young's modulus of elasticity - Rigidity modulus - Bulk modulus - Twisting couple on a wire - Torsional pendulum - determination of rigidity modulus of a wire - Depression of a cantilever - Young's modulus by cantilever - uniform and non-uniform bending. Thermal conductivity - experimental determination of thermal conductivities of good and bad conductors -Forbe's method - theory and experiment - Lee's disc method for bad conductors.										CC BT)-1 L-3			
MOD	ULE 2:	ACOUS	TICS A		RASO	NIC							(5	L+4L)
Classification of sound - Characteristics of musical sound – intensity - loudness - Weber Fechner law - Decibel - Reverberation - Reverberation time, derivation of Sabine's formula for reverberation time (Jaeger's method) - absorption coefficient and its determination - factors affecting acoustics of building (Optimum reverberation time, loudness, focusing, echo, echelon effect, resonance and noise) and their remedies Ultrasonics- Production – Magnetostriction and Piezoelectric methods – properties – applications									CC BT)-2 L-3				
MOD	ULE 3: (QUAN	rum pi	IYSICS									(5	L+4L)
Black law a exper Schrö Physit	body r nd Ray imenta dinger cal sign limensi	adiatio /leigh - al verifi /s wave nificanc on (no	n- Plan - Jean': cation e equat e of wa deriva	ick's th s law f tion – ave fur tion)	eory (d rom Pl Time ir action -	lerivati anck's ndeper - Partic	on) – D theory ident a le in a	eduction - Com and tim one di	on of W pton e e depe mensio	Vien's d ffect – endent onal bo	displace - Theor equati x - Exte	ement ry and ions – ension	C BT	0-3 L-3
MOD	ULE 4: (CRYST	AL PHY	SICS AN	ND MA	GNETIS	5M					·	(5L+	4L)
Crystal - Lattice - Unit cell - Bravais lattice - Lattice planes - Miller indices - 'd' spacing in cubic lattice - Calculation of number of atoms per unit cell - Atomic radius - coordination number - Packing factor for SC, BCC, FCC and HCP structures. Magnetic dipole moment - atomic magnetic moments- magnetic permeability and susceptibility - Types of magnetism: diamagnetism - paramagnetism - ferromagnetism - antiferromagnetism- ferrimagnetism - domain structure - hysteresis - hard and soft										oacing dius - y and netism d soft	CC BT)-4 L-3		
MOD	ULE 5:	рното		ND FIE	BER OP	TICS							(5L	.+4L)
Princ emiss chara	iple of ion - cteristi	laser: popul cs – No	s - Sti ation d-YAG	mulate inversi aser - C	ed abso on - CO ₂ lase	orption pumpi er - Sen	ng act ng act	ontane tion - uctor la	ous er active iser – a	nission med pplicat	, stimu ium - ions	ulated laser	CO BT)-5 L-3

Opti	cal fiber - principle and propagation of light in optical fibers - Numerical aperture									
and a	acceptance angle - types of optical fibers - single and multimode, step index and									
grade	graded index fibers - fiber optic communication system.									
TEXT	BOOKS									
1.	P.Mani. (2011). Engineering Physics, Voll& II, Dhanam Publications, Chennai.									
REFE	RENCE BOOKS									
1.	Gaur R.K. and Gupta S.L. (2010), <i>Engineering Physics</i> , 8 th edition, DhanpatRai publications (P) Ltd., New Delhi.									
2.	P.Charles, Poople and Frank J. Owens. (2007). Introduction to Nanotechnology, Wiley India.									
3.	Arthur Beiser. (2007). Concepts of Modern Physics, Tata McGraw – Hill Publications.									
4.	Rajendran V. Marikani A. (2003). <i>Applied Physics for engineers</i> , 3rd edition, Tata McGraw – Hill publishing company Ltd., New Delhi.									
E BOO	DKS									
1	https://books.google.co.in/books?id=w4crDAAAQBAJ&printsec=frontcover#v=onepage&q&f									
1.	=false									
2.	https://www.goodreads.com/book/show/789047.Physics_for_Scientists_and_Engineers									
MOO	C									
1.	https://www.coursera.org/learn/how-things-work									
2.	https://www.coursera.org/learn/quantum-physics									
3.	https://onlinecourses.nptel.ac.in/noc21_ph21									
4.	https://onlinecourses.swayam2.ac.in/aic20_sp64									

COURSE TITLE	EI	NGINEERING IMMERSION		CREDIT	1						
COURSE CODE	GEA4131	COURSE CATEGORY	E	S	L-T-P-S	0-0-2-2					
VERSION	1.0	APPROVAL DETAILS	24 th / 30.5.	ACM - 2018	LEARNING LEVEL	BTL-3					
ASSESSMENT SCHEME											
		CIA		ESE							
		80%		20%							
Course	To provide	the students with hands	on ex	perien	ce on various	s basic engineering					
Description	practices										
Course Objective	The course 1. Relate t 2. Learn b 3. Learn l Science	should enable the student theory and practice of basic asic concepts in Aeronautic basic concepts in Electric	s to : Civil and :al, Eleo	nd Meo Autom ctronic	chanical Engin obile Enginee s, mechatron	eering ring ics and Computer					

	Upon completion of this course, the students will be able to
Course Outcome	1. Identify and use of tools, Types of joints used in welding, carpentry and
	plumbing operations.
	2. Have hands on experience on basic fabrication techniques such as carpentry and
	plumbing practices.
	3. Have hands on experience on basic fabrication techniques of different types of
	welding and basic machining practices.

CO, PO AND PSO MAPPING

PSO
-2
-
-
-

SLOT X -LIST OF EXPERIMENTS

I. MECHANICAL ENGINEERING WORKSHOP

1. Welding: Arc welding: Butt joints

- 2. Lap joints.
- 3. Machining: Facing
- 4. Turning

II. AUTOMOBILE ENGINEERING

- 1. Dismantling and Studying of two stroke gasoline engine.
- 2. Assembling of two stroke gasoline engine.
- 3. Dismantling and Studying of four stroke gasoline engine
- 4. Assembling of four stroke gasoline engine.

III. AERONAUTICAL ENGINEERING

- 1. Study of Flow Pattern around Various Objects.
- 2. Force measurement on Aircraft Model
- 3. Determination of Young's Modulus for Aluminum Cantilever Beam
- 4. Binary Addition & Subtraction using Microprocessor

IV. CIVIL ENGINEERING

- 1. Plumbing- Basic Pipe Connection using valves, couplings and elbows.
- 2. Carpentry Sowing, Planning and making common Joints.
- 3. Bar Bending
- 4. Construction of a 50 cm height brick wall without mortar using English Bond.

SLOT Y -LIST OF EXPERIMENTS

V.ELECTRICAL ENGINEERING

- 1. Study of tools and accessories.
- 2. Study of cables.
- 3. Staircase wiring, Tube light and Fan connection.
- 4. Measurement of energy using single phase energy meter.

VI. ELECTRONICS ENGINEERING

- 1. Study of Active and Passive Components.
- 2. Study of Logic Circuits.
- 3. Making simple circuit using Electronic Components.
- 4. Measuring of parameters for signal using CRO.

VII. COMPUTER SCIENCE

- 1. Troubleshooting different parts of the computer peripherals, Monitor, Keyboard & CPU.
- 2. Installation of various operating systems, their capabilities, Windows, Unix, Linux.
- 3. Installation of commonly used software like MS Office
- 4. Assembling digital computer.

VIII. MECHATRONICS ENGINEERING

- 1. Study of Key Elements of Mechatronics Systems
- 2. Sensors Load Cell, Thermocouple
- 3. Actuators Linear & Rotary Actuators
- 4. Interfacing & Measurements Virtual Instrumentation

REFERENCE

1	Jeyapoovan T and SaravanapandianM.(2015). Engineering practices lab manual, 4th Edition,
	Vikas publishing House.
2	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K. (2008, 2010). Elements of
	Workshop Technology, Vol. I 2008 and Vol. II 2010, Media promoters and publishers private

- limited, Mumbai.
 3 Ibrahim Zeid. (2011). CAD/CAM Theory and Practice, Tata McGraw-Hill Publishing Company Ltd., New Delhi.
- 4 Robert Quesada, JeyapoovanT.(2006). *Computer Numerical Control Machining and Turning Centers*, Pearson Education, New Delhi.

METHOD OF ALLOCATION FOR ENGINEERING IMMERSION LAB

SLOT X : MECH, AERO, AUTO, CIVIL EXPERIMENTS

SLOT Y : EEE, ELECTRONICS, CSE, MECHATRONICS EXPERIMENTS

- EVERY CLASS OF
 - GROUP A (AERO, AUTO, MECH, MCT, CHEM, BIO, CIVIL
 - GROUP B (CSE, IT, ECE, EEE, AEROSPACE)

GETS DIVIDED INTO 4 SUB - GROUPS NAMELY a, b, c, d -- EACH CONSISTING OF 15 TO 20 STUDENTS MAX.

FOR EXAMPLE: GROUP A STUDENTS WILL OCCUPY SLOT X

- WEEK 1 : SLOT X ---
 - a MECH; b AUTO; c AERO ; d CIVIL
- WEEK 2 : SLOT X ---
 - b MECH; c AUTO; d AERO ; a CIVIL
- > THE ABOVE SCHEDULE WILL BE ON ROTATION EVERY MONTH (ONE CYLCE PER MONTH)

> GROUP B STUDENTS WILL OCCUPY SLOT Y

• WEEK 1 : SLOT Y ----

a – EEE; b – ECE; c – CSE ; d – MCT

- WEEK 2 : SLOT Y ---
 - b EEE; c ECE; d CSE ; a MCT

> THE ABOVE SCHEDULE WILL BE ON ROTATION EVERY MONTH (ONE CYLCE PER MONTH)

COURSE TITLE			E (Comr	NGINE non to	ERING ALL br	PHYSI anches	CS LAB of Eng	ineerir	ng)		CREDITS		1		
COURSE CODE		PHA41	31		COUR	SE CAT	EGORY	,	E	BS	L-T-	-P-S	0-0-2	2-0	
Version		1.0		Approval Details				24 th / 30.5	ACM - .2018	LEAR LE	NING /EL	BTL	3		
ASSESSM	ENT	SCHEN	IE												
				CIA					ESE						
80%											209	%			
Course Description Learn experimental methods to determine engineering properties of materials and demonstrate the use of modern tools in engineering											of				
Course	ctive	 The course should enable the students to Train students to analyze elastic properties of materials Determine thermal conductivity of a bad conductor. Train students to measure viscosity of liquids. Study the V-I characteristics of diode Train students to apply light phenomena to analyse materials 													
Course	Outo	ome	 Upon completion of this course, the students will be able to 1. Determine elastic properties of materials 2. Determine thermal conductivity of bad conductor 3. Determine viscosity of liquids 4. Plot V-I characteristics of a diode. 5. Determine thickness of thin wire and refractive index of a material 												
Prerequis	ites:	Physic	s practi	ical at h	nigher	second	ary lev	el							
CO, PO A	AND	PSO I	MAPP	ING											
со	P 0 -1	PO- 2	РО- 3	РО- 4	РО- 5	РО- 6	РО- 7	PO- 8	РО- 9	PO- 10	PO- 11	PO- 12	PS 0-1	P S O - 2	
CO-1	3	3	-	-	-	-	-	-	3	-	-	3	-	-	

CO-2	3	3	-	-	-	-	-	-	3	-	-	3	-	-
CO-3	3	3	-	-	-	-	-	-	3	-	-	3	-	-
CO-4	3	3	-	-	3	-	-	-	3	-	-	3	-	-
CO-5	3	3	-	-	-	-	-	-	3	-	-	3	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: PROPERTIES OF MATTER- SOLID												(9P)		
1. Torsional Pendulum – Determination of rigidity modulus of the material of a														
wire.											CO-	1		
2.Non Uniform Bending – Determination of Young's Modulus.											BTL	-3		
3.Uniform Bending – Determination of Young's Modulus.														
MODULE	2: PR	OPERI	TIES OF	MATT	ER- LIC	QUID							(3P)	
4. Viscosity	– D	etermi	nation	of co-	efficier	nt of vi	scosity	of a li	quid b	y Poise	uille's		CO-	2
flow.													BTL	-3
MODULE	3: TH	IERMA	L CONI	DUCTIV	/ITY									
(3P)														
5. Lee's Disc – Determination of thermal conductivity of a bad conductor.														
морше			24-10111	laiuen	yueres	111.							BIL	-3
(6P)	4. Ur	1103												
6.Air – We	dge -	- Deter	minati	on of tl	hicknes	ss of a t	thin wir	re					со	4
7.Spectron	netei	r – refr	active i	ndex o	f a pris	m							BTL	-3
MODULE	5: ES	STIMA		IETAL I	ON CO	NTENT	'S IN TH	IE SAM	IPLE					
(6P)														
8.Semicon	duct	or lasei	r – Dete	ermina	tion of	wavele	ength o	f laser	using g	grating			CO-	5
9.Semicon	duct	or diod	e – VI (charact	eristics	5							BTL	-3
TEXT BOO	KS													
1.	P. I	Mani(2	005) <i>, E</i>	nginee	ring Ph	nysics P	ractica	<i>ls,</i> Dha	nam Pi	ublicati	ons, Ch	nennai		
REFERENC	E BO	OKS												
1	Gle	enn V.	Lo, Jes	us Urre	echaga	– Aitur	na(2005	5). Intro	oducto	ry Phys	ics Lab	orator	y Manı	ıal,
1.	Par	<i>t-I,</i> Fall	l .											
2.	P. Tec	Kulkarı <i>hnolog</i>	ni.(201 w.	5). Exp	perimer	nts in i	Engine	ering P	Physics	Bache	lor of	Engine	ering c	and
E BOOKS		9	,,,											
1.	htt	p://wv	ww.aur	ora.ac.i	in/ima	ges/pd1	f/depar	tments	s/huma	anities-	and-sci	iences/	'engg-	
	phy	/-lab-m	anual.	pdt										
MOOC	1						/	,		- /: :				
1.	https://www.coursetalk.com/providers/coursera/courses/introduction-to-chemistry-1											/-1		

SEMESTER II

COUR SE TITLE			ANA	LYTICA	L MAT	HEMA	rics		C	REDIT	s		4	
COU RSE CODE	MAA 17	41 ,	С	OURSE	CATE	GORY		BS		Ŀ	T-P-S		3-0-2	2-0
Versi on	1.0	D		Appro	val Det	ails		24 th AC 30.5.20	CM - 018	LEARN	ING LE	VEL	BTL	4
ASSESS	MENT	SCHE	ME						·					
First F Asse	Periodi essmen	cal t	Sec A	ond Pe Assessn	riodica nent	1		Pract	ical co	mpone	ent		ES	E
:	15%			15%	6		20%						509	%
Co Desc	ourse criptior	n	To make the student understand the basic analytical mathematical skills that is imperative for effective understanding of engineering subject using MATLAB.											
Course Objective			 The course should enable the students to Demonstrate the fundamental understanding of integrals Apply problem solving skills vectors Understand the concepts of Laplace Transforms Understand the concept of Fourier series Understand the concepts of complex variables 											
Course Outcome			 Upon completion of this course, the students will be able to Evaluate surface and volume integrals. Perform vector operations and interpret the results geometrically Solve the system of ordinary differential equations using Laplace Transform Describe any periodic function satisfying Dirichlet's conditions that can be expressed as a Fourier series Describe complex variable theory, applications of analytic function and harmonic conjugate. 											
Prerequ	uisites:	Nil												
CO, PO	O AND	PSO	MAPP	ING										
0	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PS	PS
	1	2	3	4	5	6	7	8	9	10	11	12	0-1	0-2
CO-1	1	2	-	-	-	-	2	-	-	-	-	-	3	2
CO-2	2	1	1	2	-	-	-	-	-	-	-	-	3	2

CO-3	2	1	1	2	-	-	-	-	-	-	-	-	3	2
CO-4	2	1	-	-	-	-	-	-	-	-	-	-	3	2
CO-5	2	1	-	-	-	-	2	-	-	-	-	-	3	2
		1:\	Weakly	relate	d, 2: N	lodera	tely rel	ated a	nd 3: St	trongly	relate	d		
MODU	LE 1:M	ULTIPL	E INTE	GRALS							(10	L+2P)		
Double	integ	ration	– Car	tesian	and p	olar c	o-ordir	nates -	- Chan	ge of	order	of		
integrat	ion. A	rea as a	a doub	le inte	gral – 1	Friple ir	ntegrat	ion in (Cartesia	an coo	rdinate	s –		
Volume	as a	triple	integra	al – Cł	nange	of vari	ables l	betwee	n Cart	esian a	and po	olar	CO-	1
coordin	ates.												BTL-	3
Suggested Reading: Line Integrals														
Lab: Area and Volume using double and triple integration.														
MODULE 2:VECTOR CALCULUS (10L+2P)														
Gradient, Divergence and Curl – Unit normal vector, Directional derivative – angle														
betwee	n surfa	aces–So	olenoid	al and	Irrotat	ional v	ector f	ields, G	ireen's	theore	em - Ga	auss		
diverge	nce th	neorem	n and	Stoke	's the	orem	(withou	ut pro	of) –	Verific	ation	and	CO-	2
evaluat	ion of	the ab	ove th	eorem	s - Sin	ple ap	plicatio	ons to	regions	s such	as squ	are,	BTL	-3
rectang	le, tria	ngle, ci	uboids	and re	ctangu	lar para	allelopi	peds.						-
Sugges	ted Re	ading:	Basics	of Vect	ors									
Lab:Are	ea usin	g Gree	n's the	orem a	nd Vol	ume us	ing Ga	uss dive	ergence	e theor	em.			
MODUL	E 3:LA	PLACE	TRANS	FORM	S						(10	L+2P)		
Laplace	trans	form –	Condi	tions o	f exist	ence –	Transf	orm of	eleme	entary	functio	ns –		
propert	ies– Tr	ansfor	ms of c	lerivati	ves– Ir	nitial ar	id final	value t	heorer	ns – Tr	ansfor	m of		
periodio	c funct	ions. Ir	nverse	Laplac	e trans	storms	using p	partial f	raction	n and c	convolu	ition	CO	-3
theorer	n. Solu	tion of	linear	ODE of	secon	d order	with c	constan	t coeffi	icients.			BTL	-3
Suggest	ted Rea	ading: I	Basics (of Iran	storm			f	E la sea a		F			
	aing i	Lapiace	e and	Invers	e Lap	lace i	ransto	rm of	Eleme	entary	Functi	ons,		
Solution		ruinary			quatio	ns usin	g Lapia	ice tran	ISTORM		(10)	. 20)		
Dirichle	E 4: FU		SERIE) Dorol Fr	ourior	Corioc	044	and over	n func	tions		.+2P)		
					Juner Voalvci	series -	- Ouu a	anu eve		tions –	ndii fa	ange	<u> </u>	2
		e serie ading: I	S – Hall Basics (of sorio	Anaiysi c	5.							СО- рті	ວ ວ
Jab. Fo		orios F	vnancie	n of si	s mnla fi	unction	c Harr	nonic A	nalvcic				DIL	-3
							5, 11011		11019515	,	(10)	±2D)		
Functio	nc of			richlo	Anal	utio fur	otion		hu Di					
(Statom		a comp	viex va		– Anai	ytic Tui s functi	on (Sta	- Cauc	iiy - ri tonlu)	Cond	t equat	n of		
(Statement only) – Properties of analytic function (Statement only) – Construction of											CO-	4		
Suggest	ted Re:	ading (Comple	Num xe	hers	ictiou.							BTL	-3
	mplex	Numhe	ers											
TEXT BC	OKS													

1.	Kreyszig Erwin (2016). Advanced Engineering Mathematics, John Wiley and Sons, 10th Edition, New Delhi										
2.	A.P.Santhakumaran, P.Titus (2012). <i>Engineering Mathematics - II</i> , NiMeric Publications, Nagercoil										
3.	Chandrasekaran A (2014). Engineering Mathematics- II, Dhanam Publication										
4.	Raj Kumar Bansal, Ashok Kumar Goel, Manoj Kumar Sharma (2016). MATLAB and its Applications in Engineering, Pearson Publication, Second Edition										
REFERENCE BOOKS											
1.	Sastry, S.S (2014). <i>Engineering Mathematics</i> , Vol. I & II, PHI Learning Pvt. Ltd, 4 th Edition, New Delhi										
2.	Wylie, R.C. and Barrett, L.C.(2012). <i>Advanced Engineering Mathematics</i> , Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi.										
3.	Dean G. Duffy.(2013). Advanced Engineering Mathematics with MATLAB, CRC Press, Third Edition.										
E BOOKS											
1.	http:// nptel.ac.in/courses/122104017/28 https://www.khanacademy.org//double-integrals/double-integral. nptel.ac.in/courses/115101005/downloads/lectures-doc/Lecture-1.pdf nptel.ac.in/syllabus/122104017/ nptel.ac.in/courses/111105035/22 nptel.ac.in/syllabus/111103070/										
MOOC											
1.	https://www.edx.org/course/introduction-engineering-mathematics-utarlingtonx-engr3- 0x										

COURSE TITLE	(Con	ENGINEERING MATER	IALS Engineering)	CREDITS	3								
COURSE CODE	CYA4101	COURSE CATEGORY	BS	L-T-P-S	3-0-0-1								
Version	1.0	Approval Details	24 ACM 30.05.2018	LEARNING LEVEL	BTL-3								
ASSESSME	ASSESSMENT SCHEME												
First Periodical Assessmen t	Second Periodical Assessmen t	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendanc e	ESE								
15%	15%	10%	5%	5%	50%								

Course	This course will familiarize the student with the properties of metal, ceramic, polymer
Descriptio	and composite engineering materials. Methods to protect materials and alter their
n	properties will be discussed.

	The course should enable the student to,									
	 Make students understand the processing of metals and alloys. 									
Courses	2. Explain the applications of engineering applications of high temperature materials.									
Course	3. Appraise knowledge on nanomaterials and their engineering applications.									
Objective	4. Understand the characteristics of materials used in electronic applications.									
	5. Expose students to varieties of materials used in various engineering applications									
	and their critical properties.									
	Upon completion of this course, the students will be able to,									
	1. Suggest suitable metals for alloying.									
Course	2. Select high temperature materials for engineering applications.									
Outcome	3. Map the properties of nano-materials with their applications									
	4. Suggest suitable materials for electronic applications.									
	5. Identify the materials apt for engineering applications.									

CO, PO AND PSO MAPPING

3	PO-	PSO-													
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	P30-2	
CO- 1	3	1	1	-	-	-	1	-	-	-	-	1	1	-	
CO- 2	3	2	1	1	-	-	2	-	-	-	-	2	1	-	
CO- 3	3	1	1	-	-	-	1	-	-	-	-	2	1	-	
CO- 4	3	1	1	1	-	-	1	-	-	-	-	2	2	-	
CO- 5	3	2	1	-	-	-	2	-	-	-	-	2	2	-	

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: CRYSTAL STRUCTURE AND PHASE RULE (9 L)

Basic crystal systems – Types, characteristics, examples – Space lattice, Unit cell – types – X-ray diffraction and crystal structure. Basic terminology - Derivation of Gibbs Phase rule-Phase diagrams: One component system (water), Two component system–- Reduced phase rule: Simple Eutectic system, examples, Phase diagram: Ag-Pb system, Pb-Sn system–Applications of phase rule.

MODULE 2: POWDER METALLURGY, INORGANIC MATERIALS AND COMPOSITES.

(9L)

Steel – Composition, types, heat-treatment, Abrasives – Classification, Properties,	
Uses - Refractories – Classification, Properties, Applications. Glasses – Properties,	CO 3
Types, Specialty glasses. Composites - Introduction - Definition – Constituents –	CO-2
Classification -Fiber-reinforced Composites –Types and Applications.	BTL-3
Powder Metallurgy – Preparation of metal/alloy– Advantages and limitations.	

MODULE 3: NANOMATERIALSAND MOLECULAR SIEVES	(9L)
Introduction – Synthesis of Nanomaterials - Bottom-up and Top-down approaches – Methods of preparation – Sol-gel process, Gas-phase condensation, Chemical Vapour Deposition. Properties – Optical, Electrical, Magnetic, Chemical properties (introduction only).Characterization – FE-SEM, TEM (Principle and Applications only). Zeolite Molecular sieves – composition, structure, classification - applications – ion exchange, adsorption, separation, laundry, catalysis.	CO-3 BTL-2
MODULE 4: MATERIALS FOR ELECTRONIC APPLICATONS	(9L)
Liquid Crystals- Introduction – Characteristics – Classification- Thermotropic crystals Polymorphism in Thermotropic Liquid Crystals – Molecular arrangement in various stsres of Liquid Crystals, Lyotropic Liquid Crystals- Applications. Conducting and Super conducting Organic electronic materials - Applications. Engineering plastics: Polycarbonate – Properties and uses- Conducting Polymers:Classification, Intrinsic Conducting Polymers, Extrinsic Conducting Polymers, Applications - Biodegradable Polymers, examples and applications.	CO-4 BTL-2
MODULE 5: LUBRICANTS, ADHESIVES AND EXPLOSIVES	(9L)
Lubricants – Mechanism of Lubrication, Classification and Properties, Semi Solid Lubricants, Solid Lubricants, MoS ₂ and Graphite - Adhesives – Development of Adhesive strength, Physical and Chemical factors influencing adhesive action, Classification of Adhesives – Epoxy Resin (Preparation, Properties and Applications). Explosives – Requisites, Classification, Precautions during storage – Rocket propellants – Requisites - Classification.	CO-5 BTL-2
1. P.S. Raghavan.(2018). <i>Engineering Materials,</i> Dhanam Publications	
2. P.C. Jain and Monicka Jain. (2012). <i>Engineering Chemistry,</i> Dhanpat Raj Public Delhi	cation (P) Ltd, New
REFERENCE BOOKS	
1. Puri, Sharma and Pathania. (2020). <i>Principles of Physical Chemistry</i> , Vish Jalandar.	nal Publishing Co.
E BOOKS	
1. http://www.erforum.net/2016/01/engineering-chemistry-by-jain-and-jain-pdf	f-free-ebook.html
моос	
1. https://www.edx.org/course/materials-science-engineering-misisx-mse1x	

COURSE TITLE	PROFESSIO	NAL ENGLISH AND SOFT S	CREDITS	3	
COURSE	ELA4101	COURSE CATEGORY	HS	L-T-P-S	2-0-2-1

CODE												
Version	1.0	Approval Details	24 ACM 30 th May 2018	LEARNIN G LEVEL	BTL- 3							
ASSESSMEN	NT SCHEME											
First Periodical Assessme nt	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendan ce	ESE							
15%	15%	10%	5%	5%	50%							
Course Descriptio n	This course has been designed to meet students' current and future language and communication needs. It attempts to develop their proficiency in the four language skills and knowledge of grammar and vocabulary. This course teaches students how to communicate accurately, appropriately and fluently in professional and social situations.											
Course Objective	 To acquire self informative lis To provide and and use it for of To equip the standard literary, scient To enhance the recommendat writing. To equip the le participate in la employability 	-confidence by which the tening skills by an enhanc environment to Speak in E daily conversation, presen tudents to Read, compreh ific and technological text e writing skills of the stud- ions, checklists, process-d earners in analysing and a prainstorming, mind-map skills.	learner can i red acquisitio English at the station, group end and ans rs. ents via train escription, le pplying creat ping, audiovi	mprove upor on of the Engle of formal and i o discussion a wer question ing in instruct etter-writing a ive thinking s sual activities	n their ish language. Informal levels and debate. is based on ctions, and report skills and s and excel in							
Course Outcome	 Upon complete Demonstrate syntax. Enrich vocabu contextual massituations, Ide make suggesti Analyse and complex passive resume. Organize and manner in wr situations. Apply critical 	 participate in brainstorming, mind-mapping, audiovisual activities and excel in employability skills. Upon completion of this course, the students will be able to Demonstrate the ability to construct sentences with accuracy with focus on syntax. Enrich vocabulary, use of phrases, expressions, idioms, and proverbs. Derive the contextual meaning through reading and listening from general and academic situations, Identify specific details and general ideas. Learn to give instructions and make suggestions. Analyse and transcode data, construct different types of written essays, read complex passages and summarize ideas, create personal profiles in the form of a resume. Organize and articulate ideas, concepts, and perceptions in a comprehensive manner in written business correspondence, and speaking in formal and informal situations. 										

topics, and transact information with an audience. Prepare students for interview questions, presentation skills. Produce complex written documents such as reports, business/scientific documents, and project proposals.

Prerequisites: Plus Two English-Intermediate Level

СО, Р	CO, PO AND PSO MAPPING														
0	РО	PO-	РО	PO-	PO-	PSO	PSO	PSO							
co	-1	2	3	4	5	6	7	8	9	-10	11	12	-1	-2	-3
CO-										2			***	***	***
1	-	-	-	-	-	-	-	-	-	5	-	-			
CO-								2	2	2			***	***	***
2	-	-	-	-	-	-	-	2	2	5	-	-			
CO-										2			***	***	***
3	-	-	-	-	-	-	-	-	-	5	-	-			
CO-							2			2	2		***	***	***
4	-	-	-	-	-	-	2	-	-	5	2	-			
CO-									2	2	2	2	***	***	***
5	-	-	-	-	-	-	-	-	2	5	2	5			

1: Weakly related, 2: Moderately related and 3: Strongly related	ł
MODULE 1: FUNCTIONAL GRAMMAR AND VOCABULARY	(6L + 6P=12)
Introduction to communication skills –Self Introduction - Basic grammar (tenses,	
subject verb agreement) - Basic vocabulary (prefixes , suffixes, synonyms &	
antonyms, phrasal verbs and idioms)- Topic sentences , paragraph writing	
Suggested Activities:	
Short conversations-Situational Communication-Dialogue Writing - Writing short	
paragraph based on environment protection, societal issues, health, cultural	CO-1
contexts etc., identifying topic sentences, linking pairs of sentences.	BTL-2
Suggested Reading:	
1. Dr. Bikram K. Das et al. (2009) An Introduction to Professional English and Soft	
Skills with audio CD, Cambridge University Press.	
2. John, Dolly(2014), English for Life and the Workplace Through LSRW&T Skills,	
Pearson Publications.	
MODULE 2 – LISTENING AND SPEAKING SKILLS (6L + 6P=1	2)
Academic listening (listening to lectures different topics, audio excerpts and	
answering question) - General listening (conversations, speeches: formal and	
informal) - Giving instructions and suggestions- Active and Passive Voice	CO 3
Suggested activities:	
Listen and repeat, Listening to audio excerpts- Listening to native speakers - TED	DIL-3
Talks, short prepared speeches, Table topics – Speaking in different situations-	
MCQ's - Cloze exercises- Complete the Dialogue	

Suggested sources:									
1. Bommelje, R. (2011). LISTEN, LISTEN, LISTEN. In The top 10 ways to strengthen									
your self- leadership. International Listening Leadership Institute. Retrieved									
from http://www.listening leaders.com/Articles.html									
2. Hoppe, M. H. (2006). Active listening: Improve your ability to listen and lead									
[ebook]. Greensboro, NC: Center for Creative Leadership.									
3. Barnes, D. (2008) Exploratory talk for learning in Mercer, N. and Hodgkinson,									
S. (eds) Exploring Talk in School. London: Sage Publications									
MODULE – 3 : FUNCTIONAL READING AND WRITING	(6L+ 6P=12)								
Reading comprehension (academic texts and general texts)-Reading and									
Interpreting visual data, charts, tables and graphs Report writing- accident,									
industrial, survey, general reports – Direct and Indirect speech									
Suggested Activities:									
Identify the errors in sentences, grammar exercise, reading passage for	60 3								
identifying the contextual meaning, interpreting charts, tables and graphs,									
choose the right meaning of the word given	BIL-3								
Assignment on suggested reading activity – Book review									
Suggested sources:									
1. Murphy, Raymond (2016) Essential English Grammar, Cambridge University									
Press.									
Press. MODULE – 4 : BUSINESS CORRESPONDENCE	(6L + 6P=12)								
Press. MODULE – 4 : BUSINESS CORRESPONDENCE Memo-Notice - Agenda – Minutes of the Meeting-Action Taken report- Report	(6L + 6P=12)								
Press. MODULE – 4 : BUSINESS CORRESPONDENCE Memo-Notice - Agenda – Minutes of the Meeting-Action Taken report- Report Writing- Connectives - Cause and effect	(6L + 6P=12)								
Press. MODULE – 4 : BUSINESS CORRESPONDENCE Memo-Notice - Agenda – Minutes of the Meeting-Action Taken report- Report Writing- Connectives - Cause and effect Suggested activities:	(6L + 6P=12)								
Press. MODULE – 4 : BUSINESS CORRESPONDENCE Memo-Notice - Agenda – Minutes of the Meeting-Action Taken report- Report Writing- Connectives - Cause and effect Suggested activities: Drafting agenda, notice, memo, minutes of the meeting- ATR- Cause and effect	(6L + 6P=12)								
Press. MODULE – 4 : BUSINESS CORRESPONDENCE Memo-Notice - Agenda – Minutes of the Meeting-Action Taken report- Report Writing- Connectives - Cause and effect Suggested activities: Drafting agenda, notice, memo, minutes of the meeting- ATR- Cause and effect exercises - Presentation in the language lab (Technical or Non-technical topic)	(6L + 6P=12) CO-4 BTL-4								
Press. MODULE – 4 : BUSINESS CORRESPONDENCE Memo-Notice - Agenda – Minutes of the Meeting-Action Taken report- Report Writing- Connectives - Cause and effect Suggested activities: Drafting agenda, notice, memo, minutes of the meeting- ATR- Cause and effect exercises - Presentation in the language lab (Technical or Non-technical topic) Suggested sources:	(6L + 6P=12) CO-4 BTL-4								
Press. MODULE – 4 : BUSINESS CORRESPONDENCE Memo-Notice - Agenda – Minutes of the Meeting-Action Taken report- Report Writing- Connectives - Cause and effect Suggested activities: Drafting agenda, notice, memo, minutes of the meeting- ATR- Cause and effect exercises - Presentation in the language lab (Technical or Non-technical topic) Suggested sources: 1. Bailey, E. (2008). Writing and speaking. New York, NY: McGraw-Hill.	(6L + 6P=12) CO-4 BTL-4								
Press. MODULE – 4 : BUSINESS CORRESPONDENCE Memo-Notice - Agenda – Minutes of the Meeting-Action Taken report- Report Writing- Connectives - Cause and effect Suggested activities: Drafting agenda, notice, memo, minutes of the meeting- ATR- Cause and effect exercises - Presentation in the language lab (Technical or Non-technical topic) Suggested sources: 1. Bailey, E. (2008). Writing and speaking. New York, NY: McGraw-Hill. 2. Maynard-Smith, Julian. (2021), Ultimate Guide to Business Writing, All the	(6L + 6P=12) CO-4 BTL-4								
Press. MODULE – 4 : BUSINESS CORRESPONDENCE Memo-Notice - Agenda – Minutes of the Meeting-Action Taken report- Report Writing- Connectives - Cause and effect Suggested activities: Drafting agenda, notice, memo, minutes of the meeting- ATR- Cause and effect exercises - Presentation in the language lab (Technical or Non-technical topic) Suggested sources: 1. Bailey, E. (2008). Writing and speaking. New York, NY: McGraw-Hill. 2. Maynard-Smith, Julian. (2021), Ultimate Guide to Business Writing, All the Secrets of Creating and Managing Business Documents, Routledge.	(6L + 6P=12) CO-4 BTL-4								
Press. MODULE – 4 : BUSINESS CORRESPONDENCE Memo-Notice - Agenda – Minutes of the Meeting-Action Taken report- Report Writing- Connectives - Cause and effect Suggested activities: Drafting agenda, notice, memo, minutes of the meeting- ATR- Cause and effect exercises - Presentation in the language lab (Technical or Non-technical topic) Suggested sources: 1. Bailey, E. (2008). Writing and speaking. New York, NY: McGraw-Hill. 2. Maynard-Smith, Julian. (2021), Ultimate Guide to Business Writing, All the Secrets of Creating and Managing Business Documents, Routledge. MODULE 5 – PRESENTATION SKILLS AND INTERVIEW SKILLS	(6L + 6P=12) CO-4 BTL-4 (6L + 6P=12)								
Press. MODULE – 4 : BUSINESS CORRESPONDENCE Memo-Notice - Agenda – Minutes of the Meeting-Action Taken report- Report Writing- Connectives - Cause and effect Suggested activities: Drafting agenda, notice, memo, minutes of the meeting- ATR- Cause and effect exercises - Presentation in the language lab (Technical or Non-technical topic) Suggested sources: 1. Bailey, E. (2008). Writing and speaking. New York, NY: McGraw-Hill. 2. Maynard-Smith, Julian. (2021), Ultimate Guide to Business Writing, All the Secrets of Creating and Managing Business Documents, Routledge. MODULE 5 – PRESENTATION SKILLS AND INTERVIEW SKILLS Presentation Skills - Reading and Interpreting Advertisements—Job Application-	(6L + 6P=12) CO-4 BTL-4 (6L + 6P=12)								
Press. MODULE – 4 : BUSINESS CORRESPONDENCE Memo-Notice - Agenda – Minutes of the Meeting-Action Taken report- Report Writing- Connectives - Cause and effect Suggested activities: Drafting agenda, notice, memo, minutes of the meeting- ATR- Cause and effect exercises - Presentation in the language lab (Technical or Non-technical topic) Suggested sources: 1. Bailey, E. (2008). Writing and speaking. New York, NY: McGraw-Hill. 2. Maynard-Smith, Julian. (2021), Ultimate Guide to Business Writing, All the Secrets of Creating and Managing Business Documents, Routledge. MODULE 5 – PRESENTATION SKILLS AND INTERVIEW SKILLS Presentation Skills - Reading and Interpreting Advertisements—Job Application- Covering Letter -Curriculum Vitae –E-mail - Project proposal –Interview skills	(6L + 6P=12) CO-4 BTL-4 (6L + 6P=12)								
Press. MODULE – 4 : BUSINESS CORRESPONDENCE Memo-Notice - Agenda – Minutes of the Meeting-Action Taken report- Report Writing- Connectives - Cause and effect Suggested activities: Drafting agenda, notice, memo, minutes of the meeting- ATR- Cause and effect exercises - Presentation in the language lab (Technical or Non-technical topic) Suggested sources: 1. Bailey, E. (2008). Writing and speaking. New York, NY: McGraw-Hill. 2. Maynard-Smith, Julian. (2021), <i>Ultimate Guide to Business Writing, All the</i> Secrets of Creating and Managing Business Documents, Routledge. MODULE 5 – PRESENTATION SKILLS AND INTERVIEW SKILLS Presentation Skills - Reading and Interpreting Advertisements—Job Application- Covering Letter -Curriculum Vitae –E-mail - Project proposal –Interview skills (HR questions) – Group Discussion	(6L + 6P=12) CO-4 BTL-4 (6L + 6P=12)								
Sugar									
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Sugge	ested Activities:								
Prese	ntation in the language lab (Technical or Non-technical topic)	CO-5							
Group Discussion (Technical or Non-technical topic)									
Suggested Sources: BTL-4									
1. Ma	noharan. K(2016), Education and Personality Development, APH Publishing								
Home	Home.								
TEXT	BOOKS								
1.	Professional Skills and Soft Skills (2020), Study Material, Hindustan Institute and Science.	of Technology							
REFE	RENCE BOOKS								
1.	Pillai, Sabina and Fernandez, Agna, (2018) <i>Soft Skills & Employability Skills,</i> Cambridge University Press.								
2.	Steve Hart et al, (2016) Embark, English for Undergraduates, Cambridge University Press.								
3.	. Butterfield, Jeff(2010) Soft Skills for Everyone, Cengage Learning.								
4.	Koneru, Aruna(2015) Professional Speaking Skills, Oxford University Publis	hers.							
E BOO	DKS								
	https://www.britishcouncil.in/english/courses-business								
1									
	http://www.bbc.co.uk/learningenglish/english/features/pronunciation								
2									
	http://www.bbc.co.uk/learningenglish/english/								
3									
	http://www.cambridgeenglish.org/learning-english/free-resources/write-and-	improve/							
4									
MOO	с								
1	https://www.mooc-list.com/tags/english								
2	https://www.mooc-list.com/course/adventures-writing-stanford-online								
3	http://www.cambridgeenglish.org/learning-english/free-resources/mooc/								

COURSE	SUSTAINAE	BLE ENGINEERING SY	STEMS		2						
TITLE	(Common to	ALL Branches of Eng	ineering)	CREDITS	2						
COURSE	GEA/102	COURSE	DC		2-0-0-1						
CODE	GEA4102	CATEGORY	PC	L-1-F-3							
Vorsion	1.0	Approval Dotails	24 ACM	LEARNING	RTI 2						
VEISION	1.0	Approval Details	30.08.2018	LEVEL	BIL-5						
ASSESSMEN	ASSESSMENT SCHEME										

Fir Perio Assess	rst odical sment	Second Periodical Assessment		odical ent	Ser Assigi Pr	ninar/ nments/ oject	, Sur	prise T Quiz	Test /	Atto	endance		ESE		
15	5%		15%		1	L 0%		5%			5%		50%		
Cou Descr	urse ription	The o	course omic, a	introd and soc	uces co ial impa	oncepts acts of a	and m	ethod neerin	l for d g tech	etermi nology	ning the or proce	e net e ess	environn	nental,	
Cou Obje	 Course Objective Critically evaluate existing and new methods Develop sustainable engineering solutions by applying methods and tools to research a specific system design Clearly communicate results related to their research on sustainable engineering 												ed to for ols to		
Cou Outo	CourseUpon completion of this course, the students will be able to,1. Apply the principles of sustainability with case studies.2. Assess technologies and their impact on environment.3. Apply the concept of green energy in their projects at higher semesters.4. Assess natural resources and waste from various types of industries.5. Describe water technology and behavioral aspects of humans.														
Preree															
CO, F	PO-1	PO-2		PO-4	PO-5	PO-6	PO-7	PO-	PO-	PO-	PO-	PO-	PSO	PSO	
<u> </u>		1	1			1	2	8	9	10 1	11	12	-1	-2	
CO-2	-	3	1	-	_	1	3	1	1	1	-	2	-	_	
CO-3	-	3	2	-	-	3	3	2	2	1	-	1	-	-	
CO-4	-	1	2	-	-	1	3	1	2	3	-	2	-	-	
CO-5	-	1	1	-	-	1	3	2	2	1	-	3	-	-	
		1	: Wea	kly rela	ted, 2:	Modera	ately re	lated	and 3	: Stron	gly relat	ed			
MOD	ULE 1 :	PRINC	IPLES	OF SUS	TAINAE	BLE SYS	TEMS	(5	L)						
<u>Sustan</u> Frame	eworks	for App	lying :	Sustaina	ability F	vinciple	es - <u>Sur</u>	i <u>gn</u> , <u>S</u> imary	& Act	<u>able Er</u> ivities.	igineerii	<u>ng</u> -	BTL	-2	
MODU	JLE 2:	TECHN	OLOG	Y DEVE	LOPME	NT AND) LIFEC		ASSESS	MENT	<u> </u>			(5L)	
<u>Techno</u> (TRL) - <u>Assess</u>	ology a - techn sment (is a pa ical me LCA) m	<u>rt of a</u> etrics - ethod	<u>Emerg</u> ology - :	ogenic ing, cor Summa	enviror nverging ry & Ac	<u>nment</u> g, disru tivities.	- <u>Tech</u> ptive	nolog techno	y readi ologies	ness lev - <u>Life C</u> y	<u>vels</u> /cle	CO- BTL	-2 -3	

CURRICULUM AND SYLLABUSB.TECH – MECHATRONICS ENGINEERING

MOD	JLE 3 : <u>GREEN</u> ENGINEERING	(5L)
<u>Princ</u> Engin - <u>Sum</u>	iples of Green Engineering - Frameworks for assessment of alternatives - Green eering examples - Multifunctional Materials and Their Impact on Sustainability imary & Activities.	CO-3 BTL-3
MOD	ULE 4 : RESOURCE MANAGEMENT TECHNOLOGIES	(5L)
Waste loop techn LCA a	e management purpose and strategies - Recycling: open-loop versus closed- thinking - Recycling efficiency - Management of food waste and composting ologies - E-waste stream management - Reuse and redistribution programs - pproach to waste management systems - Summary and Activities.	CO-4 BTL-3
MOD	ULE 5 : SUSTAINABLE WATER AND WASTEWATER SYSTEMS	(5L)
<u>Wate</u> syster <u>&Acti</u>	er cycle - <u>Water conservation and protection technologies</u> - <u>Water treatment</u> msMetrics for assessment of water management technologies-Summary <u>vities</u> .	CO-4 BTL-3
MOD	ULE 6 : BEHAVIORAL ASPECTS AND FEEDBACKS	(5L)
<u>Colla</u> Facto	borative Decision Making - <u>Role of Community and Social Networking</u> - <u>Human</u> r in Sustainability Paradigm - <u>Summary & Activities</u> .	CO-4 BTL-3
TEX	KT BOOKS	
1.	Vanek, F.M., and L.D. Albright.(2008). <i>Energy Systems Engineering.</i> Implementation, McGraw Hill	Evaluation and
2.	C.U. Becker. (2012). Sustainability Ethics and Sustainability Research, Springer	
REF	ERENCE BOOKS	
1.	J.B. Guinee et al(2011)., <i>Life Cycle Assessment: Past, Present, and Futu</i> Technol., 45, 90-96.	re, Environ. Sci.
2.	Anastas, P.T., Zimmerman, J.B.(2013), <i>Innovations in Green Chemistry and Green Springer</i> .	een Engineering,
3.	Christensen, T., Ed., Wiley and Sons(2010), Solid Waste Technology & Manage & 2.	<i>ment,</i> Volume 1
4.	Sterman, J.D.(2012), In Sustainability Science: The Emerging Paradigm, Weir Turner, R.E. (Eds.), Springer Science+Business Media, LLC.	nstein, M.P. and
E BO	OKS	
1.	https://books.google.co.in/books?id=N_Xb2WYRVJ0C	
2.	https://www.goodreads.com/book/show/16786853-engineering-for-sustainab	oility
MOO	c	
1.	https://www.coursera.org/learn/sustainability	
2.	https://www.academiccourses.com/Certificate/Sustainability-Studies/India/	
3.	https://onlinecourses.nptel.ac.in/noc18_ce08/preview	
4.	https://www.coursera.org/learn/ecosystem-services	

COURSE TITLE	ENGINEERING AND	DESIGN		CREDITS	3
COURSE CODE	MHB4101	COURSE CATEGORY	PC	L-T-P-S	3-0-0-1

Version	1.0	Approval Details	24 th ACM 30.05.2018	LEARNING LEVEL	BTL-3					
ASSESSMENT SC	CHEME				1					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE					
15%	15%	10%	5%	5%	50%					
Course Description	This course is specifically designed to give the students a clear understanding of the mechanical engineering design and its process.									
Course Objective	 The course should enable the student to, Excite the students on creative design and its significance Make the students aware of the process involved in design Make the student understand the interesting interaction of various segments of humanities, sciences and engineering in the evaluation of the design. Get an exposure to engineer a design Make the student events of the IDD and trade canests. 									
Course Outcome	 Upon completie Appreciate the practice when c Aware of the producess. Aware of the producess Aware of the producess Have a broade sensitivity, safe Appraise econo 	on of this course, the different elements in called for. roduct oriented and u roduct oriented and u r perspective of des ty and other factors of mic and environmen	e students will be avolved in good of user oriented asp user oriented asp sign covering fu other than engin tal Issues, trade	e able to designs and to pects that mak pects that mak nction, cost, e eering analysis aspects and IPF	apply them in e the design a e the design a environmental					
Prerequisites: Ni	l									

60	РО	РО	РО	РО	РО	РО	РО	РО	РО	РО	РО	РО		
	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	P30-1	F30-2
CO-1	2	1	3	2	-	-	-	-	-	-	-	-	2	-
CO-2	-	-	2	2	-	-	-	-	-	-	-	-	2	-
CO-3	-	-	2	-	2	-	-	-	-	-	-	-	2	-
CO-4	1	2	3	-	-	-	-	-	-	-	-	-	2	-
CO-5	-	-	-	3	2	-	-	-	-	-	-	-	2	-
MODU	LE 1- II	NTROE	DUCTIC	ON TO	MECH	ANICA	L ENG	INEER	ING DI	ESIGN			(9))

any engineering specialization. Develop any design with over 50% standard items as parts MODULE 4- QUALITY ASPECTS IN MECHANICAL ENGINEERING DESIGN Design for "X"; covering quality, reliability, safety, manufacturing/construction, assembly, maintenance, logistics, handling; disassembly; recycling; re-engineering etc. Project: Example: List out the design requirements(x) for designing a rocket shell of 3-meter diameter and 8-meter length. Design mineral water bottles that could be packed compactly for transportation. MODULE 5 – USER CENTRED DESIGNS IN MECHANICAL ENGINEERING Product centered and user centered design. Product centered attributes and user	(9L) CO-4 BTL-2 (9L)
any engineering specialization. Develop any design with over 50% standard items as parts MODULE 4- QUALITY ASPECTS IN MECHANICAL ENGINEERING DESIGN Design for "X"; covering quality, reliability, safety, manufacturing/construction, assembly, maintenance, logistics, handling; disassembly; recycling; re-engineering etc. Project: Example: List out the design requirements(x) for designing a rocket shell of 3- meter diameter and 8-meter length. Design mineral water bottles that could be packed compactly for transportation. MODULE 5 – USER CENTRED DESIGNS IN MECHANICAL ENGINEERING	(9L) CO-4 BTL-2 (9L)
any engineering specialization. Develop any design with over 50% standard items as parts MODULE 4- QUALITY ASPECTS IN MECHANICAL ENGINEERING DESIGN Design for "X"; covering quality, reliability, safety, manufacturing/construction, assembly, maintenance, logistics, handling; disassembly; recycling; re-engineering etc. Project: Example: List out the design requirements(x) for designing a rocket shell of 3- meter diameter and 8-meter length. Design mineral water bottles that could be packed compactly for transportation.	(9L) CO-4 BTL-2
any engineering specialization. Develop any design with over 50% standard items as parts MODULE 4- QUALITY ASPECTS IN MECHANICAL ENGINEERING DESIGN Design for "X"; covering quality, reliability, safety, manufacturing/construction, assembly, maintenance, logistics, handling; disassembly; recycling; re-engineering etc. Project: Example: List out the design requirements(x) for designing a rocket shell of 3- meter diameter and 8-meter length. Design mineral water bottles that could be packed	(9L) CO-4 BTL-2
any engineering specialization. Develop any design with over 50% standard items as parts MODULE 4- QUALITY ASPECTS IN MECHANICAL ENGINEERING DESIGN Design for "X"; covering quality, reliability, safety, manufacturing/construction, assembly, maintenance, logistics, handling; disassembly; recycling; re-engineering etc. Project: Example: List out the design requirements(x) for designing a rocket shell of 3-	(9L) CO-4
any engineering specialization. Develop any design with over 50% standard items as parts MODULE 4- QUALITY ASPECTS IN MECHANICAL ENGINEERING DESIGN Design for "X"; covering quality, reliability, safety, manufacturing/construction, assembly, maintenance, logistics, handling; disassembly; recycling; re-engineering etc.	(9L)
any engineering specialization. Develop any design with over 50% standard items as parts MODULE 4- QUALITY ASPECTS IN MECHANICAL ENGINEERING DESIGN Design for "X": covering quality reliability safety manufacturing/construction	(9L)
any engineering specialization. Develop any design with over 50% standard items as parts	(91)
any engineering specialization. Develop any design with over 50% standard items as	
any application provide the Device states where the SOC is a later	i
Project: List out the standards organizations. Prepare a list of standard items used in	
operations; storage; packaging; shipping; marketing; feed-back on design	BTL-3
Planning; Scheduling; Supply chains; inventory; handling; manufacturing/construction	CO-3
Freezing the design; Cost analysis. Engineering the design - From prototype to product.	
Prototyping- rapid prototyping; testing and evaluation of design; Design modifications;	
MODULE 3 – PROTOTYPE OF MECHANICAL PARTS	(9L)
Project: An exercise in the detailed design of any two products	(0.)
needs of the design, both in its realization and in the applications.	
drawings; Tolerance; Use of standard items in design; Research needs in design; Energy	
Design detailing- Material selection, Design visualization- Solid modelling; Detailed 2D	
Concept of "Complex is Simple". Design for function and strength.	BTL-2
Communication; Realization of the concept into a configuration, drawing and model.	CO-2
meeting what the customer wants; Evaluation and choosing of a design. Design	
space; Analogies and "thinking outside of the box"; Quality function deployment-	
Design process- Different stages in design and their significance; Defining the design	
MODULE 2-PROCESSES IN DESIGN IN MECHANICAL SYSTEMS	(9L)
up to examine different solutions- Ceiling fan Group Presentation and discussion	
Project: An Exercise in the process of design initiation. A simple problem is to be taken	
arriving at solutions; Closing on to the Design needs.	
requirements; Design attributes and objectives; Ideation; Brain storming approaches;	DIL-2
product of daily use. Need identification; Problem Statement; Market survey-customer	
strength; How to initiate creative designs Initiating the thinking process for designing a	CO 1
business proposition; Functional and Strength Designs. Design form, function and	
Design from; Role of Science, Engineering and Technology in design; Engineering as a	

accept	ance. Design as a marketing tool; Intellectual Property rights - Trade secret;								
patent	; copy-right; trademarks; product liability. Group presentation of any such								
produc	products covering all aspects that could make or mar it.								
Projec	Project: Examine the possibility of value addition for an existing product.								
TEXT B	OOKS								
1	Philip Kosky, Robert Balmer, William Keat – George Wise (2015). Explore Engineering, 4 th								
1	Edition, Academic Press, Elsevier.								
REFER	ENCE BOOKS								
	Balmer, R. T., Keat, W. D., Wise, G., and Kosky, P., (2012), Exploring Engineering, Third Edition:								
1	An Introduction to Engineering and Design - [Part 3 - Chapters 17 to 27], ISBN13: 978-								
	0124158917 ISBN-10: 0124158919								
2	Dym, C. L., Little, P. and Orwin, E. J., (2013), Engineering Design - A Project based introduction -								
	Wiley, ISBN-978-1-118-32458-5								
3	Eastman, C. M. (Ed.), Design for X Concurrent engineering imperatives, (1996), XI, 489 p. ISBN								
	978-94-011-3985-4 Springer								
4	Haik, Y. And Shahin, (2011), M. T., Engineering Design Process, Cengage Learning, ISBN-13:								
•	978-0-495-66816-9								
5	Pahl, G., Beitz, W., Feldhusen, J. and Grote, K. H., (2007), Engineering Design: A Systematic								
	Approach, 3rd ed. 2007, XXI, 617p., ISBN 978-1-84628-319-2								
6	Voland, G., (2004), Engineering by Design, ISBN 978-93-325-3505-3, Pearson India								
E BOO	KS								
1	http://opim.wharton.upenn.edu/~ulrich/designbook.html								
2	http://www2.warwick.ac.uk/fac/sci/wmg/ftmsc/modules/modulelist/peuss/designforxdesign								
2	_for_x_notes_s								

COURSE TITLE	ENGINEERING MI	ECHANICS		CREDITS	4							
COURSE CODE	MEB4116	COURSE CATEGORY	РС	L-T-P-S	3-1-0-1							
Version	1.0	Approval Details	24 th ACM	LEARNING	BTL-3							
			30.05.2018	LEVEL								
ASSESSMENT SCHEME												
First Periodical Assessment	Second Periodical Assessment	Seminar/ Surprise Assignments/ Project Test / Quiz		Attendance	ESE							
15%	15%	10%	5%	5%	50%							
	This course is an ir	ntroduction to learning	and applying th	ne principles re	equired to							
Course	solve engineering	mechanics problems. Th	ne course addr	esses the mod	eling and							
Description	analysis of static e	quilibrium problems wit	th an emphasis	on real world	engineering							
	applications and p	roblem solving.										
Course	The course sh	ould enable the studen	t to,									
Objective	1. Know the basi	cs of statics										

		2.	Unders	stand t	the cor	icepts	of fric	tion a	nd its	applica	tions			
		3.	Acquire	e the k	(nowie	age or	1 prop	erties	OT SOII	as and	surrace	es		
		4.	Unders	stand t	ne cor	icepts	orayn							
		5.	Unders	stand r	nomer	itum a	ina im	puise						
Co Out	Course OutcomeUpon completion of this course, the students will be able to1.Recall the basic laws and principles of mechanics.2.Analyze the problems related to machine structures and friction.3.Apply concepts of geometrical properties such as centroid, center of gravity and moment of inertia.4.Solve engineering problems on Statics in case of equilibrium conditions.5.Solve problems on dynamics, momentum and impulse.													
Prereq	uisites:	Nil												
СО, РС) AND P	SO MA	PPING											
	PO-	PO-	PO-	РО	PO-	РО	РО	РО	PO	PO-	PO-	PO-	PSO	
CO	1	2	3	-4	5	-6	-7	-8	-9	10	11	12	-1	PSO-2
CO-1	3	2	3	2	-	-	-	-	1	-	-	1	3	-
CO-2	3	-	-	-	-	-	-	-	2	-	-	1	3	-
CO-3	3	2	3	3	-	-	-	-	1	-	-	-	3	-
CO-4	3	-	3	-	-	-	-	-	2	-	-	-	3	-
CO-5	3	2	3	3	-	-	-	-	1	-	-	1	3	-
1: Wea	akly rela	ated, 2:	Mode	rately	related	d and 3	3: Stro	ngly r	elated	ł				
MODU	JLE 1: IN	NTRODU	JCTION	TO M	IECHAI	NICS A	ND FO	RCE S	YSTEN	Л			(9L+3T)
Statics: Fundamental concepts, Units & dimensions, Laws of mechanics, System of forces – parallelogram, triangle and polygon law of forces – resultant of a force system – resultant of a concurrent, coplanar and parallel force system – resolution and composition of forces - Lami's theorem – transmissibility of forces - moment of a force – physical significance of moment - Varignon's theorem – resolution of a force into force and couple – equivalent system of forces – Equilibrium of rigid body in two dimensions - Problems. Suggested Reading: Forces in space – addition of concurrent forces in space –							B	CO1 STL2						
MODU	LE 2: FR												(9L+3	T)
Frictio coeffic advant on an i	nal resi ient of f ages ar nclined	stance friction nd disac plane -	– class - angle Ivantag Iadder	ification of fric es of friction	on of f tion – frictior on – we	rictior angle o 1 - free edge fr	n – lim of repo e body riction	niting ose - c v diagr – beli	frictio one of am - o t frictio	n - law f frictio equilibr on. Sim	rs of fri n – pro ium of ple mad	ction – perties, a body chines -	E	CO2 3TL3

Suggested Reading: Mechanical advantages – velocity ratio and their relationship.

MOD	JLE 3: PROPERTIES OF SURFACES AND SOLIDS	(9L+3T)
Prope perpe figure cylinc Princi Sugg (deriv	erties of planar surfaces – Centroid and second moment of area - Parallel and endicular axis theorem – Centroid and Moment of Inertia of composite plane e - Polar Moment of Inertia – Radius of gyration - Mass moment of inertia of ler and thin disc (No derivations required) - Product of inertia – principal axes and pal Moment of Inertia - Theorems of Pappus and Guldinus – Problems. ested Reading: Determination of Centroids of Volumes by Integration rations).	CO3 BTL3
MOD	JLE 4: BASICS OF DYNAMICS	(9L+3T)
Defin Equat veloci gravit projec motic Proble Sugg energ	ition – kinematics and kinetics – displacements, velocity and acceleration- tions of motion - Types of motion – Rectilinear motion of a particle with uniform ity, uniform acceleration, varying acceleration – motion curves – motion under y – relative motion – curvilinear motion of a particle – projectiles – angle of ction – range – time of flight and maximum height. Newton's second law of on – linear momentum – D Alembert's principle, Dynamics equilibrium - ems. ested Reading: Work energy equation of particles– law of conservation of ty – principle of work and energy.	CO4 BTL3
MOD	JLE 5: IMPULSE MOMENTUM AND IMPACT OF ELASTIC BODIES	(9L+3T)
Impul – prin Defini mome by di Applic Sugg e energ	sive force – Impulse – linear impulse and momentum – Equations of momentum ciple impulse and momentum – impulsive motion – conservation of momentum. tion – Time of compression, restitution, collision – law of conservation of entum – Co-efficient of restitution – types of impact – collision of elastic bodies rect central impact and oblique impact – Problems – MATLAB©, basics, cation in collision problems, simple programming.	CO5 BTL3
TEXT	BOOKS	
1	Beer, F. P and Johnston Jr. E.R.(2017). <i>Vector Mechanics for Engineers (In SI Unit Dynamics</i> , 11 th Edition, Tata McGraw-Hill Publishing company.	s): Statics and
۲ ۲	Shames I. H. (2016) Engineering Mechanics, Statics and Dynamics, Pearson Propti	ice .
4	<u>Rao V.</u> and <u>J. Srinivas</u> .(2015). <i>Solving Engineering Mechanics Problems with M</i> edition, New age international (P) limited.	IATLAB©, 2nd
REFEF	RENCE BOOKS	
1	Bhavikatti, S. S and Rajashekarappa, K.G.(2016). <i>Engineering Mechanics</i> , New Age (P) Limited Publishers.	International
2	Hibbeller, R.C and Ashok Gupta(2017). Engineering Mechanics: Statics and Dynam	<i>ics,</i> 14th
_	Edition, Pearson Education.	
3	Benjamin J.(2015). Engineering Mechanics, Pentex Book Publishers and Distributo	ors.

4	Boresi& J. Schmidt(2016). Engineering Mechanics: Statics and Dynamics, 3/e, Cengage learning.
5	Kumar K. L.(2015). Engineering Mechanics, Tata Mc-GrawHill Publishing Company Limited.
E BOC	DKS
1	www.springer.com > Home > Engineering > Mechanics
MOO	c
1	https://swayam.gov.in/courses/public
2	https://www.iitm.ac.in/content/nptel-open-online-course-noc-
3	nptel.ac.in/courses/122104015/
4	nptel.ac.in/courses/112103108/
5	nptel.ac.in/courses/112103109/

COURSE TITLE	BASIC	CREDITS	3								
COURSE CODE	MHB4117	COURSE CATEGORY	2-0-2-1								
Version	1.0	Approval Details	LEARNING LEVEL	BTL- 3							
ASSESSMENT SCHEME											
First Periodical Assessment Second Periodical Assessment Seminar/ Assignments/ Projects/Practical ESE											
15%	15%	15% 20% 50%									
Course Description Course Objective	This course is intend Students will under The course sho 1. Learn the differ 2. Learn about the	 This course is intended to introduce the interdisciplinary engineering concepts. Students will understand the interactions of various engineering domains The course should enable the student to, Learn the difference between the mechatronics and conventional design Learn about the sensors and actuators 									
 3. Learn about the interfaces 3. Learn about the interfaces 3. Upon completion of this course, the students will be able to 1. Differentiate traditional with concurrent mechatronics system design approach. 2. Explain the construction, working principle and applications of various sensors and their data acquisition and presentation concepts. 3. Comprehend, illustrate and explain the construction, working principle and applications of various actuation systems. 4. Discuss the use of various controllers, control algorithms, applications and their interfacing concepts with example. 											

CO, PO AND PSO MAPPING															
0	PO -	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO -	PO-	PO-	DSO	1 DC	
CO	1	2	3	4	5	6	7	8	9	10	11	12	P30-	1 75	0-2
CO-1	3	3	3	2	1	-	1	1	-	-	-	1	3		1
							_								
CO-2	3	3	3	2	1	-	1	1	-	-	-	1	3		1
CO-3	3	3	3	2	1	-	1	1	-	-	-	1	3		1
CO-4	4 3 3 3 2 1 - 1 1 - - 1 3									3		1			
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION											(6L+2P))			
Definition, basic concepts and elements of mechatronic systems and comparison with											ith				
Applics	nai app tions ir	proacn	of des	lgn, ne	eas ai	na ben vo Svs	toms o		natron	iic in m	ianuta	cturing	5-		
Applications in robotics, CNC, Automotive Systems etc. Practical component: Mini Project Selection												CO- 2	1		
Suggested Readings:													BTL-	3	
Study of Mechatronic systems: CNC machine															
 Study of Mechatronic systems: Robotic Cell 															
MODU	LE 2: SE	NSOR	S AND	DATA	ACQU	ISITIO	N						(1	12L+4P)	
Perforr	nance t	ermin	ology,	displa	cemen	t, posi	tion ar	nd pro	ximity	senso	rs - app	olicatio	ons,		
Velocit	y and n	notion	sensor	rs – ap	plicati	ons, vi	sion se	ensor,	Signal	condit	ioning	, ADC,	DAC		
– Uses,	Data p	resent	ation.												
Practic	al com	ponent		_										co [,]	-
•	IVIINI P	roject s	should	a wor	кing n t chou	100ei i Id ho li	naving	the ba		ement	s of m	ecnatro	onics	CU-4	2
•			ion	projec	t shou	iu be i		III KS. (500.					DIL-	5
Sugges	ted Rea	adings													
•	Signal	Conditi	ioning	with v	vheat	stone l	bridge								
•	Tempe	rature	measu	ureme	nt usir	ig Thei	rmoco	uple /	Therm	nistors	/ RTD.				
MODULE 3:DRIVES AND ACTUATORS											(9L+3P)				
Solenoids, relays, diodes, DC motor, AC Motor, stepper motors, Hydraulic & Pneumatic															
devices	s, Powe	r suppl	lies, va	lves.											
Practic	al com	ponent	: Mini	Projec	ct – Se	lection	of Act	tuator	S					CO -3	3
Sugges	ted Rea	adings:						-						BTL-	3
•	Speed	contro	l of ste	epper i	notor	– qual	itative	study							
Study of Single and Double Acting Cylinder									10						
MODU	LE 4: CO	ONTRO	ILLERS	AND	ALGOF	RITHM	S							(9L+3P)	

Introd (PLC), Pract Sugge	duction to Microprocessor -Microcontrollers, Programmable Logic Controllers Artificial Neural Networks (ANN), Fuzzy controls. ical component: Mini Project – Controller Programming ested Readings: Study of Programmable logic controllers and its applications using simple ladder program. Study of Sensor, Actuators and Controllers in mobile robots.	CO-4 BTL- 3
MOD	ULE 5: INTERFACING (!	9L + 3P)
Introd adapt Pract Sugge	duction to Input / Output addressing, interface requirements, peripheral interface cers, serial communications – examples. ical component: Mini Project – Interfacing and Demonstration ested Readings: Study of Various peripheral interface devices	CO-4 BTL- 3
TEXT	BOOKS	
1	W Bolton. (2019). <i>Mechatronics: Electronic Control Systems in Mechanical and Elect Engineering</i> , Pearson Education, Sixth Edition, pp. 1-682.	rical
2	D. Shetty and R. Kolk. (2011). Mechatronics System Design, 2 nd edition, SI Global Eng	gineering.
REFE	RENCE BOOKS	
1	Mechatronics – HMT. (2000). Tata McGraw Hill Publishing Company Ltd.	
2	David G. Alciatoreand Michael B Histand. (2007). Introduction to Mechatronics and Measurement systems, Tata McGraw Hill, Third Edition.	
3	Robert H. Bishop. (2002). The Mecharonics Handbook, CRC Press.	
E BOO	DKS	
1	http://www.springer.com/in/book/9783642175305	
2	http://controlmanuals.com/files/Automation/Mechatronics-p1.html	
3	http://www.philadelphia.edu.jo/academics/ttutunji/uploads/Book%20- %20MSD%20by%20Shetty.pdf	
MOC		
1	https://ocw.mit.edu/courses/mechanical-engineering/2-737-mechatronics-fall- 2014/index.htm	
2	https://onlinecourses.nptel.ac.in/noc17 me31/preview	

COURSE TITLE	FLC	OR SHOP TRAINING		CREDITS	1				
COURSE CODE	MHB4141	COURSE CATEGORY	РС	L-T-P-S	0-0-2-1				
Version	1.0	Approval Details	24 th ACM 30.05.2018	LEARNING LEVEL	BTL-3				
ASSESSMENT SCHEME									
	CIA		ESE						

				80%								20%	•	
Co Desci	urse ription	Tł lik iss	ne cou e qual sues. It	rse exp ity def : helps	olains ects, r to ana	the ba nainte alyse d	sic too nance ata & t	ls invo relate take ap	lved ir d issue opropr	n solvir es and l iate de	ig shoj basic r ecision	o floor nanage s to re	related p ement rel solve the	roblems ated problem.
Course Objecti	ive	1. 2. 3. 4.	The Rout Sequ Sche Findi	course ing mo iencing duling ing dev	shoul oveme g the p of wo viation	l d enal nt of n rocedu rkforce	ble the nateria ures ar e, reso standa	e stude al on sh nd pro- ources a ord pro-	ent to hop flo cesses and op cedure	oor app taking oeratio es and	propria place ns. proce	tely. on sho sses.	op floor.	
Course Outcon	ne	 Upon completion of this course, the students will be able to 1. Demonstrate metrology methods and practice on different parts in floor shop 2. Describe manufacturing methods and equipment. 3. Outline the safety regulations in workshop. 4. Describe method/methods for mechanical part manufacturing. 5. Infer the information in technical drawing 												
Prerequisites: Nil														
CO, PO AND PSO MAPPING														
со	PO- 1	РО -2	РО- З	РО- 4	PO -5	РО- 6	РО- 7	РО- 8	PO -9	РО- 10	РО -11	PO- 12	PSO-1	PSO-2
CO-1	3	3	2	3	2	2	2	2	3	2	2	1	3	2
CO-2	3	3	2	3	2	2	2	2	3	2	1	2	3	2
CO-3	3	3	3	3	2	2	2	2	3	3	2	1	3	2
CO-4	3	3	3	3	2	2	2	2	3	3	1	2	3	2
1: Wea	ikly rela	ated, 2	2: Mod	leratel	y relat	ted an	d 3: St	rongly	relate	ed		1		
MODU	LE 1: IN	ITROD	UCTIC	DN					(15P)	l				
1. 2. 3. 4. 5.	 Technical drawing reading. Study of Checking the limits of dimensional tolerances using comparators (Mechanical / Pneumatic / Electrical) Study of Calibration of Vernier / Micrometer / Dial Gauge Machine tools operations – selection. Fabrication process – Practice 											CO-1-5 BTL-3		
MODU	DULE 2: SAFETY AND STANDARDS (15P)													
1. 2. 3. 4.	Study a Study c Study c Study c	of JIT P of TPM of ISO s	pleme rincipl Princi standa	ntation es ples rds	ns 5S	Princip	oles							CO-1-5 BTL-3

VLab Link	
1	http://mm-nitk.vlabs.ac.in/

COURS	SE TITLI	E	(C	N Commo	/IATER on to A	IALS C	HEMIS	STRY L	AB gineeri	B CREDITS 1							
COURS	E COD	E	CYA	4131		C CA	OURS	E RY	BS L-T-P-S 0-					0-0-2-0			
Ver	sion		-	L.O		Appro	oval D	etails	24 th ACM -LEARNING30.5.2018LEVEL								
ASSESS	MENT	SCHE	ME														
				CIA					ESE								
80%										20%							
Coi Descr	urse iption	Tl ar sp	nis co nalyses ectrop	urse i of ohoton	mpart lubrio netric	s prac cants, analyse	tical e refra es for i	exposu ctories metal i	re on s & ions.	basic other	techr eng	niques ineerin	employ Ig mai	yed for the terials and			
Coi Obje	urse ective	TI 1. 2. 3. 4. 5.	he cou Trair Give misc Prov form Impa Equi spec	rse sha a pra ible lic ide th aldeh art han p the tropho	ould e tudent ctical juids (j e stud yde re ds-on stud otome	nable ts in ch exposi phenol dents sin) trainir ents try.	the stu aracte ure fou -wate praction ng in ch with	idents rizatio the c r syste cal kno naracto practic	to on of lu constru m) cowledg erizatio cal ski	Ibrican uction ge in p on of re ill in	ts by v of pha orepar efracto estima	viscosit ase dia ation ories. ation	y measu gram, f of poly of met	urement. For partially- mers (urea- tal ions by			
Course Upon completion of this course, the students will be able to 1. Grade the lubricants based on viscosity 2. Analyze the phase diagram and interpret the critical solution temperature. 3. Apply the practical knowledge gained on the preparation of polymers, for the preparation of other similar macromolecules. 4. Analyze the strength of refractory. 5. Apply the spectrophotometric method for the determination of metal ions in different environment. Prerequisites: Knowledge in fundamentals of chemistry at higher secondary level. CO. PO- PO-											ature. Ters, for the Tetal ions in PSO-2						
	1	-2	3	4	-5	6	7	8	-9	10	-11	12	1	F 30-2			
CO-1	3	2	1	-	-	-	2	-	-	-	-	2	-	-			

CO-2	2 3	2	1	-	-	-	2	-	-	-	-	2	-	-
CO-3	3	2	1	-	-	-	2	-	-	-	-	2	-	-
CO-4	3	2	1	-	-	-	2	-	-	-	-	2	-	-
CO-5	3	2	1	-	-	-	2	-	-	-	-	2	-	-
			1: Wea	kly rela	ated, 2	2: Mod	eratel	y relat	ed and	d 3: Stı	rongly	relate	d	
MOI	MODULE 1: PROPERTIES OF LUBRICANTS (6P)													
1. Determination of viscosity of polymer using Ostwald Viscometer.											CO-1			
2. Determination of Viscosity Index of lubricants.												BTL-3		
3. Determination of viscosity of oil using Red-Wood Viscometer.											((D)			
	MODULE 2: PHASE DIAGRAM IN LIQUID SYSTEM												(6P)	
4	 Construction of phenol-water phase diagram. Determination of adsorption isotherm for acetic acid on activated charges. 													
	5. Determination of adsorption isotherm for acetic acid on activated charcoal.													
	ADDULE 3: PREPARATION POLYMER RESIN													
6. Preparation of urea-formaldehyde resin.													BTI-3	
MO	OULE 4:	BASIC	PROPE	RTIES	OF REF	RACT	ORIES							(6P)
7	Dete	minat	ion of p	orosity	ofar	efracto	ory.							
8	Dete	minat	ion of a	, pparer	nt dens	sity of	porous	s solids	5.					
														DIL-3
MOI	OULE 5:	ESTIM	ATION	METAL	ION C	ONTE	NTS IN	THE S	AMPL	E				(6P)
9	Estim	ation	ot dye c ion of c	ontent	in the	ettlue	ent by	UV-Vis	ible sp	ectrop	hoton	netry.		CO-5
1	1. Estim	ation	of sodiu	im and	potas:	sium id	ons by	flame	photo	metrv.	uy.			BTL-3
1	2. Verif	cation	of Beer	-Lamb	ert's la	aw usir	ng golo	l nano	particl	es.				
TEXT	BOOKS													
1.	P.S. Ra	ghava	n, Mate	rials Cl	nemica	als Lab	orator	y Man	ual, Dł	nanam	Public	ations,	, 2018	
REFE	EFERENCE BOOKS													
1.	1. J. Mendham, R.C. Denney, J.D. Barnes and N.J.K. Thomas, Vogel's Textbook of Quantitative 1. Chemical Analysis, 6 th Edition, Pearson Education, 2009													
E BO	E BOOKS													
1.	http:// ebook.	www. html	erforum	n.net/2	016/0	1/engi	neerin	ig-cher	nistry-	·by-jair	n-and-j	ain-pd	f-free-	
MO	C													
1.	1. https://www.coursetalk.com/providers/coursera/courses/introduction-to-chemistry-1										1			

SEMESTER III

COURSE TITLE	PARTIAL DIF	FERENTIAL EQUATIC TRANSFORMS	ONS AND	CREDITS	4	
COURSE CODE	MAA 4201	MAA 4201 COURSE BS CATEGORY				

Vers	sion		1.0Approval Details24th ACM -LEARNING30.5.2018LEVEL								ING EL	BTL-1-4							
ASSESSN	/IENT S	CHEM	IE		riodical Seminar/ Surprise														
First Pe Assess	riodical ment	S	econd Asses	Periodi ssment	ical	Assign	Semina ments,	ar/ / Proje	ct ·	Surpris Test / Q	e uiz	Attenda	ance	ESE					
15	%		1	5%			10%			5%		5%	% 50%						
Course Descripti	ion	To ec	To make the student understand the basic concepts of partial differential equations and transforms and its applications																
Course Objective	e	Th 1. 2. 3. 4. 5.	 Present the main results in the context of partial differential equations and to study numerical methods for the approximation of their solution Introduce the wave equation including time and position dependence Mathematically model the way thermal energy moves through the plate Understand the concept of Fourier transform Understand the concept of Z-transform and its properties 											ns and to te					
Course Outcome	2	Ur 1. 2. 3. 4. 5.	Forn diffe Class Class Solv tech Solv	mpleti nulate srentia sify an sify an e prob niques e the	ion of and l equa d solve d solve lems r s discret	this co solve tions the V the two c related	some some Vave a dimens to en nsform	the stu e of nd Heasional I gineer	ident the at equ heat e ing ap ed to	s will be physical uations equation oplication engine	e able I pro ns ons by eering	to blems using F proble	involving Fourier Tr	g partial ransform					
Prerequis	sites: N	lil																	
CO, PO A	AND PS	60 MA	PPING	i															
со	PO -1	PO -2	РО -3	РО -4	РО -5	PO -6	РО -7	РО -8	РО -9	PO -10	PO -11	PO -12	PSO-1	PSO-2					
CO-1	2	1	1	1	1	-	-	-	-	-	-	1	-	-					
CO-2	2	1	1	1	1	-	-	-	-	-	_	1	-	-					
CO-3	2	1	1	1	1	-	-	-	-	-	-	1	-	-					
CO-4	2	1	1 1 1 1 1 -										-						
CO-5	2	1	1	1	1	-	-	-	-	-	-	1	-	-					

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: PARTIAL DIFFERENTIALEQUATIONS	(9L+3T=12)							
Formation of partial differential equations by elimination of arbitrary constants,								
arbitrary functions - Solution of standard types of first order partial differential equations								
- Lagrange's linear equation - Linear partial differential equations of second order with	BTL-4							
constant coefficients.								

Suggest	ed Reading: Partial Differentiation								
MODUL	2: ONE DIMENSIONAL WAVE AND HEAT FLOW EQUATION								
(9L+3T=1	12)								
Classific dimensio (without Suggest	ation of second order linear partial differential equations - Solutions of one onal wave equation (without proof) - One dimensional heat flow equation proof) and application in string and rod problems. ed Reading: Partial Differential Equations, Half range sine series.	CO-2 BTL-4							
MODUL	E 3: TWO DIMENSIONAL HEAT FLOW EQUATION								
(9L+3T= 1	12)								
Steady state solution of two dimensional heat equations and applications in finite plates and infinite plates problems. Suggested Reading: Partial Differential Equations, Half range sine series.									
MODUL	E 4: FOURIERTRANSFORM								
(9L+3T= 1	12)								
Fourier Integral Theorem (without proof) - Fourier transform pair - Sine and Cosine transforms - Properties - Transforms of Simple functions - Convolution theorem - Parseval's identity. Suggested Reading: Basic integration.									
MODUL	MODULE 5: Z-TRANSFORM AND DIFFERENCE EQUATIONS								
(9L+3T=1	12)								
Z-Transf Formatic Suggeste	form - Elementary Properties - Inverse Z-Transform - Convolution theorem - on of Difference equations - Solution of difference equations using Z-Transform ed Reading: Basic calculus	CO-4 BTL-4							
TEXT BO	OKS								
1.	P. Sivarama Krishna Das, C. Vijayakumar L, <i>Transforms and partial differential e</i> Pearson Publication	equations, 1							
2.	Grewal. B.S(2012). Higher Engineering Mathematics, 42nd Edition, Khanna Publis	shers, Delhi							
3.	Chandrasekaran A(2015). A Text Book of Transforms and Partial Differential Dhanam Publication	Equations,							
REFEREN	ICE BOOKS								
1.	BalLN.P and Manish Goyal (2007), "A Textbook of Engineering Mathematics", Laxmi Publications Pvt Ltd	7th Edition,							
2.	Datta.K.B.(2013), "Mathematical Methods of Science and Engineering", Cengag India Pvt Ltd, Delhi	ge Learning							
2	Veerarajan. T(2012), "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pyt. Ltd., New Delhi, Second reprint								
3.	Education Pvt. Ltd., New Delhi, Second reprint								
BOOKS	Education Pvt. Ltd., New Delhi, Second reprint								
3. E BOOKS 1.	Education Pvt. Ltd., New Delhi, Second reprint								
3. E BOOKS 1. 2.	nptel.ac.in/courses/122107037/22								
3. E BOOKS 1. 2. MOOC	nptel.ac.in/courses/122107037/ nptel.ac.in/courses/122107037/22								

2.

https://w ww.edx.org/course/introduction-differential-equations-bux- math226-1x-1

	JRSE FLE			MA	NUFAC	TURIN	g pro	CESS			CRED	ITS		3
COL CO	JRSE DE	N	1HB42	01	C/	COURS ATEGO	E RY		РС		L-T-	P-S	3	-0-0-1
Ver	sion	1.0			Appr	Approval Details		24 3	24 th ACM - 30.5.2018		LEAR LE	NING /EL		BTL-3
ASS	ESSME	NT SCI	HEME											
Fi Perio Asse e	rst odica I essm nt	P	Secono eriodic sessmo	d al ent	S Ass	iemina ignmei Project	r/ nts/ t	Sur	prise To Quiz	est /	Atter	idanc e		ESE
15	5%		15%			10%			5%		5	%		50%
Cou Desc on	A manufacturing process is how a company builds or creates a product. Involving complex activity that involves a range of machinery, tools and equipment. A company decides which production method to choose based on factors such as consumer demand, sales forecasts, the assembly technique, materials involved and what resources are available. Many of today's manufacturing processes date back to the Industrial Revolution,, which took industry from man-made to man-and-machine-made, and as technology advances, processes get easier to understand and follow. Each approach is unique with certain advantages to complete a specific task.													
Cour Obje e	rse ectiv	The c 1. Fa 2. D 3. In 4. Li 5. Er	ourse s amiliar escribe itroduc st the o numera	ize the e variou e lathe commo ate the	enable casting is weld other n plast Powde	the st proce ing pro commo ic mate er meta	udents ss ocesses on mac erials, t illurgy j	to and to hines i heir pr process	evalua n mach oductio	ite eac iine sho on proc	h. op. cesses.			
Cour Outc	CourseUpon completion of this course, the students will be able to:1. Summarize the casting process2. Outline the fabrication processes and Select appropriate method3. Summarize machining process and select machine tools for appropriate operations4. Outline the applications and limitations of forming plastic materials and metallurgy5. Summarize Principles and applications of the metal forming processes													
Prer	equisi	tes: NI	L											
СО,	PO AN	D PSO	MAPP	ING										
со	РО- 1	РО- 2	РО- 3	РО- 4	РО- 5	РО- 6	РО- 7	PO- 8	РО- 9	PO- 10	PO- 11	PO- 12	PSO -1	PSO-2
CO -1	3	2	3	2	1	1	1	1	2	1	-	1	3	2

CO -2	3	2	3	2	1	1	1	1	2	1	-	1	3	2
CO -3	3	2	3	2	1	1	1	1	2	1	-	1	3	2
CO -4	3	2	3	2	1	1	1	1	2	1	-	1	3	2
CO -5	3	2	3	2	1	1	1	1	2	1	-	1	3	2
1: W	/eakly	relate	d, 2: M	oderat	ely rela	ated ar	nd 3: St	rongly	related	d	I	I		
MO	DULE	L: CAST	ING										9	L
 Casting types, procedure to make sand mould, types of core making, moulding tools, machine moulding, special moulding processes – CO2 moulding; shell moulding, investment moulding, permanent mould casting, pressure die casting, centrifugal casting, continuous casting, casting defects. Suggested Readings: Advances in Metal castings. 											ulding shell Isting,		CO-1 BTL-2	
MO	DULE	2: WEL	DING	0-									9L	
Classification of welding processes. Principles of Oxy-acetylene gas welding. A.C metal arc welding, resistance welding, submerged arc welding, tungsten inert gas welding, metal inert gas welding, plasma arc welding, thermit welding, electron beam welding, laser beam welding, defects in welding, soldering and brazing. Suggested Readings: Evolution of welding										CO-2 BTL-3				
MODULE 3: MACHINING									91	-				
General principles of working and commonly performed operations in the following machines: Lathe, Shaper, Planer, Horizontal milling machine, Universal drilling machine. Capstan and Turret lathe. Abrasive processes: grinding wheel– specifications and selection, types of grinding process– cylindrical grinding, surface grinding, centreless grinding–honing, lapping, super finishing, polishing and buffing, gear cutting: forming, generation, shaping, hobbing. Suggested Readings:										owing rilling rheel– urface uffing,		CO-3 BTL-2		
MO	DULE 4	4: FOR	MING	AND SH	IAPING	G OF PL	ASTICS	5					9	9L
Types of plastics - Characteristics of the forming and shaping processes – Moulding of Thermoplastics – Working principles and typical applications of - Injection moulding – Plunger and screw machines –Blow moulding – Rotational moulding – Film blowing – Extrusion - Typical industrial applications – Thermoforming – Processing of Thermosets – Working principles and typical applications - Compression moulding – Transfer moulding – Bonding of Thermoplastics – Fusion and solvent methods – Induction and Ultrasonic methods Suggested Readings: Evolution of Plastic forming process										CO-4 BTL-2				
MODULE 5: METAL FORMING AND POWDER METALLURGY												9L		
Prin Wire adva	ciples drav intage	and ap wing a s, disac	oplicati and Sp Ivantag	ons of pinning, ges and	the fo Powe limitat	llowing der m tions of	; proce etallur f powd	sses: F gy – er meta	orging, Princip allurgy.	, Rollin al ste	g, Extr ps inv	usion, olved		CO-5 BTL-3

CURRICULUM AND SYLLABUSB.TECH – MECHATRONICS ENGINEERING

Sug	gested Readings: Advances in Metal forming
TEXT	BOOKS
1.	Hajra Choudhury. (2010). <i>Elements of Workshop Technology</i> , Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai.
2.	Nagendra Parashar B.S. and Mittal R.K.(2011). <i>Elements of Manufacturing Processes</i> , Prentice- Hall of India Private Limited
REFE	RENCE BOOKS
1.	SeropeKalpajian, Steven R.Schmid. (2007). <i>Manufacturing Processes for Engineering Materials</i> , 4th Edition, Pearson Education, Inc.
E BO	OKS
1.	https://books.google.co.in/books?id=FDIfTrE3BjUC&printsec=frontcover&dq=manufacturing+ process&hl=en&sa=X&ved=0ahUKEwij1IXQ9u_ZAhUHM48KHZOiBcMQ6AEIJjAA#v=onepage&q =manufacturing%20process&f=false
2.	https://books.google.co.in/books?id=FfLpEgj5F_EC&printsec=frontcover&dq=manufacturing+p rocess&hl=en&sa=X&ved=0ahUKEwij1IXQ9u_ZAhUHM48KHZOiBcMQ6AEILDAB#v=onepage& q=manufacturing%20process&f=false
MO	oc
1.	https://www.edx.org/course/fundamentals-manufacturing-processes-mitx-2-008x-0
2.	https://www.coursera.org/specializations/digital-manufacturing-design-technology

COURSE TITLE	M		INES	CREDITS	4						
COURSE CODE	MHB4202	COURSE CATEGORY	PC	L-T-P-S	3-0-2-1						
Version	1.0	Approval Details	24 th ACM - 30.5.2018	LEARNING LEVEL	BTL-6						
ASSESSMENT SCHEME											
First Periodical Assessmen t	Second Periodical Assessment	Seminar/ A Project/	ssignments/ Practical	ESE							
15%	15%	20)%	50%							
Course Descriptio n	The course aims at strengthening the knowledge of the structure of machines and mechanisms with particular attention to the kinematic, and dynamic analysis of systems with rigid links and to the dynamics of cycle machines. This course will deal with kinematic analysis of mechanisms and machines. It will include motion and force transmission analysis of linkage mechanisms, open and closed-chain planar robots, and geared transmission. The student will study mechanism, displacement diagrams of machine members by										

		acceleration polygon, coriolis acceleration, straight and curved links.												
		The	course	e will d	emons	trate v	arious d	concep	ts by w	vorking	out pr	oblem	s releva	nt to real
		life a	applica	tions c	of mech	nanism	s. The	course	is exp	ected 1	o help	stude	nts in t	heir basic
		unde	erstand	ding an	d use o	of kine	matic a	analysis	s. At th	e end	of the	course	studer	nts have a
		deep	o unde	rstandi	ng of a	ll the e	lement	ts of m	echani	cs that	are fur	ndamer	ntal for	industrial
		auto	matior	n, mast	tering	design	and co	onstruc	tion p	rinciple	es that	play a	role i	n modern
		auto	matic	machin	es.									
		The	course	should	l enabl	e the s	tudent	s to						
		1. E	Explain	the t	heory	of me	chanisr	ns, tog	gether	with i	ts sho	rtcomir	ngs, co	ncepts of
		mobility, degrees of freedom and inertia.												
Cou	rse	2. (Calcula	te forc	es and	acceler	rations	for sim	ple and	d comp	lex me	chanisı	ms.	
Obje	ective 3. Comprehend the concepts of balancing.													
	4. Create various types of linkage mechanism using modern tools and simulate the motions												late their	
5. Analyze the various mechanical elements used in vibration systems														
		Upon completion of this course, the students will be able to												
1. Recall and discuss the mechanisms, concepts of mobility, degrees of fre											of free	edom and		
		inertia.												
Cou	rse	2. Calculate and apply forces and accelerations for simple and complex mechanisms.												
Outo	come	3. F	Recall t	he con	cept of	- balano	cing of	rotatin	g and r	ecipro	cating r	nasses		
		4. (Create	variou	s types	s of lin	kage m	nechan	ism usi	ing mo	dern t	ools ar	nd simu	late their
		r	notion	S										
		5. A	Analyze	e the va	arious r	nechar	nical ele	ements	used in	n vibra	tion sys	stems		
Prer	eauisite	es: Eng	zineeri	ng Me	chanics	:								
						-								
CO,	PO ANI	D PSO	MAPP	ING			1							
со	PO-	PO	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PSO	PSO-2
	1	-2	3	4	5	6	7	8	9	10	11	12	-1	
-1	-	3	2	2	1	-	-	-	-	1	-	1	3	-
со	-	3	2	-	1	-	-	-	1	1	-	-	3	_
-2			_										-	
СО	-	-	2	-	2	-	-	-	1	1	-	-	3	-
-3														
-4	-	-	2	-	2	-	-	-	1	1	-	-	3	-
CO -5	2	2	3	-	2	-	-	-	-	-	-	-	3	-
1: W	veakly r	elate	d, 2: M	oderat	ely rela	ated ar	າd 3: St	rongly	related	d	I	1	<u> </u>	
MO	DULE 1	:BASIC		ИЕСНА	NISMS			07			(9L+6	5P)		
MODULE 1:BASICS OF MECHANISMS (9L+6P)												. ,		

Transverse vibration – free- Beam. Determination of natural frequency and	
vibrating system-Spring mass system-Determination of damping co-efficient of single degree of freedom system using MATLAR	
Practical component:	BIL-4
classification, Steps involved in vibration analysis.	CO-4
non- harmonic, – Degree of freedom, –static equilibrium position, –Vibration	
spring, mass, damper, Damper models, Motion – periodic, non-periodic, harmonic,	
Vibration and oscillation, causes and effects of vibrations, Vibration parameters –	
MODULE 4: BASIC CONCEPTS OF VIBRATION	(9L+6P)
Balancing of Simple mechanisms	
Suggested Readings:	
Balancing of rotating masses.	
Balancing of reciprocating masses.	DIL-4
Practical component:	CO-3 RTI_∕I
rotors.	CO-3
engines – Balancing of linkages – Balancing machines-Field balancing of discs and	
cylinder engine – Balancing of Multi-cylinder inline, V-engines – Partial balancing in	
Static and dynamic balancing – Balancing of rotating masses – Balancing a single	
MODULE 3: BALANCING OF ROTATING MASSES	(9L+6P)
Analysis of simple mechanism	
Suggested Readings:	
MATLAB	
Analysis of velocity and acceleration for mechanical linkages of different mechanisms - Lise of kinematics and dynamics simulation software like ADAMS	BTL-4
Practical component:	CO-2
Rinematic analysis of simple mechanisms-coincident points	
Graphical internod velocity and acceleration polygons - Computer applications in the	
Displacement, velocity and acceleration and analysis in simple mechanisms -	
MODULE 2: KINEMATICS	(9L+6P)
Difference between mechanism and structure	
Suggested Readings:	
Create various types of linkage mechanism in CAD and simulate their motions	
mechanisms.	
To study inversions of 4 Bar Mechanisms, Single and double slider crank	
To study various types of Kinematic links, pairs, chains and Mechanisms.	BTL-3
Practical component:	CO-1
and escapements - Indexing Mechanisms	
Single, double and offset slider mechanisms - Quick return mechanisms - Ratchets	
Mechanical Advantage-Transmission angle Description of common Mechanisms-	
Grashoff's law-Kinematic Inversions of 4-bar chain and slider crank chains-	
Terminology and Definitions-Degree of Freedom Mobility-Kutzbach criterion-	

deflection of Beam.									
Dete	rmination of moment of inertia by oscillation method for connecting rod and								
flyw	heel.								
Sugg	ested Readings:								
Con	cepts of vibration								
MO	DULE 5: FORCED VIBRATION	(9L+6P)							
Resp	onse of one degree freedom systems to periodic forcing – Harmonic								
distu	rbances –Disturbance caused by unbalance – Support motion –transmissibility								
– Vik	pration isolation vibration measurement.								
Prac	tical component:								
Vibra	ating system-Spring mass system-Determination of damping co-efficient of	CO-5							
singl	e degree of freedom system using MATLAB.	BTL-3							
Tran	Transverse vibration –free- Beam. Determination of natural frequency and								
defle	deflection of Beam.								
Sugg	Suggested Readings:								
Vibr	ation measuring instruments								
TEXT	BOOKS								
1.	Rattan S.S (2009). Theory of Machines, Tata McGraw-Hill Publishing Company Lt	d., New Delhi.							
2.	R. S. Khurmi, J.K. Gupta (2005). <i>Theory Of Machines</i> , Eurasia Publishing House.								
REFE	RENCE BOOKS								
1.	Thomas Bevan (2005). Theory of Machines, CBS Publishers and Distributors.								
2.	Rao J.S and Dukkipati R.V (1992). <i>Mechanism and Machine Theory</i> , Wiley-Ea Delhi.	astern Ltd., New							
3.	Ghosh A and A.K.Mallick (1998). <i>Theory of Mechanisms and Machines</i> , Affilia Pvt. Ltd., New Delhi.	ated East - West							
MO									
1.	http://nptel.ac.in/courses/112101096/								
2.	https://www.coursera.org/learn/engineering-mechanics-statics-2								

COURSE TITLE	EN	EMBEDDED SYSTEMS CREDITS								
COURSE CODE	MHB4203	CC CAT	OURSE EGORY	DE	L-T-P-S	3-0-2-1				
Version	1.0	Approv	val Details	24 th ACM - 30.5.2018	LEARNING LEVEL	BTL-3				
ASSESSMENT SC	HEME									
First Periodical Assessment	Second Period Assessmen	lical t	Practical Assessment			ESE				
15%	15%		20%			50%				

	Concept of embedded system introduces the design and use of single-purpose												
Course	processors ("hardware") and general-purpose processors ("software"), memories												
Description	and buses, illustrates hardware/software trade-offs and includes advanced												
	computation models, control systems, chip technologies, and modern design tools.												
	The course should enable the students to												
	1. Explain the concepts of an Embedded System, characteristics, applications												
	2. Learn the characteristics, design metrics and processor technologies of an												
Course	Embedded system												
Objective	3. Underlying principle and applications of various peripheral devices and the												
-	communication standards												
	4. Complete design of an embedded system, a digital camera as a case study.												
	5. Recognize and program embedded controller												
	Upon completion of this course, the students will be able to												
	1 Recall the Basic building blocks of embedded systems												
Course	2 Write a Assembly Language Program												
Outcome	2 Interface various peripherals to processors												
Outcome	4. Use the concents of embedded system for product development												
	4. Use the concepts of embedded system for product development												
	5. Develop programming skills using Arduino for embedded system												
Prerequisites:													
CO, PO AND PSC) MAPPING												

со	PO-		PSO-2											
	1	2	3	4	5	6	7	8	9	10	11	12	F30-1	F30-2
CO-1	3	3	-	-	-	I	I	2	2	-	-	2	2	-
CO-2	3	3	3	3	3	-	-	2	2	-	-	2	2	-
CO-3	3	3	-	-	-	-	-	2	2	-	-	2	2	-
CO-4	3	3	-	-	-	-	-	2	2	-	-	2	2	-
CO-5	3	3	-	-	-	-	-	2	2	-		2	2	-

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1:INTRODUCTION TO EMBEDDED SYSTEM & GENERAL-PURPOSE PROCESSOR (9L+6P)

Embedded Systems - Design challenges, optimization of design metrics. Processor									
Technology: General purpose Processor, Single-purpose processor, Application									
specific processor.									
Introduction to microprocessor & microcontroller-8085 Architecture- 8051	CO 1								
Architecture	0-1								
Practical component:									
Case study of an embedded system									
Suggested Readings:									
Evolution of embedded system									

MODULE	2:INSTRUCTION SET & BASIC PROGRAMMING	9L+6P)
8085 Instr stack and i modes – A	uction Set: Addressing modes; Data transfer, arithmetic, logical, branch, machine control groups of instruction set, 8051 Instruction set, Addressing ssembly language programming.	(0-2
Practical co	omponent:	BTI -2
• Ass	embly language Programming	
Suggested	Readings:	
Instructio	n set of 8086 Programming	
MODULE	3: PERIPHERALS AND INTERFACING	(9L+6P)
Introducti	on to peripherals- Timers, Counters, UART, PWM, LCD Controllers, Keypad	
Controllers	s, Stepper motor Controllers, A to D Converters, Real time clocks.	
Introducti	on to Interfacing- Communication Basics, Microprocessor interfacing,	
Arbitratior	n, Multilevel Bus architectures, Serial, Parallel & Wireless protocols.	CO-3
Practical o	component:	BTL-3
• Inte	erfacing of PPI and I/O devices	
Suggested	Readings:	
Study vari	ous peripheral devices interfacing concepts	
MODULE 4	: INTRODUCTION TO MEMORY AND EMBEDDED SYSTEM-CASE STUDY	(9L+6P)
Introducti	on to Memory, Common Memory types, Composing Memory, Memory	
Hierarchy	and Cache, Advanced RAM. Case study of Digital Camera - Introduction,	
Requireme	ent Specification, Design.	CO-4
Practical c	component:	BTI-2
• Blo	ck Transfer of Data	
Suggested	Readings:	
Study of v	arious types of memory and its interfacing concepts	
MODULE 5	: INTRODUCTION TO EMBEDDED CONTROLLER	(9L+6P)
Introductio	on to Arduino- Arduino IDE, Elementary Programming, - loading a simple	
program, v	writing a program to blink the onboard LED, timers, counters, analog and	
digital outp	outs-Servomotor using PWM	CO-5
Practical co	omponent:	BTL-2
 Ard 	uino Programming – Building simple Embedded system	
Suggested	Readings:	
Different A	rduino Microcontrollers	
TEXTBOOK	ζς Σ	
1.	Frank Vahid. (2011). Embedded System Design - A Unified hardware Introduction, John Wiley	& Software
REFERENC	E BOOKS	
1	James K Peckol. (2008). Embedded Systems: A Contemporary Design Tool, Wil	ey.
2	Ramesh Goankar.(2013). Microprocessor Architecture, Programming and App the 8085 6/e. Penram.	lications with

3	Muhammad Ali Mazidi, Janice GillispieMazidi, RolinD.MCKinlay. (2008). <i>The 8051 Microcontroller and Embedded Systems</i> , 2 nd edition, Pearson Education.
E BOOKS	
1.	http://www.uou.ac.in/sites/default/files/slm/Introduction-embedded system.pdf
MOOC	
1	https://www.edx.org/course/embedded-systems-shape-world-utaustinx-ut-6-10x
2	https://www.mooc-list.com/course/introduction-embedded-systems-software-and-
2	development-environments-coursera

COURSE TITLE	COMPL	CREDITS	1										
COURSE CODE	MHB4231	COURSE CATEGORY	PC	L-T-P-S	0-0-2-0								
Version	1.0	1.0Approval Details24th ACM -LEARN30.5.2018LEV											
ASSESSMENT S													
	CIA												
	1	80%			20%								
The purpose of this course is to teach the use of the basic concept and technic													
	Computer Aided De	esign (CAD) concepts	and techniques	using high-er	nd CAD systems.								
Course	The main course t	opics are 2D and 3I) parametric wit	th explicit m	odeling, feature								
Description	modeling, surface modeling, geometric drawings, assembly modeling, parametric												
	expressions and curves. Hence, the course deals with the main CAD modeling												
	techniques deigned to develop the virtual mode of complex industrial products.												
	The course will ena	ble the students to u	nderstand :										
	1. The presentatio	n of CADD and its app	olications										
Course	2. The need to lear	rn CADD hardware ar	d software.										
Objective	3. The need to fam	niliarize 2D drafting te	chniques.										
	4. The need to con	nprehend the advanc	ed CADD tools										
	5. The various met	hods to demonstrate	the developmer	nt of 3D mode	els.								
	Upon completion of	f this course, the stud	lents will be able	e to									
	1. Present an over	view of CADD and de	scribe its applica [.]	tions in differ	ent fields.								
	2. Describe comm	on terms associated v	vith CADD hardw	vare and softw	ware.								
Course	3. Familiarize the b	basic principles associ	ated with CADD	and to demo	nstrate common								
Outcome	2D drafting tech	niques.											
	4. Comprehend t	he advanced capab	ilities of CADD	and usage	for increasing								
	productivity.												
	5. Demonstrate th	rough the developme	ent of 3D models	of simple obj	iects.								
Prerequisites: N	Nil												

CO, PO AND PSO MAPPING

60	РО	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-									
	-1	2	3	4	5	6	7	8	9	10	11	12	P30-1	P30-2							
CO-1	3	3	-	-	2	-	-	2	2	-	-	3	3	-							
CO-2	3	3	-	-	2	-	-	2	2	-	-	3	3	-							
CO-3	3	3	-	-	2	-	-	2	2	1	-	3	3	3 -							
CO-4	3	3	-	-	2	-	-	2	2	1	-	3	3	-							
CO-5	3	3	-	-	2	-	-	2	2	1	-	3	3	3 -							
	1: Weakly related, 2: Moderately related and 3: Strongly related																				
MODULE 1 – 2D – DRAFTING													(20P)								
1 0													(CO-1,2							
1. D	1. Draw and Solve problems in Projections of straight lines													BTL-4							
2. D	rawin	g of fro	ont vie	w and	top vie	ew of s	imple	solids	like pri	ism, py	vramid	, cylind	er, C	CO-1,2							
co	one, e	tc, and	dimer	nsionin	g.									BTL-3							
3. D	rawin	g front	: view,	top vi	iew an	ıd side	view	of obj	ects fr	om the	e giver	n pictor	rial	CO-3							
vi	iews 4	.Drawi	ng sec	tional	views o	of prisr	n, pyra	amid, c	ylinde	r, cone	, etc.,			BTL-4							
4 0	rawin	a isom	otric n	rojocti	on of c	implo	obioct	c						CO-4							
4. D	lawiii	gisoni	etric pi	Ojectio	511 01 5	inple	object	5.						BTL-4							
MODU	ILE 2-	3D – N	IODELI	NG									(10	P)							
1. C	Creatio	on of 3	-D moo	dels of	simple	e objec	ts and	l obtaiı	ning 2-	D mult	ti-view	drawir	ngs	CO-5							
from 3-D model.											BTL-4	l I									
Note: Plotting of drawings must be made for each exercise and attached to the												he									
reco	records written by students.																				
Virtual L	.abs																				
1.	ľ	nttp://r	neche.	mit.ed	u/lab/	compι	uter-ai	ded-de	esign-la	aborato	ory										

COURSE TITLE	MANUFA	CREDITS	1									
COURSE CODE	MHB4232	L-T-P-S	0-0-3-0									
Version	1.0	Approval Details	24 th ACM - 30.5.2018	LEARNING LEVEL	BTL4							
ASSESSMENT S	CHEME											
		CIA			ESE							
		80%			20%							
	This lab provides s	students experiential	learning with t	he nature ar	nd technique of							
Course	manufacturing proc	cesses. Students can	set up and ope	rate machine	es, manufacture							
Description	parts, measure proc	parts, measure process variables, and inspect manufactured parts. Skills acquired from										
	time in the lab are i	ntegrated with prior	and subsequent	learning of ot	her engineering							

		to	topics such as engineering materials and quality planning and											
Course Object	e ive	 The course will enable the students to: 1. Develop a practical understanding of basic manufacturing processes and capabilities of each 2. Set-up and conduct engineering experiments related to various manufacturing processes. 3. Extend basic knowledge to solve manufacturing processes related problems 4. Analyze date from experiments to performed and reach conclusions 5. Require adherence to assignment deadlines 												
Course Outcor	e me	 Upon completion of this course, the students will be able to 1. Select the right tool, machining condition and relevant measurement 2. Describe the Applications of mechanics of metal cutting 3. Perform milling, drilling and grinding operations 4. Use various devices for measuring dimensions of engineering components 												
Prereq	uisites	s: Nil												
CO, PC) AND	PSO N	IAPPIN	NG								Г — Т		
со	РО -1	РО- 2	РО- 3	РО- 4	РО- 5	РО- 6	РО- 7	РО- 8	РО- 9	РО - 10	РО- 11	РО- 12	PSO-1	PSO-2
CO-1	3	3	-	1	-	-	-	-	-	-	-	-	3	-
CO-2	3	3	-	1	-	-	-	-	-	-	-	-	3	-
CO-3	3	3	-	-	2	-	-	-	-	1	-	-	3	-
CO-4	3	3	-	-	2	-	-	-	2	1	-	3	3	-
1: Wea	akly re	lated,	2: Mo	derate	ly rela	ted an	nd 3: St	rongly	relate	ed				
MODU	JLE 1 –	MAC	HINING	6									(15P)
1. 2.	Two o Cuttin One o Gear	or Mor ng Forc or Mor milling	e Meta ce) e Exero c, Keyw	al Cutt cises ir vay mil	ing Exp n Millir ling, H	perime ng Mac elical (ents (Ex chines Groove	kample (Examp millin	e: Shea ple: Mi g etc.)	r Angle Iling Po	e Measu olygon S	irement Surfaces	,	
3.	Two o Grind	or Mo ing, Cy	re Exe lindric	rcises al Grin	in Gri iding, (nding Centre	/ Abra less Gr	asive r inding	nachin , Lappi	ing (E> ng, Ho	ample: ning eta	Surface)-1,2 [1_4
4. 5.	Two o fits. Mach One c	Two or More Exercises in Machining Components for Assembly of different fits. (Example: Machining using Lathes, Shapers, Drilling, Milling, Grinding Machines etc.) BTL-4 One or More Exercises in Capstan or Turret Lathes BTL-4												
6.	One c	or Mor	e Exerc	cises ir	Gear	Machi	ning						(==)	
	MO	DULE	2 - ME		EMEN	TS	N.4			.1.1.47			(7P)	124
1.	Life N	ureme 1easur	ement	tting T etc.)	empei	rature	ivieasi	iremer	ιτ, ΙΟΟ	n wear	ivleasu	irement	, co-	1,2,4

2.	Measurement of tool life using Mat lab	BTL-4
MOD	ULE 3 – CASTING & WELDING	(8P)
1.	Welding – Arc & Gas welding	CO-3
2.	Casting- Demonstration	BTL-4
3.	Powder Metallurgy- Demonstration	
MATL	AB ASSIGNMENTS	(15P)
	1. Glass Tube Manufacturing Process	
	2. Compensator Design for a Set of Plant Models	
	3. Fault Diagnosis of Centrifugal Pumps using Steady State Experiments	
	4. Robust Tuning of Mass-Spring-Damper System	
	5. Modeling a Kanban Production System	
	6. Generalized Extreme Value Distribution	
	7. Test Real-Time Application	
Virtua	l Labs	
1.	http://mm-nitk.vlabs.ac.in/	
2.	http://mdmv-nitk.vlabs.ac.in/	

COURSE	DESIGN PROJECT I CREDITS 1												
TITLE				CREDITS	-								
COURSE	MUD/222	COURSE	DC		0020								
CODE	IVIND4233	CATEGORY	PC	L-1-P-3	0-0-2-0								
Version	1.0	Approval Dotails	24 th ACM,	LEARNING	RTI 6								
Version	1.0	Approval Details	30.05.2018	LEVEL	BIL-0								
ASSESSMENT	ESSMENT SCHEME												
First Review	Second Review	Third Review	Project Re	port & Viva	FSF								
			Vo	oce									
20%	30%	20%	30	30%									
	This course provides the student significant design experience and builds on the												
Course	knowledge and skills acquired in earlier course work. This course provides an exposure												
Description	to teamwork to emulate a typical professional design environment. Simulations are to												
Description	be used both in the execution of the design methodology and the management of the												
	design project.												
	The course should	enable the students t	0										
	1. Develop skills	in doing literature	survey, techn	ical presenta	tion and report								
Course	preparation.												
Objective	2. Enable project i	dentification and exe	cution of prelim	ninary works o	n								
	3. Enable students	s to work as team											
	 Introduce the students to work on interdisciplinary projects 												

	Upon completion of this course, the students will be able to																	
				inpieu			ui se, i	ine su	JUEIILS	will D								
Course	9	1.	Desig	gn, Sin	nulate	and fa	abricat	e a p	prototy	pe usi	ng the	e know	ledge acqu	ired in the				
Outco	me		prev	ious se	meste	ers; rela	ate to	real ti	me ind	ustrial	/societ	tal pro	blems					
		2.	Prep	are teo	chnical	drawi	ing, teo	chnica	l repor	t and t	technic	cal pres	sentation					
Prerequisites:																		
CO, PO AND PSO MAPPING																		
	РО	PO-	D- PO- PO- PO- PO- PO- PO- PO- PO- PO- PO															
	-1	2	3	4	5	6	7	8	9	-10	11	12	PSO-1 PSO-2					
CO-1	2	2	2	2	2	2	2	2	2	2	2	2	3 3					
0-1	3	3	2	2	5	2	2	3	3	3	3	5	5	5				
CO-2	3	3	2	2	3	2	2	3	3	3	3	3	3	3				
			1: We	eakly r	elated	, 2: M	oderat	tely re	lated a	and 3:	Strong	ly rela	ted					
							ĺ	NOTE										
		Tł	ne stud	lents ir	ו conv	enient	group	s of n	ot mor	e than	4 mer	nbers l	nave to ider	ntify a				
1		pr	oduct	for des	sign an	ld fabr	icatior	n. Ever	y proje	ect wo	rk shal	l have a	a guide who	o is the				
		m	ember	of the	facult	y of th	e insti	tution										
		Тс	o devel	op a n	nechat	ronic s	system	with	empha	isis on	electri	cal driv	ves (Actuato	or) for				
2		dif	ferent	applic	ations	/Svste	ems.		•				,	,				
		Tł	ne stud	lents a	are re	auired	to de	esign a	and fa	bricate	e the	choser	system a	nd				
2		de	monst	rate it	s work	ing an	art fro	m suh	mittin	g the r	noiect	renort	The repor	t should				
			ntain a	assemb	lv dra	wing	narts o	Irawin	σs nro		harts r	elatino	to fabricat	ion				

SEMESTER IV

COURSE TITLE	ELECT	RICAL MACHINES AND DRIV	/ES	CREDITS	3								
COURSE CODE	MHB4218	COURSE CATEGORY	PC	L-T-P-S	3-0-0-1								
Version	1.0	Approval Details	24 th ACM, 30.05.201 8	LEARNING LEVEL	BTL-3								
ASSESSMEN	ASSESSMENT SCHEME												
First Periodical Assessmen t	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendanc e	ESE								
15%	15%	10%	5%	5%	50%								
Course Description	Electrical machines drive the actuators that are applied in the field of movable translational or rotary systems. AC and DC machines rule the day to day commercial and domestic devices as the prime mover components. There exists a wide varied of machines based on the principle of operation and construction of the functional												

	components.										
	The basic understanding of the machines is possible with knowledge on the voltage										
	and current laws. The analysis of the circuits for the basic understanding of the flow of										
	voltage or current in a loop and the sources of power delivery is of significance.										
	There are several strategies to start and control the speed of motors for satisfactory										
	their selection has many measures of significance such as heating and cooling loading										
	conditions, classes of duty and power rating.										
	The solid-state drive mechanisms for the machines have gained a lot of importance,										
	viz. various methods using power electronic devices and recovery schemes.										
	The course should enable the students to										
	1. Know the basics of electrical circuits and characteristics of transformers										
	2. Learn the construction, working principle and characteristics of dc, ac and special										
Course	machines										
Objective	3. Comprehend the types of starting and speed control methods of dc and ac										
	machines										
	4. Realize various electrical drives and selection criteria's										
	5. Learn about the solid state devices application in drives.										
	Upon completion of this course, the students will be able to										
	1. Recall the basics of Circuit theory and equivalent circuit of Transformers										
Course	2. Comprehend the Construction and Principle of Operation of DC Motors and AC										
Course	Motors										
Outcome	3. Perform the speed control of DC and AC Motors.										
	4. Select drives for applications based on various criteria's										
	5. Design circuits using solid state devices for Electrical drives										

Prerequisites: Nil

CO, P	CO, PO AND PSO MAPPING													
со	PO- 1	Р О -2	РО- 3	РО- 4	РО- 5	РО- 6	РО- 7	РО- 8	РО- 9	РО- 10	РО- 11	РО- 12	PSO -1	PSO-2
CO- 1	3	3	-	-	-	-	-	2	2	-	-	3	3	-
CO- 2	3	3	-	-	-	-	-	2	2	-	-	3	3	-
CO- 3	3	3	-	-	-	-	-	2	2	1	-	3	3	-
CO- 4	3	3	-	-	-	-	-	2	2	1	-	3	3	-
CO- 5	3	3	-	-	-	-	-	2	2	1	-	3	3	-
			1: W	eakly r	elated,	2: Moo	deratel	y relate	ed and	3: Stro	ngly rel	lated		

MODULE 1 – CIRCUITS AND TRANSFORMERS	
(9L)	
D.C. Voltage, current, power-Ohms law-series, parallel circuits – Kirchoff's laws –	
mesh analysis – A.C. voltage – sinusoidal waves, Phasor representation – power	
factor – complex power - basic idea of transformers – simple problems.	CO-1
Suggested reading:	BTL-1,2
Study of Transformer operations	
Study of power and power factor calculation	
MODULE 2 – ELECTRICAL MOTORS	
(9L)	
Constructional details, principle of operation and performance characteristics of	
D.C. motors, single phase induction motor, three phase induction motor,	
synchronous motors, universal motors, stepper motors and reluctance motor.	CO-2
Suggested reading:	BTL-1,2
Application of special machines	
Study of Stepper Motor and Servo motor functioning and interfacing to robots	
MODULE 3 – SPEED CONTROL AND STARTERS	
(9L)	
Speed control of D.C. motors – three phase induction motors – starting methods of	
D.C. motor and three phase induction motor – electrical braking – simple problems.	CO 3
Suggested reading:	CU-3 RTI 2
Industrial application of AC motors	DIL-3
Various types of braking methods	
MODULE 4 – ELECTRICAL DRIVES	
(9L)	
Type of Electrical Drives – Selection & factors influencing the selection – heating	
and cooling curves – loading condition and classes of duty – determination of power	
rating – simple problems.	CO-4
Suggested reading:	BTL-2,3
Selection criteria and specification of various types of machines	
Study of electrical drive controllers.	
MODULE 5 – SOLID STATE DRIVES	
(9L)	
Advantages of solid state drives – D.C. motor control using rectifiers and choppers –	
control of induction motor by V, V/f and slip power recovery scheme using inverters	
and A.C. power regulators.	CO-5
Suggested reading:	BTL-2,3
Study of variable frequency drives	
Study of solid state devices for efficient control in robots	
FIELD WORK	

1.	Study of servo motor.
2.	Study of various motors used in automobile.
TEXT E	BOOKS
1.	N.K.De., P.K.Sen. (2004). <i>Electric Drives</i> , Prentice Hall, First edition
r	I.J. Nagrath, T.P. Kothari. (2002). Basic Electrical Engineering, McGraw-Hill Publishing company
Z	Ltd., Second edition
2	S.K. Bhattacharya. (2007). Electrical Machines, second edition, Tata McGraw-Hill Pvt. Company
5	Ltd., Second edition
REFER	ENCE BOOKS
1	G.K. Dubey. (2002). Fundamental Electrical Drives, second edition, Narosa Publications, Second
-	edition.
2	Pillai, S.K., A Seish.(2014). Course on Electrical Drives, Wilay Eastern Ltd., New Delhi
M000	
1	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-685-electric
L	machines-fall-2013/
2	https://onlinecourses.nptel.ac.in/noc17_ec10/preview

COURSE		DDOEESS		CREDITS	2					
TITLE		PROFESS	IONAL ETHICS AND LIFE SKI	CREDITS	2					
COURSE		GEA/216			ιτρς	2001				
CODE		GLA4210	COURSE CATEGORY	CO	L-1-F-3	2-0-0-1				
				24th ACM	LEARNING					
Version		1.0	Approval Details	-	LEVEL	BTL-3				
				30.5.2018						
ASSESSMENT SCHEME										
First										
Periodical	Se	econd Periodical	Seminar/ Assignments/	Surprise	Attendance	ESE				
Assessme		Assessment	Project	Test / Quiz						
nt										
15%		15%	10%	5%	5%	50%				
Course	Sti	udents will und	erstand the Ethical theory	y and its rol	es and its re	esponsibilities of				
Descripti	ind	dividual, employ	vee, Corporate responsibil	ities towards	stack holde	rs with friendly				
on	ар	proach.								
	Th	e course should	enable the students to							
Courso	1.	Explain busines	s ethics, levels, myths, use a	and train ones	elf to be ethic	cal.				
Objectiv	2.	Improve the Kn	owledge on Ethical principle	es, reasoning,	roles & respo	nsibilities.				
Objectiv	3.	Comprehend st	ake holder theory, Individ	ual and corp	orate respons	sibilities towards				
е		stake holders.								
	4.	Learn corporate	e responsibilities towards P	roduct Safety	& Reliability a	and environment				

		fr	iendly	approa	ch.												
		5. Learn the Employee & Corporate on responsibilities on aspects of contracts equal															
		onportunity Affirmative action sexual barassment etc															
		opportunity, Annihative action, sexual narassment etc.,.															
		1 Describe business othics, lowels and myths															
		1. D		busine	ss etni	cs, ieve		mytris	0		L'ac						
2. Explain ethical principles, reasoning, roles & responsibilities.										uda atalia							
Со	urse	3. D	escribe	SLAKE	noider	theory	, maiv	iuudi d		porate	respor	ISIDIIILI	es lowa	arus slake			
Outo	come		blaers.				: .: :+:		a u al a 🛛 🗖			.	Dellah	::::			
		4. E)	kpiain	corpoi	ate r	espons	IDIIITIES	s towa	ards H	roauci	sare	ty &	Reliac	onity and			
		er	nvironr	nent fri	endly a	approa	cn.										
		5. Co	omprer	nend tr	ie Emp	loyee	& Corp	orate (on res	ponsib	liities c	on aspe	ects of	contracts,			
		e	qual op	portun	ity , Afi	irmativ	ve actio	on, sexi	ual hara	assmer	it etc.,						
Prer	equisit	es: Nil															
со,	PO AN	ID PSO	MAPP	ING													
0	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PSO	DSO-2			
	1	2	3	4	5	6	7	8	9	10	11	12	-1	F 30-2			
CO -1	2	1	-	-	-	3	-	3	2	-	2	-		-			
CO -2	-	-	2	-	3	3	-	3	2	-	2	-		-			
CO -3	-	-	-	-	-	3	-	3	2	-	2	-		-			
CO	-	-	-	-	3	3	-	3	2	-	1	-		-			
-4																	
-5	-	-	3	-	-	3	-	3	2	-	2	1		-			
1: W	/eakly	relate	d, 2: M	oderat	ely rela	ated ar	nd 3: St	rongly	related	±							
MOL	DULE 1	L - HUN	MAN V	ALUES										(6L)			
Defi	nition	of et	hics-M	orals v	alues	and e	thics –	 integ 	rity-Wo	ork etł	nics- S	ervice					
learr	ning-Ci	vic vi	rtue-Re	espect	for of	thers-C	aring-S	haring	-Hones	ty-Cou	rage-V	aluing					
time	-Coop	eratior	n-Comr	nitmen	t-Empa	thy-Se	lf-confi	dence-	Charac	ter-Spi	ritualit	У-	со	1,BTL2			
Intro	oductio	on to	Yoga	and n	neditat	ion fo	r prof	essiona	al exce	ellence	and	stress		•			
man	ageme	ent.															
Sug	gested	Readi	ng: Cas	se study	/ of Dis	covery	failure										
MOL	DULE 2	- ENG	INEERI	NG ETH	IICS									(6L)			
Sens	ses of	'Engine	eering	Ethics'	– Varie	ety of r	noral is	ssues –	- Types	of inq	uiry –	Moral					
diler and	nmas Contro	– Mora oversy	al Auto – Mod	onomy els of p	– Kohl rofessi	berg's onal ro	theory oles - Tl	– Gilli heories	gan's t s about	heory right a	 Constant 	ensus - Self-	CO2,BTL2				
													1				

interest – Customs and Religion – Uses of Ethical Theories.	
Suggested Reading: Study the Bhopal gas tragedy	
MODULE 3- SAFETY, RESPONSIBILITIES AND RIGHTS	(6L)
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and	
Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality –	
Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights –	CO3,BTL3
Intellectual Property Rights (IPR) – Discrimination.	
Suggested Reading: Chernobyl explosion, Nuclear and thermal power plant issues	
MODULE 4 - LIFE SKILLS	(6L)
Definition, Relevance, Types of values, changing concepts of values-aims and	
values of value education- basic etiquette-morals and values in life-dealing with	
people. Personal values – Self – Strengths (self-confidence, self-assessment, self-	
reliance, self-discipline, determination, self-restraint, contentment, humility,	CO4,BTL2
sympathy and compassion, gratitude, forgiveness) Weaknesses	
Suggested Reading: Influences - Peer pressure, familial and societal expectations,	
media	
MODULE 5 - SOCIETIES IN PROGRESS	(6L)
Definition of society; Units of society; Communities – ancient and modern – Agents	
of change – Sense of survival, security, desire for comfort and ease sense of	
belonging, social consciousness and responsibility	CO5,BTL2
Suggested Reading: Personal value and professional value of Engineers on societies	
perception	

COURSE TITLE	SC	CREDITS	3							
COURSE CODE	MHB4219	COURSE CATEGO	L-T-P-S	3-0-0-3						
Version	1.0	Approval Detai	LEARNING LEVEL	BTL-3						
ASSESSMENT SCHEME										
First	Second	Seminar/								
Periodical	Periodical	Assignments/	Surpr	ise Test / Quiz	Attendance	ESE				
Assessment	Assessment	Project								
15%	15%	10%		5%	5%	50%				
Course Description	The solid mechanics as a subject may be defined as a branch of applied mechanics that deals with behaviors of solid bodies subjected to various types of loadings. This is usually subdivided into further two streams i.e Mechanics of rigid bodies or simply Mechanics and Mechanics of deformable solids. The mechanics of deformable solids which is branch of applied mechanics is known by									

		several names i.e. strength of materials, mechanics of materials etc.												
		Als pra	Also the course coverage is balanced with analytical treatments, physical concepts and practical applications in Fluid Mechanics.											
Cou Obje Cou Outo	Course The course should enable the students to 0bjective 1. Learn the fundamental principles and procedures to solve rigid bodies subjected to simple stresses and strains. 2. Learn the procedure for solving rigid bodies subjected to transverse loading 3. Learn the procedure to calculate rigid bodies subjected to torsional loading. 4. Learn the fundamental concepts of fluid flow. 5. Learn the estimation of the dimensional analysis and losses on flow through circular conduit. Upon completion of this course, the students will be able to 1. Explain the principles to solve solid bodies subjected to transverse loading. 3. Calculate to solve solid bodies subjected to transverse loading. 4. Explain the procedure to solve solid bodies subjected to simple stresses. 2. Explain the procedure to solve solid bodies subjected to transverse loading. 3. Calculate to solve solid bodies subjected to torsional loading. 4. Explain the basic concepts of fluid flow.													
Prere	quisites	s: Nil	LStilla	te uni			y 515 attu	103363		tinoug			uit.	
CO, PO AND PSO MAPPING														
		Р	_											
со	РО- 1	0 - 2	РО- 3	РО -4	РО- 5	РО- 6	РО- 7	РО- 8	РО- 9	РО- 10	РО- 11	РО- 12	PSO -1	PSO -2
CO- 1	3	3	2	-	1	-	-	2	2	1	-	3	2	-
CO- 2	3	3	3	-	1	-	-	2	2	1	-	3	2	-
CO- 3	3	3	3	-	1	-	-	2	2	1	-	3	2	-
CO- 4	3	3	0	-	0	-	-	2	2	-	-	3	2	-
CO- 5	3	3	0	-	0	-	-	2	2	-	-	3	2	-
1: We	eakly re	late	1: Weakly related, 2: Moderately related and 3: Strongly related											
MODULE 1: STRESS, STRAIN AND DEFORMATION OF SOLIDS (9L)									elated					
MOD	ULE 1: 9	STRE	SS, STR		ND DEF		tion o	F SOLIE	elated S					(9L)
MOD Conce diagra Stress of stre a giver Sugges	ULE 1: 9 pt of s m, poi in simp ess at a n plane sted Re	STRE tress sson ole a poin – M	SS, STR s-strain, 's relat nd com t, princi ohr's ciu gs:	AIN AI Hook ion, v posite iple pla rcle of	ND DEF e's law olumet bars s ane, pr stresse	ORMA , Tensi ubjecte inciple s	TION O ion, con ain, Ela ed to ax stress, r	F SOLID mpressi stic co ial loac	on and nstants ling and and lon	shear, and t tempe gitudin	stress heir re erature al stres	-strain lation. State ses on	CO1,	(9L) BTL2

forces – resultant of a force system	
MODULE 2: TRANSVERSE LOADING ON BEAMS SHEAR FORCE AND BENDING MOMENT	(9L)
Types of Beams, Transverse loading on beams shear force and bending moment in	
beams -cantilever, simply supported, overhanging beam subjected to concentrated	
load and UDL-maximum bending moment and point of contraflexure. Theory of simple	
bending and assumption-applications- leaf spring.	CO2,BTL2
Suggested Readings:	
Concepts of different beams and applications	
MODULE 3: TORSION, SPRINGS AND COLUMNS	(9L)
Theory of torsion and assumption – Torsion of circular shafts, solid & hollow – strain	
energy in torsion. Power transmission, strength and stiffness of shafts. Types of springs,	
stiffness stresses and deflection in helical spring and leaf spring. Columns – Buckling	
and stiffness due to axial loads- Euler, Rankin and Empirical formulae for columns with	CO3,BTL3
different conditions.	
Suggested Readings:	
Applications of torsional loads on shafts	
MODULE 4: FLUID FLOW CONCEPTS AND BASIC EQUATIONS	(9L)
Flow characteristics, concepts of system and control volume – continuity equation –	
Application of control volume to continuity – Energy Equation – Euler's Equation –	
Bernoulli equation and Momentum Equation –simple problems.	CO4,BTL2
Suggested Readings:	
Units and dimensions, Properties of fluids	
MODULE 5: DIMENSIONAL ANALYSIS AND FLOW THROUGH CIRCULAR CONDUITS	(9L)
Dimension and units, Buckingham π theorem, Discussions on dimensionless	
parameters- applications. Fluid flow - Laminar and Turbulent flow through circular	
tubes. Darcy Equation on pipe roughness – Friction factor – Moody diagram, Minor loss.	CO5,BTL2
Suggested Readings:	
Flow characteristics and it's applications	
TEXT BOOKS	
1. Ramamurtham, S and Narayanan .R. (2001). <i>Strength of material</i> , Dhanpat Rai Pvt.	.Ltd.,
2. Bansal.R.K. (2004). <i>Strength of Material</i> , Lakshmi publications Pvt.Ltd.	
REFERENCE BOOKS	
1. Kumar.K.L. (2006). <i>Engineering Fluid Mechanics</i> , Eurasla publishers Home Ltd.	
2. Bansal.R.K.(2014). Fluid Mechanics and Hydraulic Machines, Laxmi publications(P)	Ltd.
3. Ferdin and P.Beerand Russell Johnston .E (2005), "Mechanics of Materials SI metric", McGraw Hill	
E BOOKS	
1. https://www.kobo.com/us/en/ebook/fluid-and-solid-mechanics	
MOOC	
1	https://nptel.ac.in/courses/112/107/112107146/
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2	https://nptel.ac.in/courses/112/105/112105171/

COU TI	JRSE TLE			STAT	ISTICS	& DAT	A ANAI	YTICS			CRE	DITS		4
COL CC	JRSE DDE	N	1HB422	20	C/	COURS ATEGO	E RY		PC		L-T	-P-S	3	-0-2-0
Ver	rsion		1.0		Аррг	oval D	etails	24 3	ith ACN 0.5.202	VI - 18	LEAR LE	NING VEL		BTL-4
						ASSE	SSME	NT SCH	EME					
Fi Per Asso e	irst iodic al essm ent	P As	Second Periodical Assessment Seminar/Assignments/Project / Practical component ESE											
1!	5%		15%				20)%					50%	
Cou Dese on	rse cripti	This course helps students develop the understanding that they will need to make informed decisions using data. The course is an introduction to the essential concepts, tools and methods of statistics for students. This course covers two main branches of statistics: descriptive statistics and inferential statistics. Descriptive statistics includes collecting data and summarising and interpreting them through numerical and graphical techniques. Inferential statistics includes selecting and applying the correct statistical technique to make estimates or test claims about a population based on a sample.												
Cou Obje e	rse ectiv	The c 1. D Er 2. Er 3. H di	 The course should enable the students to 1. Develop the student's ability to deal with numerical and quantitative issues in Engineering applications 2. Enable the use of statistical and graphical wherever relevant. 3. Have a proper understanding of Statistical applications and apply it in relevant disciplines 											
Cou Outo e	rse com	 Upon completion of this course, the students will be able to 1. Find a meaningful pattern in data 2. Graphically interpret data 3. Implement the analytic algorithms 4. Handle large scale analytics projects from various domains 5. Develop intelligent decision support systems. 												
Prer	requisi	tes: Ni												
со,	PO AN	ID PSO	MAPP	ING										
со	РО -1	РО- 2	РО- 3	РО- 4	РО- 5	РО- 6	РО- 7	РО- 8	РО- 9	PO - 10	PO- 11	РО- 12	PSO -1	PSO-2
со	3	3	1	3	1	-	-	-	-	-	-	2	3	2

-1														
<u> </u>														
-2	3	3	1	3	3	-	-	-	-	-	-	2	3	2
CO -3	3	3	1	3	3	-	-	-	-	-	-	2	3	2
со	2	2	1	2	2	2	1					2	2	
-4	5	5	1	5	5	2	1	-	-	-	-	2	5	2
CO -5	3	3	1	3	3	2	1	-	-	-	-	2	3	2
1: V	1: Weakly related, 2: Moderately related and 3: Strongly related													
MO	DULE :	1: INT	RODU	CTION								(9L+6	P)	
Defi	nition	– impo	rtance	– scop	e – Po	pulatio	n and s	ample	- Elem	ents, V	ariable	s, and		
Data	a categ	gorizati	on	·	·			•		,				
Prac	ctical c	ompor	nent:										CO 1	
Imp	orting	and W	orking	with da	ata									,
Sug	gested	Readi	ngs:										DIL-2	_
Stat	istics a	nd Dat	a Anal	ytics – '	Why it	matter	s?							
Cha	llenges	s and o	pportu	nities i	n Data	Science	5							
MO	DULE 2	2: DES	CRIPTI	VE STA	TISTIC	S						(9L+6	P)	
Leve	els of I	Measur	rement	: -Data	manag	gement	and in	ndexing	, –Grap	hical a	pproad	hes –		
Mea	asures	of cent	ral Ter	ndency	– Mea	sures o	f dispe	rsion –	Skewn	ess - K	urtosis			
Prac	ctical c	ompor	nent:										CO-1	.2
Gra	phical	represe	entatio	n of da	ta								BTL-3	3
Mea	asure c	entral	tender	icy and	disper	sion or	i data c	ollecte	d					
Sug	gested	Readi	ngs:	امیں مائ		. .								
Des	criptiv	e statis	tics an	a its ro	e in re	searcn								
		S:INFEF		STATIS				•				(9L+6	י 	
IWC	Samp	le lest	is - Typ	be 1 an	d lype	e 2 Erro	ors – Cl	hi squa	re test	s – t I lihood	est - A	NOVA		
and Drav	rest o		enden	ce – co	rrelati	on anai	ysis – r	viaximi	лт пке	iinooa	lest			
Dorf		stimati	on ann	lving in	foront	ial ctati	stical n	nothod	s for a	aivon r	rohlan	n	CO-3	
Toct	hvnot	hosis a	un app bout a	nonula	ation h	ar stati	the d	ata coll	octod f	Siven F		hlom	BTL-4	ļ
Sug	rested	Readi	ngs:	popul			i the u			orugi	ven pre	Joietti		
Sign	ificand	e of hv	pothe	sis testi	ng in lı	nferent	ial Stat	istics						
MODULE 4: DATA ANALYSIS TECHNIQUES (91+6P))							
Reg	ressior	n analı	vsis -	Classif	ication	techr	niques:	super	rvised	– uns	upervi	sed -		
clus	tering		,											
Prac	Practical component:							<u> </u>						
Perf	Perform prediction based on regression analysis								,4 1					
Classify the given data using appropriate techniques							DIL-4	•						
Sug	gested	Readi	ngs:											
Dee	p learr	ning fro	om stat	istical p	perspe	ctive								
МО	MODULE 5: CASE STUDIES (9L+6P										P)			

Case Corr Prac Perf appl Sugg	Case studies in Sampling, Statistical measures, Design of experiments, ANOVA, Correlation, Regression and classification Practical component: Perform a case study on how statistical measures are used for any relevant application Suggested Readings: CO-4,5 BTL-4						
IEA	Development Chris Clean Jack Devene (2016) Introduction to statistics & Date A						
1.	Roxy Peck, Chris Olsen, Jay L. Devore. (2016), <i>Introduction to statistics & Data Analysis</i> , Cengage Learning , 5 th Edition.						
REF	REFERENCE BOOKS						
	TotstenHothorn. (2014). A Handbook of Statistical Analyses using R, CRC press,	3 rd Edition.					
	Clemens Reimann, Peter Filzmoser. (2007). Statistical Data Analysis Explained,	Wiley					
	publications						
E BC	DOKS						
	http://www.stat.wmich.edu/s160/hcopy/book.pdf						
	https://advanceddataanalytics.net/ebooks/						
	http://www.statsref.com/StatsRefSample.pdf						
MO	MOOC						
	https://www.coursera.org/browse/data-science/data-analysis?languages=en						

COU TIT	JRSE FLE	ELECTRICA	ELECTRICAL MACHINES AND DRIVES LAB CREDITS						
COL CO	JRSE DE	MHB4242	COURSE CATEGORY	PC	L-T-P-S	0-0-2-0			
Ver	sion	1.0	Approval Details	24th ACM - 30.5.2018	LEARNING LEVEL	BTL4			
ASS	ASSESSMENT SCHEME								
			CIA			ESE			
			80%			20%			
	The	purpose of the mod	lule is to teach principles o	of DC, AC mo	tors and AC t	ransformers and			
Со	how	they work. Basic co	ncepts of electromagnetic	circuits as the	ey relate to vo	oltages, currents,			
urs	and p	physical forces induc	ed in conductors are cover	red, including	loading effect	ts of mechanical			
е	e and electrical braking methods. Practical calculation of mechanical and electrical characteristic								
De	De of the system under varying conditions and analysis of power requirements, power capability,								
scr	effici	ency, operating cha	aracteristics, control requir	rements, and	electrical de	mands of these			
ipt	mach	nines. This course is	also a "writing-intensive"	' course that	teaches stud	lents to prepare			

formal, written technical documents. This goal is accomplished through extensive writing

exercises performed in the context of laboratory exercises that accompany the course.

ion

Co urs e Ob jec tiv e	 The course will enable the students to understand: 1. The basic construction and working principle of Machines and Transformers 2. The need to perform load test on DC motors 3. The need to perform load test on AC motors 4. The need to perform load test on stepper motors 5. The various methods to the speed of motors. 													
Со	Upor	l comp	letion	of this	course,	, the st	udents	will be	e able t	o				
urs	1. C	Conduct	t exper	iments	on DC	machi	nes and	l Trans	former	charac	teristic	cs.		
e	2. A	nalyze	the pe	rforma	nce un	der vai	rying lo	ad con	ditions	on DC	motor	s.		
Ou	3. A	nalyze	the pe	rtorma	nce un	der vai	rying lo	ad con	ditions	on AC	motor	S		
το	4. A	nalyze	the pe	rtorma	nce un	der vai	rying io	ad con	aitions	on Ste	pper m	lotors.		
me	5. P	eriorm	speed	contro	or or va	rious m	iotors.							
Prere	Prerequisites: Nil													
CO,	CO, PO AND PSO MAPPING													
0	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PSO	PSO-2
	1	2	3	4	5	6	7	8	9	10	11	12	-1	130-2
CO -1	3	3	-	-	-	-	-	2	2	-	-	3	3	-
CO -2	3	3	-	-	-	-	-	2	2	-	-	3	3	-
CO -3	3	3	-	-	-	-	-	2	2	1	-	3	3	-
CO -4	3	3	-	-	-	-	-	2	2	1	-	3	3	-
CO -5	3	3	-	-	-	-	-	2	2	1	-	3	3	-
		·	1: We	akly re	lated,	2: Moc	lerately	y relate	ed and	3: Stro	ngly re	lated		
MO	DULE	L – EXP	ERIME	NTS OF	N ELEC	TRICAL	MACH	INES						(25P)
	1 Load test on DC shunt Motor CO-1,2													
1 -	1. Load test on DC shunt Motor BTL-4													

- 2. Speed Control of DC shunt Motor
- 2. Spece control of De shull Notor
 BTL-3

 3. Swinburne's Test
 CO-1,2

 4. Performance characteristics of single phase transformers
 BTL-4

 5. Load Test on Single Phase Induction Motor
 CO-3

 6. Load test on three phase squirrel cage induction motor
 CO-3

CO-1,2

CURRICULUM AND SYLLABUSB.TECH – MECHATRONICS ENGINEERING

		BTL-3					
	No load and Plackad rator tast on three phase induction mater	CO-3					
	. No load and blocked rotor test on three phase induction motor	BTL-4					
	No load and Blocked robet test on single phase industion motor	CO-4					
, i	s. No load and Blocked robot test on single phase induction motor	BTL-4					
) Load test on synchronous motors	CO-4					
	5. Load test on synchronous motors	BTL-4					
	10 Performance characteristics of stenner motor	CO-5					
10. Performance characteristics of stepper motor BTL-4							
MAT	LAB ASSIGNMENTS	(5P)					
•	Model a transformer using fundamental magnetic library blocks						
•	Nonlinear Transformer Characteristics						
•	Three-Phase Core-Type Transformer						
•	Operation of a forward converter.						
•	Single-Phase Asynchronous Machine - Voltage Control of Auxiliary Wind	ing					
•	Implementation of a nonlinear inductor						
•	Variable Reluctance Actuator						
•	Custom Inductor (B-H Curve)						
•	Solenoid with Magnetic Blocks Parameterize a Permanent Magnet Synchronous Motor						
Virtu	Virtual Labs						
1.	http://103.37.201.114/						
2.	http://em-coep.vlabs.ac.in/						

	SOLID /	AND FLUID MECHANICS LA	CREDITS	1					
CODE	MHB4243	COURSE CATEGORY	COURSE CATEGORY PC						
Vorsion	1.0	Approval Dotails	24 th ACM -	LEARNING	RTI /				
Version	1.0	Approval Details	30.5.2018	LEVEL	DIL4				
ASSESSME	ASSESSMENT SCHEME								
	CIA ESE								
		80%			20%				
	The purpose of the	nis module is to teach th	ne fundamen	tal concepts	on selection of				
Course	materials through	mechanical testing for a d	ifferent appli	cation. Mech	anical properties				
Doscrinti	such as tensile, con	npressive, impact, shear, st	rength and ha	rdness etc., T	his course enrich				
Descripti	the knowledge to	measure and analyze t	the above p	roperties by	various testing				
on	instruments. Hence, This course would enable the student to have a clear understanding								
	for determining var	ious mechanical properties	•						

		The o	ourse	will ena	ble the	e stude	nts to ι	underst	and:					
		1. T	he basi	c conce	epts ar	nd work	king pri	nciple	of mec	hanical	testing	g mach	ines	
Cou	rse	2. T	he nee	d to pe	rform r	nateria	al stren	gth tes	t on te	nsile te	st mac	hine		
Obje	ectiv	3. T	he nee	d to pe	rform ł	nardne	ss test	on haro	dness t	est ma	chine			
е		4. T	he nee	d to pe	rform o	compre	ession t	est on	springs					
		5. T	5. The need to perform and record flow measurements and characteristics study of											
		р	pumps.											
		U	pon co	mpleti	on of tł	nis cou	rse, the	e stude	nts will	be abl	e to			
		1. P	1. Perform tension, shear and torsion test on solid materials.											
Cou	rse	2. Determine the toughness of the material using Charpy and Izod test.												
Outo	come	3. D	etermi	ne the	Brinell	and Ro	ockwell	hardne	ess nun	nber of	the giv	ven spe	ecimen.	
		4. P	erform	flow m	easure	ements	and lo	ss in pi	pes.					
		5. R	ecord t	he cha	racteris	stic stu	dy of p	umps,	turbine	es etc.,.				
Prer	Prerequisites: Nil													
6														
τυ,														
со	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PSO	PSO-2
	1	2	3	4	5	6	/	8	9	10	11	12	-1	
-1	3	3	-	-	-	-	-	2	2	1	-	3	3	-
-1														
-2	3	3	-	-	-	-	-	2	2	1	-	3	3	-
со	_	_						_				_	_	
-3	3	3	-	-	-	-	-	2	2	1	-	3	3	-
СО	2	2	_	_	_	_	_	2	2	1	_	2	2	_
-4	5	3	-	-	-	-	-	2	2	-	-	3	3	-
со	3	3	-	-	-	-	-	2	2	1	-	3	3	-
-5								_	_				•	
			1: We	eakly re	lated,	2: Moc	leratel	y relate	ed and	3: Stro	ngly re	lated		
MO	DULE :	1 – EXF	PERIME	NTS OF		D MECH	HANICS	5					(20F	')
													C	0-1,2
. 1	1) Tension test on a mild steel rod													

2) Double shear test on Mild steel and Aluminium rods

5) Hardness test on metals - Brinnell and Rockwell Hardness Number

3) Torsion test on mild steel rod

4) Impact test on metal specimen

6) Deflection test on beams

BTL-4 CO-1,2

BTL-3 CO-1,2

BTL-4 CO-1

BTL-4 CO-3

BTL-4 CO-3

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	BTL-3
7) Compression test on belied environ	CO-3
7) Compression test on helical springs	BTL-4
MODULE 2 – EXPERIMENTS ON FLUID MECHANICS	(20P)
1) Determination of the Coefficient of discharge of given Orificemeter.	CO-4
	BTL-3
2) Determination of the Coefficient of discharge of given Venturimeter.	CO-4
	BTL-3
3) Calculation of the rate of flow using Rotameter.	CO-4
	BTL-3
4) Determination of friction factor for a given set of pipes.	CO-4
	BTL-3
5) Conducting experiments and drawing the characteristic curves of	CO-5
centrifugal pump/ submergible epump	BTL-4
6)Conducting experiments and drawing the characteristics curves of Francis	CO-5
turbine	BTL-3
7)Conducting experiments and drawing the characteristic curves of Kaplan	CO-5
turbine	BTL-4
MATLAB ASSIGNMENTS	(5P)
1. Detect Abrupt System Changes Using Identification Techniques	
2. Single-Acting Cylinder with 3-Way Valve	
3. Pump with Pressure-Reducing Valve and Two Loads	
4. Hydraulic Flapper-Nozzle Amplifier	
5. Flow Divider Test Rig	
6. Segmented Pipeline Test Rig	
Virtual Labs	
1. <u>http://sm-nitk.vlabs.ac.in/</u>	
2. <u>http://fm-nitk.vlabs.ac.in/</u>	

COURSE TITLE		CREDITS	1		
COURSE CODE	MHB4244	COURSE CATEGORY	РС	L-T-P-S	0-0-2-0
Version	1.0	Approval Details	24 th ACM, 30.05.2018	LEARNING LEVEL	BTL-
ASSESSMEN	T SCHEME				
First Review	Second Review	cond Review Third Review Project Report & Viva Voce		port & Viva Dce	ESE
20%	30%	20%	30)%	

	This course provides the student significant design experience and builds on the							
Course	knowledge and skills acquired in earlier course work. This course provides an exposure to							
Descripti	teamwork to emulate a typical professional design environment. Simulations are to be							
on	used both in the execution of the design methodology and the management of the design							
	project.							
	The course will enable the students to understand :							
	1. To develop skills in doing literature survey, technical presentation and report							
Course	preparation.							
Objective	2. To enable project identification and execution of preliminary works on							
	3. To enable students to work as team							
	4. To introduce the students to work on interdisciplinary projects							
	Upon completion of this course, the students will be able to							
Course	1. Design, Simulate and fabricate a prootype using the knowledge acquired in the							
Outcome	previous semesters; relate to real time industrial/societal problems							
	2. Prepare technical drawing, technical report and technical presentation							

Prerequisites:

CO, PO AND PSO MAPPING

DCA 7
F30-2
2
3
2
5
-

	1: Weakly related, 2: Moderately related and 3: Strongly related					
	NOTE					
	The students in convenient groups of not more than 4 members have to identify a product for design					
1	and fabrication. Every project work shall have a guide who is the member of the faculty of the					
	institution.					
r	To develop a mechatronic system with emphasis on electrical drives (Actuator) for different					
Z	applications/Systems.					
	The students are required to design and fabricate the chosen system and demonstrate its working					
3	apart from submitting the project report. The report should contain assembly drawing, parts drawings,					
	process charts relating to fabrication.					

SEMESTER V

COURSE TITLE	METRO	LOGY AND MEASUR	CREDITS	4	
COURSE CODE	MHB4301	COURSE CATEGORY	РС	L-T-P-S	3-0-2-1
Version	1.0	Approval Details	24 ACM, 30.05.2018	LEARNING LEVEL	BTL-6

CURRICULUM AND SYLLABUSB.TECH – MECHATRONICS ENGINEERING

ASSESSME	NT SCHEME								
First Periodica I Assessm ent	Second Periodical Assessment	Practical Assessment	ESE						
15%	15%	20%	50%						
Course Descripti on	 Engineering metrology deals with the applications of measurement science in ipti manufacturing processes. It provides a means of assessing the suitability of measuring instruments, their calibration, and the quality control of manufactured components. 								
Course Objective	 The course will ena knowledge on o knowledge on l knowledge on f knowledge on o knowledge on o 	ble the students to understand: concepts of measurements inear and angular measurements techniques form measurements techniques uses of laser assisted metrology techniques rechniques for measurements of physical quantities							
Course Outcome Prerequisit	 S. Knowledge on techniques for measurements of physical quantities Upon completion of this course, the students will be able to Use precision measurement instruments found in a workshop (metrology) Examine the design critically and to understand the use of precision measuring instruments commonly found in various applications. Select the right measuring tool with decided accuracy for a given application								
CO, PO AN	D PSO MAPPING								

-														
со	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	РО- 10	PO- 11	PO- 12	PSO-1	PSO- 2
CO -1	3	3	2	-	1	1	-	-	1	1	-	1	3	-
CO -2	3	3	2	-	1	1	-	-	1	1	-	1	3	-
CO -3	3	3	2	2	1	1	-	-	1	1	-	1	3	2
CO -4	3	3	2	2	1	1	-	-	1	1	-	1	3	2
	1: Weakly related, 2: Moderately related and 3: Strongly related													
MO	DULE 1	: CONC	EPT O	F MEAS	SUREM	ENT		(9L+6P)					

General concept–Generalized measurement system-Units and standards-measuring	
instruments- sensitivity, readability, range of accuracy, precision-static and dynamic	CO-1
response- repeatability-systematic and random errors-correction, calibration,	BTL-6
interchangeability.	

Practical component:	
Calibration of vernier, micrometer, vernier height gauge	
Suggested Readings:	
limits, fits, tolerances, Manufacturing cost and tolerances	
MODULE 2: LINEAR AND ANGULAR MEASUREMENT	(9L+6P)
Definition of Metrology - Linear measuring instruments: Vernier, Micrometer,	
internal measurement, Slip gauges and classification, Interferometery, optical	
flats, limit gauges- Comparators: Mechanical, pneumatic and electrical types,	
applications. Angular measurements: Sine bar, optical bevel protractor, angle	CO-2
Deckkor – Taper measurements	BTL-6
Practical component:	DIEG
Linear and angular measurements.	
Suggested Readings:	
Statistical analysis of experimental data, Regression analysis	
MODULE 3: FORM MEASUREMENT	(9L+6P)
Measurement of screw threads-Thread gauges, floating carriage micrometer-	
measurement of gear-tooth thickness-constant chord and base tangent method-	
Gleason gear testing machine - radius measurements-surface finish, straightness,	
flatness and roundness measurements.	CO-3
Practical component:	BTL-6
Form measurement(screw thread profile, gear profile)	
Suggested Readings:	
Quality standard principle, Design of experiments	
MODULE 4: LASER AND ADVANCES IN METROLOGY	(9L+6P)
MODULE 4: LASER AND ADVANCES IN METROLOGYPrecision instruments based on laser-Principles- Laser Interferometer-application	(9L+6P)
MODULE 4: LASER AND ADVANCES IN METROLOGYPrecision instruments based on laser-Principles- Laser Interferometer-applicationin linear, angular measurements and machine tool metrology Coordinate	(9L+6P)
MODULE 4: LASER AND ADVANCES IN METROLOGY Precision instruments based on laser-Principles- Laser Interferometer-application in linear, angular measurements and machine tool metrology Coordinate measuring machine (CMM)- Constructional features – types, applications – digital	(9L+6P)
MODULE 4: LASER AND ADVANCES IN METROLOGY Precision instruments based on laser-Principles- Laser Interferometer-application in linear, angular measurements and machine tool metrology Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection.	(9L+6P) CO-4
MODULE 4: LASER AND ADVANCES IN METROLOGY Precision instruments based on laser-Principles- Laser Interferometer-application in linear, angular measurements and machine tool metrology Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection. Practical component:	(9L+6P) CO-4 BTL-6
MODULE 4: LASER AND ADVANCES IN METROLOGY Precision instruments based on laser-Principles- Laser Interferometer-application in linear, angular measurements and machine tool metrology Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection. Practical component: Coordinate measurement(vision based measurement, tool makers microscope)	(9L+6P) CO-4 BTL-6
MODULE 4: LASER AND ADVANCES IN METROLOGY Precision instruments based on laser-Principles- Laser Interferometer-application in linear, angular measurements and machine tool metrology Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection. Practical component: Coordinate measurement(vision based measurement, tool makers microscope) Suggested Readings:	(9L+6P) CO-4 BTL-6
MODULE 4: LASER AND ADVANCES IN METROLOGY Precision instruments based on laser-Principles- Laser Interferometer-application in linear, angular measurements and machine tool metrology Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection. Practical component: Coordinate measurement(vision based measurement, tool makers microscope) Suggested Readings: Importance of nano dimension, Importance of nano metrology	(9L+6P) CO-4 BTL-6
MODULE 4: LASER AND ADVANCES IN METROLOGY Precision instruments based on laser-Principles- Laser Interferometer-application in linear, angular measurements and machine tool metrology Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection. Practical component: Coordinate measurement(vision based measurement, tool makers microscope) Suggested Readings: Importance of nano dimension, Importance of nano metrology MODULE 5: MEASUREMENT OF POWER, FLOW &TEMPERATURE RELATED PROPERTI	(9L+6P) CO-4 BTL-6 ES (9L+6P)
MODULE 4: LASER AND ADVANCES IN METROLOGY Precision instruments based on laser-Principles- Laser Interferometer-application in linear, angular measurements and machine tool metrology Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection. Practical component: Coordinate measurement(vision based measurement, tool makers microscope) Suggested Readings: Importance of nano dimension, Importance of nano metrology MODULE 5: MEASUREMENT OF POWER, FLOW &TEMPERATURE RELATED PROPERTI Force, Torque, Power - Mechanical, Pneumatic, Hydraulic and Electrical type. Flow	(9L+6P) CO-4 BTL-6 ES (9L+6P)
MODULE 4: LASER AND ADVANCES IN METROLOGY Precision instruments based on laser-Principles- Laser Interferometer-application in linear, angular measurements and machine tool metrology Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection. Practical component: Coordinate measurement(vision based measurement, tool makers microscope) Suggested Readings: Importance of nano dimension, Importance of nano metrology MODULE 5: MEASUREMENT OF POWER, FLOW &TEMPERATURE RELATED PROPERTI Force, Torque, Power - Mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement:-Venturi, Orifice, Rotometer, Pitot tube. Temperature: Bimetallic	(9L+6P) CO-4 BTL-6 ES (9L+6P)
 MODULE 4: LASER AND ADVANCES IN METROLOGY Precision instruments based on laser-Principles- Laser Interferometer-application in linear, angular measurements and machine tool metrology Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection. Practical component: Coordinate measurement(vision based measurement, tool makers microscope) Suggested Readings: Importance of nano dimension, Importance of nano metrology MODULE 5: MEASUREMENT OF POWER, FLOW &TEMPERATURE RELATED PROPERTI Force, Torque, Power - Mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement:-Venturi, Orifice, Rotometer, Pitot tube. Temperature: Bimetallic strip, Thermometers, Thermocouples, Electrical resistance Thermister. 	(9L+6P) CO-4 BTL-6 ES (9L+6P)
 MODULE 4: LASER AND ADVANCES IN METROLOGY Precision instruments based on laser-Principles- Laser Interferometer-application in linear, angular measurements and machine tool metrology Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection. Practical component: Coordinate measurement(vision based measurement, tool makers microscope) Suggested Readings: Importance of nano dimension, Importance of nano metrology MODULE 5: MEASUREMENT OF POWER, FLOW &TEMPERATURE RELATED PROPERTI Force, Torque, Power - Mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement:-Venturi, Orifice, Rotometer, Pitot tube. Temperature: Bimetallic strip, Thermometers, Thermocouples, Electrical resistance Thermister. Practical component: 	(9L+6P) CO-4 BTL-6 ES (9L+6P)
 MODULE 4: LASER AND ADVANCES IN METROLOGY Precision instruments based on laser-Principles- Laser Interferometer-application in linear, angular measurements and machine tool metrology Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection. Practical component: Coordinate measurement(vision based measurement, tool makers microscope) Suggested Readings: Importance of nano dimension, Importance of nano metrology MODULE 5: MEASUREMENT OF POWER, FLOW &TEMPERATURE RELATED PROPERTI Force, Torque, Power - Mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement:-Venturi, Orifice, Rotometer, Pitot tube. Temperature: Bimetallic strip, Thermometers, Thermocouples, Electrical resistance Thermister. Practical component: Physical quantity measurement (LVDT calibration, load cell, strain measurement, 	(9L+6P) CO-4 BTL-6 ES (9L+6P) CO-5 BTL-6
 MODULE 4: LASER AND ADVANCES IN METROLOGY Precision instruments based on laser-Principles- Laser Interferometer-application in linear, angular measurements and machine tool metrology Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection. Practical component: Coordinate measurement(vision based measurement, tool makers microscope) Suggested Readings: Importance of nano dimension, Importance of nano metrology MODULE 5: MEASUREMENT OF POWER, FLOW &TEMPERATURE RELATED PROPERTI Force, Torque, Power - Mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement:-Venturi, Orifice, Rotometer, Pitot tube. Temperature: Bimetallic strip, Thermometers, Thermocouples, Electrical resistance Thermister. Practical component: Physical quantity measurement (LVDT calibration, load cell, strain measurement, torque measurement etc) 	(9L+6P) CO-4 BTL-6 ES (9L+6P) CO-5 BTL-6
MODULE 4: LASER AND ADVANCES IN METROLOGY Precision instruments based on laser-Principles- Laser Interferometer-application in linear, angular measurements and machine tool metrology Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection. Practical component: Coordinate measurement(vision based measurement, tool makers microscope) Suggested Readings: Importance of nano dimension, Importance of nano metrology MODULE 5: MEASUREMENT OF POWER, FLOW &TEMPERATURE RELATED PROPERTI Force, Torque, Power - Mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement:-Venturi, Orifice, Rotometer, Pitot tube. Temperature: Bimetallic strip, Thermometers, Thermocouples, Electrical resistance Thermister. Practical component: Physical quantity measurement (LVDT calibration, load cell, strain measurement, torque measurement etc) Suggested Readings:	(9L+6P) CO-4 BTL-6 ES (9L+6P) CO-5 BTL-6
 MODULE 4: LASER AND ADVANCES IN METROLOGY Precision instruments based on laser-Principles- Laser Interferometer-application in linear, angular measurements and machine tool metrology Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection. Practical component: Coordinate measurement(vision based measurement, tool makers microscope) Suggested Readings: Importance of nano dimension, Importance of nano metrology MODULE 5: MEASUREMENT OF POWER, FLOW &TEMPERATURE RELATED PROPERTI Force, Torque, Power - Mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement:-Venturi, Orifice, Rotometer, Pitot tube. Temperature: Bimetallic strip, Thermometers, Thermocouples, Electrical resistance Thermister. Practical component: Physical quantity measurement (LVDT calibration, load cell, strain measurement, torque measurement etc) Suggested Readings: Errors in temperature measurement, testing quality assurance sciences using Matlab 	(9L+6P) CO-4 BTL-6 ES (9L+6P) CO-5 BTL-6
MODULE 4: LASER AND ADVANCES IN METROLOGY Precision instruments based on laser-Principles- Laser Interferometer-application in linear, angular measurements and machine tool metrology Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection. Practical component: Coordinate measurement(vision based measurement, tool makers microscope) Suggested Readings: Importance of nano dimension, Importance of nano metrology MODULE 5: MEASUREMENT OF POWER, FLOW &TEMPERATURE RELATED PROPERTI Force, Torque, Power - Mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement:-Venturi, Orifice, Rotometer, Pitot tube. Temperature: Bimetallic strip, Thermometers, Thermocouples, Electrical resistance Thermister. Practical component: Physical quantity measurement (LVDT calibration, load cell, strain measurement, torque measurement etc) Suggested Readings: Errors in temperature measurement, testing quality assurance sciences using Matlab TEXTBOOKS	(9L+6P) CO-4 BTL-6 ES (9L+6P) CO-5 BTL-6
MODULE 4: LASER AND ADVANCES IN METROLOGY Precision instruments based on laser-Principles- Laser Interferometer-application in linear, angular measurements and machine tool metrology Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection. Practical component: Coordinate measurement(vision based measurement, tool makers microscope) Suggested Readings: Importance of nano dimension, Importance of nano metrology MODULE 5: MEASUREMENT OF POWER, FLOW &TEMPERATURE RELATED PROPERTI Force, Torque, Power - Mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement:-Venturi, Orifice, Rotometer, Pitot tube. Temperature: Bimetallic strip, Thermometers, Thermocouples, Electrical resistance Thermister. Practical component: Physical quantity measurement (LVDT calibration, load cell, strain measurement, torque measurement etc) Suggested Readings: Errors in temperature measurement, testing quality assurance sciences using Matlab TEXTBOOKS 1. Richard S Figliola, Donald E Beasley. (2014). Theory and Design for Mechanical	(9L+6P) CO-4 BTL-6 ES (9L+6P) CO-5 BTL-6
MODULE 4: LASER AND ADVANCES IN METROLOGYPrecision instruments based on laser-Principles- Laser Interferometer-application in linear, angular measurements and machine tool metrology Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection.Practical component: Coordinate measurement(vision based measurement, tool makers microscope)Suggested Readings: Importance of nano dimension, Importance of nano metrologyMODULE 5: MEASUREMENT OF POWER, FLOW &TEMPERATURE RELATED PROPERTI Force, Torque, Power - Mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement:-Venturi, Orifice, Rotometer, Pitot tube. Temperature: Bimetallic strip, Thermometers, Thermocouples, Electrical resistance Thermister.Practical component: Obysical quantity measurement (LVDT calibration, load cell, strain measurement, torque measurement etc)Suggested Readings: Errors in temperature measurement, testing quality assurance sciences using MatlabTEXTBOOKS1.Richard S Figliola, Donald E Beasley. (2014). Theory and Design for Mechanical Measurements, 6th Edition, Wiley India	(9L+6P) CO-4 BTL-6 ES (9L+6P) CO-5 BTL-6

1.	Graham T.Smith. (2016). <i>Machine Tool Metrology: An Industrial Handbook,</i> 1 st ed. Kindle Edition
2	N V Raghavendra and Krishnamurthy. (2013). Engineering Metrology and Measurement, Oxford
Ζ.	University Press.
E BC)OKS
1.	https://www.bbau.ac.in/dept/UIET/Study%20MAterials%20for%20EME-403.pdf
MO	oc
1.	https://www.mooc-list.com/course/internet-measurements-hands-introduction-fun
2.	https://www.classcentral.com/course/swayam-engineering-metrology-14037

COURSE TITLE	со	CONTROL SYSTEMS						
COURSE CODE	MHB4304	COURSE CATEGORY	PC	2-1-2-2				
Version	1.0	Approval Details	Approval24 ACM,LEARNINDetails30.05.2018LEVEL		BTL-3			
ASSESSMENT SCHEME								
First Periodical Assessment	First Second Periodical Practical Assessment ESE iodical Assessment ESE							
15%	15%	20% 50%						
Course Description	Control system is designed to provide a clear concept of system analysis based on various aspects. This course gives theoretical and practical exposure for the students to understand open loop and closed loop, modelling, controller design, stability analysis and design of compensators suitable for system. This course is very essential as it works towards controller and the automation. If finds its role in academic, industry and research.							
Course Objective	 The course will enable the students to understand: 1. Analyse and model the systems to derive its transfer function 2. Study about time and frequency domain analysis using mathematical equations and response. 3. Provide adequate knowledge on the concept of stability of control system and methods of stability analysis 4. Explore various methods of designing compensators for the control system. 							
Course Outcome Prerequisites:	 S. Learn the designing of controllers and its application Upon completion of this course, the students will be able to 1. Describe various input/output models of dynamic system 2. Use frequency domain descriptions for dynamic analysis 3. Explain the concept of stability and effect of feedback control on sensitivity 4. Apply the basic methods of classical control system design such as root locus and phase lead-lag compensation based on Bode plots 5. Apply the principles of control theory 							

Transforms.									
CO, PO AND PSO MAPPING									
CO PO- PO- PO- PO- 1 2 3 4 5	РО- 6	РО- 7	РО- 8	РО- 9	PO- 10	РО- 11	PO- 12	PSO-1	PSO-2
CO-1 3 3 3 1	1	1	1	2	2	1	1	2	3
CO-2 3 3 3 3 3	1	1	1	2	2	1	1	2	3
CO-3 3 3 3 3 3	1	1	1	2	2	1	1	2	3
CO-4 3 3 3 3 3	1	1	1	2	2	1	1	2	3
CO-5 3 3 3 3 3	1	1	1	2	2	1	1	2	3
1: Weakly related, 2: Moderately relate	ed and	3: Str	ongly r	elated	l				
MODULE 1: SYSTEMS AND THEIR REPRI	ESENT	ATION						(9L+6	P)
Basic elements in control systems – open and closed loop systems Examples – Mathematical model, Translational & Rotational systems – transfer function – block diagram reduction techniques – signal flow graph. Practical component: Solving transfer function of Mass, Damper and Spring Systems. Suggested Readings: Differential Equations, Laplace Transforms MODULE 2: TIME RESPONSE Definition of Metrology - Linear measuring instruments: Vernier, Micrometer, internal measurement, Slip gauges and classification, Interferometery, optical flats, limit gauges-Comparators: Mechanical, pneumatic and electrical types, applications. Angular measurements: Sine bar, optical bevel protractor, angle Deckkor – Taper measurements							- 6P) nternal auges- .ngular ments	CO-1 BTL-3	
PID controller Suggested Readings: Error analysis, Controller Design and analysis.									
MODULE 3: FREQUENCY RESPONSE AN	ALYSIS	S AND	DESIG	N			(9L+	-6P)	
Introduction to Performance specifications – correlation to time domain specifications – Bode plots and polar plots – gain and phase margin – constant M and N circles and Nichols chart – all pass and non-minimum phase systems. Practical component: Bode & Nichols plot. Suggested Readings: Erequency Domain characteristics and Analysis							– nols	CO-3 BTL-3	
MODULE 4: STABILITY OF CONTROL SYS	STEMS						(9)L+6P)	

Charact root loo criterio Practic Methoo Sugges Stability	teristic equation – location of roots in s-plane for stability – Routh Hurwitz criterion – cus techniques – construction – gain margin and phase margin – Nyquist stability n. al component: d of Frequency analysis ted Readings: analysis of Systems.	CO-4 BTL-3
MODU	LE 5: COMPENSATION DESIGN (9L+6P)	
Design and fre probler Practic Design Sugges Cascade	concepts – realization of basis compensation – cascade compensation in time domain quency domain (simple MATLAB applications to analysis and compensators design ns.) al component: of Lead-Lag Compensator. ted Readings: e system, Compensator Design	CO-5 BTL-3
TEXT B	OOKS	
1	Katsuhiko Ogata. (2010). <i>Modern Control Engineering,</i> 4 th Edition, Pearson Education (I 7808-579-8)	SBN 81-
2	Gopal M.(2012). Control System Principles and Design, Tata McGraw-Hill	
REFERE	INCE BOOKS	
1.	Dorf R.C. and Bishop R.H. (1995). <i>Modern Control systems,</i> Addison – Wesley (MATLAE reference)	3
2.	Leonard N.E. and William Levine. (1995). Using MATLAB to Analyze and Design Control Systems, Addision Wesley.	
3.	Chesmond C.J. (1998). Basic Control System Technology, Viva Low Priced Student Edition	on.
4.	Datton K., Banaclough W. and Thompson S. (2000). <i>The Art of Control Engineering</i> , Add Wesley.	dison
MOOC		
1.	https://www.edx.org/course/introduction-control-system-design-first-mitx-6-302-0x	
2.	https://onlinecourses.nptel.ac.in/noc17_ee12/preview	

COURSE								
TITLE	HYDR	AULICS AND PNEUMATICS		CREDITS	3			
COURSE			DC	гтрс	2001			
CODE	101104303	COURSE CATEGORY	FC	L-1-F-3	3-0-0-1			
Vorsion	1.0	Approval Dotails	24 ACM,	LEARNING	RTI 2			
VEISION	1.0	Approval Details	30.05.2018	LEVEL	DIL-3			
ASSESSME	NT SCHEME							
First	Second Periodical	Seminar/ Assignments/	Attendanc	ECE				
Periodica	Assessment	Project	Test / Quiz	е	LJL			

Ass	l essm	n												
1	5%		15%			10)%		5	%	5	%		50%
Cor Des c	urse cripti on	power, using pressurized fluids. Both liquids and gases are considered fluids. Fluid power is the muscle of the industry used to push, pull, regulate, or drive virtually all the machines of modern industry. In fact, it is almost impossible to find a manufactured product that hasn't been fluid powered in some way at some stages of its production or distribution. Currently, a revolutionary change has taken place in the field of fluid power technology due to the integration of electronics as a control medium for fluid power components and systems. Due to the increased sophistication of fluid power and allied fields of engineering, the fluid power-driven machines are now able to generate more power and higher accuracy in speed, force, and position control. Hence this course is essential in engineering and technology to cope in modern industry to tackle a variety of problems and search for better solutions in power transmission and control. The course will enable the students to understand the:												
Co Obje	urse ective	The contract of the contract o	 The course will enable the students to understand the: Terms and the concepts of governing equations of fluid power Working principle of the sources of fluid power and their symbols Underlying principle of hydraulic and pneumatic system components, symbols and use Various operations using basic and simple circuits Terms of servo mechanism, troubleshoots and analyze 											
Col	urse come	 Terms of servo mechanism, troubleshoots and analyze Upon completion of this course, the students will be able to Explain the fundamental theoretical concepts of governing fluid power. Comprehend sources of fluid power through (pumps, compressors)their use, symbols and their performance characteristics. Illustrate common hydraulic and pneumatic system components (actuators, valves, etc.,) their functions, use and symbols. Familiarize the operation of basic circuits for directional, speed, pressure, force and flow control. Explain servo mechanism, troubleshoots and analyze 												
Prer	equisites: -nil													
СО,	PO ANI	20 AND PSO MAPPING												
со	РО- 1	РО- 2	РО- 3	РО- 4	РО- 5	РО- 6	РО- 7	РО- 8	РО- 9	РО- 10	РО- 11	РО- 12	PSO -1	PSO-2
CO -1	3	3	-	-	1	-	-	-	-	-	-	2	2	-
CO -2	3	3	-	-	1	-	-	-	-	-	-	2	2	-

CO -3	3	3	-	-	1	-	-	-	-	-	-	2	2	-
CO	3	3	-	-	2	-	-	-	-	-	-	2	2	-
CO														
-5	3	3	-	-	2	-	-	-	-	-	-	2	2	-
1: W	/eakly	related	, 2: Mo	derate	ly relat	ed and	3: Stro	ongly re	lated					
MO	DULE 1	: INTR	ODUCT) FLUID	POWE	R				(9L)			
Intro	oductio	on to fl	uid po	wer, A	dvanta	ges of	fluid p	ower, A	Applica	tion of	fluid p	ower		
system. Types of fluid power systems, Compressibility and incompressibility of														
fluids-Stagnation states, Mach waves and Mach cone - Effect of Mach number on										er on				
compressibility – Isentropic flow through variable ducts –Nozzle and Diffusers. Ideal											. Ideal		CO-1 BTL-2	
Gas equations - Applications of Pascal's Law – Laminar and Turbulent flow–Reynolds											nolds		BTL-2	
number – Darcy's equation – Losses in fluid power system.														
Suggested Readings:														
Applications of Pascal's Law											(01)			
MO	DULE 2	SOUF		F FLUID	POWE	:R				<u> </u>			(9L)	
Basi	cs of H	-lydrau	lics –Pi	roperti	es of r	iydraul		ls -Sou	irces o	f Hydr	aulic P	ower-		
comparison of numps. An overview of Basic hydraulic system, Basics of Phoumatics														
comparison of pumps. An overview of Basic hydraulic system. Basics of Pneumatics -														
Con	structi	bi coli bac ac	workin	eu all-	moros	s or Do	rform	nco of	compr					
	lasic n		workin	tom. (Compa	rison d	of num	n and	comp	ressor		nd for		CO-2
	nresse	d air o	onditio	ning –	nneun	natic d	rver –	Filter i	regulat	or and	lubric	ator –		BTL-2
fluid		er accu	mulato	ors – pi	urpose	and ty	vpes.	Distrib	ution o	of Fluid	h nowe	r and		
safe	tv mea	sures					/							
Sugg	, gested	Readir	ngs:											
Distribution of Fluid power and safety measures.														
MODULE 3: COMPONENTS OF HYDRAULIC AND PNEUMATIC SYSTEMS									(9L)					
Fluid power actuators - selection of actuators – pneumatic and hydraulic actuators –									tors –					
type	s and	ISO sy	mbols	– linea	ar and	rotary	. Cons	tructio	n and	workir	ng of d	ouble		
acting cylinder – special actuators – rodless, tandem, impact, duplex and telescopic														
cylir	cylinders types of actuating mechanism. Sensors -limit switches, reed switches								itches					
and	pressu	ire swit	ches C	ushion	ing me	chanisı	n in pr	neumat	ic and	hydrau	ılic cyliı	nders.		CO-3
Con	trol va	lves – t	types o	of valve	s .Cons	structio	on and	workin	g of co	ontrol v	valves -	3/2,		BTL-3
4/2	, 5/3	and 4	/3 Dire	ection o	control	valve,	flow	contro	l valve	, classi	ificatio	n and		
wor	king of	pressu	ire cont	trol val	ves ,se	quenci	ng and	relief v	alve.					
Sugg	gested	Readir	ngs:											
Арр	licatior	ns in Lo	w cost	autom	ation									
MO	DULE 4	: DESIC	GN OF I	HYDRA	ULIC A	ND PN	EUMAT		CUITS				(9L)	

Desi linea met hydr Desi Mul	gn of simple hydraulic and pneumatic circuits-Speed and force calculation of ar actuator. Design considerations of pneumatic and hydraulic circuits .meter in, er out and counter balancing circuits. Design of multi cylinder pneumatic and raulic sequencing circuit. Fluidics–Introduction to fluidic devices, simple circuits. gn of simple Electro pneumatic and Electro-hydraulic circuitslocation.Design of ti cylinder electro pneumatic and electro-hydraulic circuits – ladder diagram.	CO-4 BTL-2
Con	flict signals – identification of conflict signal. Cascading method – step counter	
met	nod, Karnaugn-Veitch method and combinational circuit design.	
Ann	lications of Logic Gates in Low cost automation	
MO	DULE 5: SERVO MECHANISM AND ELEXIBLE MANUFACTURING SYSTEM	(9L)
Serv	o systems – Hydro Mechanical servo systems. Electro hydraulic servo systems	()=/
and	proportional valves. Pneumatic PID circuits. PLC applications in fluid power	
cont	rol, ladder diagrams, Timers and counters .Low Cost Automation using	CO-5
pne	umatics and Flexible manufacturing system. Fluid power circuits; failure and	
trou	bleshooting maintenance.	BTL-2
Sugg	gested Readings:	
Failu	are and Troubleshooting maintenance	
TEX		
1.	Anthony Esposito. (2013). Fluid Power with application, Prentice Hall.	
2.	MajumdarS.R. (2009) Oil Hydraulics, Tata McGraw-Hill, New Delhi.	
3.	Anderson, J.D. (2003) <i>Modern Compressible flow</i> , 3 rd Edition, McGraw Hill.	
REFI	RENCE BOOKS	
1	Mariano Carreras, (2012), A text book of Basic Pneumatics, SMC Pneumatics.	
2	Mariano Carreras, (2012), A text book of Electro Pneumatics, SMC Pneumatics.	
3	Harry Stevart.D.B. (1976). Practical guide to fluid power, Taraoealasons and Port	Ltd. Broadey.
4	Michael J, Prinches and Ashby J. G. (1989). Power Hydraulics, Prentice Hall.	
E BC	DOKS	
1.	https://www.hydraulicspneumatics.com/learning-resources/ebooks/article/2188	<u>83632/fluid-</u>
MO		
1	https://nptel.ac.in/courses/112/106/112106300/	
2	https://nptel.ac.in/courses/112/105/112105046/	

COURSE TITLE	В		S	CREDITS	3
COURSE	GEA4304	COURSE	PC	L-T-P-S	3-0-0-1

СС	DDE				CA	TEGO	RY									
Ver	rsion		1.0		Appr	oval D	etails	2 30 th	4 ACM May 2	l, 018	LEAR LE\	NING /EL		BTL-2		
ASSI	ESSME	NT SCH	IEME													
Fi Peri Asso e	irst odica I essm ent	Secor As	nd Perio sessme	odical ent	S Ass	eminaı ignmeı Project	r/ nts/ t	Surj	orise Te Quiz	est /	Atten	idanc e		ESE		
1	5%		15%			10%			5%		59	%	50%			
Co Des	urse cripti on	Busin organ quant	usiness economics assesses certain factors impacting corporations—business ganization, management, expansion, and strategy—using economic theory and uantitative methods.													
Co Obje	urse ective	The co 1. F 2. [3. F 4. E 5. L	 Familiarize the students with the basic concept of economics Describe the demand and supply analysis in business applications Familiarize students with the production and cost structure under different stages of production. Explain the pricing and output decisions under various market structures. Learn and apply the various decision tools to understand the market structure. 													
Cor Out	urse come	Upon 1. 2. 3. 4. (5.	compl Describ Perforr Describ Compre Describ	etion o pe basic n simpl pe cons ehend t pe finan	f this c conce cost umer's the con	ourse, pts of E analysi and pr nponer rvices	the stu Enginee s roducei nts of b	dents v ering eo r's beha oudget	will be a conomi avior	able to cs						
Prer	equisit	es: NIL	-													
СО,	PO AN	D PSO	MAPPI	NG												
со	PO - 1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	РО - 10	PO- 11	PO- 12	PSO- 1	PSO-2		
CO -1	1	2	-	2		-	-	-	-	-	2	-	2	-		
CO -2	-	-	-	-	2	-	-	-	2	2	2	-	2	-		
CO -3	-	1	2	-	-	-	-	-	3	3	2	-	2	-		
CO -4	2	2	-	2	-	-	-	-	-	-	2	-	2	-		

CO -5	1	2	3	-	-	-	-	-	-	-	2	-	2	-
1: W	/eakly	related	l, 2: Mo	oderate	ely rela	ted an	d 3: Stı	rongly	related					
MO	DULE 1	: INTR	ODUCT		ECON	OMICS	5					(9L)		
Intro	oductio	n to l	Econon	nics- F	low in	an eo	conomy	, Law	of su	pply a	nd der	nand,		
Con	cept of	f Engir	neering	Econo	mics -	- Engin	eering	efficie	ncy, Ed	conomi	ic effic	iency,		CO 1
Scop	oe of er	ngineer	ring eco	onomic	s									
Suggested Readings:												DIL-2		
Economics, Engineering Economics														
MODULE 2: COST ANALYSIS									(9L)					
Туре	es of (Cost, E	lemen	t of co	osts, N	1argina	l cost,	Marg	inal Re	venue	, Sunk	cost,		
Орр	ortunit	y cost,	Break	even a	nalysis,	Econo	mies o	f Scale	Cost Cl	assifica	ation			CO-2
Sugg	gested	Readir	ngs:											BTL-2
Cost impacts.														
MO	DULE 3	: CONS	SUMER	'S AND	PROD	UCER'S	BEHA	VIOR					(9L)	
Consumer Behaviour: Law of Diminishing Marginal utility – Equimarginal Utility -											ility –			
Consumer's Equilibrium - Indifference Curve – Production: Law of Variable											riable			
Proportion – Laws of Returns to Scale – Producer's equilibrium – Economies of Scale										Scale	CO-3			
Cost Classification											BTL-2			
Sugg	gested	Readir	ngs:											
Proc	luct Ide	entifica	ition, C	onsum	er cost	S								
MOI	DULE 4	: BUDO	GET										(9L)	
Proc	ess of	budge	eting in	India	–classi	ficatio	n of bu	udgets	trends	– eva	luation	l		
syste	ems –	types	of defi	cits –	fiscal p	olicy -	- indica	ators –	– taxat	ion –	centre,	,		CO-4
state	e and lo	ocal – p	oublic c	lebt an	d mana	agemer	nt.							BTL-2
Sug	gested	Readir	ngs:											
Reve	enue Cl	assifica	ation, C	Governi	ment s	pendin	g							
MOI	DULE 5	: FINA	NCE									(9L)		
Basi	cs of fi	inance	and fi	nancial	enviro	onment	t – inst	trumen	ts of f	inancia	I mark	ets –		
finai	ncial in	ter-me	ediatior	n – Inve	estmen	t bank	ing and	l broke	rage se	ervices	– secu	irities		
- ty	pes of s	securit	ies – m	arket f	or secu	irities -	- how a	and wh	ere tra	ded –	initial p			CO-5
offering (IPO) – secondary markets – trading on exchanges and trading with									with		BTL-2			
margins.														
Sugg	gested	Readin	igs:	nking	Dobi+	Cradit								
TEX			nce, ba	anking,	Debit,	creuit.								
1	S Shar	. nkaran	(2018) Rusir	ness Fr	onomir	s Mar	oham D	ublicat	ions				
1.	5.51101		. (2010	. Dusii			, iviai	Бнанг	ubiicat					
2.	H.L. A	huja, (2019),	Busines	ss Econ	omics -	– Micro	» & Ма	<i>cro,</i> Sul	tan Ch	and & :	Sons, N	lew De	lhi-55.
REFE	ERENCE	BOOH	٢S											

1	S.A.Ro	S.A.Ross, R.W.Westerfield, J.Jaffe and Roberts. (2019), Corporate Finance, McGraw-Hill.									
2	Josep	h E Stiglitz. (2000), Economics of the Public Sector.									
E BC	OKS										
1.	https://sites.google.com/site/readbookpdf7734/pdf-download-business-economics-by										
	markt	aylor-read-online									
MO	ос										
	1	https://www.edx.org/search?q=business									

COURSE TITLE		HYDR/	AULICS & PNEUMAT	ICS LAB	CREDITS	1							
COURSE CODE		MHB4334	COURSE CATEGORY	PC	L-T-P-S	0-0-2-0							
Version		1.0	Approval Details	24 ACM, 30.05.2018	LEARNING LEVEL	BTL4							
			ASSESSME	NT SCHEME									
	CIA ESE												
80% 20%													
	The purpose of this lab course is to teach fluid power technology. This technology deals												
	with the generation, control and transmission of power, using pressurized fluids. Both												
Course	liquids and gases are considered fluids. Due to the increased usage of fluid power and												
Descripti	all	allied fields of engineering, the fluid power – driven machines are now able to generate											
on	more power and higher accuracy in speed, force and position control. Hence, this course is												
	es	sential in engine	ering and technolog	y for giving better s	olutions in po	ower transmission							
	and control.												
	The course will enable the students to understand :												
Course	1.	1. The working of basiccomponents used in hydraulics & pneumatics circuits											
Objectiv	2.	2. The need to create meter in and meter out circuit											
e	3.	The need to de	monstrate speed cor	ntrol of pneumatic m	otor circuit								
	4.	The need to de	velop the circuit for	reciprocation of mul	tiple cylinders								
	5.	The componen	ts of FMS and troubl	eshoot.									
	U	pon completion	of this course, the st	udents will be able to	о 								
	1.	Control of actua	ators by simple hydra	aulic & pheumatic cir	cuits.								
Course	2.	Create and dem	ionstrate of meter in	and meter out circu	it.								
Outcome	3.	Demonstration	of hydraulic & ph	eumatic circuit for	speed contro	of hydraulic &							
		pneumatic mot	or.			a a Pada a							
	4. Develop the pneumatic circuit for sequence of operation using multiple cylinders.												
	5. Familiarize the components of Fivis and troubleshoot.												
Prerequisi	ites:	Nil											

со,	PO AN	ID PSO	MAPP	ING										
С	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PSO	PSO-2
0	1	2	3	4	5	6	7	8	9	10	11	12	-1	
C	3	3						2	2	-				
0-			-	-	-	-	-				-	2	2	-
	3	3						2	2			3	5	
0-	5	5	-	-	-	-	-	2	2		-			-
2												3	3	
С	3	3						2	2	1				
0-			-	-	-	-	-				-			-
3												3	3	
C	3	3						2	2	1				
0- 4			-	-	-	-	-				-	3	3	-
C	3	3						2	2	1			5	
0-	_		-	-	-	-	-				-			-
5												3	3	
			1: W	eakly r	elated,	2: Mo	derate	ly relat	ed and	3: Stro	ongly r	elated		
Μ	ODULE	1 – EX	PERIM	ENTS C	ON HYC	RAULI	CS & P	NEUMA	ATICS					(30P)
	1 Elow rate through the orifice										CO-1,2			
	1. Flow rate through the orifice										BTL-4			
	2. Sin	nulatio	n and i	nodeliı	ng of fl	ow, pr	essure	and te	mpera	ture of	fluid p	ower		
	sys	tem												CO-1.2
	3. (Lo	ops – I	Recursi	on usir	ng shift	registe	ers,loca	l and g	lobal v	ariable	string	s and		BTL-3
	file	I/O- st	ring m	anipula	ations ,	read a	nd wri	te text	in file a	and sea	arch str	ing in		
	file	arrays	- matri	x trans	lation ,	transf	ormatio	on and	rotatio	n)				
	4. Sin	nulatio	n of the	e perfo	rmance	e of the	comp	ressor						
														DIL-4
	5. Sin	nulatio	n of the	e perfo	rmance	e of the	e pump							BTI-4
														CO-3
	6. Sin	nulatio	n using	the Ap	plicati	on of p	ressure	e seque	ncing v	/alve				BTL-4
														CO-3
	7. Sin	nulatio	n using	the Ap	plication	ons of s	special	actuate	ors					BTL-3
	o c:		o of				:		1 :0	المربط ا	ulia ci			CO-3
	8. Simulation of sequencing of multi cylinder pneumatic and hydraulic circuits									Luits		BTL-4		
	9. De	sign an	d exec	ution o	fseque	encing	of mult	i cylinc	ler eleo	ctro pn	eumati	c and		CO-4
	ele	ctro hy	draulio	circuit	S									BTL-4
Virt	ual Lab	os												
1.	http:	//vlabs	.iitb.ac	.in/vlal	os-									

dev/vlab_bootcamp/bootcamp/COEP_KNOWLEDGE_SEEKERS/labs/exp1/theory.html

CO TI	URSE TLE		VIRTUAL INSTRUMENTATION LAB CREDITS											3		
	URSE DDE	N	1HB433	85	C/		E RY		РС		L-T-	-P-S	C)-1-3-2		
Vei	rsion		1.0		Appr	oval D	etails	2 30	24 ACM 0.05.20	l, 18	LEAR LEV	NING /EL		BTL 6		
ASS	ESSME	NT SCH	IEME													
						CIA								ESE		
						80%								20%		
Co Des	urse cripti on	The p with variou high progr	ourpose various us tool automa ammin	e of the s softw box re- ation c g tools	e modu are pla quired over th for de	ile is to atforms for be e netw velopin	o teach 5. LabV ginners vorks. 19 Fron	1 basic IEW pr 5 and a The co t end G	of virt ovides advance ntrol a iUI and	ual ins a rich ed lear ind fur backe	trumer set of rners to nction nd inte	ntation virtua o do si palette rpretat	system Il instru imple e provio tions.	ns available iments and exercises to de a lot of		
Co Obje	urse ective	 The course will enable the students to understand: 1. The basic concepts in virtual instrumentation 2. The hardware and software required for virtual instrumentation 3. The basic programming concepts in virtual instrumentation 4. The basics of interfacing sensor signal to systems 5. The need for virtual instrumentation in various automation systems Upon completion of this course, the students will be able to 														
Co Out	urse come	 Upon completion of this course, the students will be able to 1. Comprehend the concepts of virtual instrumentation 2. Discuss the architecture of LabVIEW 3. Write simple programs 4. Perform data acquisition using LabVIEW 														
Prer	equisit	es: Nil														
со,	PO AN	D PSO	ΜΑΡΡΙ	NG												
со	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	РО- 10	PO- 11	PO- 12	PSO- 1	PSO-2		
CO	3	3	-	1	1	1	1	2	2	1	1		_	-		
-1	3	3						2	2	1		5	5			
-2	-		-	1	1	1	1		_	_	1	3	3	-		
CO -3	3	3	1	1	1	1	1	2	2	1	1	3	3	-		
CO -4	3	3	1	1	1	1	1	2	2	1	1	L 3 3 -				
CO -5	3	3	1	1	1	1	1	2	2	1	1	3	3	-		
			1: We	eakly re	elated,	2: Mo	derate	y relat	ed and	3: Stro	ongly re	elated				
MO	DULE 1	-TUTO	RIAL										(16	L+14P)		

Basics and architecture of Virtual Instrumentation	CO-1,2
	BTL-1,2
MODULE 2 – LabVIEW PROGRAMMING	(30P)
1. LabVIEW simple program (Temperature conversion, calculator)	CO-1,2
	BTL-3
2. LabVIEW programming	CO-1,2
(Loops – Recursion using shift registers, local and global variable strings and file	BTL-3
I/O- string manipulations , read and write text in file and search string in file arrays-	
matrix translation , transformation and rotation)	
3. Simulate sine signal and display in time & frequency domain	CO-3
	BTL-3
Design LPF, HPF, BPF using LabVIEW	CO-3
	BTL-3
5. Math script interface in LabVIEW using Math script node	CO-3
	BTL-3
6. LabVIEW program to acquire and to generate signal using virtual DAQ	CO-4
	BTL-3
7. Data acquisition from different sensors like temperature, strain and	CO-4
Vibration	BTL-3
8. Acquire ECG signal using NI DAQ & display in LabVIEW	CO-4
	BTL-3
9. Perform GPIB port communication	CO-4
	BTL-3
10. Perform Image processing algorithms using VISION toolkit	CO-5
	BTL-3
11. Develop a DC motor control using NI hardware and software	CO-5
	BTL-3
12. Labview program to count and to display encoder signal	CO-5
	BTL-3
13. Design of PID Controller using LabVIEW	CO-5
	BTL-3
14. Real time sequential control of any batch process.	CO-5
	BTL-3
MATLAB ASSIGNMENTS	
1. Model a transformer using fundamental magnetic library blocks	
2. Nonlinear Transformer Characteristics	
3. Three-Phase Core-Type Transformer	
4. Operation of a forward converter.	
5. Single-Phase Asynchronous Machine - Voltage Control of Auxiliary Winding	
6. Implementaion of nonlinear inductor	
7. Implementation of a nonlinear inductor	
8. Variable Reluctance Actuator	
9. Custom Inductor (B-H Curve)	
10. Solenoid with Magnetic Blocks Parameterize a Permanent Magnet Synchronou	us Motor
Virtual Labs	

1.	http://iitg.vlab.co.in/?sub=61&brch=174
2.	http://202.3.77.143/virtuallab/

COU TI	JRSE TLE				DESIG	N PROJ	ECT III				CREDI	TS		1
COU	JRSE TLE				DESIG	N PROJ	ECT III				CREDI	TS		1
	JRSE DDE	N	ИНВ433	6	СС	OURSE C	CATEGO	RY	P	PC .	L-T	-P-S		0-0-2-0
Ver	sion		1.0		A	Approva	al Detai	ls	24 th 30.05	ACM, 5.2018	LEAR LE ^V	NING /EL		BTL-6
ASSE	SSMEN	IT SCHE	ME											
Fi Rev	rst view	Seco	ond Rev	/iew		Third I	Review		Pro	ject Rej Vo	port & \ oce	/iva		ESE
20	0%		30%			20	0%			30)%			
Co Des c	urse cripti on	This c and s emula execu	ourse kills aco ate a ty ition of	provide quired /pical p	es the s in earli professi esign m	tudent er cour onal de ethodo	signifi rse wor esign e blogy ar	cant de k. This nviron nd the	esign ex course ment. : manag	kperien e provic Simulat ement	ce and les an ions ai of the	builds exposu re to b design	on the re to te e used project	knowledge eamwork to both in the
Cor Obje	urse ective	The c 1. To p 2. To 3. To 4. To	ourse v o deve reparat o enab o enab o enab	vill ena elop si tion. le proje le stude le stude	ble the kills in ect ider ents to ents to	e stude doing ntificati work a work c	nts to u g litera ion and as team on deve	underst ature I execu N elopme	and: survey, tion of nt of h	, techı prelim ardwar	nical p inary w re	vorks o	ation in	and report
Cor Oute	urse come	Upon 1. l t 2. F	compl dentify hem fo Prepare	etion o a prol or majo e techn	f this c olem, c r proje ical dra	ourse, lo surv ct wing, t	the stu ey, dev technic	dents velop r al repo	will be nethod rt and	able to lology a technic	and do cal pres	the sin	mulatic on	ons and use
Prere	equisite	25:												
CO, F	PO AND) PSO MAPPING												
	PO- 1	РО- 2	РО- 3	РО- 4	РО- 5	РО- 6	РО- 7	РО- 8	РО- 9	PO - 10	РО- 11	РО- 12	PSO -1	PSO-2
CO -1	3	3	2	2	3	2	2	3	3	3	3	3	3	3
со	3	3	2	2	3	2	2	3	3	3	3	3	3	3

-2														
1: W	1: Weakly related, 2: Moderately related and 3: Strongly related													
	NOTE													
	1	The st design the ins	udents and fa stitutior	in con Ibricatio n.	venient on. Ever	groups y proje	s of not ct work	t more shall h	than 4 ave a g	membo uide wł	ers have no is the	e to ide e meml	entify a per of t	product for he faculty of
	2	To de applica	velop a ations/S	a mech Systems	atronic	systen	n with	empha	sis on	electric	al drive	es (Act	uator) 1	for different
	3	The st workin parts o	udents ng apar drawing	are re t from s, proce	equired submit ess char	to de ting the ts relat	esign ar e projecting to fa	nd fabr t repor abricatio	icate t t. The i on.	he cho report s	sen sys should d	stem a contain	nd dem assemt	ionstrate its oly drawing,

SEMESTER VI

COURSE TITLE	SENSO	RS AND MOTION CONTROL	-	CREDITS	3
COURSE CODE	MHB4321	COURSE CATEGORY	РС	L-T-P-S	3-0-0-2
Version	1.0	Approval Details	24 th ACM, 30.05.2018	LEARNING LEVEL	BTL - 4
ASSESSME	NT SCHEME				
First Periodica I Assessm ent	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendanc e	ESE
15%	15%	10%	5%	5%	50%

CO TI	URSE TLE			SENSO	RS ANI	D MOT	ION CO	NTROI	L		CRED	ITS		3
Co Des	urse cripti on	Motic involv exten engin accur enabl Robor comp it use contr neces senso the ge desig actua emph struct	on conved in resively eering, acy of e move tics de uter sy es spectors and of to res and of to res and tors an inters and inters and inters an inters an inters and inters an i	trol is moving used i mover ement, als wit vstems cialized govern b be far actuat his cou dustria nd con on the nd mot	a sub- g parts in a v o manu ment a but, m for the equip its mo cors, sin cors, sin sors is t syste trol str fundar ion mo	field o of mad ariety ufactur re of v ore im design eir cont ment's otion. vith bri mulatic o intro ms. Th ructure nentals odes.	f autor chines i of fiel ing and vital im portan , const and r To des nging t on, pro duce the is count s of sen	mation, in a co lds for d prod portan tly, it e cruction hsory fi equires ign suc ogethe gramm ne mot rse pro ired fo	, encor ntrolled autor luction nce. No nsures n, oper eedbac s syste ch syste	mpassin d mani nation lines, ot only that a ration, ck, and m desi ems, as rols, kin nd mac ntrol co the bas ion con ral quar	ng the ner. A purpo where does a machir and us inform ign and s a me nematio hine do ncepts sic con ntrol s ntities,	systen motion pses, ir powe a motion e can se of r ation p d integ chatron cs, dyn esign a and co cepts o ystem actuate	ns or s contro ncluding er, efficion on con stop. For robots, process gration nics en amics, spects. ompone of sens design ors, driv	sub-systems of system is g precision ciency, and trol system or example, as well as ing. Hence along with gineer, it is electronics, Therefore, ents for the sors, drives, . The main ves, control
Co Obje	urse ective	The c 1. ⁻ 2. ¹ 3. 4. ¹ 5.	 The course will enable the students to understand the: 1. Term Motion Control and appreciate its use in Industries. 2. Working principle of various sensors, associate signal processing and its applications 3. Underlying principle of Drives, actuators and transmission mechanisms 4. Various motion profiles and control strategies applied in motion control 											
Co Out	urse come	 Upon completion of this course, the students will be able to 1. Comprehend various sensors and its characteristics 2. Identify and select suitable sensors for various mechatronic applications 3. Comprehend various drives, controls, transmission mechanisms and motion profiles of a motion control system 4. Design a simple motion control system for mechatronic applications 												
Prer	equisit	ites: NIL												
τυ,														
со	1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	10	11	12	1	PSO-2
CO -1	3	3	1 1 1 2 1 2 2 1 1 2 3 1											
CO -2	3	3	3	2	2	2	1	2	2	1	1	2	3	1

COU TI	JRSE TLE	SENSORS AND MOTION CONTROL CREDITS												3
со	3	3	3	2	2	2	1	2	2	1	1	2	3	1
-3														
со	3	3	3	3	3	2	1	2	2	1	2	2	3	2
-4														
1: W	eakly	related	l , 2 : Mo	oderate	ely rela	ted an	d 3: Stı	rongly	related					
MOI	DULE 1	: INTRO	ODUCT	ION TO	SENS	ORS		(6L)						
Intro	oductio	n –	Senso	rs and	d Tra	nsduce	rs –	Classi	ficatior	ι —	Perforr	nance		
Char	acteris	stics - C	alibrat	ion.										
Prac	tical co	ompon	ent: N	il										CO-1
Sugg	gested	Readin	igs:	und ite a	locifi	ation								BIT-3
	Vari Cali	lous se bratior	nsors a moth	nu its (ods and	ldssiii(h ctand	ation ards of	sonso	rc and t	rancdu	icors				
MO		: SENS	ORS FC		CE. PRI		E AND S	STRAIN			NS			(9L)
σνΤ	es. chai	racteris	stics. m	easure	ment t	echnia	ues an	ilaas b	cations	s of Fo	rce. Pre	essure		ι - <i>ι</i>
and	Strain	Senso	rs – St	rain Ga	auge, F	iezo e	lectric	sensor	, Force	e Sensi	tive re	sistor,		
load	cell, to	orque s	ensor		0,				,			,		
Prac	tical co	mpon	ent: Ni	I										CO-2
Sugg	ested	Readin	igs:											BTL - 4
	• Sig	nal Cor	ndition	ing witl	ו whea	t stone	e bridge	9						
	 Desitive 	sign of	Strain	Gauge	Load co	ell – Ca	ntileve	r type						
MO	DULE 3	: SENS	ORS FC	OR POS	TION,	VELOC	ITY AN	D TEM	PERAT	URE				(9L)
Туре	es, char	acteris	tics, m	easure	ment t	echniq	ues and	d applio	ations	Positio	on, Velo	ocity		
& Te	mpera	ture Se	ensors											
Prac	tical co	ompon	ent: Ni	I										CO - 2
Sugg	gested	Readin	igs:										I	BTL - 4
	 Sigr 	nal con	ditionir	ng for v	arious	tempe	rature	sensors	5					
•	Sigr	nal con	ditionir	ng syste	em des	ign for	positio	on and v	velocity	/ senso	ors			
MODULE 4 : MOTION CONTROL (9L)														
Introduction – components of a motion control system – sensors for motion control														
– dri	ves / a	ctuato	rs for n	notion	contro	– tran	smissic	on mecl	hanism	is – cor	ntrol de	vices		
Prac	tical co	ompon	ent: Ni	I										CO-3
Sugg	gested	Readin	igs:											BTL- 4
	• Stu	idy of E	Basic co	ontrol s	tructur	es and	loops	of a mo	tion co	ontrol s	system			
	• Stu	idy of A	AC serv	o and li	nductio	on mot	or Moc	lel						
MODULE 5: MOTION PROFILE, CONTROLLERS, AND APPLICATIONS										(1	.2L)			

COI TI	JRSE TLE	SENSORS AND MOTION CONTROL	CREDITS	3							
Mot	ion pro	files – position and velocity controls – Inner and Cascaded lo	oops – Pulse								
Width Modulation for DC motors, Servo Systems - Motion modes – linear, circular											
and											
– ma	aster sla		CO-3, CO-4								
Prac	tical co	mponent: Nil		BTL- 4							
Sugg	gested	Readings:									
•	Sim	ulation model for vector control of an AC Induction motor									
•	Sim	ulation model for vector control of an AC Servo motor									
TEX	TBOOK	S									
	Hakar	Gurocak. (2016). Industrial Motion Control – Motor selection,	Drives, Contr	oller tuning,							
	Applic	ations, John Wiley and Sons Ltd., pp.1 to 314									
	Natha	n Ida. (2014). Sensors, Actuators and their Interfaces, A multic	disciplinary in	troduction, SCI							
	TECH	Publications, pp. 1 to 119, 281-324.									
REFE	RENCE	BOOKS									
1.	Musa	Jouaneh. (2015). Fundamentals of Mechatronics, Cengage Lea	arning, 1 st edi [:]	tion.							
2.	Clarer	nce W. de Silva. (2016). Sensors and Actuators Engineering Sys	stem Instrume	entation, CRC							
	press.										
E BC	OKS										
1.	https:	//link.springer.com/book/10.1007/978-1-4302-6014-1									
MO	OC										
1.	https:	<pre>//ocw.tudelft.nl/course-lectures/5-motion-control/</pre>									
2.	https:	//nptel.ac.in/courses/108/108/108108147/									

COURSE TITLE	DESIGN (DESIGN OF MECHATRONICS SYSTEMS CRED										
COURSE CODE	MHB4322	COURSE CATEGORY	РС	L-T-P-S	2-0-2-0							
Version	1.0	Approval Details	24 th ACM, 30.05.2018	LEARNING LEVEL	BTL-3							
ASSESSME	NT SCHEME											
First Periodica I Assessm ent	Second Periodical Assessment	Practical Assessm	ient		ESE							
15%	15%	20%		50%								

Cou Dese c	urse cripti on	The constant	ourse i eering	s inten system	ded to s invol [,]	expos ving Ele	é the s ectrical	tudent , Mech	s to an anical a	integr and Co	ated a mpute	pproac r Engin	h to th eering.	e design of
Cou Obje	urse ective	The sp 1. 2. 3. 4.	Decific Intro Learr Appr Learr	objecti duce th real ti eciate o about	ves of t ne Mec me inte case str advan	he Cou hatron erfacin, udies o ced ap	urse en ics syst g and p n Data plicatic	able th em and process Acquis ons in N	e stude d syster contro ition ar lechati	ents to m mod ol nd con ronics	elling trol.			
Cor Oute	urse come	Stude 1. 2. 3. 4. 5.	nts wil Desc Mode Fami Perfc Apple proce	l be abl ribe the el simp liarize a prm sim y mech ess con	e to e differ le elect and out ople pro atronio trol	ence b tromec tine m ocess co cs conc	etweer hanica echatro ontrol a epts a	n tradit I syster onics pr applica nd algo	ional an ns roduct tions prithms	nd meo develo ; in fau	chatror pment ılt diag	nosis, 1	tem measur	ement and
Prer	equisit	AND PSO MAPPING												
	PU AN	PO 2 PO 2 PO 4 PO 5 PO 6 PO 7 PO 8 PO 9 PO - PO PO - PSO - PSO 2												
со	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	10	11	12	1	PSO-2
со -1	3	2	3	2	2	1	1	1	1	1	1	-	1	2
CO -2	3	2	3	3	3	1	1	1	1	1	2	-	1	3
CO -3	3	2	3	3	2	1	1	1	1	1	1	-	1	3
CO -4	3	3	3	3	2	1	1	1	1	1	1	-	1	3
			1: We	eakly re	elated,	2: Mo	deratel	y relat	ed and	3: Stro	ongly re	elated		
MO	DULE 1	: INT	RODU	CTION					(8L +	· 4P)			1	
Intro	ductio	n to M	echatr	onics s	/stem -	- Key e	lement	s – Me	chatro	nics De	esign pi	rocess		
– Ty	pes of hatron	Design icc M	– Trad	itional chino ii	and M	echatro o indu	onics de	esigns -	- Advai	nced a	pproac	hes in		
Suga	natron rested	Readin	an ma	chine ii	iteriac	e, mau	strial u	esign a	na erge	onormo	ls, sale	ty.		CO-1
HMI	in mar	nufactu	' 5∙ Iring											BTL-2
Case	Study													
Desi	gn for (ergono	mics, i	ntegrat	ed pro	duct de	evelopr	nent ca	ase stu	dy				
MO	DULE 2	: DATA	ACQU	ISITION	N AND	INTERF	ACING						(8L + 4	IP)
Real	Real-time interfacing – Introduction – Elements of data acquisition and control –													
Over	view o	of I/O p	rocess,	Analo	g signal	s, disci	rete sig	nals, a	nd Frec	quency	signals	5.		BTL-2
Sugg	gested	reading	g											-

Signal proce	ssing and feature selection	
Practical		
 Sign 	al processing for specific applications	
MODULE 3:	SYSTEM MODELLING	(8L + 4P)
Basic buildi	ng blocks of system modelling. Modelling of mechanical system-	
Modelling o	f mechanical and electrical systems. Electromechanical systems – Simple	
exercises in	linear, rotary motions	CO 3
Demonstra	ion	BTI 2
Modelling a	nd simulation of Mechatronics Systems, System identification	DIL-3
Practical		
 Mod 	elling of mechanical, electrical, electromechanical systems	
MODULE 4:	MEASUREMENTS – CASE STUDIES	(8L + 4P)
Case studi	es on Data Acquisition: Introduction – Cantilever Beam Force	
Measureme	nt system-Vibration and Sound Measurement - Strain gauge weighing	
system –Fo	prce-Displacement calibration system - Rotary optical encoder -	
Controlling	emperature of a hot/cold reservoir – pick and place robot.	CO-3
Suggested F	leading	BTL-2
Data acquis	tion for online monitoring	
Practical		
• Tem	perature, Vibration monitoring	
MODULE 5:	ALGORITHMS AND APPLICATIONS	(8L + 7P)
Advanced	applications in Mechatronics: Sensors for condition Monitoring -	
Mechatroni	c Control in Automated Manufacturing – Artificial intelligence in	
Mechatroni	cs – Fuzzy Logic Applications in Mechatronics	CO 4
Suggested F	leading	
AI applicatio	ons in Manufacturing	BIL-2
Practical		
• Simu	lation of AI based automation systems	
• Simu TEXT BOOK	lation of AI based automation systems	
Simu TEXT BOOK Devda	llation of AI based automation systems 5 sshetty, Richard A. Kolk. (2010). <i>Mechatronics System Design,</i> Thomson L	earning Publishing
Simu TEXT BOOK Devda Compa	llation of AI based automation systems 5 sshetty, Richard A. Kolk. (2010). <i>Mechatronics System Design,</i> Thomson L iny, Vikas publishing house	earning Publishing
• Simu TEXT BOOK 1 Devda Compa REFERENCE	llation of AI based automation systems 5 sshetty, Richard A. Kolk. (2010). <i>Mechatronics System Design</i> , Thomson L iny, Vikas publishing house	earning Publishing
• Simu TEXT BOOK 1 Devda Compa REFERENCE 2 W Bo	llation of AI based automation systems 5 sshetty, Richard A. Kolk. (2010). <i>Mechatronics System Design</i> , Thomson L any, Vikas publishing house ton. (2010). <i>Mechatronics - Electronic Control systems in Mechani</i>	earning Publishing cal and Electrical

COURSE TITLE		CNC TECHNOLOGY		CREDITS	4
COURSE CODE	MHB4323	COURSE CATEGORY	РС	L-T-P-S	3-0-2-3

Ve	ersion		1.0		A	pprova	al Detai	ils	24 th /	ACM, .2018	LEAR LE\	NING /EL		BTL-6	
ASSE	SSMENT	SCH	EME												
Per Asse	First riodical essment	I A	Secor Periodi ssessn	nd ical nent		Pra	ctical A	ssessm	nent				ESE		
	15%		15%			10)%		5	%			50%		
Co Des	ourse cription	This tool devi code	course s and ices en es. Wit	e woul proces nploye th ever	d intro ses. I d in CI y part,	oduce t t will o NC ma there y	the ide cover c chines, will be	a of Co classific 2D pr MCQ, t	ompute ation c ogrami utorial,	er Num of such ming a , proble	nerical mach nd inte em solv	Contro ine too erpolat ving an	ol (CNC ols, te ion us d discu	C) of machine chnology and sing G and M ussions.	
C Ob	ourse jective	The 1. 2. 3. 4. 5.	 The course will enable the students to understand the: Terms in the Computer Numerical Control Machines: Introduction and classification Working principle of various technologies and devices employed in CNC machines Underlying principle of the control systems, feedback devices used in CNC machines Various coding to develop 2D programming and interpolation Terms in troubleshoot and maintenance 												
Cu	ourse itcome	Upo 1. 2. 3. 4. 5.	n com Explair Familia Illustra Compr Descril	pletion the fuarize th te con ehend be trou	of this indame e techi trol sys the de iblesho	course ental th nologie tems, f velopm ot and	e, the sineoretions and constant of feedbar ment of mainte	tudents cal cond devices ck devi 2D pro enance	s will be cepts o emplo ces use gramm metho	e able t f Comp yed in o ed in CN ning an ds	to outer N CNC mac NC mac d inter	umeric achines hines polatio	cal con 5 n.	trol Machines	
Prere	equisites	-													
СО, Р	PO AND P	SO I	MAPPI	NG											
со	PO-1	Р О -2	РО- 3	РО- 4	PO-5	PO-6	PO-7	PO-8	PO-9	РО- 10	РО- 11	PO- 12	PSO -1	PSO-2	
CO -1	3	3	0	0	1	0	0	0	0	0	0	2	3	2	
CO -2	3	3	0	0	1	0	0	0	0	0	0	2	3	2	
CO -3	3	3	0	0	1	0	0	0	0	0	0	2	3	3	
CO -4	3	3	0	0	2	0	0	0	0	0	0 2 3 3				
CO	3	3	0	0	2	0	0	0	0	0	0	2	3	3	

1: Weakly related, 2: Moderately related and 3: Strongly related

-5

MODULE 1: FUNDAMENTALS OF MECHANICAL MEASUREMENTS AND CNC MACHINES	6 (9L+6P =15)
 Introduction to Computer Numerical Control: CNC Systems – An Overview of Fundamental aspects of machine control, Different types of CNC machines – Advantages and disadvantages of CNC machines. Practical component: Demonstration on mechanical measurements, measurement of cutting tool parameters, gear measurement. Suggested Readings: Difference between conventional machine and CNC machines 	CO-1 BTL-4
MODULE 2: CONSTRUCTIONAL FEATURES OF CNC MACHINES & RETROFITTING	(9L+6P =15)
 Features of CNC Machines: Structure, Drive Mechanism, gearbox, Main drive, feed drive, Spindle Motors, Axes motors. Timing belts and pulleys, Spindle bearing – Arrangement and installation, Slide ways, Re-circulating ball screws – Backlash measurement and compensation, linear motion guide ways. Tool magazines, ATC, APC, Chip conveyors, Retro-fitting of Conventional Machine Tools: Modification to be carried out on conventional machines for retrofitting. Practical component: Work setting and tool setting using tool holders, Setting the CNC machine and setting work reference Suggested Readings: Accessories of conventional machine and CNC machine 	CO-2 BTL-4
MODULE 3: CONTROL SYSTEMS, FEED BACK DEVICES AND TOOLING(9L)	
Description of a simple CNC control system, Interpolation systems, Features available in a CNC system – introduction to widely used CNC control systems. Types of measuring systems in CNC machines – Incremental and absolute rotary encoders, linear scale – resolver – Linear inductosyn – Magnetic Sensors for Spindle Orientation, Qualified and pre-set tooling – Principles of location – Principles of clamping – Work holding devices. Practical component: CNC coordinate systems Suggested Readings: Modern sensors for measuring systems in CNC machine	CO-3 BTL-3
MODULE 4: CNC PART PROGRAMMING	(9L+6P =15)
Part Program Terminology - G and M Codes – Types of interpolation Methods of CNC part programming – Manual part programming – Computer Assisted part programming – APT language – CNC part programming using CAD/CAM-Introduction to Computer Automated Part Programming. Practical component: Manual and computer assisted part programming for linear interpolation and circular	CO-4 BTL-2

interpolatio	n for milling machine operations and turning machine operations.									
Suggested F	Readings:									
Specification	ns of machines and control system.									
MODULE 5:	ECONOMICS AND MAINTENANCE	(9L+6P =15)								
Factors influ	encing selection of CNC Machines – Cost of operation of CNC Machines –									
Practical asp	pects of introducing CNC machines in industries – Maintenance features									
of CNC Mac	CO-5									
Practical co	BTL-2									
Programmir	DIL-2									
Suggested R	Readings:									
Troubleshoo	oting and Maintenance features of CNC machines									
техтвоокѕ	i									
1.	Mike Mattson. (2003). CNC Programming, Thomson Learning.									
2.	Radhakrishnan P. (2008) Computer Numerical Control Machines, New Ce	Radhakrishnan P. (2008) Computer Numerical Control Machines, New Central Book Agency.								
3.	Berry Leatham–Jones. (2006). Computer Numerical Control, Pitman, Lon	don.								
REFERENCE	BOOKS									
1.	YoreurKoren. (2008). Computer Control of Manufacturing Systems, Pitma	an, London.								
2	Groover, M.P. (1998). Automation, Production Systems and Co	mputer Integrated								
۷.	Manufacturing, Prentice Hall.									
3.	Hans B. Kief and T. Frederick Waters.(1998) <i>Computer Numerical Co</i> McGrawHill.	ontrol, Macmillan /								
моос										
1	https://nptel.ac.in/courses/112/105/112105211/									
2	https://www.classcentral.com/course/swayam-computer-numerical-com	ntrol-cnc-of-								
	Ingrume-roois-qua-blocesses-13322									

COURSE	INDUSTRIAL ELECTRONICS CREDITS 3										
TITLE											
COURSE	MUD/22/		DC	ітрс	2002						
CODE	WIND4524	COURSE CATEGORY	FC	L-1-F-3	3-0-0-5						
Version	1.0	Approval Dataila	24 th ACM,	LEARNING	DTI 2						
version	1.0	Approval Details	30.05.2018	LEVEL	DIL-3						
ASSESSMENT SCHEME											
First	Second Periodical	Seminar/ Assignments/	Surprise	Attendanc	ECE						
Periodica	Assessment	Project	Test / Quiz	е	LJE						

Ass	l essm													
e 1	5%		15%			10)%		5	%	5	%		50%
Co Des	urse cripti on	This c expose Course and i charae conve	This course is designed to provide students with an overview of the basic concepts and exposure to application oriented electronic circuits commonly used in the industries. Course deals with an introductory exposition of the semiconductor, operational amplifiers and integrated circuits for industrial applications, power semiconductor devices their characteristics and applications, digital and embedded systems, knowledge of inverters and converters. It also Involves related experiments for better understanding of the concepts.											
Co Obje	urse ective	 The specific objectives of the Course enable the students to 1. Familiarize the basic concepts of semiconductor devices, configuration and its applications 2. Analyse and develop an operational amplifier for application based circuits 3. Introduce the principle and protocols of digital systems and 8085 programming 4. Study the working of triggering devices like BJT, FET, SCR & IGBT and its characteristics 5. Determine the performance parameters of controlled rectifiers and AC voltage controller. Upon completion of this course, the students will be able to 												
Cour Out Prer	rse come requisit	 Summarize the semiconductor devices and its applications Design operational amplifier circuits. Use the digital systems, protocols and program 8085 in assembly language Evaluate the dynamic and switching characteristics of power semiconductor devices Analyse the inverters and converters for DC and AC 												
CO,	PO AN	D PSO	MAPPI	NG										
со	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	РО- 10	РО- 11	РО- 12	PSO- 1	PSO-2
CO -1	3	3	1	1	-	-	-	-	-	-	-	-	2	1
CO -2	3	3	3	2	1	-	-	2	1	1	-	-	2	2
CO -3	3	3	3	3	3	-	-	2	2	-	-	3	2	3
CO -4	3	3	3	3	3	-	-	1	1	1	-	-	2	3
CO -5	3	3	3	3	3	-	-	1	1	1	-	-	2	3
			1: W	eakly r	elated,	2: Mo	deratel	y relat	ed and	3: Stro	ngly re	lated		
MO	MODULE 1: SEMICONDUCTOR DEVICES AND APPLICATIONS (9L)													

Semiconductor materials- intrinsic and extrinsic types, Ideal Diode, PN junction diode, Zener diode and applications, Rectifier Circuits, Clipping and Clamping circuits, Bipolar Junction Transistors (BJTs)- Physical structure and operation modes, Active region operation of transistor, Transistor as an amplifier, Transistor as a switch: cut-off and saturation modes, Basic BJT amplifier configuration: common emitter, common base and common collector amplifiers. Practical component: PN junction diode, Zener Diode Suggested Readings: Special diodes and its applications	CO-1 BTL-2
MODULE 2: OPERATIONAL AMPLIFIER AND ITS APPLICATIONS(9L)	
Basic information on Op-Amps-Ideal operational amplifier- General operational amplifier stags and internal block diagram of IC 741-Characteristics-open and closed loop configurations, Practical op amp circuits- inverting amplifier, non - inverting amplifier, weighted summer, integrator, differentiator. Other applications of op-amps: instrumentation amplifier, active filters, Schmitt triggers, comparators Practical component: Practical op amp circuits, Applications of Op amp Suggested Readings: Oscillators and Multivibrators	CO-2 BTL-3
MODULE 3: DIGITAL SYSTEMS AND MICROPROCESSORS(9L)	
DACs and ADCs, memory devices (SRAM, DRAM, Flash, PLD's, ROM), microcomputer, microprocessor architecture (8085), digital communication standards. Practical component: 8085 programming Suggested Readings: Electronics with Microcontroller interface	CO-3 BTL-3
MODULE 4: POWER SEMI-CONDUCTOR DEVICES(9L)	
Study of switching devices, - Power Diodes, Power transistors, Power MOSFET, DIAC, TRIAC, IGBT - static characteristics and principle of operation, SCRs: Static and dynamic characteristics – two transistor analogy – gate characteristics. Practical component: Study of BJT, FET, SCR & IGBT characteristics Suggested Readings: Commutation techniques of SCR	CO-4 BTL-3
MODULE 5: INVERTERS & CONVERTERS (9L)	
Single phase and three phase inverters, Choppers: Basic principle – Classification, Basic Principle of Cycloconverters (schematic diagrams and wave forms only), Single	CO-5 BTL-3

pha	se AC voltage controllers (Analysis not required)							
Prac	ctical component:							
Stuc	dy of Inverter & Converter characteristics							
Sug	gested Readings:							
UPS	& SMPS							
TEX	T BOOKS	L						
1	Millman and Halkias. (2017). Integrated Electronics, 2 nd Edition, Tata McGraw-Hi	ll publishers.						
2	Ramesh Gaonkar. (2013). <i>Microprocessor Architecture, Programming & Applications with 8085,</i> 6 th							
2	Edition, Penram International Publishing							
REF	ERENCE BOOKS							
1	Reshid, M.H. (2011). Power Electronics – Circuits Devices and Application, 3 rd Ed	lition,Prentice Hall						
-	International, New Delhi.							
2	Philip T.Krein. (2016). <i>Elements of Power Electronics,</i> 2 nd Edition, Oxford Universi	ty Press.						
2	Ramakant. A. Gayakwad. (2001). Linear integrated circuits, 3 rd Edition, Prentic	ce – Hall of India,						
5	New Delhi							
4	P.S.Bimbra. (2006). <i>Power Electronics,</i> 3 rd Edition, Khanna Publishers							
MO	OC C							
1	http://nptel.ac.in/syllabus/112106179/							
2	http://www.nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Power%	620						
2	Electronics/New_index1.html							

COURSE TITLE	SENSORS AND	SENSORS AND MOTION CONTROL LABORATORY CREDITS 2									
COURSE	MHB4345	COURSE CATEGORY	РС	L-T-P-S	0-0-3-2						
Version	1.0	Approval Details	LEARNING LEVEL	BTL - 6							
ASSESSME	INT SCHEME										
Continuous Internal Assessment ESE											
	80% 20%										
	The goal of this Laboratory course is to expose the students to the field of industrial motion control where system design and integration plays a vital role. The students are										
Course	exposed to the bas	sic components of a motion	n control syst	em such as se	ensors, drives and						
Descripti	actuators, controllers and to relate the separately learnt topics to design simple motion										

	, , , , , , , , , , , , , , , , , , , ,
on	control applications. In this laboratory course, experiments are planned in two modules
	where, module 1 provides the hand on experience on use of sensors for applications of
	speed and position measurement. Module 2 provides a holistic view of the motion control

		applications by applying control strategies and programming drives to produce desired												
		motio	ons su	ch as l	inear,	rotary	in uni	- axial	and n	nulti a	xial, in	open	and c	losed loop
		respe	ctively	using	PLC's, /	AC (VFI	D) and	Servo d	drives.	As an c	outcom	ie of th	is labo	ratory, the
		stude	ents wi	ill have	e the a	ability	to pre	cisely	contro	comp	olex m	otions	in mu	Itiple axes
		enab	ling the	e desigr	n of Ind	ustrial	machir	ies.						
		The o	course	will en	able the	e stude	nts to u	ndersta	and the:					
-		1. To	erm M	otion C	ontrol	and ap	preciat	e its us	e in Inc	lustries	5.			
Cou	irse	2. Working principle of various sensors, associate signal processing and its applications												
Obj	ectiv	3. Underlying principle of Drives, actuators and transmission mechanisms												
е		4. V	arious	motion	profile	es and o	control	strateg	gies app	olied in	motio	n contr	ol.	
		5. D	esign a	simple	e single	and m	ulti-axi	s motic	on cont	rol syst	tem.			
		Upon completion of this course, the students will be able to												
		1. A	nalyze	the ch	naracte	ristics	of sen	sors a	nd do	ladder	r progr	ammin	g for	simple PLC
Cou	irse	a	pplicati	ions										
Out	come	2. D	evelop	the mo	otion co	ontrol	or Uni-	axial a	nd Mul	ti-axial	contro	ol applio	cations	
		3. A	nalyze,	apply	and	develo	o close	ed loop	o conti	rol app	olicatio	n usin	g moti	on control
		te	echniqu	les										
Prer	equisit	es: NIL	-											
CO	, PO A	ND PS	SO MA	PPIN	G									
С	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PSO	PSO-2
0	1	2	3	4	5	6	7	8	9	10	11	12	-1	
C	3	3	2	2	2	2	2	2	3	2	-	2	2	2
1														
C	3	2												
		3	3	3	3	2	2	2	3	2	-	2	3	3
0-		3	3	3	3	2	2	2	3	2	-	2	3	3
0- 2		3	3	3	3	2	2	2	3	2	-	2	3	3
0- 2 C	3	3	3	3	3	2	2	2	3	2	-	2	3	3
0- 2 C 0-	3	3	3	3	3	2	2	2	3	2	-	2	3	3
O- 2 C O- 3	3	3	3	3	3	2	2	2	3	2	-	2	3	3
O- 2 C O- 3	3	3	3 3 1: W	3 3 eakly r	3 3 elated,	2 2 2: Mo	2 2 derate	2 2 ly relat	3 3 ed and	2 2 3: Stro	- - ongly re	2 2 elated	3	3
0- 2 0- 3 MO	3 DULE 1	3 3 L – SEN	3 3 1: W SORS(3 3 eakly r 12 P)	3 3 elated,	2 2 2: Mo	2 2 derate	2 2 ly relat	3 3 ed and	2 2 3: Stro	- ongly re	2 2 elated	3	3
0- 2 0- 3 MO	3 P DULE 1 1. Fa	3 3 L – SEN	3 3 1: W ISORS(zation	3 3 eakly r 12 P) of vario	3 3 elated,	2 2 • 2: Mo sors	2 2 derate	2 2 ly relat	3 3 ed and	2 2 3: Stro	- ongly re	2 2 elated	3	3
O- 2 C O- 3 MO	3 DULE 1 1. Fa 2. Se	3 3 L – SEN amiliari ensor b	3 3 1: W ISORS(zation ehavio	3 eakly ro 12 P) of vario ur, calil	3 3 elated, bus sen	2 2 2: Mo	2 2 derate	2 2 ly relat	3 3 ed and	2 2 3: Stro	- ongly re	2 2 elated	3	3
0- 2 0- 3 MO	3 DULE 1 1. Fa 2. Se 3. M	3 3 L – SEN amiliari ensor b easure	3 3 1: W SORS(zation ehavio	3 eakly ro 12 P) of vario ur, calil of force	3 elated, bus sen bration	2 2 2 Sors ure and	2 2 derate	2 2 ly relat	3 3 ed and	2 2 3: Stro	- ongly re	2 2 elated	3	3
0- 2 0- 3 MO	3 DULE 1 1. Fa 2. Se 3. M 4. M	3 3 amiliari ensor b easure easure	3 3 1: W SORS(zation ehavio ement o	3 eakly re 12 P) of varic ur, calil of force of posit	3 elated, bus sen bration , press ion, ve	2 2 2 Sors ure and locity a erature	2 2 derate	2 2 ly relat	3 3 ed and	2 2 3: Stro	- ongly re	2 2 elated	3	3 3 CO-1

Suggested Readings:

Sensors for measurement of various physical quantities •

• Signal conditioning circuit design for sensors

• Ladder Programming for
MODULE 2: Motion Control (33 P)	
 6. Speed Control of Uni Axial System – Servo motors, Induction Motors 7. Simple Positioning Control of Uni Axial System – Servo Motor, Induction Motor 8. Modulo Positioning Control of Uni Axial System – Servo Motor 9. Linear Operation: GANTRY SYSTEMS – Multi Axial Control 10. Rotary Operation: Indexing Table 11. Integration and Real Time Applicationsusing Motion controller / PLC Suggested Readings: Introduction to Motion Controllers 	CO-2 and CO-3 BTL- 6
 Study of SEW EURODRIVE - MOVIDRIVE[®], MOVITRAC[®], MOVIFIT[®], 	
MOVIAXIS® motion controllers	
MATLAB ASSIGNMENT (SELF STODY)	
1. Visualize Sensor Coverage, Detections, and Tracks	
2. Optical Sensor Image Generation	
3. Collision Detection Using Line Sensor	
4. Measure Strain using an Analog Bridge Sensor	
5. Track and Follow an Object	
6. Tuning of a Digital Motion Control System	
7. Stepper Motor with Control	
8. Power Window Control Project	
9. Control Stepper Motor using Digital Outputs	
VIRTUAL LABS	
1. http://sl-coep.vlabs.ac.in/	
2. http://iitg.vlab.co.in/?sub=61&brch=174	

COURSE TITLE		DESIGN PROJECT IV			CREDITS	1								
COURSE CODE	MHB4346	COURSE CATEGORY		РС	L-T-P-S	0-0-2-0								
Version	1.0	Approval Details	24 30	4 th ACM, 0.05.2018	LEARNING LEVEL	BTL-6								
ASSESSME	NT SCHEME	СНЕМЕ												
First Review	Second Review	Third Review		Project Rep Vo	oort & Viva	ESE								
20%	30%	20%		30)%									
Course Descripti on	This course provide and skills acquired i emulate a typical p execution of the de	is the student signific in earlier course wor professional design en sign methodology ar	cant de k. This nvironi nd the i	sign experien course provic ment. Simulat management	ce and builds les an exposu ions are to be of the design	on the knowledge re to teamwork to e used both in the project.								

		The s	pecific	objecti	ves of t	he Cou	irse en	able th	e stude	ents to						
		1. T	o deve	elop sl	kills in	doing	litera	ature	survey,	techn	ical p	oresent	ation	and	report	
Со	urse	р	reparat	ion.		-					•					
Obje	ective	2. T	o enabl	e proje	ect ider	tificati	on and	execu	tion of	prelimi	nary v	vorks o	n			
-		3. T	o enab	le stude	ents to	work a	s team				•					
		4. T	o enabl	e stude	ents to	work o	n deve	lopme	nt of ha	ardwar	е					
		1. T	o ident	ify a pr	oblem,	do sur	vey, de	evelop	metho	dology	and d	o the si	mulati	ons a	nd use	
Со	urse	tł	nem for	major	projec	t		•		0,						
Out	come	2. Pi	repare	technic	al drav	ving, te	chnica	l repor	t and te	echnica	l prese	entatio	า			
Pror	eauisit															
1101	equisit	ites:														
со,	PO AN	O AND PSO MAPPING														
0	PO-1	PO-2	PO-3 PO-4 PO-5 PO-6 PO-7 PO-8 PO-9 PO- PO- PO- PSO- PSO-2													
									.03	10	11	12	1		50 2	
СО	3	3	2	2	3	2	2	3	3	3	3	3	3		3	
-1																
-2	3	3	2	2	3	2	2	3	3	3	3	3	3		3	
			1: W	eakly r	elated,	2: Mod	deratel	y relate	ed and	3: Stro	ngly re	lated				
				-			NC)TF								
		The s	tudent	s in con	venien	t grour	ns of no	ot more	• than 4	1 memł	hers ha	ave to i	dentify	/ a pr	oduct	
	1	for de	sign ar	nd fabri	cation	Fverv	nroiect	twork	shall ha	ive a gi	iide w	ho is th	e men	her o	of the	
						,	project						e men			
		tacult	faculty of the institution.													
	2	facult To de	y of the velop a	e institi mecha	ution. atronic	system	ı with e	empha	sis on e	lectrica	al drive	es (Actu	iator) f	or di	fferent	
	2	To de appliq	velop a	e institu mecha /Systen	ution. atronic ns.	system	n with e	empha	sis on e	lectrica	al drive	es (Actu	iator) f	or dif	fferent	
	2	To de applie	velop a velop a cations, tudents	e institu mecha /Systen s are r	ution. atronic ns. equire	system	with e	empha	sis on e	lectrica	al drive	es (Actu	ator) f	or di	fferent	
	2	To de applie The s	velop a cations, tudents	e institu mecha /Systen s are r e its wo	ution. atronic ns. equire rking a	system d to de	esign a	emphas and fal	sis on e oricate	lectrica the ch	al drive	es (Actu system The rea	ator) f	or dif	fferent	
	2	To de applie The s demc conta	velop a cations, tudents onstrate	e institu n mecha /Systen s are r e its wo mbly d	ution. atronic ns. equire rking a rawing	system d to de part fro	esign a om sub	emphase and falo mitting	sis on e pricate g the pr	lectrica the ch oject r arts re	al drive nosen eport. lating	es (Actu system The re to fabri	ator) f and port sh	or dif	fferent	

COURSE TITLE		COMPREHENSION		CREDITS	1
COURSE CODE	MHB4347	COURSE CATEGORY	РС	L-T-P-S	1-0-0-0
Version	1.0	Approval Details	LEARNING LEVEL	BTL-6	
ASSESSME	NT SCHEME				
First Po Asses Basic Scie	eriodical ssment nces (MCQ)	Second Periodical Assessment Core Engineering (MCQ)	Third Pe Asses Emergir (Preser	eriodical sment ng areas ntation)	ESE

2	0%		50%				30%					
Course Descripti on	This course i fundamenta students to o using approp	s designed to Is and also to categorize, pr priate techno	help the grasp the esent and logy.	Mechatro e ideas allie d communi	nics E ed to cate	ingineer their fie informa	ring studer eld of stud ation and t	nts to su y. It also to provi	ummor o facilit de solu	n up t ates ition	he the by	
Course Objective	To develop placements	the analyti	cal and	technical	skills	requi	red for c	ompeti	tive ex	kams	and	
Course Outcome	Upon compl 1. Comprel competi 2. Revise interviev	etion of this o hend any giv tive exam for all major w.	course, the ven probl Job, GAT subject	e students em relate E, IES etc. required	will k d to to	oe able mecha clear	to tronics er written	ngineeri exam	ng fiel and	d to to	face face	
Prerequisit	es:											

CO, PO AND PSO MAPPING

										PO-	PO-	PO-	PSO-			
СО	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	-6 PO-7 PO-		PU-6 PU-7		PO-9	10	11	12	1	PSO-2
СО	3	3	-	3	3	-	_	3	3	3	3	3	_	3		
-1	5							5	,)	5	,)		
СО	2	2	-	3	3	_	_	1	n	2	_	2	_	_		
-2	3						-	-	5	2	-	5	_	-		

1: Weakly related, 2: Moderately related and 3: Strongly related

NOTE

A student will have to appear for a MCQ Test and Comprehensive Viva-Voce examination covering all the subjects before a board of examiners.

SEMESTER VII

COURSE TITLE	NDT ANI	CONDITION MONITORI	NG	CREDITS	3
COURSE CODE	MHB4407	COURSE CATEGORY	РС	L-T-P-S	3-0-0-1
Version	1.0	Approval Details	24 th ACM, 30.05.201 8	LEARNIN G LEVEL	BTL-3
ASSESSMENT S	СНЕМЕ				
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendan ce	ESE

15%	,)		15%			10)%		5	%	5	%		50%
Cours Descrip	se tion	This c moni and s cours appli	course toring electic se also cations	intenc techni on of va elabor	led to ques p arious rates tl	introdu practice NDT te ne inte	uce va ed in ir echniq erdiscip	rious n ndustri ues an plinary	on-de: es. Thi d conc systen	structiv s cours lition n ns for e	ve test se inclu nonito engine	ing and udes th ring m ering t	d cond ne intro ethods esting	ition oduction 5. This
Cours Object	se ive	The s 1. T 2. T 3. T 4. T 5. T	pecific o intro o reco o knov o emp o knov	objec oduce t gnize t v the s athise v the c	tives o the cor the har ensors the int apabil	f the C ncepts dware and s terfaci ities of	course of ND aspec ignal c ng con f vario	enable T and c ts of ir onditic cepts t us mor	e the st conditionspection oning chroug	tudent on mo on h NDT g syste	s to nitorin metho ms	g ods		
Cours Outco Prerequi	se me sites: k	 5. To know the capabilities of various monitoring systems Students will be able to: Comprehend various techniques of condition monitoring and NDT methods and select the method for various defects flaws Arrange the instrumentation for Vibration Monitoring. Describe the materials and methods – UT, LPT, MPT, ECT and codes, standards, specifications. Interpret the results using different analysis methods Es: Knowledge in sensors and hardware 												
со, ро а	ND PS	O MAI	PPING											
со	РО- 1	РО- 2	РО- 3	РО- 4	РО- 5	РО- 6	РО- 7	РО- 8	РО- 9	РО - 10	РО- 11	РО- 12	PSO -1	PSO-2
CO-1	3	3	1	2	2	1	1	1	1	1	1	-	1	3
CO-2	3	3	2	2	3	1	1	1	1	1	2	-	1	3
CO-3	3	3	2	2	2	1	1	1	1	1	1	-	1	3
CO-4	3	3	2	2	2	1	1	1	1	1	1	-	1	3
		1:\	Weakly	relat	ed, 2: I	Moder	ately	related	and 3	: Stror	ngly re	lated		
MODULE	1: 1	NTRO	DUCTIO	DN					(9L)					
Outline: v diagnosis Optical a Suggeste Case Stud	ne: vibration analysis, performance analysis, temperature monitoring , Fault osis Introduction to various non-destructive methods- Visual Inspection, al aids, Applications. ested Reading: Study on selection of testing methods													
MODULE	2:	VIBRAT		IONIT	ORING	ì								(9L)

Use of ov Monitorir Suggeste Vibration	erall vibration level. Assessment of vibration severity. Frequency analysis, ng of bearing - Case study d reading monitoring of machine tools	CO-2 BTL-2
MODULE	3: LIQUID PENETRANT AND MAGNETIC PARTICLETESTING	(9L)
Physical p Emulsifial Demonst Liquid per	rinciples, procedure for penetrant testing, water washable, post – plemethods, Principle of MPT, procedure , Equipment , Applications r ation netrant testing	CO-3 BTL-3
MODULE	4: EDDY CURRENT TESTING	(9L)
Principles High sens Suggeste Fabricatio	, Instrumentation for ECT, Absolute - differential probes, Techniques – itivity Techniques, Applications d Reading on of simple EM sensors	CO-3 BTL-2
MODULE	5: ULTRASONIC	TESTING
(9L)		
Principle Equipmer Suggestee Study of L	Ultrasonic transducers ,Inspection Methods, Ultrasonic Flaw detection ht , Modes of display A- scan , B-Scan , C- Scan ,Applications d Reading Jltrasonic probes	CO-4 BTL-2
TEXT BOO	DKS	
1	Baldev raj, T Jeyakumar, M. Thavasimuthu. (2019). <i>Practical Non Destructive</i> Publishing House.	e Testing, Narosa
2	Amiya R. Mohanty .(2015). Condition Monitoring Principles and Practices, CF	RC Press, USA
REFEREN	CES	
3	Krautkramer. J. (1996). <i>Ultrasonic Testing of Materials</i> , 2nd Edition, Springer Publication, New York, 1996.	r Verlag
4	Peter J. Shull. (2003). Non Destructive Evaluation: Theory, Techniques and A Marcel	pplication,
Web Reso	ource	
1	https://www.nde-ed.org/index_flash.html	

COURSE TITLE	ROBOTICS AN	ID MACHINE VISION	SYSTEMS	CREDITS	4
COURSE CODE	MHB4408	COURSE CATEGORY	РС	L-T-P-S	3-1-0-2
Version	1.0	Approval Details	24 th ACM, 30.05.2018	LEARNING LEVEL	BTL- 4

ASSESSI	SSESSMENT SCHEME														
First Pe Asses	eriodica sment	al Se	econd I Asses	Period ssment	ical	Se Assi F	eminar gnmen Project	/ its/	Surp	rise Te: Quiz	st / µ	Attendar	ice		ESE
15	5%		1	5%			10%			5%		5%		Ę	50%
Cou Descr	urse fiption	Rol me Rol cor Rol the tas The tas fun fun visi dev visi env of kin alo	nechanical engineering, electronics engineering, computer science, and others. tobotics deals with the design, construction, operation, and use of robots, as well as omputer systems for their control, sensory feedback, and information processing. tobots are rapidly evolving from factory workhorses, which are physically bound to heir work-cells, to increasingly complex machines capable of performing challenging asks in our daily environment. The goal of this program is to introduce the hardware and programming concepts of ndustrial robots and their applications. Secondly, this course also introduces the undamentals of vision systems and image processing that could be used along with the obots. Therefore, this course provides the basic concepts and algorithms required to levelop mobile robots that act autonomously in complex environments integrating rision systems. The main emphasis is put on robot locomotion and kinematics, environment perception, vision system and motion planning. The lectures and exercises of this course introduce several types of industrial robots and their modelling, inematics, path planning, various image processing and machine vision techniques long with application of vision system in robots. The specific objectives of the Course enable the students to Learn the concents of robot kinematics												
Course C	Objecti	The 1. 2. 3. 4. 5.	e speci Learn Learn Learn Learn Learn	fic obje the co the pr the se methe the co	ectives oncept inciple ensors ods of oncept	s of the s of ro es of ro used i develo s of va	e Cours bot kir obot dr n robo oping s rious r	se enal nemati rives a ts. olution nachir	ble the cs. nd cor ns for l ne visic	e stude itrols. Robot o on and	nts to configu image	urations. process	ing te	echniq	lues
Course (Dutcon	Up 1. 2. 3. 4. 5.	 Learn the concepts of various machine vision and image processing techniques Upon completion of this course, the students will be able to Classify and discuss different robotic systems, their actuators, drives and controls. Infer, Interpret and Develop Kinematic solutions for robots. Classify, illustrate, and appreciate different gripping mechanisms and sensors for robotics. Discuss the role of machine vision techniques in robotics. Comprehend and discuss various image processing techniques in robotics 												
Prerequi	isites:	NIL													
со, ро А	AND PS	50 MA	PPINO	6		I	1								
со	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PS	0-1	PSO-2

CO-1	3	3	3	3	1	0	0	2	2	0	0	2	2	2			
CO-2	3	3	3	3	1	0	0	2	2	0	0	2	2	3			
CO-3	3	3	3	3	0	0	0	2	2	0	0	2	2	3			
CO-4	3	3	3	3	0	0	0	2	2	0	0	2	2	2			
CO-5	3	3	3	3	0	0	0	2	2	0	0	2	2	2			
	1: Weakly related, 2: Moderately related and 3: Strongly related																
	MODULE 1: INTRODUCTION														:12)		
Introdu	troduction to robotics - Basic Structure- Classification of robot and Robotic systems -																
laws of	aws of robotics – robot motions – workspace, precision of movement – Drives and																
Actuato	ctuators.																
Suggest	uggested Readings:																
•	Configurations of SCARA, PUMA 360, STANFORD arm																
•	 Various Mechanical, Electric, Hydraulic and Pneumatic Actuators used for Robotic 																
	various Mechanical, Electric, Hydraulic and Pneumatic Actuators used for Robotic Applications.																
	Applications. MODULE 2: KINEMATICS OF ROBO																
Introdu	ction.	Matr	ix Re	eprese	ntatio	n. Ro	obot	Trans	format	tions	- Hoi	mogene	eous				
transfor	matior	ı, —	Forwa	rd an	d Inv	, erse l	Kinema	atics -	Inve	rse K	inemati	cs – [ΣН				
Represe	entatio	n, Deg	enerad	y, dex	terity,	Basics	of Tra	jector	/ planr	ning.							
Suggest	ed Rea	dings:	:											CO-2			
•	Derive	kinen	natic s	olutio	ns of 2	2,3,4 a	and 6	DOF ro	botic	and w	rist cor	nfigurat	ions	BTL- 4			
	using [Denavi	t – Hai	rtenbe	rg Ma	trix.											
•	Derive	FK an	nd IK s	olutior	n for t	he 4 🛛	D.O.F (GANTR	Y Rob	ot con	sidering	g the AG	CME				
	Lead S	crew t	ransm	ission	directl	y coup	oled wi	th elec	tric m	otor in	1 X,Y, Z a	axis.					
MC	DULE	B: END	EFFEC	TORS	& SEN	SORS								(9L+3T=	12)		
Robot E	End Eff	ectors	: Туре	s of e	nd eff	ectors	– Me	chanic	al grip	pers -	- Types	of Grip	oper				
mechan	isms –	- Grip	per's f	force a	analysi	is – O	ther t	ypes o	of Grij	ppers	– Vacu	um cup	os –				
Magnet	ic Grip	pers -	- Adhe	esive (Grippe	rs — R	Robot	end ef	fector	inter	face – S	Sensors	for				
Robotic	s – Des	ign of	Two a	nd Thr	ee fing	ger me	chanic	al Grip	pers –	- Soft G	Grippers	.		CO-3			
Suggest	ed Rea	dings:												BTL-3			
•	Variou	s Actu	ators ι	used fo	or desi	gn of r	obotic	config	uratio	ns.							
•	Study	of Gra	sping N	Nodes	, Force	s, and	Stabil	ity									
•	Ultrase	onic, O	pto m	echani	ical an	d Sma	rt Tact	ile Sen	sors fo	or gripp	per desi	gn.					
MOD	OULE 4:	MAC	HINE V	ISION	AND I	MAGE	PROCE	SSING	i					((8L)		
Introdu	ction –	Imag	e proc	essing	Vs in	nage a	nalysis	s, imag	e Acq	uisitio	n, digita	al Imag	es –				
Samplin	g and	Quant	izatior	n – Ima	age de	efinitio	n, leve	els of (Compu	utation	. Data ı	reductio	on –	CO-4			
Window	ving, d	igital	conve	rsion.	Opera	ation of	on im	ages:	Segme	entatio	n — Th	reshold	ling,	BIT-3	BTL-3		

Connec	tivity, Noise Reduction, Edge detection, Segmentation, Region growing and Region	
Splittin	g -Mondic – Diadic – Spatial – Morphology – Binary Morphology and grey	
morpho	ology operations. Boundary detection – Hit and miss transform – Shape changing:	
Croppir	ng – resizing – pyramids – warping.	
Suggest	ted Readings:	
•	Various Image processing techniques used for object identification and detection.	
MOL	DULE 5: MULTIPLE IMAGES	(8L)
Object	recognition by features, Depth measurement, specialized lighting techniques.	
Segmer	ntation using motion – Tracking. Region Features: Classification – Representation –	
Descrip	tion - Line Features – Point features - Feature correspondence – Geometry of	CO-5
multiple	e views – Stereo vision – Structure and motion, interfacing with industrial robots,	BTI-3
Real tin	ne Image processing.	512 0
Suggest	ted Readings:	
•	Principles of Stereo Vision and its application in industrial robotics system.	
ТЕХТВС	DOKS	
1.	Saeed B. Niku. (2019). Introduction to Robotics: Analysis, Systems, Applicatio	<i>ns,</i> Wiley. <i>,</i> 3rd
	edition, pp. 1 to 324	
_	Mikell P. Groover, Mitchel Weiss, Roger N Nagel, Nicholas G Odrey, Ashish Dutta. (2017). <u>Industrial</u>
2.	Robotics: Technology, Programming, and Applications, McGraw-Hill Companies.,2	2 nd edition, 12 th
	Reprint, pp. 1 to 183.	
REFERE	INCE BOOKS	
1.	Davies, E.R. (2012). <i>Machine Vision: Theory, Algorithms, Practicalities</i> , Academic Pre 1 to 487	ess, London. pp.
n	Peter Corke. (2017). Robotics, Vision and Control: Fundamental Algorithms in MA	TLAB, Springer,
۷.	2 nd edition, pp. 1 to 683.	
2	K.S. Fu, R.C. Gonzalez, C.S.G Lee. (2017). Robotics, Control, Sensing, Vision a	nd Intelligence,
5.	McGraw-Hill Education, pp. 1 to 571.	
E BOOK	<s< td=""><td></td></s<>	
1.	https://robotacademy.net.au/lesson/principles-of-stereo-vision/	
моос		
1.	https://www.coursera.org/specializations/modernrobotics	
2.	https://nptel.ac.in/courses/107/106/107106090/	

COURSE TITLE	ARTIFICIAL INTE	LLIGENCE FOR MECH	ATRONICS	CREDITS	4	
COURSE CODE		COURSE			3-0-2-3	
	IVIND4409	CATEGORY	PC	L-1-P-3		

Vei	rsion			1	0		Appro	oval De	etails	24 ^t 30.0	^h ACM 05.201	, 8	LEARN LEVI	ING EL	BTL-4
ASSES	SMEN	r sc	HEME	1											
Fi Perio Asses	irst odical ssment	t	Seco A	ond I sses	Period sment	ical		Practi	cal Ass	essme	nt			ESE	
1	5%			1	5%				20%					50%	
Co Desci	urse ription	ı	a computer. The goal of this course is to understand how to make a mechatronics system to learn, plan, and solve problems autonomously using AI. In this course, we will study the most fundamental knowledge for understanding AI. We will introduce some basic search algorithms for problem solving, knowledge representation and reasoning, neural networks, and scheduling.												
Co Obje	urse ective		 The specific objectives of the Course enable the students to: 1. Provide the most fundamental knowledge to the students so that they can understand what AI is. 2. Enable the student to apply AI techniques in applications which involve perception, reasoning and learning 3. Provide a basic exposition to the goals and methods of various AI techniques 												
Co Out	urse come		Upon 1. A 2. lc 3. lc 4. D 5. A	i con inaly dent dent Desig	npletic vse the ify and ify and n Neu v SLAM	on of t buildi apply apply ral net	his cour ing bloc v prope v differe works i utomat	rse, the k of Ai r decis ent Sea for spe ic navij	e stude rtificial ion-ma urching ecific ap gation	nts wil Intellig king te algorit pplicati and pa	l be ab gence echniqu hms of ons th plar	le to les of <i>i</i> f Al in s nning ii	AI in sp specific n robot	ecific ap : applicat ics	plications tions
Prereq	luisite	s: M	HB42	20 -	- Statis	tics ar	nd Data	Analy	rtics						
CO, PC) AND	PSO	MAP	PIN	G										
со	PO -1	PO 2	- P	0 - 3	PO - 4	PO - 5	PO - 6	PO - 7	PO - 8	PO - 9	PO -10	PO - 11	PO -12	PSO -1	PSO -2
CO-1	3	3		-	3	-	1	1	-	2	1	-	2	-	3
CO-2	3	3		3	2	3	-	-	-	2	1	-	2	2	3
CO-3	3	3		3	2	3	-	-	-	2	1	-	2	2	3
CO-4	3	3		3	2	3	-	-	-	2	1	2	2	2	3
CO-5	3	3		3	2	3	-	-	-	2	1	-	2	2	3
			1: \	Wea	kly rel	ated,	2: Mod	eratel	y relate	ed and	3: Stro	ongly r	elated		
						Ν	NODUL	E 1:IN	rodu	CTION					(9L+6P)

perception - cognition - execution - applications CO-1 Practical component: CO-1 Case study on Intelligent system in Engineering BTL-2 Suggested Readings: Import the world MODULE 2: SEARCH (91+6P) Artificial Intelligence is ransforming the world (CO-2, 3 Artificial Intelligence in engineering - Applications - Tree search: Depth first, Breadth first, A* - Gradient Descent - Probabilistic Search CO-2, 3 Practical component: A* - Gradient Descent - Probabilistic Search BTL-4 3. Probabilistic search BTL-4 BTL-4 3. Probabilistic search Suggested Readings: GO-2, 3 How search engines use Al to power results (91+6P) Adversarial search - Optimal and imperfect decisions - Alpha, Beta pruning - Logical agents BTL-4 Practical component: CO-2, 3 Login Artificial neural unit - Pattern classification - feed forward network - learning - feedback network - multi layer perceptron Practical component: Design Neural network for . CO-4 1. Pattern classification feed forward networks - learning - feedback network - multi layer perceptron Practical component: CO-4 Design Neural network for CO-4	Artificial Intelligence in Engineering – Strong and Weak AI – Intelligence in Machines –	
Practical component: CO-1 Case study on Intelligent system in Engineering BTI-2 Suggested Readings: Image and the study on Intelligence is transforming the world MODULE 2: SEARCH (glt+6P) Artificial Intelligence in engineering – Applications – Tree search: Depth first, Breadth first, A* - Gradient Descent - Probabilistic Search Practical component: Apply searching algorithm for engineering applications CO-2, 3 I. Informed search BTI-4 3. Probabilistic search BTI-4 Suggested Readings: (glt+6P) Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents CO-2, 3 Practical component: CO-2, 3 Suggested Readings: BTI-4 Practical component: CO-2, 3 Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents BTI-4 Suggested Readings: BTI-4 Practical component: CO-2, 3 Representation of the world in Tesla BTI-4 MODULE 4: NEURAL NETWORKS (glt+6P) Artificial neural unit – Pattern classification – feed forward network – learning – feedback network – multi layer perceptron Practical component: Design Neural network fo	perception – cognition – execution – applications	
Case study on Intelligent system in Engineering BTL-2 Suggested Readings: (91-4692) How Artificial Intelligence is transforming the world (91-4692) Artificial Intelligence in engineering – Applications – Tree search: Depth first, Breadth first, (0-2, 3) A* - Gradient Descent - Probabilistic Search Practical component: Apply searching algorithm for engineering applications (0-2, 3) BTL-4 Dimformed search BTL-4 3. Probabilistic search BTL-4 Bougested Readings: (91-669) How search engines use Al to power results (91-669) MODULE 3: KNOWLEDGE AND REASONING (91-669) Adversarial search - Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents BTL-4 Practical component: CO-2, 3 I. Apply reasoning algorithm for decision making BTL-4 Suggested Readings: BTL-4 Representation of the world in Tesla (91-669) MODULE 4: NEURAL NETWORKS (91-469) Artificial neural unit – Pattern classification – feed forward network – learning – feedback network for CO-4 1. Prediction CO-4 BTL-3 3. Classification SUggested Readings:	Practical component:	CO-1
Suggested Readings: (91-6P) MODULE 2: SEARCH (91-6P) Artificial Intelligence in engineering – Applications – Tree search: Depth first, Breadth first, A* - Gradient Descent - Probabilistic Search CO-2, 3 Practical component: Apply searching algorithm for engineering applications CO-2, 3 A. Informed search BTI-4 BTI-4 3. Probabilistic search BTI-4 Suggested Readings: (91-6P) How search engines use Al to power results (91-6P) Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents BTI-4 Practical component: CO-2, 3 I. Apply reasoning algorithm for decision making BTI-4 Suggested Readings: CO-2, 3 Practical component: CO-2, 3 I. Apply reasoning algorithm for decision making BTI-4 Suggested Readings: BTI-4 Representation of the world in Tesla Ge1-6P) Artificial neural unit – Pattern classification – feed forward network – learning – feedback network – multi layer perceptron Ge1-6P) Praterical component: Design Neural network for ECO-4 I. Pattern classification Suggested Readings: BTI-3	Case study on Intelligent system in Engineering	BTL-2
How Artificial Intelligence is transforming the world (91+6P) MODULE 2: SEARCH (91+6P) Artificial Intelligence in engineering – Applications – Tree search: Depth first, Breadth first, A* - Gradient Descent - Probabilistic Search Practical component: Apply searching algorithm for engineering applications CO-2, 3 I. Informed search BTL-4 3. Probabilistic search BTL-4 Suggested Readings: (91+6P) How search engines use Al to power results (91+6P) Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents Practical component: Practical component: CO-2, 3 1. Apply reasoning algorithm for decision making BTL-4 Suggested Readings: BTL-4 Representation of the world in Tesla (91+6P) Artificial neural unit – Pattern classification – feed forward network – learning – feedback network – multi layer perceptron Practical component: Practical component: CO-4 BTL-3 Design Neural network for SU-60 SU-60 1. Pattern classification feed forward network – learning – feedback network – multi layer perceptron BTL-3 Practical component: CO-4 BTL-3 2	Suggested Readings:	
MODULE 2: SEARCH (91+6P) Artificial Intelligence in engineering – Applications – Tree search: Depth first, Breadth first, A* - Gradient Descent - Probabilistic Search Practical component: Practical component: CO-2, 3 Apply searching algorithm for engineering applications ECO-2, 3 . Informed search BTL-4 . Uninformed search BTL-4 . Uninformed search (O-2, 3) Bysterd Readings: (P1+6P) How search engines use AI to power results (P1+6P) Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents Practical component: Practical component: CO-2, 3 Apply reasoning algorithm for decision making BTL-4 Suggested Readings: BTL-4 Representation of the world in Tesla (P1+6P) Artificial neural unit – Pattern classification – feed forward network – learning – feedback network – multi layer perceptron Practical component: Practical component: CO-4 BTL-3 Design Neural network for BTL-3 1. Pattern classification Fordical in the pattern classification – feed forward network – learning – feedback network – multi layer perceptron Practical component: CO-4 Design Neural network for BTL-3 2. Prediction CO-4 3. Classification	How Artificial Intelligence is transforming the world	
Artificial Intelligence in engineering – Applications – Tree search: Depth first, Breadth first, Ar A* - Gradient Descent - Probabilistic Search Practical component: Apply searching algorithm for engineering applications . 1. Informed search . 2. Uninformed search . 3. Probabilistic search . Suggested Readings: . How search engines use Al to power results . MODULE 3: KNOWLEDGE AND REASONING (9L+6P) Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents . Practical component: . Apply reasoning algorithm for decision making BTL-4 Suggested Readings: . Representation of the world in Tesla . MODULE 4: NEURAL NETWORKS (9L+6P) Artificial neural unit – Pattern classification – feed forward network – learning – feedback network – multi layer perceptron . Practical component: . . Design Neural network for . . 1. Pattern classification . . 2. Prediction . . . 3. Classification . .	MODULE 2: SEARCH	(9L+6P)
A* - Gradient Descent - Probabilistic Search Practical component: Apply searching algorithm for engineering applications CO-2, 3 Apply searching algorithm for engineering applications BTL-4 2. Uninformed search BTL-4 3. Probabilistic search BTL-4 Suggested Readings: (91-6P) Adversarial search - Optimal and imperfect decisions - Alpha, Beta pruning - Logical agents CC-2, 3 Practical component: CC-2, 3 1. Apply reasoning algorithm for decision making BTL-4 Suggested Readings: BTL-4 Representation of the world in Tesla (91-6P) Artificial neural unit - Pattern classification - feed forward network - learning - feedback network - multi layer perceptron Practical component: Design Neural network for CO-4 BTL-3 1. Pattern classification Eep Learning and Neural Networks BTL-3 Suggested Readings: CO-4 BTL-3 Design Neural network for CO-4 BTL-3 3. Classification Suggested Readings: BTL-3 Deep Learning and Neural Networks graphs and networks - shortest paths - critical path analysis - critical path activity scheduling Practical component: CO-5 <td>Artificial Intelligence in engineering – Applications – Tree search: Depth first, Breadth first,</td> <td></td>	Artificial Intelligence in engineering – Applications – Tree search: Depth first, Breadth first,	
Practical component: CO-2, 3 Apply searching algorithm for engineering applications CO-2, 3 I. Informed search BTL-4 2. Uninformed search BTL-4 3. Probabilistic search Suggested Readings: How search engines use AI to power results (91+6P) Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents Practical component: Practical component: CO-2, 3 I. Apply reasoning algorithm for decision making BTL-4 Suggested Readings: Representation of the world in Tesla MODULE 4: INCURAL NETWORKS (91+6P) Artificial neural unit – Pattern classification – feed forward network – learning – feedback network – multi layer perceptron Representation of the world in Tesla Design Neural network for CO-4 BTL-3 I. Pattern classification EG-4 BTL-3 Suggested Readings: Design Neural Networks BTL-3 Suggested Readings: CO-4 BTL-3 Design Neural network for CO-4 BTL-3 Suggested Readings: Deep Learning and Neural Networks BTL-3 Suggested Readings: CO-4 BTL-3 Detais	A* - Gradient Descent - Probabilistic Search	
Apply searching algorithm for engineering applications CO-2, 3 1. Informed search BTL-4 2. Uninformed search BTL-4 3. Probabilistic search BTL-4 Suggested Readings: How search engines use AI to power results CO-2, 3 MODULE 3: KNOWLEDGE AND REASONING (9L+6P) Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents CO-2, 3 Practical component: CO-2, 3 1. Apply reasoning algorithm for decision making BTL-4 Suggested Readings: Representation of the world in Tesla CO-2, 3 MODULE 4: NEURAL NETWORKS (9L+6P) Artificial neural unit – Pattern classification – feed forward network – learning – feedback network – multi layer perceptron CO-4 Practical component: CO-4 BTL-3 2. Prediction BTL-3 3. Classification Edisplay 4. Practical component: CO-4 9. Prediction BTL-3 3. Classification BTL-3 Suggested Readings: GE CO-4 Deep Le	Practical component:	
1. Informed search BTL-4 2. Uninformed search BTL-4 3. Probabilistic search BTL-4 3. Probabilistic search GU-2, 3 Suggested Readings: How search engines use AI to power results (9L+6P) Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents CO-2, 3 Practical component: CO-2, 3 1. Apply reasoning algorithm for decision making BTL-4 Suggested Readings: Representation of the world in Tesla CO-2, 3 MODULE 4: NEURAL NETWORKS (9L+6P) Artificial neural unit – Pattern classification – feed forward network – learning – feedback network – multi layer perceptron Fractical component: Design Neural network for . CO-4 1. Pattern classification EC-4 3. Classification EC-4 Suggested Readings: Deep Learning and Neural Networks GU-4 Deep Learning and Neural Networks MODULE 5: SCHEDULING (9L+6P) Introduction – representation in scheduling – graphs and networks – shortest paths – critical path activity scheduling CO-5 In Devel	Apply searching algorithm for engineering applications	CO-2 3
2. Uninformed search BTL4 3. Probabilistic search Suggested Readings: How search engines use Al to power results (91+6P) Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents Practical component: CO-2, 3 1. Apply reasoning algorithm for decision making BTL4 Suggested Readings: Representation of the world in Tesla (91+6P) Artificial neural unit – Pattern classification – feed forward network – learning – feedback network – multi layer perceptron (91+6P) Practical component: CO-2, 3 CO-4 Design Neural network for 1. Pattern classification – feed forward network – learning – feedback network – multi layer perceptron Practical component: Design Neural network for 2. CO-4 BTL-3 2. Prediction 3. Classification BTL-3 3. Classification Suggested Readings: CO-4 Deep Learning and Neural Networks Sufficial networks – shortest paths – critical path activity scheduling Practical component: CO-5 Introduction – representation in scheduling – graphs and networks – shortest paths – critical path analysis – critical path activity scheduling CO-5 Suggested Readings: Practical component:	1. Informed search	CO-2, 3 RTI /
3. Probabilistic search Suggested Readings: How search engines use AI to power results (9L+6P) Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents CO-2, 3 Practical component: CO-2, 3 I. Apply reasoning algorithm for decision making BTL-4 Suggested Readings: Representation of the world in Tesla MODULE 4: NEURAL NETWORKS (9L+6P) Artificial neural unit – Pattern classification – feed forward network – learning – feedback network – multi layer perceptron (9L+6P) Practical component: CO-4 Design Neural network for Ent-3 I. Pattern classification Feedicion Suggested Readings: Ent-3 Design Neural network for Ent-3 I. Pattern classification Suggested Readings: Deep Learning and Neural Networks Introduction – representation in scheduling – graphs and networks – shortest paths – critical path analysis – critical path activity scheduling CO-4 Practical component: CO-5 Suggested Readings: Develop an intelligent robotic system using MATLAB BTL-3 Path planning algorithms in robots Step estep e	2. Uninformed search	DIL-4
Suggested Readings: How search engines use Al to power results (9L+6P) Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents Practical component: CO-2, 3 1. Apply reasoning algorithm for decision making BTL-4 Suggested Readings: BTL-4 Representation of the world in Tesla (9L+6P) Artificial neural unit – Pattern classification – feed forward network – learning – feedback network – multi layer perceptron (9L+6P) Practical component: (9L+6P) Design Neural network for Ent-4 1. Pattern classification Feedback 2. Prediction CO-4 3. Classification BTL-3 Suggested Readings: CO-4 Deep Learning and Neural Networks (9L+6P) Introduction – representation in scheduling – graphs and networks – shortest paths – critical path analysis – critical path activity scheduling (0-4 Practical component: CO-4 Deep Learning and Neural Networks Suggested Readings: Deep Learning and Neural Networks Suggested Readings Deep Learning and Neural Networks Suggested Readings Introduction – representation in schedul	3. Probabilistic search	
How search engines use Al to power results (9) MODULE 3: KNOWLEDGE AND REASONING (9) Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents CO-2, 3 Practical component: CO-2, 3 I. Apply reasoning algorithm for decision making BTL-4 Suggested Readings: BTL-4 Representation of the world in Tesla (9) MODULE 4: NEURAL NETWORKS (9) Artificial neural unit – Pattern classification – feed forward network – learning – feedback network – multi layer perceptron Practical component: Practical component: CO-4 Design Neural network for E 1. Pattern classification Suggested Readings: 2. Prediction Sclassification 3. Classification Suggested Readings: Deep Learning and Neural Networks (9) Introduction – representation in scheduling – graphs and networks – shortest paths – critical path analysis – critical path activity scheduling CO-5 1. Develop an intelligent robotic system using MATLAB BTL-3 Suggested Readings: Practical component: CO-5 1. Develop an intelligent robotic system using MATLAB BTL-3 Practical component: <td< td=""><td>Suggested Readings:</td><td></td></td<>	Suggested Readings:	
MODULE 3: KNOWLEDGE AND REASONING(9L+6P)Adversarial search - Optimal and imperfect decisions - Alpha, Beta pruning - Logical agentsCO-2, 3Practical component:CO-2, 31. Apply reasoning algorithm for decision makingBTL-4Suggested Readings: Representation of the world in Tesla(9L+6P)Artificial neural unit - Pattern classification - feed forward network - learning - feedback network - multi layer perceptron(9L+6P)Practical component: Design Neural network for 1. Pattern classificationCO-4 BTL-3Suggested Readings: 	How search engines use AI to power results	
Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents CO-2, 3 Practical component: CO-2, 3 1. Apply reasoning algorithm for decision making BTL-4 Suggested Readings: Prectical component: Representation of the world in Tesla (9L+6P) Artificial neural unit – Pattern classification – feed forward network – learning – feedback network – multi layer perceptron CO-4 Practical component: CO-4 Design Neural network for CO-4 1. Pattern classification CO-4 BTL-3 Suggested Readings: Deep Learning and Neural Networks MODULE 5: SCHEDULING (9L+6P) Introduction – representation in scheduling – graphs and networks – shortest paths – critical path analysis – critical path activity scheduling CO-5 Practical component: CO-5 Introduction – representation in scheduling – graphs and networks – shortest paths – critical path analysis – critical path activity scheduling CO-5 Practical component: CO-5 I. Develop an intelligent robotic system using MATLAB BTL-3 Suggested Readings: Path planning algorithms in robots	MODULE 3: KNOWLEDGE AND REASONING	(9L+6P)
agents of Co-2, 3 Practical component: Apply reasoning algorithm for decision making Suggested Readings: Representation of the world in Tesla MODULE 4: NEURAL NETWORKS (9L+6P) Artificial neural unit – Pattern classification – feed forward network – learning – feedback network – multi layer perceptron Practical component: Design Neural network for Artificial neural unit of Co-2, 3 CO-4 BTI-3 CO-4 CO-4 BTI-3 CO-4 BTI-3 CO-4 BTI	Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical	
Practical component: CO-2, 3 1. Apply reasoning algorithm for decision making BTL-4 Suggested Readings: representation of the world in Tesla MODULE 4: NEURAL NETWORKS (9L+6P) Artificial neural unit – Pattern classification – feed forward network – learning – feedback network – multi layer perceptron Practical component: Design Neural network for CO-4 1. Pattern classification CO-4 3. Classification BTL-3 Suggested Readings: CO-4 Deep Learning and Neural Networks MODULE 5: SCHEDULING Introduction – representation in scheduling – graphs and networks – shortest paths – critical path analysis – critical path activity scheduling CO-5 Practical component: CO-4 Develop an intelligent robotic system using MATLAB BTL-3 Suggested Readings: Path planning algorithms in robots	agents	
1. Apply reasoning algorithm for decision makingBTL-4Suggested Readings: Representation of the world in Tesla(9L+6P)MODULE 4: NEURAL NETWORKS(9L+6P)Artificial neural unit – Pattern classification – feed forward network – learning – feedback network – multi layer perceptronPractical component: Design Neural network for 1. Pattern classification2. Prediction 3. Classification3. ClassificationSuggested Readings: Deep Learning and Neural NetworksMODULE 5: SCHEDULING(9L+6P)Introduction – representation in scheduling – graphs and networks – shortest paths – critical path analysis – critical path activity schedulingPractical component: Develop an intelligent robotic system using MATLABCO-5Path planning algorithms in robotsBTL-3	Practical component:	CO-2, 3
Suggested Readings: Representation of the world in Tesla(9L+6P)MODULE 4: NEURAL NETWORKS(9L+6P)Artificial neural unit – Pattern classification – feed forward network – learning – feedback network – multi layer perceptronPractical component: Design Neural network for 1. Pattern classificationDesign Neural network for 3. Classification3. Classification 3. ClassificationBTI-3Prediction 3. ClassificationDeep Learning and Neural NetworksIntroduction – representation in scheduling – graphs and networks – shortest paths – critical path analysis – critical path activity schedulingPractical component: 1. Develop an intelligent robotic system using MATLABSuggested Readings: Path planning algorithms in robots	1. Apply reasoning algorithm for decision making	BTL-4
Representation of the world in Tesla (9L+6P) MODULE 4: NEURAL NETWORKS (9L+6P) Artificial neural unit – Pattern classification – feed forward network – learning – feedback network – multi layer perceptron Practical component: Practical component: Design Neural network for Practical component: Design Neural network for . CO-4 1. Pattern classification BTL-3 2. Prediction . CO-4 3. Classification BTL-3 Suggested Readings: Deep Learning and Neural Networks (9L+6P) Introduction – representation in scheduling – graphs and networks – shortest paths – critical path analysis – critical path activity scheduling CO-5 1. Develop an intelligent robotic system using MATLAB BTL-3 Suggested Readings: Path planning algorithms in robots	Suggested Readings:	
MODULE 4: NEURAL NETWORKS(9L+6P)Artificial neural unit – Pattern classification – feed forward network – learning – feedback network – multi layer perceptronPractical component:Practical component:Design Neural network for.1. Pattern classificationECO-4 BTL-32. Prediction.3. Classification.Begested Readings:.Deep Learning and Neural NetworksMODULE 5: SCHEDULINGIntroduction – representation in scheduling – graphs and networks – shortest paths – critical path analysis – critical path activity schedulingCO-51. Develop an intelligent robotic system using MATLABBTL-3Suggested Readings: 	Representation of the world in Tesla	
Artificial neural unit – Pattern classification – feed forward network – learning – feedback retwork – multi layer perceptron Practical component: Design Neural network for CO-4 1. Pattern classification BTL-3 2. Prediction Classification BTL-3 3. Classification MODULE 5: SCHEDULING (9L+6P) Introduction – representation in scheduling – graphs and networks – shortest paths – critical path activity scheduling CO-5 CO-5 1. Develop an intelligent robotic system using MATLAB BTL-3 BTL-3 Suggested Readings: Path planning algorithms in robots BTL-3	MODULE 4: NEURAL NETWORKS	(9L+6P)
network - multi layer perceptronImage: perceptronImage: perceptronImage: perceptronPractical component:CO-4Design Neural network forBTL-3BTL-31. Pattern classificationBTL-3BTL-32. PredictionSuggested Readings:Image: perceptron3. ClassificationDeep Learning and Neural NetworksSuggested Readings:Suggested Readings:Deep Learning and Neural NetworksMODULE 5: SCHEDULING9L+6P)Introduction - representation in scheduling - graphs and networks - shortest paths - critical path analysis - critical path activity schedulingCO-5Practical component:CO-5Suggested Readings:BTL-31. Develop an intelligent robotic system using MATLABBTL-3BTL-3Path planning algorithms in robotsFather analysis - critical path activity schedulingFather analysis - critical path activity schedulingPath planning algorithms in robotsFather analysis - critical path activity schedulingFather analysis - critical path activity scheduling	Artificial neural unit – Pattern classification – feed forward network – learning – feedback	
Practical component:CO-4Design Neural network forCO-41. Pattern classificationBTL-32. PredictionBTL-33. ClassificationCO-4Suggested Readings:CO-4Deep Learning and Neural NetworksMODULE 5: SCHEDULINGIntroduction – representation in scheduling – graphs and networks – shortest paths –GU-4critical path analysis – critical path activity schedulingCO-5Practical component:CO-51. Develop an intelligent robotic system using MATLABBTL-3Suggested Readings:Path planning algorithms in robots	network – multi layer perceptron	
Design Neural network forCO-4 BTL-31. Pattern classificationBTL-32. PredictionEdssification3. ClassificationDespterating and Neural NetworksMODULE 5: SCHEDULING (9L+6P)Introduction – representation in scheduling – graphs and networks – shortest paths – critical path analysis – critical path activity schedulingPractical component:CO-51. Develop an intelligent robotic system using MATLABBTL-3Suggested Readings:Path planning algorithms in robots	Practical component:	
1. Pattern classificationCO-42. PredictionBTL-33. ClassificationEnd of the second se	Design Neural network for	CO 4
2. PredictionDIL-S3. ClassificationSuggested Readings: Deep Learning and Neural NetworksDeep Learning and Neural NetworksMODULE 5: SCHEDULINGIntroduction - representation in scheduling - graphs and networks - shortest paths - critical path analysis - critical path activity scheduling(9L+6P)Practical component: 1. Develop an intelligent robotic system using MATLABCO-5 BTL-3Suggested Readings: Path planning algorithms in robotsBTL-3	1. Pattern classification	CU-4
3. ClassificationImage: constraint of the second secon	2. Prediction	DIL-3
Suggested Readings: Deep Learning and Neural NetworksMODULE 5: SCHEDULING(9L+6P)Introduction - representation in scheduling - graphs and networks - shortest paths - critical path analysis - critical path activity schedulingCO-5Practical component: 1. Develop an intelligent robotic system using MATLABBTL-3Suggested Readings: Path planning algorithms in robotsHotel State S	3. Classification	
Deep Learning and Neural NetworksMODULE 5: SCHEDULING(9L+6P)Introduction - representation in scheduling - graphs and networks - shortest paths - critical path analysis - critical path activity schedulingCO-5Practical component: 1. Develop an intelligent robotic system using MATLABBTL-3Suggested Readings: Path planning algorithms in robotsCO-5	Suggested Readings:	
MODULE 5: SCHEDULING(9L+6P)Introduction – representation in scheduling – graphs and networks – shortest paths – critical path analysis – critical path activity scheduling–Practical component: 1. Develop an intelligent robotic system using MATLABCO-5Suggested Readings: Path planning algorithms in robotsBTL-3	Deep Learning and Neural Networks	
Introduction – representation in scheduling – graphs and networks – shortest paths – critical path analysis – critical path activity scheduling Practical component: CO-5 1. Develop an intelligent robotic system using MATLAB BTL-3 Suggested Readings: Path planning algorithms in robots	MODULE 5: SCHEDULIN	IG (9L+6P)
critical path analysis – critical path activity schedulingCO-5Practical component:CO-51. Develop an intelligent robotic system using MATLABBTL-3Suggested Readings:Path planning algorithms in robots	Introduction - representation in scheduling - graphs and networks - shortest paths -	
Practical component:CO-51. Develop an intelligent robotic system using MATLABBTL-3Suggested Readings:Path planning algorithms in robots	critical path analysis – critical path activity scheduling	
1. Develop an intelligent robotic system using MATLABBTL-3Suggested Readings:Path planning algorithms in robots	Practical component:	CO-5
Suggested Readings: Path planning algorithms in robots	1. Develop an intelligent robotic system using MATLAB	BTL-3
Path planning algorithms in robots	Suggested Readings:	
	Path planning algorithms in robots	

TEXT B	BOOKS								
1	Stuart Russel and Peter Norvig. (2003). Artificial Intelligence: A Modern Approach, Pearson								
1.	Education, 2 nd Edition.								
REFER	ENCE BOOKS								
1	George F.Luger. (2002). Artificial Intelligence – Structures and Strategies for Complex Problem								
1.	Solving, Pearson Education, 4 th Edition.								
2	David Allan Bradley, Derek Seward, David Dawson, Stuart Burge. (2000). Mechatronics and the								
2.	Design of Intelligent Machines and Systems, CRC Press								
E BOO	KS								
1.	http://ciml.info/dl/v0_8/ciml-v0_8-all.pdf								
MOOC									
1.	https://www.my-mooc.com/en/mooc/destination-ai-introduction-to-artificial-intelligence/								
2.	https://www.coursera.org/learn/introduction-to-ai								

COURSE TITLE	FUNDAMEN	TALS OF SIGNAL PRO	CESSING	CREDITS	4					
COURSE CODE	MHB4410	COURSE CATEGORY	РС	L-T-P-S	3-0-2-0					
Version	1.0	Approval Details	24 th ACM, 30.05.2018	LEARNING LEVEL	BTL-4					
ASSESSMENT SCH	IEME									
First Periodical Assessment	Second Periodical Assessment	Practical Ass	sment ESE							
15%	15%	20% 50%								
Course Description	Signal processing focuses on analyzing, modifying, and synthesizing signals such as sound, images, and scientific measurements to improve transmission, storage efficiency and subjective quality and to also emphasize or detect components of interest in a measured signal									
Course Objective	 Be able to des mathematical o on the depende Be familiar wit function, sinuso Be able to class periodic, energ anti-symmetric Be able to con defined signals Fourier transfo 	 Be able to describe signals mathematically and understand how to perform mathematical operations on signals. The operations should include operations on the dependent as well as independent variables. Be familiar with commonly used signals such as the unit step, ramp, impulse function, sinusoidal signals and complex exponentials. Be able to classify signals as continuous-time vs. discrete-time, periodic vs. non- periodic, energy signal vs. power signal, odd vs. even, conjugate symmetric vs anti-symmetric Be able to compute the Fourier series or Fourier transform of a set of well- defined signals from first principles. Further, be able to use the properties of the 								

	broader class of signals.
	5. Be able to familiarize the application of Fourier transformations
	Upon completion of this course, the students will be able to
	1. Outline the basic properties of signal & systems and the various methods of
Course	classification
Course	2. Apply Fourier transform for Signals
Outcome	3. Apply and analyse the techniques in fast Fourier transform
	4. Apply the Z transform & DTFT and their properties
	5. Illustrate the digital signal processing and its hardware architecture
D	

Prerequisites:

MODULE 2: DISCRETE FOURIER SERIES

CO, PO	CO, PO AND PSO MAPPING													
60	PO-	РО	РО	РО	PO	РО	PO	PO	PO	PO-	PO-	PO-		
	1	-2	-3	-4	-5	-6	-7	-8	-9	10	11	12	P30-1	PSU-2
CO-1	3	3	-	-	-	-	-	2	2	-	-	2	2	1
CO-2	3	3	3	3	3	-	-	2	2	-	-	2	2	1
CO-3	3	3	-	-	-	-	-	2	2	-	-	2	2	1
CO-4	3	3	-	-	-	-	-	2	2	-	-	2	2	1
CO-5	3	3	-	-	-	-	-	2	2	-	-	2	2	1
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1: SIGNALS AND SYSTEMS (9L+6P)														
Introduct	ion to	contir	nuous,	Discre	ete an	d Digit	al sign	als, Cl	assific	ation c	of contir	nuous a	nd	
Discrete	Time s	signal	– Peri	odic,	Even a	and O	dd, En	ergy a	and Pc	wer, [Determi	nistic a	nd	
Random,	Comp	lex ex	ponen	tial sig	gnlas,	Eleme	ntary s	signals	– UN	IT step	, Ramp	, Impul	se,	
Classifica	tion of	syste	ms: Liı	near, 1	Time ir	nvariar	nt, Cau	ısal, St	able, I	nvertik	ole syste	ems, Bl	во	
Stability criterion.											CO-1			
Practical component:									1	BTL-4				
Programs using mathematical computing tool for mathematical operations on CT, DT									DT					
signals														
Suggested Readings:														
LTI Systems														

(9L+6P)

DFS Repr Fourier T Practical • M Suggested Circular (esentation of Periodic Sequence, properties of Discrete Fourier Series. Discrete ransforms: Properties of DFT, Linear Convolution of Sequences using DFT. component: latlab program on linear convolution I Readings: Convolution	CO-2 BTL-4						
MODULE	3: FAST FOURIER TRANSFORMS (9L+6P)							
Fast Four	ier Transforms (FFT) – Radi Decimation-in-Time and Decimation-in-Frequency							
FFT Algori	thms, InverseFFT, and FFT with General Radix-N.							
Practical o	component:	CO-3						
• In	nplementing FFT algorithm in Matlab	BTL-4						
Suggested	Readings:							
Applicatio	on of FFT							
MODULE	4: DISCRETE TIME SIGNALS AND Z TRANSFORM (9L+6P)							
DTFT – Pro	operties of DTFT. Definition of Z transforms, Properties, Inverse Z transform.							
Practical of	component:	CO-4						
 Z transform to find zero pole and gain of transfer function 								
Suggested Readings:								
Transfer	unction							
MODULE	5: DIGITAL SIGNAL PROCESSOR (9L+6P)							
Introduct	ion to Digital Signal Processing, DSP processor, architecture of DSP processors.							
Bus Archi	tecture and Memory, Data Addressing Capabilities, Address Generation Unit,							
Programn	nability and Program Execution, Features for External Interfacing	CO-5						
Practical of	component:	BTL-4						
• St	udy of external interfacing with DSP processor							
Suggestee	Readings:							
Architect	ure & Implementation							
TEXTBOO	KS							
1	John G. Proakis, Dimitris G. Manolakis. (2007). Digital Signal Processing	g, Principles,						
1.	Algorithms, and Applications, Pearson Education / PHI.							
REFERENC	CE BOOKS							
1	Li Tan. (2018). Digital Signal Processing — Fundamentals and Applications – Academic Press.	–, Elsevier –						
2	2 Robert Schilling, Sandra L. Harris. (2013). Fundamentals of Digital Signal Processing using MATLAB, Cengage.							
E BOOKS								
1.	http://www.fourierandwavelets.org/FSP_v1.1_2014.pdf							
MOOC								
1	https://www.mooc-list.com /dsp							

COURS	E TITLI	E	RO	BOTIC	S AND) MAC LABOR	HINE V RATOR	/ISION Y	SYSTE	MS	С	CREDITS 1			1
COURS	e codi	E	MHE	34437		C CA	OURSE TEGOF	E RY		РС		L-T-P-S	5	0	-0-2-1
Vers	sion		1	L .0		Appro	oval De	etails	24 ¹ 30.	th ACM 05.201	, I 8	LEARNING LEVEL BTL - 4			3TL - 4
ASSESS	MENT	SCHEN	/IE												
			Contir	nuous	ntern	al Asse	essmer	nt					ESE	-	
					80%								20%	6	
Cou Descri	basic concepts of industrial robots and their applications in MATLAB. This course provides the basic concepts and algorithms required to develop robots that act autonomously in complex environments in MATLAB through Robotics Systems Toolbox and MOTOSIM. The main emphasis is put on robot locomotion and kinematics, and motion planning in simulation as well as in real time using MOTOMAN industrial robot. Little emphasis is given on understanding the basics of image acquisition and processing using MATLAB. The exercises of this course introduce several types of industrial robots and their modelling, kinematics and path planning in simulation as well as in real time.														
Course Objectiv	/e	1 n 1. 2. 3. 4. 5.	e spec Lear Lear Lear Lear Lear	n the c n the c n the p n meth n meth	jective concep princip nods o nods o concep	es of tr les of r f deve f path ots of v	obot k robot c loping planni arious	rse ena inema drives kinem ng for machi	able th tics. and co atic so indust ne visi	e stud ntrols. lutions rial rok on and	ents to s for Ro pots. I image	: bot con proces	figura sing te	itior	ns. niques.
Course OutcomeUpon completion of this course, the students will be able to 1. Recall the basics of Robots and elements of Industrial Robotic 2. Design and develop a Kinematic solution of Industrial rol performance in Robotics System Toolbox, MATLAB as wel MOTOMAN Robot.Outcome3. Apply methods of path planning and trajectory tracking for analyse its performance in Robotics System Toolbox, MATLAB 4. Learn the concepts of basic image processing techniques for by performing operations on digital imagesPrerequisites: NIL								obotic S al robo s well a g for inc ATLAB. es for ro	ystem ts anc is in r dustria	ı. real al rc apı	nalyze its time for obots and olications				
СО, РО /	AND P	SO MA	APPINO	G	20				20	20					
со	РО- 1	РО- 2	РО- 3	РО- 4	РО- 5	РО- 6	РО- 7	РО- 8	РО- 9	РО- 10	РО- 11	РО- 12	PSO-	1	PSO-2

60.1	3	3	2	2	1	0	0	2	2	0	0	2	2	2
0-1	2	2	2	2	1	0	0	2	2	0	0	2	2	2
CO-2	5	3	3	3	1	0	U	2	2	0	0	2	2	5
CO-3	3	3	3	3	0	0	0	2	2	0	0	2	2	3
CO-4	3	3	3	3	0	0	0	2	2	0	0	2	2	2
1: Weal	dy rela	ited, 2	: Mod	erately	relat	ed and	l 3: Str	ongly	relate	d				
MOD	JLE 1 -	- ROBO	DTICS											(18 P)
1.	Build a	robot	t using	Robot	ics Sys	tems ⁻	Foolbo	x MAT	LAB					
2.	Forwa	rd Kine	ematic	s of M	ove Ma	aster F	RM 501	1 Robo	t					
3. Forward Kinematics of PUMA 560 Robot														
4.	Inverse	e Kiner	matics	of PUI	MA 56	0 Robo	ot							
5.	Model	ling a	nd Sin	nulatio	n of a	a 2 D	.O.F Jo	ointed	arm	Robot	using	MATLA	В —	
	Forwa	rd Kine	ematic	S										
6.	Model	ling a	nd Sin	nulatio	n of a	a 3 D.	.O.F Jo	ointed	arm	Robot	using	MATLA	в —	
	Forwa	rd Kine	ematic	S										
7.	7. Modelling and Simulation of a 2 D.O.F Jointed arm Robot using MATLAB –									в — 🛛	CO-1, CO-2			
	Inverse Kinematics										and CO-3			
8.	8. Modelling and Simulation of a 3 D.O.F Jointed arm Robot using MATLAB –									в —	BTL- 4			
	Inverse Kinematics													
9.	2-D Pa	th Tra	cing of	[:] a Mar	nipulat	or wit	h Invei	rse Kin	emati	CS				
Suggest	ed Rea	adings	:											
•	Forwa	rd and	l Inver	se Kin	ematio	cs of 2	2, 3, 4	and 5	DOF	articul	ated ro	obotic a	arm	
	using (Geome	etric ar	nd Ana	lvtical	Metho) d (D-F	l Meth	nod)					
•	Study	of 4	D.O.F	Ganti	v Roł	oot in	Moti	on Co	ntrol	Labora	atory.	Centre	for	
	Autom	ation	and Ro	obotics	HITS						,)			
•	Study	of 6 D	OF Yas	kawa r	obot a	nd de	rive th	e kinei	matic	solutio	n.			
MODU	LE 2: II	NTERF									····			(8 P)
Real tin	ne exp	erimei	nts:											(0.7)
10.	Sorting	oner:	ation (ising M	ιοτος	IM FG	-VRC a	nd Mo	otomai	n MH S	eries R	obot		
11.	Machi	ning ol	peratio	on usin	g MOI		FG-VF	RC and	Moto	man M	IH Serie	s Robo	+ (CO-2. CO-3
12	PICK a	nd PI A		eratio	n using	σ 4 Δχί	s GAN		BOT					and CO-4
Suggest	ed Rea	adings			i using	5 - 7 0/1	5 0/ 11							RTI-4
Juggest			· ONTRO		and 1	Vvis G			т					
	RORO.							Ково	•					
												(A D)		
13 Acquiring and Basic operations on Imagos using MATLAP										(+)				
Suggested Readings:										CO - 4				
Basic Operations on Images using MATLAR											BTL - 4			
		operat			ΜΔΤΙ					עחווד)				
1	Image	Acqui	cition						JLLF J					<u> </u>
⊥.	mage	Acqui	รานปท											CO-4

2. Basic Image Processing Operations	BTL - 4							
3. Segmentation and Feature extraction								
4. Object detection and Counting								
5. Monocular Visual Odometry								
6. Scene Change Detection								
7. Motion Detection								
8. Color-based object detection								
VIRTUAL LABS								
1. http://vlabs.iitkgp.ernet.in/mr/exp2/index.html								
2. http://cse19-iiith.vlabs.ac.in/index.html								

COURSE TITLE	NDT AND CC	NDITION MONITOR	ING LAB	CREDITS	2				
COURSE CODE	MHB4438	COURSE CATEGORY	РС	L-T-P-S	0-0-3-1				
Version	1.0	Approval Details	24 th ACM, 30.05.2018	LEARNING LEVEL	BTL-3				
ASSESSMENT SCI									
Continuous Internal Assessment ESE									
	809	6		20	0%				
Course Description Course	This course provides vibration measurem values, time domain oneself on guideline mechanical element of vibration measur The specific objectiv 1. Impart basic kno in Engineering F	s the attendee an int nent analysis, LPT, ND n and spectrum analy es, how to decide on t. Practical exercises ement analysis. yes of the Course ena owledge and importa fields among the stud	roduction to vibi oT concepts, FEN sis. The attended mechanical conc during the training ble the students ance on Vibration lents	ration measure 1M, vibration cl e will additiona dition of the rot ng complemen s to: n Based Conditi	ment and haracteristic Ily familiarize ating t to the theory ion Monitoring				
Objective	 Create the awa Application area Know the usage 	reness on Vibration a of LPT and FEMM as	Based Condition	n Monitoring in nts	Research and				
Course Outcome	 Know the usage of LPT and FEMM as per requirements Upon completion of this course, the students will be able to Comprehend the Condition Monitoring Techniques and its interdisciplinary approach Arrange the instrumentation for NDT and Condition Monitoring Comprehend the standards and calibrate the instruments and Test the various defects flaws and monitor the different parameters 								

Prerequ	Prerequisites: Nil													
CO, PO AND PSO MAPPING														
со	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PSO-1	PSO-2
	1	2	3	4	5	6	7	8	9	10	11	12		
CO-1	3	3	2	3	2	2	2	2	3	2	2	1	3	3
CO-2	3	3	2	3	2	2	2	2	3	2	1	2	3	3
CO-3	3	3	3	3	2	2	2	2	3	3	2	1	3	3
CO-4 3 3 3 2 2 2 2 3 3 1 2 3									3	3				
1: Weal	1: Weakly related, 2: Moderately related and 3: Strongly related													
MODULE 1: NON DESTRUCTIVE TESTING (30P)														
Practice in Ultrasonic Testing, Eddy Current and MPT for the detection of defects in									CO-1-5					
various	applica	ations	like we	elding,	castin	g etc.								BTL-3
MODUL	.E 2 : VI	BRATI	ON M	ΟΝΙΤΟ	RING						(15P)			
Experim	nents ir	n cond	ition m	nonito	ring ap	plicati	ons lik	e shaf	t misal	lignme	nt, bea	ring		
failure,	loosen	ess eto	с.											
1. (Conditi	ion Mo	onitori	ng and	Progn	ostics	Using	Vibrat	ion Sig	nals				
2.	Tune P	ID Con	troller	in Rea	al Time	e Using	g Open	-Loop	PID Au	ito tun	er Bloc	k		CO-1-5
3.	Fault D	iagnos	sis of C	entrifu	igal Pu	imps u	ising R	esidua	l Analy	/sis				BTL-3
4.	4. Estimate Model Parameters and Initial States (GUI)													
5. Fault Detection Using Data Based Models														
6. Wind Turbine High-Speed Bearing Prognosis														
VLab Lii	VLab Link													
1	1 http://vlabs.iitkgp.ac.in/mssp/exp6/index.html#													

COURSE TITLE	D	ESIGN PROJECT V	CREDITS	1							
COURSE CODE	MHB4439	COURSE CATEGORY	РС	L-T-P-S	0-0-2-0						
Version	1.0	Approval Details	24 th ACM, 30.05.2018	LEARNING LEVEL	BTL-6						
ASSESSMENT SCHEME											
First Review	Second Review	Third Review	Project Rep	ort & Viva Voce	ESE						
20%	30%	20%	:	30%							
Course Description	This course provides the student significant design experience and builds on the knowledge and skills acquired in earlier course work. This course provides an exposure to teamwork to emulate a typical professional design environment. Simulations are to										

	be used both in the execution of the design methodology and the management of the
	design project.
	The specific objectives of the Course enable the students to:
	1. To develop skills in doing literature survey, technical presentation and report
Course	preparation.
Objective	2. To enable project identification and execution of preliminary works on
	3. To enable students to work as team
	4. To enable students to work on development of hardware
	Upon completion of this course, the students will be able to
Course	1. To identify a problem, do survey, develop methodology and do the simulations and
Outcome	use them for major project
	2. Prepare technical drawing, technical report and technical presentation

Prerequisites:

CO, PO AND PSO MAPPING													
PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO -	PO-	PO-		
1	2	3	4	5	6	7	8	9	10	11	12	P30-1	P30-2
3	3	2	2	3	2	2	3	3	3	3	3	3	3
3	3	2	2	3	2	2	3	3	3	3	3	3	3
	AND PO- 1 3 3	AND PSO M PO- PO- 1 2 3 3 3 3	AND PSO MAPPIN PO- PO- 1 2 3 3 3 2 3 3 2	AND PSO MAPPING PO- PO- PO- 1 2 3 4 3 3 2 2 3 3 2 2	AND PSO MAPPING PO- PO- PO- PO- 1 2 3 4 5 3 3 2 2 3 3 3 2 2 3	AND PSO MAPPING PO- <	PO- PO- <td>PO- PO- PO-<td>PO- PO- PO-<td>PO- PO- PO-<td>PO- PO- PO-<td>PO- PO- PO-<td>AND PSO MAPPING PO- PO-</td></td></td></td></td></td>	PO- PO- <td>PO- PO- PO-<td>PO- PO- PO-<td>PO- PO- PO-<td>PO- PO- PO-<td>AND PSO MAPPING PO- PO-</td></td></td></td></td>	PO- PO- <td>PO- PO- PO-<td>PO- PO- PO-<td>PO- PO- PO-<td>AND PSO MAPPING PO- PO-</td></td></td></td>	PO- PO- <td>PO- PO- PO-<td>PO- PO- PO-<td>AND PSO MAPPING PO- PO-</td></td></td>	PO- PO- <td>PO- PO- PO-<td>AND PSO MAPPING PO- PO-</td></td>	PO- PO- <td>AND PSO MAPPING PO- PO-</td>	AND PSO MAPPING PO- PO-

1: Weakly related, 2: Moderately related and 3: Strongly related

	NOTE
	The students in convenient groups of not more than 4 members have to identify a product for
1	design and fabrication. Every project work shall have a guide who is the member of the faculty
	of the institution.
2	To develop a mechatronic system with emphasis on electrical drives (Actuator) for different
	applications/Systems.
	The students are required to design and fabricate the chosen system and demonstrate its
3	working apart from submitting the project report. The report should contain assembly drawing,
	parts drawings, process charts relating to fabrication.

SEMESTER VIII

COURSE TITLE	PRO	12			
COURSE CODE	MHB4448	COURSE CATEGORY	РС	L-T-P-S	0-0-24-0
Version	1.0	Approval Details	24 th ACM, 30.05.2018	LEARNING LEVEL	BTL-6
ASSESSMENT SCH	EME				
First Review	Second Review	Third Review,	ESE		

20	%		30% 30% 20%											
Cou Descri	Th kn ex Sir m	This course provides the student significant design experience and builds on the knowledge and skills acquired in earlier course work. This course provides an exposure to teamwork to emulate a typical professional design environment. Simulations are to be used both in the execution of the design methodology and the management of the design project.												
Cou Objec	rse ctive	Th 1. 2.	 The specific objectives of the Course enable the students to: 1. Design and fabricate a mechatronics system / or investigations 2. Prepare technical drawing, technical report and acquire skills 									condu re proj	ct exper ect mana	imental gement
Course O	utcom	e Ur 2.	 Upon completion of this course, the students will be able to 1. Design and fabricate a mechatronic system /Conduct experimental investigations 2. Modelling and simulation study of engineering systems/problem. 											
Prerequisites:														
CO, PO A	ND PS	O MA	PPING											
со	PO- 1	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO -	PO-	PO-	PSO-1	PSO-2
CO-1	3	3	3	2	3	2	2	3	3	3	3	3	2	3
CO-2	3	3	3	2	3	2	2	3	3	3	3	3	2	3
1: Weakl	y relat	ed, 2:	Mode	rately	relate	d and	3: Stro	ongly r	elated				<u> </u>	
NOTE														
1		The pro woi	stude duct/p k shall	nts in process I have	convei 5 for de a guid	nient g esign a e who	roups nd fab is the	of not pricatic memb	more on or e er of t	than 4 xperim he facu	membo nental st ulty of t	ers have tudy. Ev he insti	e to identi very proje tution.	fy a ct
2		Stu assi rea	Students will be exposed to lecture modules on Project and Thesis work followed by assignment of individual projects involving designing a mechatronics system for a real time problem with societal impact.											
3		The den con and	al time problem with societal impact. The students are required to design and fabricate/ conduct experiments and emonstrate its working apart from submitting the project report. The report should intain assembly drawing, parts drawings, process charts, programming, modelling and simulation, analysis relating to the project.											

DEPARTMENTAL ELECTIVES – SEMESTER III

COURSE TITLE	BASICS OF ROBOTICS CREDITS							
COURSE CODE	MHC4251	COURSE CATEGORY	DE	L-T-P-S	3-0-0-1			

COURSE TITLE	BA	SICS OF ROBOTICS		CREDITS	3			
Version	1.0	Approval Details	24 th ACM <i>,</i> 30.05.2018	LEARNING LEVEL	BTL - 3			
ASSESSMENT SCHI	EME							
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE			
15%	15%	10%	5%	5%	50%			
Course Description	Robotics is an inter- design, construction their control, sensor The goal of this co- their applications. algorithms require environments. The its key elements se emphasis is given various industrial a several types of ind their applications.	disciplinary branch of n, operation, and use ry feedback, and info urse is to introduce This course provide d to develop rob main emphasis is on such as sensors, ac on developing forw pplications. The lect	f engineering an e of robots, as w rmation process the basic conce es the basic co oots that act introducing var ctuators, and p ard kinematic s ures and exerci eir modelling, ba	d science that deals vell as computer sys ing. epts of industrial ro oncepts, key eleme autonomously in ious configuration of rogramming etc. N olution for robots ses of this course in sics of kinematics a	with the stems for bots and ents and complex of robots, Moderate used for ntroduce long with			
Course Objective	 The specific objectives of the Course enable the students to understand: 1. The different robotic configurations, classification of end effectors, sensing and actuation. 2. The robotic drive systems and mechanical transmission methods. 3. Underlying principle and applications of various grippers and its design. 4. The Kinematics and dynamics of Robot. 5. Safety considerations of the robot and Applications of robot for material transfor wolding assembly. Spray painting etc. 							
Course Outcome Prerequisites: Ni	 Upon completion of Recall and id Illustrate an design of ro Classify variants Recall, Inferriants Discuss the of robots. 	^t this course, the stud dentify the parts of ro d discuss the various bots. ous end effectors and , Interpret and Develovarious applications	lents will be able obots, its configu drives and powe d appraise the de op Kinematic sol of robots, justif	e to irations, D.O.F of Ro er transmission syste esign of grippers. utions for robots. ication, and implem	bots. em in the nentation			

COURS	E TITLI	E			BAS	ICS OF	ROBC	TICS			CF	REDITS		3
CO, PO	AND P	SO MA	APPINO	3									I	
со	PO - 1	РО- 2	РО- 3	РО- 4	РО- 5	РО- 6	РО- 7	РО- 8	РО- 9	PO - 10	РО- 11	PO- 12	PSO-1	PSO-2
CO-1	3	3	3	3	1	2	2	1	1	1	1	2	2	2
CO-2	3	3	3	3	2	2	2	1	1	1	1	2	2	2
CO-3	3	3	3	3	2	2	2	1	1	1	1	2	2	2
CO-4	3	3	3	3	2	2	2	1	1	1	1	2	2	2
CO-5	3	3	3	3	1	2	2	1	1	1	1	2	2	2
		-	1: Wea	kly rel	ated, 2	2: Mod	leratel	y relat	ed and	3: Str	ongly r	elated	I	
MODUL	.E 1: IN	TROD	UCTIO	N TO F	ROBOT	ICS		(9L)						
An overview of Robotics — classification by coordinate system and control systems- Components of the Industrial Robotics: Degrees of freedom — End effectors: Mechanical gripper — Magnetic —Vacuum cup and other types of grippers —General consideration on gripper selection and design, Robot actuator and sensors. Suggested Readings: Model different configurations of robots using various joints and study its workspace, work volume and D.O.F.								CO-1 BTL-3						
MODUL	.E 2 :R0	OBOT	DRIVE	S AND	POWE	R TRA	NSMIS	SSION	SYSTE	MS				(9L)
Robot of drives, chains, convers Suggest	drive n Mecha Link – ion, Ra	nechai anical Rod s ack and adings	nisms, transn system d Pinio : Vario	hydra nission s – Ro n drive ous Act	ulic – meth tary-to es, Lea	electr nod - o-Rota d screv s used	ic – s Gear ry mo ws, Bal for de	ervom transn tion co Il Beari sign of	otor- nission onvers ing scr	steppe , Belt ion, Ro ews. ic conf	r moto drives otary-to	or – pn , cables o-Linear ons.	eumatic 5, Roller 7 motion	CO-2 BTL - 4
MODUL	.E 3 : R	овот	END E	FFECT	ORS									(7L)
 Classification of End effectors – Tools as end effectors. Drive system for grippers- Mechanical Adhesive-Vacuum-Magnetic - Grippers, Hooks scoops. Gripper force analysis and gripper design. Active and passive grippers. Suggested Readings: Study of Grasping Modes, Forces, and Stability 								CO - 3 BTL - 3						
	Ultras	onic, C OBOT	ptom	echani	cal and	d Smar	t Tacti MICS	le Sen	sors fo	or gripp	er des	ign.		(111)
	. . N			Anco		DINA	wiles							(111)

COURS	E TITLE	BASICS OF ROBOTICS	CREDITS	3					
Positior	ns, Orient	ations and frames, Mappings: Changing descriptions from	m frame to frame,						
Operators: Translations, Rotations and Transformations – Transformation Arithmetic –									
Forward	d and inve	erse Kinematics of Six Degree of Freedom Robot Arm		CO-4					
Suggest	ed Readi	ngs:		DTI 2					
• Derive forward and Inverse kinematic solutions of 2 and 3 DOF robotic arm.									
•	Derive Fk	Cand IK solution for the 4 D.O.F GANTRY Robot							
•	Study of	six axis YASKAWA robot.							
MODUI	.E 5: APPL	ICATIONS OF ROBOTS		(9L)					
Industri	al Applica	tions of Robots for material transfer, machine loading / ι	Inloading, welding,						
assemb	ly and spi	ray-painting operation. RGV, AGV, Implementation of Rol	oots in Industries –	CO-5					
Various	Steps; Sa	tety Considerations for Robot Operations		BTL-3					
Suggest	Docign an	ngs: d Dovelopment of AGV for inductrial transportation							
IEAID	JOKS								
1.	Deb S. R	. and Deb S. (2017). Robotics Technology and Flexible Auto	omation, 2 nd edition,	Tata					
	McGraw	Hill Education Pvt.Ltd,.							
2.	Mikell P.	Groover, Mitchel Weiss, Roger N Nagel, Nicholas G Odrey	/, Ashish Dutta. (201	7).					
	Industric	al Robotics: Technology, Programming, and Applications, 2	nd edition, 12th Rep	orint,					
DEEEDE	McGraw	-Hill Companies.							
KEFEKE	NCE BOO	KS							
1.	Saeed B. Wiley.,	Niku. (2019). Introduction to Robotics: Analysis, Systems,	Applications, 3rd ed	ition.,					
2.	K.S. Fu, F	R.C. Gonzalez, C.S.G Lee. (2017). Robotics, Control, Sensing	, Vision and Intellige	ence,					
	McGraw	-Hill Education.							
E BOOK	S								
1.	http://w	iki.ros.org/Events/ICRA2010Tutorial							
MOOC									
1. <u>https://www.coursera.org/specializations/modernrobotics</u>									
2.	https://r	nptel.ac.in/courses/107/106/107106090/							

COURSE TITLE	MECHATRO	NICS SYSTEM APPLIC	ATIONS	CREDITS	3
COURSE CODE	MHB4252	L-T-P-S	3-0-0-1		
Version	1.0	1.0Approval Details24th ACM, 30.05.2018		LEARNING LEVEL	BTL-4
ASSESSMENT SC	HEME				
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/	Surprise Test / Quiz	Attendance	ESE

						F	Project							
15	5%		1	5%			10%			5%		5%		50%
Cor Descr	urse iption	In as in m	the M semble dustria echani	lechati e, maii al proc ical, ele	ronics ntain a esses i ectron	systen and opt integra ic or a	n appli timize iting di utoma	cation produ fferen tion to	stude cts, sys t funct pols.	nts will stems, i tions an	be trai machin id maki	ned to les, inst ing use	develop, allations o of differer	r It
 The specific objectives of the Course enable the students to understand: The key elements of Mechatronics system, representation into block diagr The concept of transfer function, reduction and analysis The principles of sensors, its characteristics, interfacing with microcontroller Objective The concept of PLC system and its ladder programming, and significance systems in industrial application The system modeling and analysis in time domain and frequency domain. The control actions such as Proportional, derivative and integral and significance in industrial applications 									ram DAQ e of PLC tudy its					
Course OutcomeUpon completion of this course, the students will be able to 1. Recall the modern mechatronics components. 2. Comprehend the principles and alternatives for mechatronics systems desi 3. Apply the elements of mechatronics systems for various applications. 4. Analyze the system for the given mechatronics problem. 5. Evaluate the various applications of mechatronics systems, justificatic implementation of mechatronics system								ign on, and						
Prerequ	isites:	Nil												
CO, PO	AND P	SO M	APPIN	G										
со	PO- 1	PO -2	PO- 3	РО- 4	PO -5	РО- 6	РО- 7	PO- 8	PO -9	PO- 10	PO- 11	PO- 12	PSO-1	PSO-2
CO-1	3	3	3	3	3	3	3	3	3	3	2	2	3	2
CO-2	3	3	3	3	3	2	2	3	3	2	3	3	3	2
CO-3	3	3	3	3	3	3	3	3	2	2	3	3	3	2
CO-4	3	3	3	3	3	3	3	3	3	3	3	3	3	2
CO-5	3	3	3	3	3	3	3	3	3	3	3	3	3	2
1: Wea	kly rela	ated, 2	: Mod	eratel	y relat	ted and	d 3: Sti	rongly	relate	d				
MODU	LE 1: IN	ITROD	UCTIC	N					(9L)					

Introdu	action to basics mechatronics components - Sensors, Actuators, Micro-controllers,	
PLC's.		CO-1
Sugges	ted reading:	BTL-2
Read c	on how AI can be improved for our future upcoming Chandrayaan-3	
MODU	LE 2: BIOMIMICRY USING MECHATRONICS	(9L)
Biomin	nicry – Introduction, Concept, Advantages. Bio-Inspired Robots – Mechanisms,	
Contro	ls, Actuations. Case Studies - Wall-Climbing Caterpillar Robot, Hexapedal robot	60 3
inspire	d by cockroach locomotion.	
Sugges	ted reading:	BIL-2
Read c	on the topic of heat-seeking missiles used in our Indian Air force	
MODU	LE 3: MEDICAL APPLICATIONS	(9L)
Introd	uction to mechatronics for medical applications, Importance of Mechatronics in	
Medica	al Applications, Applications of Mechatronics in Medicine - Robotics in Medicine,	
Smart	Instruments and Probes. Case Studies - Handheld Snake-Like Robots, 3D Printed	CO 3
Skull.		BTI-2
Sugges	ted reading:	DIL-3
Read	d on the difference mechatronics application used in Chandrayaan-2 vs Chang'e 5-	
T1		
MODU	LE 4: SAFETY, SECURITY AND DEFENCE APPLICATIONS	(9L)
Industr	ial safety systems, Smart security systems, Mechatronics in defence, Artificial	
Intellig	ence in security systems. Case Studies: Cobots (Collaborative Robots), Smart	CO-4
Doors,	Heat-seeking missiles.	8TI -3
Sugges	ted reading:	DIE-5
Read c	on the hexahedral robot which has been inspired by cockroach	
MODU	LE 5: MANUFACTURING APPLICATIONS	(9L)
Introd	uction to manufacturing systems, Retrofitting, CNC machines, Rapid Prototyping,	
Industr	rial Robots. Case Studies – Laser cutting, Quality inspecting robots.	CO-5
Sugges	ted reading:	BTL-4
Read c	on EMG and EEG is recorded from patients for health diagnosis	
TEXT B	ООКЅ	
1.	W Bolton. (2011). Mechatronics, Pearson Education, Fourth Edition	
REFERE	ENCE BOOKS	
1	SiamakNajarian, JavadDargahi, Ph.D.,GoldisDarbemamieh, SiamakHajizadehFark	oush. (2012),
	Mechatronics in Medicine: A Biomedical Engineering Approach, McGraw-Hill Educa	ition.
2	David G. Alciatore& Michael B Histand. (2003). Introduction to Mechatronics and a systems. Tata McGraw Hill	Weasurement
E BOOK	(S	
1.	http://www.springer.com/in/book/9783642175305	
MOOC		

1	www.mooc-list.com/course/me209x-thermodynamics-edx
2	www.class-central.com/tag/thermodynamics

COURSE TITLE		MOBILE ROBOTS		CREDITS	3								
COURSE CODE	MHC4253	COURSE CATEGORY	DE	L-T-P-S	3-0-0-1								
Version	1.0	Approval Details	24 th ACM, 30.05.201 8	LEARNING LEVEL	BTL-4 (ANALYZE)								
ASSESSME													
First Periodica I Assessm ent	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendanc e	ESE								
15%	15%	10%	5%	5%	50%								
Course Descripti on	Mobile Robot is an in an environment industry, and envir skill like the robot on sensor characte programming know interface to the co Image based senso obstacles and find mobile robots for suitable controllers	autonomous navigating de t. The autonomous robots conmental monitoring. The mechanisms, electronic circ eristics and selection of ser vledge of robots with Pythe ontrollers. Autonomous na ors, mapping and localisati the optimal path for reaching various applications by se s for the effective implement	evice that can are applied application o cuits and arra- nsor for varies on and C lang avigation of n on of robots ng the target electing sense atation is focu	maneuver an in many fiel f mobile robo y of sensors. A ty of applicati uage and to o nobile robots by various al location. Desigors, navigatio sed here.	d reach the target ds viz healthcare, ot requires a basic A basic knowledge ons. Fundamental design the sensors with the help of gorithms to avoid gn and developing n techniques and								
Course Objectiv e	 The course will enable the students to understand the: Term of mobile robots and appreciate its use in industries Working principle of the knowledge on sensors and actuators for robot applications Apply vision based navigation in mobile robots Various system integration for mobile robots Learn the applications of mobile robots 												

		Upon completion of this course, the students will be able to
	1.	Recall the fundamentals of mobile robots
Course	2.	Apply knowledge on sensors and actuators for robot applications
Outcome	3.	Apply vision-based navigation in mobile robots
	4.	Perform system integration for mobile robots
	5.	Build Mobile Robots for specific applications

Prerequisites: Nil

CO, PO AND PSO MAPPING

· ·														
С	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PSO	
0	1	2	3	4	5	6	7	8	9	10	11	12	-1	F 30-2
С	3	3	3	2	2	-	-	-	-	-	1	1	2	3
0-														
1														
С	3	3	3	3	2	2	2	1	1	1	1	2	2	3
0-														
2														
С	3	3	3	3	2	2	2	1	1	1	1	2	2	3
0-														
3														
С	3	3	3	3	2	2	2	1	1	1	1	2	2	3
0-														
4														
С	3	3	3	3	2	2	2	1	1	1	1	2	2	3
0-														
5														
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1 – INTRODUCTION (9L)										(9L)				
Intr	oducti	on to	mohile	Dobo	tc I	214/5	of Dob	otc	Pohot	Anato	mu	Pacie		

Introduction to mobile Robots – Laws of Robots – Robot Anatomy – Basic	
Mechanics of Robots – Basic Electronics for Robots, Companion Robots – Robots for	
Agriculture Applications – Space Robots – Defense Robots.	CO-1
Suggested reading:	BTL-1,2
Study of mechanical and electrical quantities in robot application	
Case study of mobile robots in various domains	
MODULE 2 – SENSORS AND ACTUATORS	(9L)
Sensors for mobile robots – Sensor Characteristics – Classification of Sensors –	
Electric Actuators – DC Motors – Servo motor, stepper motor – Linear Actuators –	
Encoders – Motor Drives.	CO-2
Suggested reading:	BTL-1,2
Study of calibration of sensors	
Study of electrical drives and controllers	
MODULE 3 – VISION AND NAVIGATION	(9L)

Ima	ge Acquisition – Obstacle Detection and Avoidance – Localization – Path	
Plan	ning Methods – Monte Carlo Methods.	
Sug	gested reading:	CO-3
Stu	dy of optimization algorithm for navigation	BTL-2,3
Stu	dy of localization algorithm.	
MO	DULE 4 – PROGRAMMING AND INTERFACING	(9L)
Rob	ot Programming using Python – Basic Embedded C Programming for Robots –	
Data	a Acquisition – Interfacing Sensors and Actuators with Robot Controller –	
Prog	gram for Interfacing.	CO-4
Sug	gested reading:	BTL-3,4
Stu	dy of interfacing programming of sensors and actuators	
Stu	dy of python programming for interfacing	
MO	DULE 5 – BUILDING OF MOBILE ROBOTS	(9L)
Buil	ding of various types of mobile robots – Use of various Sensing methods,	
Nav	igation and Vision-Demonstration and Exercises	CO-5
Sug	gested reading:	BTL-3.4
Stu	dy of sensing methods in mobile robots	, _
Stu	dy of mobile robots for variable applications	
LAB	/ MINI PROJECT / FIELD WORK	
1.	Design and develop a mobile robot for a specific application	
TEX	T BOOKS	
1.	Ulrich Nehmzow. (2003). <i>Mobile Robots - A practical introduction</i> , Springer, seco	ond edition.
2.	S.R. DEB, S. DEB. (2011). Robotics Technology and Flexible Automation, McGraw-	Hill, 2nd Edition
2	Mikell P. Groover, Roger N. Nagel (2012). Industrial Robotics: Technology, Progra	amming, and
5.	Applications, McGraw-Hill Companies	
REF	ERENCE BOOKS	
1	Woo-Kyung Choi, Hong-Tae Jeon, Seong-Joo Kim. (2007). Multiple Sensor Fu	ision and Motion
1.	Control of Snake Robot Based on Soft-Computing, INTECH Open Access Publisher	•
2.	S.R. DEB, S. DEB. (2011). Robotics Technology and Flexible Automation, Mc-Graw	/Hill, 2nd Edition.
3.	Katsuhiko Ogata. (2011). Modern Control Engineering, Pearson Education.	
E B	ООКЅ	
1.	http://home.deib.polimi.it/gini/robot/docs/siegwart.pdf	
2.	https://mitpress.mit.edu/books/introduction-autonomous-mobile-robots	
MO	OC	
1.	https://www.coursera.org/learn/mobile-robot	
2.	https://www.open2study.com/courses/mobile-robotics	

DEPARTMENTAL ELECTIVES – SEMESTER IV

COL TI	JRSE TLE	INDUSTRIAL ROBOTS CREDITS 3												
CO CC	URSE DDE	N	/HC420	66	со	URSE	CATEG	ORY	C	DE	L-T-	P-S	:	3-0-0-1
Vei	rsion		1.0		A	opprov	al Deta	ils	24 th 30.0!	ACM, 5.201 8	LEAR LE\	NING /EL		BTL-3
ASS	ESSME	NT SCI	HEME											
Fi Perio Asse	irst odical essme nt	Second Periodical AssessmentSeminar/ Assignments/ ProjectSurprise Test / QuizAttendanceESE											ESE	
1	5%		15%			1	0%		5	%	59	%		50%
Co Dese	urse cripti)n	The course is aimed at providing concepts and skills in the industrial automation domain related to mechatronics, robotics, electrical machines and drives. Students will learn, in the first module, fundamental concepts and methodologies for understanding and modelling mechatronic systems and industrial robots; then, they will acquire fundamental knowledge and competences on how to simulate and program industrial robots. In the second module the course discusses the theoretical basis and the practical applications of the electrical drives technology applied to automation and mechatronic systems. At first, the theory of electrical motors (actuators) is introduced. Then, the drive system is analyzed considering all of its components and the various control strategies that can be adopted. Emphasis is given to practical applications, especially considering the advantages												
Cou Obje e	rse ectiv	The s 1. Re 2. Ca 3. Id 4. Cr 5. Di	pecific ecogniz alculate entify a reate in scuss a pon co	objecti e the k e kinem actuato ndustria about v mpletia	ves of pasics c natics o ors and al robo arious on of tl	the Cou of robot of indus sensor t progr applica his cou	urse en ts. strial ro rs used ammin ations in rse, the	able th bots. in indu g n indus e stude	e stude Istrial r tries nts will	obots	e to			
Cou Outo Prer	rse come equisit	 Co Do Id Ai Ai Do Do Es: Nil 	ompref erive th entify a oply ind escribe	nend th ne kine actuato dustrial applic	e basio matics ors and robot ations	cs of ro of robo sensor progra of indu	bots. ots. rs used mming strial re	in indu g. obots	istrial r	obots.				
со,	PO AN	ID PSO	MAPP	ING										
C O	PO- 1	РО- 2	РО- 3	РО- 4	РО- 5	РО- 6	РО- 7	РО- 8	РО- 9	PO- 10	PO- 11	PO- 12	PSO -1	PSO-2

								1	1					
C O- 1	3	3	2	2	1	-	-	-	-	1	-	1	2	2
C O- 2	3	3	2	2	1	-	-	-	1	1	-	-	2	2
C O- 3	3	3	2	2	2	-	-	-	1	1	-	-	2	2
С О- 4	3	3	2	2	2	-	-	-	1	1	-	-	3	3
C O- 5	2	2	3	2	2	-	-	-	-	-	-	-	3	3
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1:INTRODUCTION												9L		
History of Robots – Robot Anatomy – Robot Configurations – Work Volume – Robot Safety. Suggested Readings: History of Robots MODULE 2: KINEMATICS										CO-1 BTL-3 9L				
Repr Sugg Stu	resenta gested dy of fo	ation Readin orward	igs: I and in	nverse	geome		TOTWA					- 011		CO-2 BTL-3
MO	DULE 3	: DRIVI	ES, ACT	UATO	RS SEN	SORS A	AND EN	D EFFE	CTORS		_			9L
Fund Sele Vacu Sugg Bala	ctions of ction of uum an gested ancing	of Drive of Sens Id Adhe Readin of Simp	e Syste ors – esive G i gs: ole med	ms – A Classifi rippers chanisn	C, DC N cation ns	vlotors of Sen	– Pneu Isors –	Data <i>i</i>	and Hy Acquisi	draulic tion –	: Actua Mecha	tors – inical,		CO-3 BTL-2
MO	DULE 4	: ROBC	DT LAN	GUAGE	S AND	PROG	RAMM	ING						9L
Robot Languages – Classification of Languages –VAL II- Motosim, Computer Control and Robot Software. Suggested Readings: Robot languages											CO-4 BTL-2			
MO	DULE 5	: APPLI	ΙCATIO	NS										9L
MODULE 5: APPLICATIONS Robot Applications – Welding, Palletizing, Deburring, Assembly- Hands on training in material handling and processing applications, recent trends in industrial robots- Building of grippers – Exercises											CO-5 BTL-3			

Sugg	gested Readings:									
Stu	dy of Robots applications in industries									
TEX	T BOOKS									
1	Mikell P. Groover, Roger N. Nagel. (2012). Industrial Robotics: Technology, F	Programming, and								
т.	Applications, McGraw-Hill Companies.									
2.	Rao. P.N. (2003). <i>Manufacturing Technology - Metal Cutting and Machine Tools,</i> Tata McGraw-Hill.									
REFI	REFERENCE BOOKS									
1	S.R. DEB, S. DEB. (2011). Robotics Technology and Flexible Automation, Mc-GrawHill, 2nd Edition,									
1.	2011.									
2.	Roy. A.Lindberg. (2006). Process and Materials of Manufacture, Fourth Edition, PHI/Pearson									
	Education.									
3.	Edquist. (1988). Flexible Automation: The Global Diffusion of New Technology, V	Viley-Blackwell.								
E BO	OKS									
1.	http://onlinelibrary.wiley.com/book/10.1002/9780470172506									
MO	DC									
1.	https://www.coursera.org/specializations/robotics									

COURSE TITLE	MACHINING TECHNOLOGY CREDITS 3											
COURSE CODE	MHC4267	COURSE CATEGORY	L-T-P-S	3-0-0-1								
Version	1.0	Approval Details	LEARNING LEVEL	BTL-4								
ASSESSME	SESSMENT SCHEME											
First Periodical Assessme nt	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE							
15%	15%	10%	5%	5%	50%							
Course Descripti on	Machining is a process in which a material (often metal) is cut to a desired final shape and size by a controlled material-removal process. Machining is a part of the manufacture of many metal products, but it can also be used on other materials such as wood, plastic, ceramic, and composite material.											
	The specific object	ives of the Course enable t	he students to	D								
Course	1. Comprehend the	e metal cutting theories and	d concepts									
Objectiv	2. Present various	turning machining methods	5									
е	3. Familiarize diffe	rent finishing operations.										
	4. Describe non-tra	aditional methods and show	v their superio	prity of proces	s.							

	5. Describe the Laser and Plasma arc machining.													
		Upon	compl	etion o	of this c	ourse,	the stu	Idents	will be	able t	o:			
		1. Co	mpreh	end the	e funda	imenta	l conce	pts of	metal c	utting				
Cou	rse	2. Se	lect the	e mach	ining m	ethod:	5.							
Outco	ome	3. Describe turning and finishing operations.												
		4. C0	-, comprehend the unterent types of non-traditional machining, operation and its											
		5. De	. Describe the operation of Laser beam & plasma arc machining.											
Prereguisites: NIL														
CO PO AND PSO MAPPING														
	Р				_									
со	0-	PO- 2	PO- 3	PO- 1	РО- 5	PO-	PO- 7	PO-	PO- a	PO- 10	PO-	PO-	PSO -1	PSO-2
	1	-	5	-	5	0	,	0	5	10		12	-1	
CO- 1	3	2	3	2	1	1	1	1	2	1	-	1	3	2
CO- 2	3	2	3	2	1	1	1	1	2	1	-	1	3	2
CO- 3	3	2	3	2	1	1	1	1	2	1	-	1	3	2
CO- 4	3	2	3	2	1	1	1	1	2	1	-	1	3	2
CO- 5	3	2	3	2	1	1	1	1	2	1	-	1	3	2
			1: W	eakly r	elated,	2: Mo	deratel	y relat	ed and	3: Stro	ongly r	elated		
MOD	ULE 1	L: TH	EORY	OF MET	AL CUT	TING							9L	
Mech	anics	of chi	p form	ation, s	ingle p	oint cu	tting to	ol, for	ces in r	nachin	ing, Ty	pes of		
cnip,	cutti g to	ng too ol mat	us – n terials	tool	lature, wear	ortno tool li	gonai i fe sur	netai face f	Cutting inish	, theri	mai as , fluide	pects,		CO-1
Machi	inabi	lity.		001	wear,		ic, 501			Satting	,			BTL-4
Sugge	ested	Readi	ngs											
Adva	nces	in The	ory Of	Metal (Cutting									
MODULE 2:TURNING MACHINES									9	_				

Centre metho		
estima	CO-2	
autom	BTL-2	
Sugges		
Advar	ices in Turning Machines	
MODU	LE 3: ABRASIVE PROCESS AND BROACHING	9L
Abrasi	ve processes: grinding wheel – specifications and selection, types of grinding	
proces	s– cylindrical grinding, surface grinding, centreless grinding and internal	
grindir	ng- Typical applications – concepts of surface integrity, broaching machines:	CO-3
broach	n construction – push, pull, surface and continuous broaching machines	BTL-2
Sugge	sted Readings:	
Best p	ractices for Abrasive Process and Broaching	
MODU	LE 4 :NON-TRADITIONAL MACHINING	9L
Introd capabi	uction, need, Abrasive Jet Machining , Parametric Analysis, Process lities, Ultrasonic Machining –Mechanics of cutting, models, Parametric	
Analvs	is. Water Jet Machining —principle, equipment process characteristics .	
perfor	mance. EDM – principles, equipment, generators, analysis of R-C circuits.	CO-4
MRR.	BTL-3	
Sugges		
Evolut		
MODU	LE 5: LASER BEAM & PLASMA ARC MACHINING	9L
Laser	Beam Machining – Principle of working, equipment, Material removal rate,	
Proces	s parameters, performance characterization, Applications. Plasma Arc	
Machi	ning – Principle of working, equipment, Material removal rate, Process	CO-5
param	eters, performance characterization, Applications	BTL-4
Sugges	ted Readings:	
Next-g	generation LASER BEAM & PLASMA ARC Techniques.	
TEXT B	OOKS	
1.	H.A. Taha (2003). <i>Operations Research - An Introduction</i> , Prentice Hall of Education	India./Pearson
2.	J.K. Sharma(2006). Operations Research, Macmillan	
REFER	ENCE BOOKS	
1.	F S Hiller and G J Leiberman(2000), Introduction to Operations Research	
2.	Gupta Prem Kumar and Hira D S (2010). Operations Research	
MOOC		

COURSE TITLE	F	RODUCT	DEVELOP	MENT	•			CRE	DITS	3			
COURSE CODE	MHC4269	COL	IRSE CAT	EGOR	Y	DE		L-T-	P-S	3-0-0 1	0-		
Version	1.0	Арр	roval De	tails		24 th ACN 30.0 18	1, 5.20	LEA G LE	RNIN VEL	BTL-	4		
ASSESSMENT SCHEME													
First Periodical Assessment	Second Periodi Assessment	cal Sem Assi	inar/ gnments,	/ Proje	ect	Surp Test Quiz	orise /	Atte ce	endan	ESE			
15%	15%	10%	•			5%		5%		50%			
Course Description	This course immer objective of learning them to gain thoro from consumer new evaluation, product new products in or for the students t product and efficient The course should 1. Learn terms in the 2. Learn how to interval	This course immerses students in the new product development process with the objective of learning modern key tools, techniques and methods. This course will help them to gain thorough understanding in the entire new product development process from consumer need identification, product ideation, concept development, concept evaluation, product design to marketing of any product. Since every industry develop new products in order to be successful in the business market this course is important for the students to be familiar and use latest technology tools for designing any product and efficiently handle whole project management cycle. The course should enable the student to, Learn terms in the new product development process.											
Course Objective	 Learn and apply the concepts and tools necessary through case examples and assignments. Use the new product development process by conceiving your own new product or service and an introductory launch plan. Participate in group work sessions and teams to become acquainted with the importance of teamwork and collaboration that is critical to new product success. 												
Course Outcome	 importance of teamwork and collaboration that is critical to new product success. Upon completion of this course, the students will be able to Describe the nature and techniques of new product development process Discuss the market opportunities, develop an understanding of customer and user needs, and assess the competitive landscape Competent with a set of tools and methods for product design and development. Demonstrate the best level of practice in each problem situation within the context of innovation and new product development Work collaboratively on a team to successfully complete a design project and to effectively communicate the results of projects and other assignments in a written and oral format 												
Prerequisite	s: NIL												
CO, PO AND	PSO MAPPING												
со	P 0 PO-2 PO I -3 -	PO PO 4 -5	РО -6	PO -7	PO -8	РО -9	PO -10	PO -11	PO -12	PS 0-1	P S		

		1	1		1	1	1	1	1	1	1	1		<u> </u>
	- 1													0 -
														2
CO-1	3	3	1	1	-	2	-	-	-	1	-	-	1	2
CO-2	3	3	2	1	-	2	1	-	-	1	-	2	1	2
CO-3	3	3	2	2	3	2	-	-	-	1	-	2	1	2
CO-4	3	3	3	3	3	2	1	-	-	1	-	2	1	2
CO-5	3	3	3	3	1	2	0	2	2	1	2	2	1	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE 1:	INTF	RODUCTI	ON	(9	€L)									
Research and new product development –Need for developing new products -relevance of product lifecycle issues in design-Generic New Product Development Process- Intellectual property rights (IPR)-Patents - Patent search - Patent laws - International code for patents. Suggested Readings: Intellectual property rights (IPR), patent laws										CO-1 BTL-	L 2			
MODULE 2: 0	CONS	SUMERS /	AND O	PPORT	UNITIE	S (9L)								
Identifying customer needs –voice of customer –customer populations- hierarchy of human needs-need gathering methods – affinity diagrams – needs importance- establishing engineering characteristics-competitive benchmarking- quality function deployment- house of quality- product design specification-case studies									CO-2 BTL-	2 3				
MODULE 3: I	NEW	PRODUC		LOPM	ENT PF	ROCESS	5-1			(9L)			
Idea generation- Collection of ideas and purpose of project - Selection criteria - screening ideas for new products - Principal, Point Forward Developing and Selecting Product Concepts- concept development- Concept evaluation techniques.									CO-3 BTL-	} 3				
MODULE 4:	NEW	V PRODU	CT DE\	/ELOPN	VENT P	ROCES	is – II				(9L)			
Design process- Different stages in design and their significance - Design detailing- Material selection, Design visualization- Solid modeling; Detailed 2D drawings; Tolerance; Use of standard items in design; Research needs in design- Designing and branding a product. Selecting a brand name, packaging Suggested Readings: Designing and branding a product									CO-4 BTL-	l 4				
MODULE 5: STRATEGIC MARKETING									(9L)					
Sales Forecasting and Financial Analysis- Marketing Plan-Secrets of New Product Success- Strategic Launch Planning -Implementation of the Strategic Plan-Cases Examples of New Innovative Product Forecasting Before Launching- Open innovation; User innovation; Crowd sourcing; Free innovation-Continuous innovation and creating a culture of innovation PROJECT: Creative design - Model Preparation - Testing - cost evaluation Suggested Readings: Sales forecasting and financial analysis								CO-5 BTL-	; 3					
TEXTBOOKS														

1.	Anita Goyal, Karl T Ulrich, Steven D Eppinger. (2009). <i>Product Design and Development</i> , 4th Edition, Tata McGraw-Hill Education, ISBN-10-007-14679-9
REFERENCE	BOOKS
1.	Isaacson, Walter. (2014). <i>The Innovators: How a Group of Hackers, Geniuses, and Geeks Created the Digital Revolution</i> , Simon and Schuster, New York, NY.
2.	Gladwell, Malcolm. (2000). <i>The Tipping Point: How Little Things Can Make a Big Difference</i> , Little, Brown, and Co.: New York, NY.
3.	Norman, Donald A. (2004). <i>Emotional Design: Why We Love (or Hate) Everyday Things,</i> Basic Books: New York, NY.
4.	Christensen, Clayton M. (1997). The Innovator's Dilemma, Harper Collins: New York, NY.
5.	Urban, Glen L. and John R. Hauser. (1993). <i>Design and Marketing of New Products,</i> Revised Edition, Prentice-Hall, Inc.: Englewood Cliffs, NJ.
6.	Moore, Geoffrey. (1991). Crossing the Chasm, Harper Collins Publishers, New York.
E BOOKS	
1.	https://www.designbetter.co/principles-of-product-design
MOOC	
1.	https://www.coursera.org/learn/new-product-development
2.	https://www.edx.org/course/new-product-development

DEPARTMENTAL ELECTIVES – SEMESTER V

COURSE TITLE	BUI	CREDITS	3									
COURSE CODE	MHC4355	COURSE CATEGORY	DE	L-T-P-S	3-0-0-1							
Vorsion	1.0	Approval Dotails	24 th ACM,	LEARNING								
Version	1.0	Approval Details	30.05.2018	LEVEL	DIL-4							
ASSESSMENT SCHEME												
First Periodical	Second Periodical	Seminar/	Surprise Test /	Attendance	FSF							
Assessment	Assessment	Assignments/ Project	Quiz	Attendance	LJL							
15%	15%	10%	5%	5%	50%							
	Building automation is an automatic centralized control system that provides automate											
	intelligent system of	both hardware and s	oftware connecti	ng heating ven	ting and air							
	conditioning system (HVAC). lighting, securi	ity, and other sys	tems to commu	inicate on a							
	single platform. The a	utomation system is u	used to deliver the	e crucial informa	ation on the							
Course	operational performa	rce of a building. Secu	rity of the buildin	g and safety of p	personal are							
Description	becoming important a	spects now a day and i	in near future, it v	vill be in a great	demand.							
	The objectives of buil	ding automation were	e to enhance the	safety and con	nfort of the							
	occupants, efficient o	peration of building sy	stems, reduction	in energy consu	mption and							
	operating costs, and	improved life cycle o	f utilities. Comple	ex infrastructure	e requires a							
	variety of building aut	omation and control S	ystems. This subj	ect will help the	students to							
	understand the variou	s aspects of different s	systems seen in w	ell structured bu	ilding.							

Course Objective	Tł	ne course should enable the student to,
	1.	Study the current values, technology, terminology and practices used in building
		automation system
	2.	Analyze and choose the suitable hardware and software for HVAC system and various
		applications
	3.	Appraise the concept of energy management system and techniques adopted
	4.	Evaluate different safety standards and features of integrated systems
		Upon completion of this course, the students will be able to
	1.	Select and evaluate the different transducers, actuators, AC, refrigeration systems in
Courses		modern Buildings.
Course	2.	Identify the importance and techniques of energy conservations in BAS for simple
Outcome		applications
	3.	Design and installation methods of safety sensors for simple application
	4.	Describe the procedure for integrated and secure smart building techniques

Prerequisites: Nil

CO, PO AND PSO MAPPING

со	PO -1	PO -2	РО- 3	РО- 4	РО- 5	РО- 6	РО- 7	РО- 8	РО- 9	РО- 10	PO- 11	PO- 12	PSO-1	PSO-2
CO- 1	2	1	1	-	-	2	1	2	2	1	2	3	3	2
CO- 2	2	2	1	1	-	2	2	2	2	1	2	3	3	2
CO- 3	3	2	3	1	1	1	1	1	1	1	2	3	3	2
CO- 4	2	1	1	2	1	2	2	1	1	1	2	3	3	3

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: INTRODUCTION (9L)							
Introduction to Building Automation System, Features, Characteristics, Drawbacks of Building							
Automation system. Various Systems of Building Automation – Building Management							
System, Energy Management System, Security System, Safety System, Video Management							
System.	CO-1						
Practical component:							
Building parameter control using basic sensors and actuators							
Suggested Readings:							
Level of Vulnerabilities							
MODULE 2: BUILDING MANAGEMENT SYSTEM(9L)							
Qualitative study- Introduction, HVAC, Sensors & Transducers – Temperature, Pressure, Level, Flow, RH. Meaning of Analog & Digital Signals, Valves and Actuators, Valve & Actuator Selection, Various Controllers, Job IO Summary Calculation, Controller Sizing, AI to DI Conversion, Cable Selection, Earthing – Meaning, Importance, Panel Earthing, EMI & Tackling EMI. Logic Examples, CL Programming. Practical component: Heating, Ventilation and Air-conditioning (HVAC) Suggested Readings: Building automation communication standards	CO-2 BTL-3						
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MODULE 3: ENERGY MANAGEMENT SYSTEM(9L)							
Concept, Energy Meters, Types, Meter Networking, Monitoring Energy Parameters, Analysis of Power Quality – Instantaneous Power, Active Power, Reactive Power, Power Factor, Voltage, Current. Effect of Power Quality on Energy Consumption, Energy Reports, Energy Conservation, Importance of Energy Saving. Practical component: Illumination (lighting) control Suggested Readings: Concept of Green building (LEED)	CO-3 BTL-3						
MODULE 4: SAFETY SYSTEMS (9L)							
Introduction, Fire –Meaning, Fire Development Stages, Fire Sensors & Detectors, Detector Placement, Detectors Required For Various Applications. Fire Extinguishing Principles, Fire Extinguishers & Its Classification. Fire Alarm System – Controllers, Components, Features, Concept of Fire Loop & Fire Devices, 2-Wire & 4-Wire Loops, Working Principle, System Description, Pre-alarm, Alarm, Trouble, Fault, Differences, Cable Selection, Installation Guidelines Best Installation Practices, Logic Example. NFPA and IS2189 Stds, System Programming Practical component: Fire detector & alarm system Suggested Readings: Design aspects and components of PA system	CO-4 BTL-3						
MODULE 5: INTEGRATED SYSTEMS (9L)							
Introduction, Integration of Building Management System, Energy Management System, Safety System, Security Systems & Video Management, Benefits of Integrated Systems, Challenges, Future Prospects of Integrated Systems. Practical component: Access control Suggested Readings: Intelligent Building	CO-5 BTL-3						
TEXT BOOKS							

1	You Lin Xu & Jia He. (2017). Smart Civil Structures, CRC Press.
2	Nancy G. Leveson. (2011). Engineering a Safer World: Systems Thinking Applied to Safety
2	<i>(Engineering Systems),</i> 1 st Edition, The MIT Press.
REFERENCE BO	DOKS
1	Geoff Levermore. (2000). Building Energy Management Systems: An Application to
1	<i>Heating, Natural Ventilation, Lighting and Occupant Satisfaction,</i> 2 nd Edition, Routledge.
2	Haralick, R.M. and Shapiro, L.G. (1990). Computer and Robot Vision (Volumes I and II),
2	Addison Wesley, Reading Massachusetts.
	Reinhold A. Carlson, Robert A. Di Giandomenico. (1991) Understanding Building
3	Automation Systems: Direct Digital Control, Energy Management, Life Safety, Security
	Access Control, Lighting, Building, 1 st edition, R.S. Means Company Ltd.
моос	
1	https://www.ed2go.com/courses/construction-and-trades/trades/ctp/hvacr-
	controlsbuilding-automation-systems

COURSE TITLE	ELECTI	ELECTRONIC DEVICES & CIRCUITS CREDITS 3											
COURSE CODE	MHC4356	COURSE CATEGORY	DE	L-T-P-S	3-0-0-1								
Version	1.0	Approval Details	24 th ACM, 30.05.201 8	LEARNING LEVEL	BTL-3								
ASSESSME	SSMENT SCHEME												
First Periodical Assessme	Second Periodical Assessment	Seminar/ Assignments/ Project	Attendance	ESE									
IIL													
15%	15%	10%	5%	5%	50%								
15% Course Descripti on	15% Electronic Devices and circuits such a power supplies, am	10% and Circuits deals with the s passive components, dio plifying circuits, electronic	5% design and a des, triodes a instruments,	5% oplications of nd transistors and oscillators	50% electronic devices 5, rectification and 5.								

		Upon completion of this course, the students will be able to
	1.	Describe the fundamental concepts of electronic devices
	2.	Explain and Analyse the different types of diodes, operation and its characteristics
Course	3.	Describe the operation of BJT and FET, its biasing and input-output characteristics of
Outcomo		different configurations
Outcome	4.	Differentiate the different type of negative feedback amplifiers and oscillator circuits
		with their design equations.
	5.	Design diode application circuits, amplifier circuits and oscillators employing BJT, FET
		devices.

Prerequisites:

CO, PO	AND	PSO	MAPF	PING
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со	Р О- 1	РО- 2	РО- 3	РО- 4	РО- 5	РО- 6	РО- 7	РО- 8	РО- 9	PO- 10	PO- 11	PO- 12	PSO -1	PSO-2
CO- 1	3	3	-	-	-	-	-	2	2	-	-	2	2	2
CO- 2	3	3	3	3	3	-	-	2	2	-	-	2	2	2
CO- 3	3	3	-	-	-	-	-	2	2	-	-	2	2	2
CO- 4	3	3	-	-	-	-	-	2	2	-	-	2	2	2
CO- 5	3	3	-	-	-	-	-	2	2	-	-	2	2	2

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: SEMICONDUCTORS & DIODES (6L+	6P)
Semiconductor fundamentals – Energy Band diagram – Intrinsic and Extrinsic	
Semiconductors PN j unction diode-Qualitative Theory of P-N Junction, P-N Junction	
as a Diode, Diode Equation, Volt- Ampere Characteristics, Temperature dependence	CO-1
of VI characteristic, Breakdown Mechanisms in Semiconductor Diodes, Zener Diode.	BTL-2
Suggested Readings:	
Semiconductor	
MODULE 2: RECTIFIERS AND FILTERS	(6L+6P)
P-N junction as a Rectifier, Half wave Rectifier, Full wave Rectifier, Bridge Rectifier, Harmonic components in a Rectifier Circuit, Inductor Filters, Capacitor Filters, L- Section Filters, π - Section Filters, , Voltage Regulation using Zener Diode. Suggested Readings: Comparison of Filters	CO-2 BTL-2
MODULE 3: BIPOLAR JUNCTION TRANSISTOR	(6L+6P)

Principle of transistor action – Cut off, Active and saturation regions of a transistor –	
CE,CB,CC Configurations - Comparison -Transistor as a switch and amplifier-	
Classification of amplifiers- Distortion in amplifiers- frequency response of an	CO-3
amplifier.	BTL-3
Suggested Readings:	
BJT Hybrid Model	
MODULE 4: FIELD EFFECT TRANSISTOR	(6L+6P)
Junction Field Effect Transistor (Construction, principle of operation, symbol) -	
Pinch-off Voltage - Volt-Ampere characteristics, FET Amplifiers MOSFET	
(Construction, principle of operation, symbol), MOSFET Characteristics in	CO-4
Enhancement and Depletion modes	BTL-2
Suggested Readings:	
JFET Small Signal Model	
MODULE 5: OSCILLATORS & MULTI VIBRATORS	(6L+6P)
Classification of oscillators - Barkhausen criterion operation and analysis of RC	
phase shift – Hartely and colpitts oscillators – Multivibrators – astable, monostable	CO-5
and bistablemultivibrators	BTL-2
Suggested Readings:	
Schmitt Trigger	
TEXT BOOKS	
Boylestad&Nashelsky, (2001), Electronic Devices & Circuit Theory, Eighth ed	ition, Prentice Hall
^{1.} Of India (P) Ltd.	
REFERENCE BOOKS	
1 Millman and Halkias, (2015), Electronic devices and Circuits, Tata McGraw Edition.	Hill International,
2 Thomas L. Floyd, (2010), Electron Devices, Charles & Messil Publications.	
MOOC	
1 https://www.mooc-list.com/course/electronic-materials-and-devices-edx	
2 https://www.mooc-list.com/course/04832430x-electronic-circuits-edx	

COURSE TITLE	INDUS	INDUSTRIAL INSTRUMENTATION CREDITS											
COURSE CODE	MHC4357	MHC4357 COURSE CATEGORY DE L-T-P-S 3-0-0-1											
Version	1.0	Approval Details	24 th ACM, 30.05.201 8	LEARNING LEVEL	BTL5								
ASSESSME	INT SCHEME												

F Peri Asso	irst odical essme	Seco	nd Perio	odical ent	Sem	ninar/ A Pro	ssignme	ents/	Surj Test /	prise / Quiz	Atten	dance		ESE	
	nt														
1	.5%		15%			10	0%		5	%	5	%	50%		
Co Des	Industrial Instrumentation delivers the automation tools required for the Real t application. The knowledge of programmable logic controller basics, design for softw course and hardware requirements for a successful deployment. The different methods programming the PLC and instructions used to program PLC are dealt with. The exposur- on SCADA tools gives a cutting-edge deployment of effective management of resour available in plant or networked zones. The Distributed control system plays a vital rol industry scenario to monitor and control the day to day operations of the plant.														
Co Obj	Course Objectiv eThe course will enable the students to understand: 1. The basics Industrial instrumentation systems 2. The fundamental operation of PLC and DCS 3. The real time interface of sensor and actuators in various applications														
Co Out	ourse come	Upor 1. Cc 2. De 3. De	n comp ompref escribe esign a	letion d nend ar PLC an utomat	of this o nd gain nd DCS ion sys	course, knowle stem ar	the stu edge ab nd deve	idents bout in lop PL	will be dustria C ladde	able to l contro er logic	o ollers for sys	tems.			
Prer	equisit	es:													
CO	, PO A	ND PS	SO MA	PPIN	G										
C O	PO- 1	РО- 2	РО- 3	РО- 4	РО- 5	PO- 6	РО- 7	РО- 8	РО- 9	PO- 10	PO- 11	PO- 12	PSO -1	PSO-2	
C O- 1	3	3	3	2	2	-	-	-	-	-	1	1	2	2	
C O- 2	3	3 3 2 2 1 1									2	2			
C O- 3	3	3	3	2	2	-	-	-	-	-	1	1	2	2	
			1: W	eakly r	elated,	, 2: Mo	derate	y relat	ed and	3: Str	ongly r	elated			
MO	DULE 1	1 – INT	RODUC	CTION										(9L)	
Intr	oductio	on to a	utomat	tion too	ols – PL	.C, SCA	DA, DC	S, Hybr	id DCS	-PLC				CO-1	

BTL-1,2

(9L)

MODULE 2 – PROGRAMMABLE LOGIC CONTROLLERS

Har	dware, selection, I/O devices and programming	
Sug	gested reading:	CO-2
Stu	dy of Digital data systems	BTL-1,2
Stu	dy of data acquisition devices.	
MO	DULE 3 – AUTOMATION SPECIFICATIONS	(9L)
Fun	ctional design specifications for automation tool, Development of user	
requ	uirement specifications.	CO- 2
Sug	gested reading:	BTI -3 4
Stu	dy of key components of automation systems	512 3,4
Stu	dy of various types of automation systems	
MO	DULE 4 – DISTRIBUTED CONTROL SYSTEM	(9L)
Arc	hitecture, specifications, sensor interfacing	
Sug	gested reading:	CO-3
Stu	dy of key components of distributed control systems	BTL-4,5
Stu	dy of data interfacing and communication from field devices	
MO	DULE 5 – APPLICATIONS	(9L)
Cas	e Study – Industrial process monitoring and automation	
Sug	gested reading:	CO-3
Stu	dy of redundant systems and history servers	BTL-5
C+	dy of DCS implementation for industries	
Stu	ay of Des implementation for industries	
	/ MINI PROJECT / FIELD WORK	
LAB	/ MINI PROJECT / FIELD WORK Study of automation systems	
LAB 1. 2.	/ MINI PROJECT / FIELD WORK Study of automation systems PLC programming for motor control	
LAB 1. 2. 3.	/ MINI PROJECT / FIELD WORK Study of automation systems PLC programming for motor control Study of DCS for industrial process applications	
LAB 1. 2. 3. TEX	/ MINI PROJECT / FIELD WORK Study of automation systems PLC programming for motor control Study of DCS for industrial process applications T BOOKS	
LAB 1. 2. 3. TEX	/ MINI PROJECT / FIELD WORK Study of automation systems PLC programming for motor control Study of DCS for industrial process applications T BOOKS William C Dunn.(2005). Fundamentals of Industrial Instrumentation and Process	<i>control,</i> McGraw
LAB 1. 2. 3. TEX 1.	/ MINI PROJECT / FIELD WORK Study of automation systems PLC programming for motor control Study of DCS for industrial process applications T BOOKS William C Dunn.(2005). Fundamentals of Industrial Instrumentation and Process Hill, 2005.	<i>control,</i> McGraw
LAB 1. 2. 3. TEX 1.	 / MINI PROJECT / FIELD WORK Study of automation systems PLC programming for motor control Study of DCS for industrial process applications T BOOKS William C Dunn.(2005). Fundamentals of Industrial Instrumentation and Process Hill, 2005. Donald P. Eckman. (2009). Industrial Instrumentation, CBS Publishers & Distribute 	<i>control,</i> McGraw
LAB 1. 2. 3. TEX 1. 2	 / MINI PROJECT / FIELD WORK Study of automation systems PLC programming for motor control Study of DCS for industrial process applications F BOOKS William C Dunn.(2005). Fundamentals of Industrial Instrumentation and Process Hill, 2005. Donald P. Eckman. (2009). Industrial Instrumentation, CBS Publishers & Distribute edition 	<i>control,</i> McGraw
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LAB 1. 2. 3. TEX 1. 2 REF	 / MINI PROJECT / FIELD WORK Study of automation systems PLC programming for motor control Study of DCS for industrial process applications T BOOKS William C Dunn.(2005). Fundamentals of Industrial Instrumentation and Process Hill, 2005. Donald P. Eckman. (2009). Industrial Instrumentation, CBS Publishers & Distribute edition ERENCE BOOKS Chennakesava R. Alavala, (2011). Principles of Industrial Instrumentation and C CENGAGE Learning Asia. 	<i>control,</i> McGraw
LAB 1. 2. 3. TEX 1. 2 REF 1 2	 / MINI PROJECT / FIELD WORK Study of automation systems PLC programming for motor control Study of DCS for industrial process applications T BOOKS William C Dunn.(2005). Fundamentals of Industrial Instrumentation and Process Hill, 2005. Donald P. Eckman. (2009). Industrial Instrumentation, CBS Publishers & Distribute edition ERENCE BOOKS Chennakesava R. Alavala, (2011). Principles of Industrial Instrumentation and C CENGAGE Learning Asia. S K Singh. (2010). Industrial Instrumentation & Control, Tata McGraw Hill Educati 	<i>control,</i> McGraw ors, second <i>Control Systems</i> , on.
LAB 1. 2. 3. TEX 1. 2 REF 1 2 3 3 3	 / MINI PROJECT / FIELD WORK Study of automation systems PLC programming for motor control Study of DCS for industrial process applications T BOOKS William C Dunn.(2005). Fundamentals of Industrial Instrumentation and Process Hill, 2005. Donald P. Eckman. (2009). Industrial Instrumentation, CBS Publishers & Distribute edition ERENCE BOOKS Chennakesava R. Alavala, (2011). Principles of Industrial Instrumentation and C CENGAGE Learning Asia. S K Singh. (2010). Industrial Instrumentation & Control, Tata McGraw Hill Educati C. R. Venkataramana. (2010). Mechatronics, Sapna Book house, Bangalore. 	<i>control,</i> McGraw ors, second <i>control Systems,</i> on.
LAB 1. 2. 3. TEX 1. 2 REF 1 2 3 NO	 / MINI PROJECT / FIELD WORK Study of automation systems PLC programming for motor control Study of DCS for industrial process applications FBOOKS William C Dunn.(2005). Fundamentals of Industrial Instrumentation and Process Hill, 2005. Donald P. Eckman. (2009). Industrial Instrumentation, CBS Publishers & Distribute edition ERENCE BOOKS Chennakesava R. Alavala, (2011). Principles of Industrial Instrumentation and C CENGAGE Learning Asia. S K Singh. (2010). Industrial Instrumentation & Control, Tata McGraw Hill Educati C. R. Venkataramana. (2010). Mechatronics, Sapna Book house, Bangalore. OC 	<i>control,</i> McGraw ors, second <i>Control Systems,</i> on.
LAB 1. 2. 3. TEX 1. 2 REFI 1 2 3 MO 1	 / MINI PROJECT / FIELD WORK Study of automation systems PLC programming for motor control Study of DCS for industrial process applications FBOOKS William C Dunn.(2005). Fundamentals of Industrial Instrumentation and Process Hill, 2005. Donald P. Eckman. (2009). Industrial Instrumentation, CBS Publishers & Distribute edition ERENCE BOOKS Chennakesava R. Alavala, (2011). Principles of Industrial Instrumentation and C CENGAGE Learning Asia. S K Singh. (2010). Industrial Instrumentation & Control, Tata McGraw Hill Educati C. R. Venkataramana. (2010). Mechatronics, Sapna Book house, Bangalore. OC https://ocw.mit.edu/courses/chemical-engineering/10-450-process-dynamics-o 	<i>control,</i> McGraw ors, second <i>Control Systems,</i> on.
Stur LAB 1. 2. 3. TEX 1. 2 REF 1 2 3 MO 1	 / MINI PROJECT / FIELD WORK Study of automation systems PLC programming for motor control Study of DCS for industrial process applications T BOOKS William C Dunn.(2005). Fundamentals of Industrial Instrumentation and Process Hill, 2005. Donald P. Eckman. (2009). Industrial Instrumentation, CBS Publishers & Distribute edition ERENCE BOOKS Chennakesava R. Alavala, (2011). Principles of Industrial Instrumentation and C CENGAGE Learning Asia. S K Singh. (2010). Industrial Instrumentation & Control, Tata McGraw Hill Educati C. R. Venkataramana. (2010). Mechatronics, Sapna Book house, Bangalore. DC https://ocw.mit.edu/courses/chemical-engineering/10-450-process-dynamics-o andcontrol-spring-2006/ 	s Control, McGraw ors, second Control Systems, on.
LAB 1. 2. 3. TEX 1. 2 REF 1 2 3 MO 1 1 2 3	 / MINI PROJECT / FIELD WORK Study of automation systems PLC programming for motor control Study of DCS for industrial process applications F BOOKS William C Dunn.(2005). Fundamentals of Industrial Instrumentation and Process Hill, 2005. Donald P. Eckman. (2009). Industrial Instrumentation, CBS Publishers & Distribute dition ERENCE BOOKS Chennakesava R. Alavala, (2011). Principles of Industrial Instrumentation and C CENGAGE Learning Asia. S K Singh. (2010). Industrial Instrumentation & Control, Tata McGraw Hill Educati C. R. Venkataramana. (2010). Mechatronics, Sapna Book house, Bangalore. OC https://ocw.mit.edu/courses/chemical-engineering/10-450-process-dynamics-o andcontrol-spring-2006/ https://www.eit.edu.au/cms/courses/industrial-automation-instrumentation- 	<i>control,</i> McGraw ors, second <i>Control Systems,</i> on.

DEPARTMENTAL ELECTIVES – SEMESTER VI

COUR TITL	SE E			0	PERAT	IONS R	ESEAR	СН			CRED	ITS		3
COUR COD	RSE DE	Ν	ИНС43	71	со	URSE	CATEGO	ORY	C	DE	L-T-	P-S		3-0-0-1
Versi	on		1.0		Д	LEAR LE ^V	NING /EL		BTL-3					
ASSES	ASSESSMENT SCHEME													
Firs Period Assess nt	t ical me	Second Periodical AssessmentSeminar/ Assignments/ ProjectSurprise Test / QuizAttendanceESE												
15%	6		15%			10	0%		5	%	5	%		50%
Cour Descri on	se ipti	e5%5%50%operations Research nowadays are widely used in the area of decision making for the real life problems. Managers and decision makers get idea for optimizing and approximating industrial problems. They not only strive to devise appropriate measures for problem solving but also apply scientific techniques to monitor the organizations ongoing activities such as production mix, transportation, queuing, assignment, dynamic, Integer, goal and game problem.												
Cours Object e	e tiv	The c 1. Fa 2. Pr 3. M 4. As 5. Fa	course v amiliari ractice laster C ssign th amiliari	will ena ze with various CPM an ne resou ze with	ible the decisi Trans d PERT urces in invent	e stude on mak oortatio techni n an op cory co	nts to: king cor on moc ques ai timum ntrols.	ncepts lels. nd to a manne	and too dopt th er.	ols. nem su	itably f	or the _l	oroject	S.
Cours Outco	e me	Upon 1. 2. 3. 4. 5.	compl Differe making Build a Design Develo Determ	etion o ntiate approa nd solv simple p critica nine EO	f this c the typ aches a e Trans model al think Q in fa	ourse, bes of and too sportat s like C ting and ctory li	the stu decisio Is to be ion mo PM and d objec ve situa	dents n mak e used dels ar d PERT tive an ations	will be a ing env in each id assig to imp alysis d and the	able to vironm type. nment rove do lecisior e inven	ental a model ecision makir tories e	and app s. making ng. effective	oropria g ely.	te decision
Prereq	luisit	es:												
СО, Р	O AN	ID PSO	MAPP	ING										
со	Р О- 1	РО- 2	РО- 3	РО- 4	РО- 5	РО- 6	РО- 7	РО- 8	РО- 9	РО- 10	РО- 12	PO- 12	PSO -1	PSO-2
CO- 1	3	2	3	2	1	1	1	1	2	1	-	1	3	2

CO- 2	3	2	3	3	1	1	1	1	2	1	-	1	3	2	
CO- 3	3	2	3	2	1	1	1	1	2	1	-	1	3	2	
CO- 4	3	2	3	2	1	1	1	1	2	1	-	1	3	2	
CO- 5	3	2	3	2	1	1	1	1	2	1	-	1	3	2	
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: PROGRAMMING PROBLEM (9L)															
Graphical Solution – Bounded and Unbounded Solutions – Simplex Method – Big M method-Duality - Two phase Method – Dual Simplex method.														CO-1 BTL-2	
MODULE 2: SEQUENCING AND GAME THEORY														(9L)	
Algorithm – Two Machine and three Machine problem – Game theory with saddle point and without saddle point – Dominance properties – Graphical Solutions. Dynamic Programming Suggested Readings: Advances in Sequencing And Game Theory														CO-2 BTL-2	
MODULE 3: ASSIGNMENT ANDTRANSPORTATIONPROBLEM 9L															
Purchase Model with and without Shortages – Manufacturing Model with and															
without Shortages, Probabilistic Model.															
Suggested Readings:														DIL-3	
MODU	JLE 4	: PERT	- CPM	-DECIS	IONTH	EORY	iiques.						9L		
MODULE 4: PERT - CPM -DECISIONTHEORY Concepts of feedback – Classification of feedback amplifiers – General characteristics of negative feedback amplifiers – Effect of Feedback on Amplifier														<u> </u>	
analys	sis													BTL-2	
Sugge	sted	Readir	ngs:												
Schm	itt Tr	igger													
MODU	JLE 5	: DETE	RMINA		FEOQ	&INVE	NTORY	CONT	ROL					9L	
Class	A Po	wer Ar	nplifier	r, Push	Pull ar	id Com	plimen	itary Sy	mmetr	y Class	B and	Class			
AB Po	wer	Amplif	iers – I	Principl	e of o _l	peratio	n of cla	ass C a	nd D A	mplifie	er, Tran	sistor		CO-5	
Power	r Diss	sipatior Decision	n, Heat	Sinks,	Tuned	Ampliti	ers							BTL-2	
Suggested Readings:															
Tuned Amplifiers															
1.		H.A. India.	Taha. /Pears	(2003 on Edu). <i>Ope</i> cation	erations	s Res	earch	- Ar	n Intr	roductio	on, P	rentice	Hall of	
REFER	ENC	E BOOK	(S												

1	F S Hiller and G J Leiberman. (2000), Introduction to Operations Research
2	Gupta Prem Kumar and Hira D S.(2010). Operations Research
MOOC	
1	https://onlinecourses.nptel.ac.in/noc17_mg10/preview

COURSE TITLE	AN	ALOG ELECTRONICS		CREDITS	3						
COURSE CODE	MHC4370	COURSE CATEGORY	L-T-P-S	3-0-0-1							
Version	1.0	Approval Details	LEARNING LEVEL	BTL-3							
ASSESSMENT S											
First Periodical Assessment	Second PeriodicalSeminar/Surprise Test /AttendanceESEAssessmentProjectQuizAttendanceESE										
15%	15%	10%	5%	5%	50%						
Course Description	Analog electronics deals with a continuously variable signal and is widely used in radio and audio equipment along with other applications where signals are derived from analog sensors before being converted into digital signals for subsequent storage and processing.										
Course Objective	 To introduce circuit realizations with components such as diodes, BJTs and transistors studied earlier. To give understanding of various types of amplifier circuits such as small signal, cascaded, large signal and tuned amplifiers. To familiarize the Concept of feedback in amplifiers so as to differentiate between negative and positive feedback. 										
Course Outcome	 Upon completion Comprehend the Describe the tran Design FET and N Design and reali useable for audio Utilize the Conception 	of this course, the stu small signal amplifier sistor models at high f IOSFET amplifier circu ze different classes and Radio applicatior pts of negative feedba	idents will be able circuits applying t requencies its of Power Amplifi is. ick to improve the d oscillations.	e to he biasing techn ers and tuned e stability of amp	iques. amplifiers lifiers and						
Prerequisites:	Prerequisites:										

0	РО	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	РО	РО		
	-1	2	3	4	5	6	7	8	9	10	-11	-12	F30-1	F30-2
CO-1	3	3	-	-	-	-	-	2	2	-	-	2	2	2
CO-2	3	3	3	3	3	-	I	2	2	-	I	2	2	2
CO-3	3	3	-	-	-	-	-	2	2	-	-	2	2	2
CO-4	3	3	-	-	-	-	-	2	2	-	-	2	2	2
CO-5	3	3	-		-	-	•	2	2	-	-	2	2	2
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODU	JLE 1:	INTRO	DUCTI	ON TO	ELECTE	RONIC	DEVIC	S &CI	RCUITS			(6L+	6P)	
Diodes, BJT, FET, MOSFET – Principle of operation, Characteristics, Applications, Rectifiers,														
Amplifiers, Oscillators.												CO-1		
Suggested Readings:													BTL-2	
Semiconductors Theory														
MODULE 2: BJT AMPLIFIERS (6L+6													+6P)	
Review of transistor biasing, Classification of Amplifiers – Distortion in amplifiers, Frequency														
response of BJT Amplifiers, effect of coupling and bypass capacitors, Design of single stage													e stage	CO-3
RC coupled amplifier, Cascode amplifier, Darlington pair.														CU-2 BTL-2
Suggested Readings:												DIL-2		
Hybrid- pi (π) – Common Emitter transistor model														
MODULE 3: FET AMPLIFIERS (6L												+6P)		
CS, CD	, CG J	FET A	mplifie	rs, Bas	ic Con	cepts o	of MO	S Amp	lifiers,	MOS S	mall s	ignal	model,	
Cascod	le and	Folded	d Casco	de Am	plifier.									CO-3
Sugges	sted Re	eading	s:											BTL-3
Comm	on sou	urce ar	nplifier	with r	esistive	e, Diod	e conn	ected a	and Cu	rrent so	ource l	oads,	Source	2.20
follow	er.													
MODU	LE 4: F	EEDB	ACK AN	ID OSC	ILLATO	R CIRC	UITS						(6L+	5P)
Conce	pts of	feedba	ack – C	lassifica	ation of	f feedb	ack an	plifier	s – Ger	neral ch	aracte	eristics	of	
negati	ve fee	dback	amplifi	ers – Ef	fect of	Feedb	ack on	Ampli	fier cha	aracteri	stics. (Condit	ion for	CO-4
oscillat	tions.	RC and	LC typ	e Oscil	lators -	- Gene	ralized	analys	is					BTL-2
Sugges	sted Re	eading	s:											
Schmitt Trigger														
MODULE 5: LARGE SIGNAL AMPLIFIERS (6L+6												-6P)		
Class	A Pow	ver Am	nplifier,	, Push	Pull ar	nd Con	nplime	ntary S	Symme	etry Cla	ss B a	and C	ass AB	
Power Amplifiers – Principle of operation of class C and D Amplifier, Transistor Power													Power	CO-5
Dissipa	ation, I	Heat Si	inks, Tu	ined Ar	nplifie	ſS								BTL-2
Sugges	sted Re	eading	s:											
Tuned	Ampl	itiers												
TEXT BOOKS														

1.	David A. Bell. (2010). <i>Electronic Devices and Circuits</i> , 5th Edition, Oxford.											
REFERENCE BOOKS												
1	Jacob Millman, Christos C Halkias. (2017). <i>Integrated Electronics</i> , McGraw Hill Education.											
2	Thomas L. Floyd. (2015). <i>Electronic Devices Conventional and current version</i> , Pearson.											
моос												
1	https://www.coursera.org/learn/electronics											

COURSE TITLE	ROBOTIC	OPERATING SYSTEM	1	CREDITS	3				
COURSE CODE	MHC4372	COURSE CATEGORY	DE	L-T-P-S	3-0-0-1				
Version	1.0	Approval Details	24 th ACM, 30.05.2018	LEARNING LEVEL	BTL- 4				
ASSESSMENT SCHEM	1E								
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE				
15%	15%	10%	5%	5%	50%				
Course Description	The Robot Operating System (ROS) enables to quickly build robotic application through access to a large set of open-source software and tools. Over the years ROS has become the essential tool for roboticists. A large community surround ROS and there has been extensive input from industrial users in the development of these tools. In this course, the students will learn to use different ROS tools t create a complete robotic application. Students will be working with their ow standalone Ubuntu-Linux installation and with industrial and mobile robots on th physics-based simulation engine, Gazebo/webots. Students will learn to prograr and configure basic robotic tasks such as pick-and-place objects, and navigat through obstacles.								
Course Objective	 The course should e Use ROS communiformation betwee Visualization and cression and cression of the robote Mapping of the robote How to implement a Design of a complete 	nable the student to nication tools (top n functional modules eation of a custom er of environment and r pick-and-place func e robotic application	D Dics, service s nvironment v navigation wi ction with ind with state m	s, actions) to e vith a robot th a mobile robot ustrial robot arms nachines	xchange				

	Upon completion of this course, the students will be able to
	1. Comprehend the ROS architecture
Course Outcome	2. Model a robot in ROS
	3. Simulate a mobile robot
	Plan movement of a robot by avoiding collisions
	5. Interface sensors and actuators with ROS

Prerequisites: NIL **CO, PO AND PSO MAPPING** PO-СО PO-1 PO-2 PO-3 PO-4 PO-5 PO-6 PO-7 PO-8 PO-9 PO-11 PO-12 PSO-1 PSO-2 10 CO-1 3 1 1 1 2 1 2 3 ------CO-2 3 3 3 1 3 1 -2 1 1 2 3 --CO-3 3 3 3 1 3 3 1 -2 1 1 2 --CO-4 3 3 2 1 3 1 2 1 1 2 3 ---CO-5 3 2 2 1 3 1 2 1 1 1 2 3 _ _ 1: Weakly related, 2: Moderately related and 3: Strongly related **MODULE 1: INTRODUCTION** (9L) Introduction to ROS - ROS file system level - ROS computation graph level - ROS community level CO-1 Practical component: BTL-2 Working with ROS packages, nodes & messages Suggested Readings: Applications of ROS MODULE 2: 3D ROBOT MODELING IN ROS (9L) ROS packages for robot modelling - Creating ROS package for robot description - Visualizing robot in 3D model CO-2 **Practical component:** BTL-3 Creating URDF model, using RVIZ for visualizing 3 D model & robot description Suggested Readings: URDF MODULE 3: SIMULATING ROBOTS (9L) Understanding Gazebo - Robotic arm simulation - Simulating joints - Interfacing with ROS CO-3 controllers

BTL-4

Practical component:

Simulating robotic arm, moving joints using Gazebo & moving mobile robot Suggested Readings:

ROS Gaz	zebo	
MODULE	4: MOTION PLANNING	(9L)
Configur	ation Space - Collision matrix - Motion planning methods - Motion planning using ROS	-
ROS Cont	trollers	CO-4
Practical	component:	0-4
Movelt co	onfiguration package setup & motion planning	BTL-4
Suggeste	ed Readings:	
Forward	kinematics and inverse kinematics of robotic manipulators	
MODULE	5: INTERFACING I/O BOARDS, SENSORS & ACTUATORS (9L)	
ROS Seria	al package – ROS and Microcontroller - Interfacing Sensors & Actuators	
Practical	component:	CO-5
ROS seria	l package – ROS and microcontroller – Interfacing sensors and actuators	
Suggeste	ed Readings:	DIL-4
ROS com	munication in real-time with sensors and actuators	
TEXTBOC	OKS	
1.	Lentin Joseph. (2015). <i>Mastering ROS for Robotic Programming</i> , Packt Publishing.	
2.	Morgan Quigley, Brian Gerkey, William D. Smart. (2015). <i>Programming Robots wit Practical Introduction to the Robot</i> , O'Reilly.	h ROS: A
REFEREN	CE BOOKS	
1.	Anis Koubaa. (2016). <i>Robot Operating System (ROS): The Complete Reference – Volume</i> Springer.	· 1.
2.	R. Patrick Goebel. (2012). ROS by Example: A Do-It-Yourself Guide to the Robot Operation System. Lulu.	ing
моос		
1.	https://www.udemy.com/course/ros-for-beginners/	
2.	https://robocademy.com/2021/01/19/advanced-ros-programming-live-course-by-lent joseph/	tin-

COURSE TITLE		VIRTUAL REALITY	CREDITS	3	
COURSE CODE	MHC4373	L-T-P-S	3-0-0-1		
Version	1.0	Approval Details	24 th ACM, 30.05.2018	LEARNING LEVEL	BTL-6
ASSESSMENT SCH	IEME				
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%

Course Description	This course is designed to provide students with an overview of the basic principles of virtual reality, scripting and rendering virtual environments. The goal is to learn enough about the strengths and limitations of VR technology to be able to construct simple immersive environments. Students in the course will be given an opportunity to interact directly with immersive virtual environment technology and will gain
	experience by developing a VR-based application
Course Objective	 To provide an understanding on the fundamental concepts relating to Virtual Reality such as presence, immersion, and engagement To introduce students to the field of virtual reality (VR) and provide students with hands-on experience developing applications for modern virtual To enable students to explore libraries and tools for creating VR experiences such as Unity
Course Outcome	 Upon completion of this course, the students will be able to Discuss Virtual reality concepts Develop VR applications using Unity3D Move around the 3D world Run Unity 3D application in VR on a smart phone.

Prerequisites: Nil

(CO, PO AND PSO MAPPING														
	со	PO -1	РО- 2	РО- 3	PO- 4	РО- 5	РО- 6	РО- 7	РО- 8	РО- 9	PO -10	PO- 11	PO- 12	PSO -1	PSO-2
	CO-1	2	3	3	1	3	2	2	1	2	2	2	2	-	-
	CO-2	2	3	3	1	3	1	1	1	1	1	1	1	-	-
	CO-3	2	3	3	1	3	1	1	1	1	1	1	1	-	-
	CO-4	2	3	3	1	3	1	1	1	1	1	1	1	-	-

1: Weakly related, 2: Moderately related and 3: Strongly related

	(9L)
Virtual Reality – Types – Virtual Reality Vs Augmented Reality – Applications – Technical skills required Suggested Readings:	CO-1 BTL-2
Immersive technologies: VR, AR, MR and XR MODULE 2: BUILDING SIMPLE SCENES	(9L)
Introduction to Unity IDE – Objects and Scale – Creating a simple diorama – VR Device integration	
Practical component: Working with Unity 3D with scene and objects Suggested Readings:	CO-2 BTL-3
Computer Graphics and Virtual Reality MODULE 3: GAZE BASED CONTROL	(9L)

CO 3
BIL-0
(9L)
(32)
CO-4
BTL-6
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DEPARTMENTAL ELECTIVES – SEMESTER VII

COURSE TITLE	ROBOT	TIC PROCESS AUTOMATION	I	CREDITS	3
COURSE CODE	MHC4459	COURSE CATEGORY	L-T-P-S	3-0-0-1	
Version	1.0	Approval Details	24 th ACM, 30.05.201 8	LEARNING LEVEL	BTL-6

ASSESSMENT SCHEME														
Fi Peri a Asse ei	rst odic Il essm nt	Second Periodical Assessment			Seminar/ Assignments/ Project				Surprise Test / Atte Quiz			tendan	ce	ESE
15	5%		15%			10	0%		5	%		5%		50%
Cou Desc o	urse cripti n	Robotic Process Automation (RPA) can transform business processes by elim mundane, time-consuming, manual tasks that professionals complete; enabling time to focus on critical thinking. This course will help students to unde characteristics, benefits, risks, and challenges of RPA. This course will also enab to develop RPA solutions for simple applications.											ninating the them more erstand the ole students	
Cou Obje	urse ectiv e	1. T 2. T 50 3. T	 To introduce robotics process automation to participants To impart basic proficiency in RPA tools so that they are able to write their own RPA solutions To create bots to automate common work processes 											eir own RPA
Cou Outo	urse come	Upon completion of this course, the students will be able to 1. Able to recognize robotic process automation 2. Able to create different types of workflows 3. Able to create control flow and record events 4. Able to perform scraping 5. Perform image and text automation												
CO.	PO AN	ID PSO	MAPP	ING										
со	PO -1	PO-	PO-	PO- 4	РО- 5	PO-	РО- 7	PO- 8	РО- 9	PO -10	PO- 11	PO- 12	PSO -1	PSO-2
CO -1	1	2	-	-	-	-	-	-	-	-	2	1	-	-
CO -2	3	3	3	-	3	-	-	-	3	3	-	-	-	-
CO -3	3	3	3	-	3	-	-	-	3	3	-	-	-	-
CO -4	3	3	3	3	3	-	-	3	3	3	3	3	3	3
CO -5	3	3	3	3	3	-	-	3	3	3	3	3	3	3
1: Weakly related, 2: Moderately related and 3: Strongly related														
MO	DULE	1: INTR	ODUC	TION T	O ROB	OTIC P	ROCES	S AUTO	MATIO	ON		(9L)		
Intro and Tech Prac Wor Sugg Tren	INITIODULE 1: INTRODUCTION TO ROBOTIC PROCESS AUTOMATION (9L) Introduction to Business process automation – Robotic process automation – RPA Tools and and Technology CO-1 Practical component: BTL-2 Working with UIPath Studio and StudioX BTL-2 Suggested Readings: Trends in RPA													

MODULE 2: WORKFLOW(9L)							
Types of Workflow – Sequences – Flowcharts – State Machines – Variables – Arguments							
Namespaces							
Practical component:	CO-2						
Create RPA workflow using UIPath	BTL-3						
Suggested Readings:							
Workflow automation Vs RPA							
MODULE 3: CONTROL FLOW & RECORDING	(9L)						
Control flow – Control flow activities. Recording: Types – Automatic Recording							
Interface	CO 3						
Practical component:							
Develop RPA solution for a given problem using appropriate control flows	BIL-0						
Myths in RPA recorder							
MODULE 4: UI Suggested Readings:							
ELEMENTS & SCRAPING(9L)							
UI elements – UI activities properties – Input Methods. Scraping: Data Scraping – Screer							
Scraping – Relative Scraping							
Practical component:							
Scrap data from various UI elements- Perform screen scraping							
Suggested Readings:							
Scraping, Data Extraction and Automation in Help systems							
MODULE 5: IMAGE AND TEXT AUTOMATION	(9L)						
Introduction – Mouse and keyboard activities – Text activities – OCR activities – Image							
activities							
Practical component:	CO-5						
Perform image and text automation	BTL-6						
Suggested Readings:							
RPA and intelligent automation							
TEXT BOOKS							
Tom Taulli. (2020). The Robotic Process Automation Handbook: A Guide to Imple	menting RPA						
¹ . Systems, Apress	_						
REFERENCE BOOKS							
Nandan Mullakara, Arun Kumar Asokan. (2020). Robotic Process Automation Project	ts: Build real-						
world RPA solutions using UiPath and Automation Anywhere, Packt Publishing Ltd.							
MOOC							
1 https://www.udemy.com/robotic-process-automation/							
2 https://academy.uipath.com/landing							

COURSE TITLE	INE	DUSTRIAL ENGINEERING		CREDITS	3
COURSE CODE	MHC4460	COURSE CATEGORY	DE	L-T-P-S	3-0-0-1

Ver	sion		1.0		Approval Details 3			24 th 30.05	ACM, .2018	LEAR LE\	NING /EL	BTL-4		
ASSE	ASSESSMENT SCHEME													
Fi Peric Asses	rst odical sment	Second Periodical AssessmentSeminar/ Assignments/ ProjectSurprise Test / QuizAttendanceESE											ESE	
15	5%		15%			10)%		5	%	59	%		50%
Cou Desci	n Industrial Engineering covers a broad spectrum including production planning and contro manufacturing systems and processes, facilities design, human factors, occupational safet quality control, systems reliability, and systems analysis and design with a strong emphasis c advanced computing.												and control, tional safety, emphasis on	
Cours Objec	 The objectives of the industrial engineering are to produce graduates who: Contribute to the success of companies through effective problem solving. Design, develop, implement, and improve integrated systems that include people, materials, information, equipment, and environments. Achieving Maximum results with minimum efforts. Increasing the Efficiency of factors of Production. Maximum Prosperity for Employees 													
Cours Outco	se ome	Up 1. Co 2. De 3. Op 4. An 5. Eva	on con nduct r monstr timize under aluate	npletio market rate the the res standir the pro	n of thi resear e know sources ng of th oductio	is cours ch, der ledge o s of an e impa n planr	se, the mand fo of desig organiz oct of in ning an	studer precast gning p ation a dustria d conti	its will ing and lants a and imp al engir rol	be able d costir nd con prove p neering	e to ng trolling product solutio	; produ ivity. ons	ction	
Preree	quisite	es: Nil												
CO, P	O ANI	D PSO I	MAPPI	NG										
со	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	2	3	2	3	3	2	2	3	3	3	3	3
CO-2	3	2	2	3	2	2	2	3	3	3	3	2	3	3
CO-3	3	2	2	3	2	3	3	3	3	3	3	2	3	3
CO-4	3	2	2	3	2	3	3	3	3	3	3	2	3	3
CO-5	3	2	3	3	2	3	3	3	3	3	3	2	3	3
MOD	1: Weakly related, 2: Moderately related and 3: Strongly related MODULE 1: DEMAND EORECASTING AND ELEMENTS OF COST (91)													

Demand Forecasting and Elements of Cost Macro and micro economics - Demand	
and supply – Factors influencing demand – Elasticity of demand – Demand	
forecasting - Time series - Exponential smoothing casual forecast - Delphi method -	
Correlation and Regression - Barometric method – Long run and Short run forecast.	CO 1
Elements of cost – Determination of Material cost - Labour cost - Expenses – Types of	
cost.	DIL-2
Suggested Reading:	
Read on how the Delphi method helps in improving the taste quality of Dominos Indi	
Tandoori Paneer Pizza.	
MODULE 2: INDUSTRIAL ORGANISATION	(9L)
Introduction to Industrial Engineering – Concepts - History and Development of	
Industrial engineering – Roles of Industrial Engineer – Applications – Productivity –	
Factors affecting productivity – Increasing productivity of resources – Kinds of	60 3
productivity measures.	
Suggested Reading:	BIT-5
Read on how the iPhone's elasticity of demand creates a huge impact on the mobile	
market	
MODULE 3: WORK DESIGN	(9L)
Introduction to work study – Method study – Time study – stopwatch time study –	
Standard data - Method Time Measurement (M-T-M) – Work sampling – Ergonomics.	60 3
Suggested Reading:	CU-5 BTL 2
Read on the factors that affect the productivity of the tyre industry	BIL-5
MODULE 4: PLANT LAYOUT AND GROUP TECHNOLOGY	(9L)
Plant location - Factors - Plant layout - Types - Layout design process - Computerized	
avout Planning - Construction and Improvement algorithms -ALDER - CORFLAP and	
CRAFT Group technologyProblem definition - Production flow analysis - Heuristic	
methods of grouping by machine matrices – Elevible Manufacturing System - EMS	CO-4
work stationsMaterial handling and Storage system-Cellular Manufacturing System	BTL-3
Suggested Reading:	
Read on the concent of a flexible manufacturing system with an application	
MODULE 5: PRODUCTION PLANNING AND CONTROL	(9L)
Types of productions, Production cycle-Process planning, Forecasting, Loading,	
Scheduling,	
Dispatching, Routing- Simple problems. Materials Planning – ABC analysis – Incoming	
materials control – Kanban system – Just in time. MRP systems- Master Production	CO-5
Schedule – Bill of Materials – MRP calculations	BTL-4
Suggested Reading:	
Read on how the thermal power plant layout process was carried out along with its	

TEXT	BOOKS
1.	Buffa E.S. (2009). Modern Production / Operational Management, John Wiley & Sons, 2009
REFE	RENCE BOOKS
1	Nigel Slack, Stuart Chambers, Robert Johnston., (2010). Operation Management, Pearson Education.
2	R.Danreid& Sanders., (2009). Operations Management, John Wiley & Sons, 2009
моо	C
1	http://engineering.nyu.edu/academics/online/masters/industrial-engineering
2	https://online.engineering.arizona.edu/online-programs/industrial-engineering/master-ofscience- in-industrial-engineering/

COURSE TITLE		TOTAL QUALITY MANAGEMENT CREDITS 3									
COURSE CODE		MHC4461	COURSE CATEGORY	РС	L-T-P-S	3-0-0-0					
Version		1.0	Approval Details	24 th ACM, 30.05.2018	LEARNING LEVEL	BTL-2					
ASSESSME	NT S	CHEME									
First Periodica I Assessm ent	irst Second Second I Periodical essm Assessment nt		Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE					
15%		15%	10%	5%	50%						
Course	Tot	tal quality mana	agement (TQM) is the con	tinual proces	s of detecting	and reducing or					
Descripti	elir	ninating errors i	n manufacturing, streamlin	ing supply cha	ain managemen	t, improving the					
on	cus	tomer experiend	ce								
Course Objective	 To diagnose problems in the quality improvement process. To identify ethical and unethical behavior in Quality Management. To Utilize Statistical Process Control techniques as a means to diagnose, reduce and eliminate causes of variation To perform process capability and specification studies. To propose how business leaders might plan and execute quality management strategies to gain and sustain a competitive advantage in today's global business areas. 										

Course Outcome	 Upon completion of this course, the students will be able to Discuss the overview of quality and TQM Comprehend customer Focus, Employee Focus and their involvement, continuous process improvement and Supply chain Management. Describe the basic and new seven management tools, Quality concepts like Six sigma, Failure mode effect analysis. Describe industrial applications of Quality function deployment Taguchi quality concepts and TPM Discuss various quality systems like ISO and its standards
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Prerequisites: NIL

CO, PO AND PSO MAPPING

со	PO - 1	РО- 2	РО- 3	РО- 4	РО- 5	РО- 6	РО- 7	РО- 8	РО- 9	PO - 10	PO- 11	PO-12	PS O- 1	PSO-2
CO -1	1	2	-	2	1	-	-	-	-	-	2	1	-	-
CO -2	1	-	2	-	2	-	-	-	2	2	1	1	-	-
CO -3	2	1	2	1	-	1	-	-	3	3	-	1	-	-
CO -4	2	2	-	2	-	1	2	2	-	-	-	1	-	-
CO -5	1	2	3	1	-	3	3	2	1	-	-	2	-	-
1: Weakly related, 2: Moderately related and 3: Strongly related														
МО	MODULE 1: INTRODUCTION (9L)													

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality. Suggested Readings: Product & service Quality Management.	CO-1 BTL-1
MODULE 2: TQM PRINCIPLES (9L)	
Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership – Partnering. Suggested Readings: Quality Management, Organizational structure	CO-2 BTL-1
MODULE 3: TQM TOOLS AND TECHNIQUES I (9L)	

The Met marl Sugg Strat	seven traditional tools of quality - New management tools - Six sigma: Concepts, hodology, applications to manufacturing, service sector including IT - Bench king - Reason to bench mark, Bench marking process - FMEA - Stages, Types. gested Readings: regic and systematic approach, Fact-based decision making.	CO-3 BTL-2			
MO	OULE 4: TQM TOOLS AND TECHNIQUES II (9L)				
Cont Deve need Sugg Mana	rol Charts - Process Capability - Concepts of Six Sigma - Quality Function elopment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement ds - Performance measures. gested Readings: agement commitment, Continuous improvement	CO-4 BTL-2			
MO	DULE 5: QUALITY SYSTEMS	9L)			
Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sectors.CSuggested Readings: Quality Management Standards, Business Process.B					
TEXT	BOOKS				
1.	Dale H. Besterfiled, et al. (2016). Total quality Management, Pearson Education As	sia.			
REFE	RENCE BOOKS				
1	Oakland J. (2003). TQM – Text with Cases, A Butterworth-Heinemann Title.				
E BO	OKS				
1.	http://psbm.org/Ebooks/Total%20Quality.pdf				
MOC					
1	https://onlinecourses.nptel.ac.in/noc17_mg18/preview				

COURSE TITLE	FIN	FINITE ELEMENT ANALYSIS CREDITS 3										
COURSE CODE	MHC4462	COURSE CATEGORY	DE	L-T-P-S		3-0-0-1						
Version	1.0	Approval Details	24 th ACM, 30.05.2018	LEARNING LEVEL		BTL-3						
ASSESSMEN	NT SCHEME											
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance		ESE						
15%	15%	10%	5%	5%		50%						

	The F	inite Element Analysis (FEA) is the simulation of any given physical phenomenon using								
	the nu	Imerical technique called Finite Element Method (FEM). Engineers use FEA software to								
	reduce the number of physical prototypes and experiments and optimize components in									
Course	their design phase to develop better products, faster while saving on expenses.									
Descriptio	It is necessary to use mathematics to comprehensively understand and quantify any physical									
n	phenc	omena such as structural or fluid behavior, thermal transport, wave propagation, the								
11	growth of biological cells, etc. Most of these processes are described using Partial Differential									
	Equations (PDEs). However, for a computer to solve these PDEs, numerical techniques have									
	been developed over the last few decades and one of the prominent ones, today, is the Finite									
	Eleme	nt Analysis.								
	1.	To understand the Mathematical Modeling of field problems in Engineering								
	2.	To solve the 1D problems								
	3.	To discuss about the various Galarkin approach, Temperature effects stress strain								
Courso		relations, plane problems of elasticity and element equations								
Objective	4.	To solve Axi-symmetric formulation , Element stiffness matrix and force vector ,								
Objective		Galarkin approach and Problems								
	5.	To discuss about Numerical integration and application to plane stress problems,								
		Matrix solution techniques Solutions Techniques to Dynamic problems, Introduction								
		to Analysis Software								
	1.	Comprehend the Mathematical Modeling of field problems in Engineering								
	2.	Solve the One Dimensional Second Order Equations								
	3.	Describe Galarkin approach, Temperature effects stress strain relations, plane								
Course		problems of elasticity and element equations								
Outcome	4.	Solve Axi-symmetric formulation, Element stiffness matrix and force vector, Galarkin								
		approach and Problems								
	5.	Solve Numerical integration and application to plane stress problems, Matrix solution								
		techniques Solutions Techniques to Dynamic problems.								

Prerequisites: Nil

CO,]	CO, PO AND PSO MAPPING																	
6	РО	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PSO					
0	-1	2	3	4	5	6	7	8	9	10	11	12	-1	F30-2				
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СО	_	3	2	_	1	_	_	_	1	1	_	_	_	_				
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со	2	2	R	_	2	_	_	_	_	-	_	_	_	_				
-5	2	L	,		2									_				
			1: W	/eakly r	elated	, 2: Mo	derate	ly relat	ed and	3: Stro	ongly re	elated						

MODULE 1:INTRODUCTION 9L	
Historical Background – Mathematical Modelling of field problems in Engineering –	
Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value	
problems– Weighted Residual Methods – Variational Formulation of Boundary Value	CO-1
Problems – Ritz Technique – Basic concepts of the Finite Element Method.	BTL-3
Suggested Readings:	
Application to bar element, Application to the continuum.	
MODULE 2: ONE DIMENSIONAL PROBLEMS9L	
One Dimensional Second Order Equations - Derivation of Shape functions and Stiffness	
matrices and force vectors- Galarkin approach - Assembly of stiffness matrix and load vector	
- Solution of problems from solid mechanics and heat transfer-Finite element equations -	CO-2
Longitudinal vibration frequencies and mode.	BTL-3
Suggested Readings:	
Applications to plane trusses, Quadratic shape functions.	
MODULE 3: TWO DIMENSIONAL CONTINUUM9L	
Introduction - Finite element modelling - Scalar valued problem - Poisson equation - Laplace	
equation - Triangular elements - Element stiffness matrix - Force vector - Galarkin approach	
- Temperature effects - stress strain relations – plane problems of elasticity – element	
equations – assembly – need for quadrature formulae – transformations to natural	CO-3
coordinates – Gaussian quadrature – example problems in plane stress, plane strain using	BTL-3
MATLAB and Abaqus.	
Suggested Readings:	
Structural mechanics applications.	
MODULE 4: AXISYMMETRIC CONTINUUM 9L	
Axisymmetric formulation - Element stiffness matrix and force vector - Galarkin approach -	
Body forces and temperature effects - Stress calculations - Boundary conditions -	
Applications to cylinders under internal or external pressures - Rotating discs - Plate and shell	CO-4
elements.	BTL-3
Suggested Readings:	
Axisymmetric applications.	
MODULE 5: ISOPARAMETRIC FORMULATION9L	
Natural co-ordinate systems – Isoparametric elements with mat lab coding – Shape	
functions for iso parametric elements – One and two dimensions– Numerical integration	
and application to plane stress problems - Matrix solution techniques – Solutions	CO-5
Techniques to Dynamic problems – Introduction to Analysis Software.	BTL-3
Suggested Readings:	
Application of four node quadrilateral.	
TEXT BOOKS	

1	C Krishnamoorthy. (2017). Finite Element Analysis: Theory and Programming, McGraw Hill
1.	Education.
2.	Anand V. Kulkarni. (2017). A Primer On Finite Element Analysis, Laxmi Publications.
REFERENCI	E BOOKS
1	Randy Shih. (2016). Introduction to Finite Element Analysis Using SOLIDWORKS Simulation,
	SDC Publications.
2	Daryl L. Logan. (2016). A First Course in the Finite Element Method CL Engineering; Oxford, 6th
	edition, 2016.
моос	
1	https://www.coursera.org/learn/finite-element-method
2	http://www.open.edu/openlearn/science-maths-technology/introduction-finite-
2	elementanalysis/content-section-0

NON-DEPARTMENTAL ELECTIVES – SEMESTER III

COURSE TITLE	BUILDI	NG OF MOBILE ROB	DTS	CREDITS	3						
COURSE CODE	MHD4281	COURSE CATEGORY	NE	L-T-P-S	3-0-0-1						
Version	1.0	Approval Details	24 th ACM, 30.05.2018	LEARNING LEVEL	BTL- 4						
ASSESSMENT SCHEME											
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE						
15%	15%	10%	5%	5%	50%						
Course Description	Robots are rapidly their work- cells, challenging tasks in the basic concepts autonomously in co locomotion and k localization and ma course introduce se	evolving from factor to increasingly c our daily environme s and algorithms re omplex environment kinematics, environr apping, and motion everal types of robots	y workhorses, workhorse	which are physic es capable of e of this course lop mobile ro whasis is put on a, probabilistic ectures and ex- d robots, legge	cally bound to of performing e is to provide bots that act mobile robot c map based ercises of this d robots.						
Course Objective	 The course should enable the student to, 1. Remember, Recall and Identify basic mechanisms of Mobile Robots 2. Comprehend various sensors and actuators used in the design of mobile robots. 3. Design a simple controller / program for the control of mobile robot 4. Design and Develop a mobile robot integrating sensor – actuator – controller for simple applications 										

Course Upon completion of this course, the students will be able to 0utcome 1. Apply knowledge about sensors and actuators forselection for application. 2. Use vision system for navigation of the mobile robot. 3. Write program for various applications of mobile robots. 4. Design mobile robot for simple applications.								ion for	a typical					
CO, PO AND PSO MAPPING														
со	РО- 1	PO -2	РО- 3	РО- 4	РО -5	РО- 6	РО- 7	РО- 8	РО -9	PO- 10	PO- 11	PO- 12	PSO-1	PSO-2
CO-1	3	3	-	-	-	-	-	-	-	-	2	2	1	-
CO-2	3	3	2	2	1	1	1	1	1	2	2	2	1	-
CO-3	3	3	3	2	3	1	1	2	3	3	2	2	1	-
CO-4	3	3	3	3	3	1	1	2	3	3	2	2	3	-
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODU	LE 1: IN	NTROD	UCTIC	N					(9L)					
Introdu Robots- for Agri Suggest	ection t - Basic culture ed Rea Mobile	to mot Electr Appli Adings e robot	oile Rol conics f cation : ts appl	bots – for Rol s – Spa ication	Laws pots, F ace Ro	of Rob Robot 7 bots —	ots – F Applica Defen	Robot <i>i</i> ations se Rob	Anatoı - Com oots.	my — Banion	asic Me Robots	chanics 5 — Rob	of ots	CO-1 BTL-2
MODUL	e 2: Se	NSOR	S											(9L)
Sensors Characte Vision – Suggest	Sensors for mobile robots – Need – Types & Classification of Sensors- Sensor Characteristics – Sensors for Navigation, Motion, Position, Force, Range, Tactile and Vision – Selection of Sensors Suggested Readings: BTL- 3							CO-2 BTL- 3						
MODUL	E 3: A0	CTUAT	ORS											(9L)
Actuatic Actuato Motor d	on me rs – Di Irives.	chanis C Mot	m for ors – S	robot Servo	ts – M motor	Лесhai , stepp	nical A Der mo	Actuato otor –	ors an Linear	nd driv Actua	e train: tors – (s, Elect Gripper	ric s –	CO-3 BTL-3

Suggested Readings:							
MODULE 4: CONTROLLERS (9L)							
 Analog Controller –design of simple controller by basic electronic devices – Digital controller – design of simple controller using logic gates – Introduction to Microcontroller – Arduino – simple program for Obstacle Detection and Avoidance – Localization Suggested Readings: Arduino interfacing with motor drive 							
MODULE 5: BUILDING OFMOBILE ROBOTS (Project)(9L)							
Building of simple mobile robot – Use of various Sensing methods - Interfacing Sensors and Actuators with Robot Controller – Design of simple programs for Interfacing. PROJECT: Build simple mobile robot Suggested Readings: • Arduino programming							
TEXTBOOKS							
1. Ulrich Nehmzow. (2003). <i>Mobile Robots - A practical introduction</i> , Springer.							
REFERENCE BOOKS							
1. S.R. DEB, S. DEB. (2011). <i>Robotics Technology and Flexible Automation</i> , McGra	w-Hill.						
E BOOKS							
1. http://www.robotshop.com/blog/en/how-to-make-a-robot-lesson-1-3707							
MOOC							
1. http://www.nptelvideos.in/2012/12/robotics.html							
2. <u>http://nptel.ac.in/courses/112108093/</u>							

NON-DEPARTMENTAL ELECTIVES – SEMESTER IV

COURSE TITLE		AI IN ROBOTICS		CREDITS	2
COURS E CODE	MHD4292	COURSE CATEGORY	NE	L-T-P-S	2-0-0-1

COURSE TITLE		AI IN ROBOTICS		CREDITS	2
Versio n	1.0	Approval Details	23 ACM, 06.02.20 21	LEARNING LEVEL	BTL - 4
ASSESSN	IENT SCHEME				
First Periodi cal Assess ment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Descri ption	Robotics is a pro- applications in in Mobile robots an software tool wit interest. Mobile agricultural, med tasks, including h market is mainly among end users mobile robot sys market. This cour is to develop con simulation enviro exercises that are	grammable system able to p ndustries, surveillance, disa re robots that are designed h tight coupling between pe robotics technology is bed ical and defense. Farmers narvesting, collecting crop of driven by growing applicat . Decreasing cost of sensors, tems is one of the key fac se is designed as a project-b trollers incorporating the Al nment. The assessment is ba planned to be carried out at	berform multip ster manager ad on hardwa rception to ac coming popula use mobile ro data, and wee tion sectors a actuators and ctors driving t ased learning for mobile ro ased on evalua the end of ea	ourpose activit nent and defe re platforms of tions in the en ar in various obots to perfo eding. The mo eding. The mo and increasing I simplicity in f he growth mo course, where obot applicatio tion of the out ch unit.	ties and finds ense sectors. with suitable wironment of sectors such orm different obile robotics in popularity functioning of obile robotics the outcome ns in Webots comes of the
Course Objecti ve	 The objective of t Physical structure intelligent robot Comprehend the in robot system Capability of Ide appropriate for a By considering 	his course is to enable the st are, sensing/actuation and e sensory techniques that an ntifying and Applying suitabl a range of different robotic a case studies they will be a	udents to unde programming re used to pro e robot naviga pplications able to critica	erstand g required to duce intelliger tion and contr lly appraise ro	develop an nt behaviours ol techniques obot systems

COUR TITL	RSE E		AI IN ROBOTICS CREDITS 2											
Cou Out me	rse co	 Upon completion of this course, the students will be able to Acquire the fundamental concepts behind Intelligent Robotic systems and differentiate various intelligent control techniques. Identify and Apply Intelligent algorithms, navigation and control techniques appropriate for a range of different robotic applications Comprehend the sensory techniques that are used to produce intelligent behaviours in robot system Design, Develop and Program an artificially intelligent robot for applications involving the basic modalities of sensing, path planning and navigation. 												
Prerec														
co,	0-1	PO-2	D PSO MAPPING 20-2 PO-3 PO-4 PO-5 PO-6 PO-7 PO-8 PO-9 PO-10 PO-11 PO-12 PSO-1 F										PSO-2	
CO-1	3	3	1	1	1	-	-	-	-	-	-	2	-	-
CO-2	3	3	2	2	2	1	1	2	2	2	-	2	-	-
CO-3	3	3	2	2	1	-	-	-	-	-	-	2	-	-
CO-4	3	3	3	3	3	1	1	2	2	2	-	2	-	-
			1: W	eakly r	elated,	2: Moo	derately	/ relate	d and 3	: Strong	ly rela	ted		
MO	DULE	1: INT	RODUC	TION					(6L)				-	
Artificia	al Int	elliger	nce –	Introdu	uction	– Hist	ory –	State	of the	Art –	Agen	ts and		
Enviroi	nmen [.] Parad	ts — H lioms	kole an – Histo	id Appl rv – Ne	lication	s in Ri Intelligi	obotics	, Autor Social	mation Implica	and M	anutac Telenr	turing.		
and Se	mi-Au	itonon	nous co	ntrol –	Seven	Areas of	of AI – c	classifica	ations	tions	reiepi	coence	СС	D-1
Practi	cal co	mpor	nent:										BT	L-3
•	Study	of We	bots – E	Inviron	nent, Ph	nysical N	/lodel, N	lodes ar	nd Contr	rollers				
Sugge	sted	Readi	ngs:											
	Webo	ots Cur	riculum	and Tec	chnical N	/Janual							(01)	
Hierard	chical		horativ	a and	React	ivo Pa	aradigm	<u>)s – /</u>	Attribut	· os - (losed	world	(9L)	
assum	ptions	; – a	dvanta	ges &	disad	vantag	es –	Reactiv	ve Para	adigms	– Bio	ological		
Founda	ations	– Be	ehaviou	irs – r	eflexive	e, coor	dinatio	n and	perce	otion ir	beha	viours-		
Schem	a The	eory –	Transf	ferring	Insight	s to ro	obots.	Attribu	tes of	Reactiv	e Para	digm -	С	0 - 2
Subsur	nptio	n Arch	itecture	e – Pot	ential F	ield M	ethodo	logies -	Impler	nentatio	on of r	eactive	B	TL - 4
system	is - De	signin	g a Rea	ctive In	npleme	ntatior	n – Case	e studie	2S					
sugges	Stud	v of ki	gs: Inemati	c mode	l for Di	fferent	ial driv	e mohil	e rohot	ts.				
-	Juu	y OI KI	nemati			incrent								

CO T	URSE ITLE	AI IN ROBOTICS	CREDITS	2			
	MODU	LE 3: SENSORS AND SENSING TECHNIQUES FOR ROBOTS		(6L)			
Overview- Sensors – Transducers – Attributes - Sensors for Motion, Force, Position,							
Light, Vision - Tactile sensing – Advanced Sensors – Applications; Hybrid Control							
Paradigms and its architectural attributes							
Sug	gested F	Readings:		512 0			
 Various Actuators used for design of robotic configurations. 							
MC	DULE 4	: PATH PLANNING AND NAVIGATION		(9L)			
Intro	oduction	n to Path planning and Navigation – Landmarks – Relational an	d associative				
met	hods; N	1etric Path planning – Configuration Space – Graph based pa	ath planners.	CO-4			
Loca	alization	 – continuous localization – feature based localization – explorat 	ion.	BTL-3			
Sug	gested F	Readings:					
	• Stud	ly of Braitenberg controller model for mobile robots and its beh	aviors				
		MODULE 5: Design of Robotic Applications	using AI in W	ebots (15L)			
Web	oots – I	ntroduction – design of differential drive mobile robot – Tel	eoperation –				
Brai	tenberg	control - Path Planning and Navigation					
Practical component: -							
• Build simple tele-operative differential drive mobile robots in "Webots" environment.							
Tele-operation can be performed using Keyboard control.							
 Integrate sensors in the previously build model and make the robot to navigate the environment using braitenberg control. 							
• N	1odify t	ne controller designed by implementing behaviours for a robo	t to navigate	BTL-3			
tł	ne envir	onment by avoiding obstacles					
• N n	Modify the controller designed by making the robot to plan its path using any navigational methods to reach the goal by avoiding the obstacle						
Sug	gested F	Readings:					
0	 Stud 	dy of Robot Behaviors					
TEX	твоок	S					
1.	Robert	R Murphy. (2001). Introduction to AI Robotics, MIT Press, 2 nd ed	ition.				
2.	Roland	Siegwart and I. Nourbaksh. (2011). Introduction to Mobile Robo	ts, MIT Press, 2	2 nd edition.			
REF	ERENC	BOOKS					
	Igor Sk	rjanc, Andrej Zdesar, SasoBlazic and Gregor Klancar. (2017). Wh	eeled Mobile R	obotics From			
1.	Fundaı	nentals Towards Autonomous Systems, ELSEVIER.					
Ν	1000						
1.	https:/	/www.coursera.org/specializations/modernrobotics					

COURSE TITLE	AI IN ROBOTICS	CREDITS	2					
SOFTWARE								
WEBOTS (WEBOTS (OPEN SOURCE)							
• <u>htt</u>	<u>https://cyberbotics.com/#download</u>							
• <u>htt</u>	<u>https://cyberbotics.com/doc/guide/tutorials</u>							
• <u>htt</u>	 https://en.wikibooks.org/wiki/Category:Book:Cyberbotics%27 Robot Curriculum 							
• <u>htt</u>	ps://en.wikibooks.org/wiki/Cyberbotics%27 Robot Curriculum							

NON-DEPARTMENTAL ELECTIVES – SEMESTER VI

COURSE TITLE	IMM	IERSIVE TECHNOLOGIES	CREDITS	2							
COURSE CODE	MHD4392	COURSE CATEGORY	DE	L-T-P-S	1-1-0-0						
Version	1.0	Approval Details	23 ACM, 06.02.202 1	LEARNIN G LEVEL	BTL-5						
ASSESSM	ASSESSMENT SCHEME										
First Periodica I Assessm ent	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendanc e	ESE						
15%	15%	10%	5%	5%	50%						
Course Descrip tion	Due to its potential benefits, immersive technologies such as augmented reality, virtual reality, mixed reality and 360 VR are increasingly incorporated in various applications. These technologies can provide a platform for increased engagement, immersion, interaction, enjoyment, and experience. This course aims to provide an understanding of this technology and its capabilities. Also, this course will enable to develop content using immersive technologies.										
Course Objectiv e	 To establis To work in To expering applications, 	h a broad and compreher collaborative group proje ences different immersi	nsive underst ects and deve ve technolog	anding imme lop working gies that ca	ersive applications prototypes In be used in various						

		ι	Upon completion of this course, the students will be able to												
Cours	se	1. C	Disting	uish be	etween	the va	arious	immer	sive te	chnolo	ogies a	nd ava	ilable	resour	ces
) m	2. R	eflect	on the	e exper	ience	with in	nmersi	ve tec	hnolog	gies				
e		3. lo	3. Identify a suitable immersive technology for a given application												
		4. E	4. Evaluate a use case and identify the important considerations when designing an												
	application using immersive technology.														
Prerequisites: CSB231 - Cryptography and Network Security															
CO, PO AND PSO MAPPING															
	Ρ														
со	0	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO	PO-	PO-	PS	PS	
	-	2	3	4	5	6	7	8	9	-10	11	12	0-1	0-2	
<u> </u>	1 2	3	3	1	3	2	2	1	2	2	2	2	2		
1	_	0	0	_	Ū	_	_	-	_	_		_	_	-	
CO-	2	3	3	1	3	1	1	1	1	1	1	1	2		
2														-	
CO-	2	3	3	1	3	1	1	1	1	1	1	1	2	_	
3															
CO-	2	3	3	1	3	1	1	1	1	1	1	1	2	_	
4															
1: We	eakly	relat	ed, 2:	Moder	ately r	elated	l and 3	: Stror	ngly re	lated					
MOD	ULE	1: INT	RODU	CTION	TO IN	IMERS	IVE TE	CHNO	LOGIES	5			(4L)		
Introd	ucti	on to I	mmer	sive Te	chnolo	ogies –	Histor	у — Туј	pes - Ir	nteract	ions		<u> </u>		
Sugge	sted	Read	ings:										CU-1 BTL-2		
Imme	rsive	e Techr	nology	: What	is it aı	nd Hov	v can v	ve Use	it Tod	ay?			DIL	2	
MOD	ULE	2: BUI	LDING	i IMMI	ERSIVE	ENVIE	RONM	ENTS		((7L)				
Worki	ng v	vith U	nity 3I	D, Obje	ects ar	nd Scal	le – Cr	eating	; a sim	ple di	orama	– VR			
Device	e inte	egratio	on - Ex	perien	cing vi	rtual re	eality						CO-2	2	
Sugge	sted	Read	ings:					11					BTL-	-3	
Creati	ng I	mmer	sive V	irtual I	Enviro	nment	s with	Unity							
MOD	ULF	3: USF		ERACT	IONS					(7	7L)				
Intera	ctio	ns with	n virtua	al envi	ronme	nts – C	Control	lers – I	Ravcas	t – Pai	rticle e	ffects			
Sugge	sted	Read	ings:						, 000				CO-2	2	
Gestu	re In	iteract	ion in '	Virtual	Realit	у							BTL-	-3	
MOD	ULE	4: AU	GEMN	TED RE	EALITY		MIXED	REALI	ТҮ				1		(7L)

Introduction Suggested Virtual Res MODULE A case stu	on to Augmented Reality , Mixed reality – AR Toolkit I Readings: ality Vs Augemented Reality Vs Mixed Reality 5: CASE STUDY dy on design of an application using immersive technologies	CO-3 BTL-2 (5L)					
Suggested	Readings:	CO-4					
Industrial case studies using immersive technologies BTL-5							
TEXT BOO	DKS						
1	Lawrence, C. (2016). <i>Cyber security for Dummies</i> , John Wiley & Sons Inc., 2 nd Edition,						
1.	pp.213432.						
REFEREN							
1	Jason Jerald. (2015), The VR Book – Human Centered Design for Vi Claypool	rtual Reality, Morgan &					
2	Tony Parisi. (2016), Learning Virtual Reality, O'Reilly Media, 2016						
E BOOKS							
1	https://profs.info.uaic.ro/~avitcu/FII%202015-2016/Animatie%203D	Documentatie/					
1.	<u>VR.pdf</u>						
MOOC							
1	https://in.udacity.com/course/introduction-to-virtual-realityud1012						
2	https://www.edx.org/course/creating-virtual-reality-vr-apps-uc-san-di	egox-cse190x					

HONOURS COURSE

COURSE TITLE	AUTOMA	ATION IN MANUFACTURI	CREDITS	3					
COURSE CODE	MHH4376	COURSE CATEGORY	Honours	L-T-P-S	3-0-0-2				
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3				
ASSESSMENT SCHEME									
First Periodic al Assessm ent	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE				
15%	15%	10%	5%	5%	50%				

Cou Desc o	irse cripti n	The p for m used mech	The primary focus of this course is on the design and development of automated systems for modern manufacturing industries. The course introduces various automated systems used in the manufacturing industries. It presents a detail of sensors, actuators, drives and mechanisms, hydraulic and pneumatic systems.												
Cou	ırse	1. ⊢ 2. F	 Highlight the importance of automation in the manufacturing industry Familiarize various components of an automated system 												
Obje	ectiv	3. E	xpose	the ro	le of se	ensors	requir	ed in a	utoma	ited sy	stem f	or mai	nufacti	uring	
e	9	4. A	waren	ess on	variou	us driv	es syst	tems a	nd its t	types	le omn	Jourd	in indu	ictri/	
		5. 3	5. Study on advanced manufacturing management tools employed in industry												
		1. D	escribe	- the ii	mporta	ance of	f autor	nation	in the	manu	facturi	.o ng ind	ustrv.		
Cou	ırse	2. S	electsu	iitable	mecha	nical c	ompor	nents c	of an ai	utoma	ted svs	stem w	vith sta	indard	S.
Out	com	3. R	ecomn	nend a	pprop	riate s	ensors	requir	ed for	autom	, nated s	system	S		
e	9	4. C	ompar	e the v	/arious	drive	systen	n							
		5. E [,]	valuate	e the	featur	es of	advan	ced m	anufa	cturing	g with	manu	ıfactur	ing ma	anagement
		to	ools.												
Prerequisites: Manufacturing, Basics of sensors.															
CO, PO AND PSO MAPPING															
со	РО	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	РО	PO-	PO-	PSO	PSO	PSO-3
	-1	2	3	4	5	6	7	8	9	-10	11	12	-1	-2	
со	3	2	2	3	3	2	1	2	2	3	2	2	3	3	-
1	5												-	-	
-1 CO													_		
-1 CO -2	2	2	3	2	2	3	2	1	2	2	2	1	2	3	-
-1 CO -2 CO -3	2	2	3	2	2	3	2	1	2	2	2	1	2	3	-
-1 CO -2 CO -3 CO -4	2 3 2	2 3 2	3 2 2	2 1 3	2 1 2	3 2 1	2 2 2 2	1 2 1	2 1 2	2 3 3	2 1 1	1 2 2	2 2 3	3 2 2	-
-1 CO -2 CO -3 CO -4 CO -5	2 3 2 3	2 3 2 2	3 2 2 3	2 1 3 2	2 1 2 3	3 2 1 2	2 2 2 2 2	1 2 1 2	2 1 2 2 2	2 3 3 1	2 1 1 2	1 2 2 1	2 2 3 3	3 2 2 3	-
-1 CO -2 CO -3 CO -4 CO -5	2 3 2 3	2 3 2 2	3 2 2 3 1: V	2 1 3 2 Veakly	2 1 2 3 relate	3 2 1 2 ed, 2: N	2 2 2 2 2 Modera	1 2 1 2 ately re	2 1 2 2 elated	2 3 3 1 and 3	2 1 1 2 : Stron	1 2 2 1 gly rel	2 2 3 3 ated	3 2 2 3	-
-1 CO -2 CO -3 CO -4 CO -5 MOI	2 3 2 3 3	2 3 2 2 1: INTF	3 2 2 3 1: V	2 1 3 2 Veakly	2 1 2 3 relate	3 2 1 2 ed, 2: N	2 2 2 2 Modera	1 2 1 2 ately ro	2 1 2 2 elated	2 3 3 1 and 3	2 1 1 2 : Stron	1 2 2 1 gly rel	2 2 3 3 ated	3 2 2 3	
-1 CO -2 CO -3 CO -4 CO -5 MOI Intro	2 3 2 3 DULE	2 3 2 2 1: INTF	3 2 2 3 1: V RODUC	2 1 3 2 Veakly CTION	2 1 2 3 relate	3 2 1 2 2 2 2 2 2 2 2 2 3 7 0 MA 3 3 7 1 2 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	2 2 2 2 Modera TION I	1 2 1 ately ro N MAI	2 1 2 elated NUFAC	2 3 3 1 and 3 cTURIN	2 1 1 2 : Stron IG IND	1 2 2 1 gly rel USTRV d adva	2 2 3 3 ated ((9L) nced	3 2 2 3	-
-1 CO -2 CO -3 CO -4 CO -5 MOI Intro man	2 3 2 3 DULE	2 3 2 2 1: INTF on: Im uring p	3 2 2 3 1: V RODUC	2 1 3 2 Veakly CTION ce of a analys	2 1 2 3 relate TO AU automa	3 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 Modera TION I n the n analys	1 2 1 ately ro N MAI nanufa is proc	2 1 2 elated NUFAC cturing ess: Da	2 3 3 1 and 3 TURIN g indus	2 1 2 : Stron IG IND stry an	1 2 2 1 gly rel USTRY d adva	2 2 3 3 ated ′(9L) nced	3 2 2 3	-
-1 CO -2 CO -3 CO -4 CO -5 MOI Intro man diffe	2 3 2 3 DULE induction ufactur rent r	2 3 2 2 1: INTF on: Im uring p manufa	3 2 2 3 1: V RODUC portan rocess acturin	2 1 3 2 Veakly CTION ce of a analys g setti	2 1 2 3 relate TO AU automa sis. The ng – di	3 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 Modera TION I n the n analys manu	1 2 1 ately ro N MAI nanufa is proc facturi	2 1 2 elated NUFAC cturing ess: Da ng sett	2 3 3 1 and 3 TURIN g indus ata col	2 1 2 Stron IG IND stry an lection d cont	1 2 2 1 gly rel d adva in inuous	2 2 3 3 ated ((9L) nced	3 2 2 3	- - - - CO-1
-1 CO -2 CO -3 CO -4 CO -5 MOI Intro man diffe man	2 3 2 3 DULE vduction ufacturent r ufacturent	2 3 2 2 1: INTF on: Im uring p manufa uring. I	3 2 2 3 1: V RODUC portan rocess acturin ntrodu	2 1 3 2 Veakly CTION ce of a analys g setti iction	2 1 2 3 relate TO AU automa sis. The ng – di to digit	3 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 Modera TION I analys manu ead con	1 2 1 ately ro nanufa is proc facturi mpone	2 1 2 elated NUFAC cturing ess: Da ng sett	2 3 3 1 and 3 cTURIN g indus ata col ting an d the v	2 1 2 Stron IG IND stry an lection d cont vision o	1 2 2 1 gly rel USTRY d adva n in inuous of digit	2 2 3 3 ated (9L) nced	3 2 2 3	- - - - CO-1 BTL-2
-1 CO -2 CO -3 CO -4 CO -5 MOI Intro man diffe man	2 3 2 3 DULE 0 duction ufacturent r ufacturent r	2 3 2 2 1: INTF on: Im uring p manufa uring. I uring a	3 2 2 3 1: V RODUC portan rocess acturin ntrodu ntrodu	2 1 3 2 Veakly CTION ce of a analys g setti action ign.	2 1 2 3 relate TO AU automa sis. The ng – di to digit	3 2 1 2 2 2 2 2 3 3 3 3 2 3 3 3 3 3 3 3	2 2 2 Modera TION I analys manu ead con	1 2 1 ately re nanufa is proc facturi mpone	2 1 2 elated NUFAC cturing ess: Da ng sett ents an	2 3 3 1 and 3 5 TURIN g indus ata col ting an d the v	2 1 2 Stron IG IND stry an lection d cont <i>v</i> ision o	1 2 2 gly rel USTRY d adva in inuous of digit	2 2 3 ated ((9L) nced	3 2 2 3	- - - - - CO-1 BTL-2
-1 CO -2 CO -3 CO -4 CO -5 MOI Intro man diffe man Sugg Man	2 3 2 3 DULE duction ufactur ufactur ufactur ufactur ufactur ufactur	2 3 2 2 1: INTF on: Im uring p manufa uring. I uring a I Readi uring s	3 2 2 3 1: V RODUC portan rocess acturin ntrodu ntrodu ntrodu sings: ettings	2 1 3 2 Veakly ce of a analys g setti iction ign.	2 1 2 3 relate TO AU automa sis. The ng – di to digit	3 2 1 2 2 2 2 2 2 3 2 3 2 2 2 3 2 3 2 3	2 2 2 Modera TION In the manalys manuead com	1 2 1 2 ately ro nanufa is proc facturi mpone	2 1 2 elated NUFAC cturing ess: Da ng sett	2 3 3 1 and 3 5 TURIN g indus ata col ting an d the v	2 1 2 Stron GIND Stry an lection d cont <i>v</i> ision o	1 2 2 1 gly rel USTRY d adva n in inuous	2 2 3 3 ated ((9L) nced	3 2 2 3	- - - - CO-1 BTL-2

MODULE	2: DESIGN OF AN AUTOMATED SYSTEM(9L)	
Introducti	on to designing of an automated system, Building block of an automated	
system, w		
componer	CO-2	
design req	BTL-2	
Suggested		
Design of		
MODULE	3: SENSORS AND MICROPROCESSORS (9))
Introducti	on to sensors- Study of various sensor required in a typical automated	
system for	manufacturing. Construction and principle of operation of sensors.	
Microproc	CO-3	
microproc	essor or micro controllers and its configurations.	BTL-2
Suggested	Readings:	
Various m	odern sensors and their usage	
MODULE	4: DRIVES IN AUTOMATION(9L)	
Introducti	on to drives and its types. Electrical drives – types selection criteria,	
constructi	on and operating principle. Hydraulic systems: hydraulics power pack,	
pumps, va	CO-4	
configurat	ions, compressors, valves, distribution and conditioning. Designing of	
various sir	BIL-3	
Suggested	Readings:	
Compariso	on of hydraulic, pneumatic and electrical drives	
MODULE !	5: MANUFACTURING MANAGEMENT TOOLS	(01)
		(9L)
Digital tec	nnology – Roadmap to success in Digital Manufacturing and Design,	
Digital tec Industry o	nnology – Roadmap to success in Digital Manufacturing and Design, pportunities A Business case for digital implementation, SWOT analysis,	
Digital tec Industry o Future in I	nnology – Roadmap to success in Digital Manufacturing and Design, pportunities A Business case for digital implementation, SWOT analysis, Digital Manufacturing and design. Finding the Bottleneck, Labor cost and	
Digital tec Industry o Future in I Labor utili	nnology – Roadmap to success in Digital Manufacturing and Design, pportunities A Business case for digital implementation, SWOT analysis, Digital Manufacturing and design. Finding the Bottleneck, Labor cost and zation, Inventory turns, Make to stock vs Make to order/ Reasons for	
Digital tec Industry o Future in I Labor utili inventory,	nnology – Roadmap to success in Digital Manufacturing and Design, pportunities A Business case for digital implementation, SWOT analysis, Digital Manufacturing and design. Finding the Bottleneck, Labor cost and zation, Inventory turns, Make to stock vs Make to order/ Reasons for Dealing with multiple flow units, The seven sources of waste, financial	(5L) CO-5
Digital tec Industry o Future in I Labor utili inventory, value of pr	nnology – Roadmap to success in Digital Manufacturing and Design, pportunities A Business case for digital implementation, SWOT analysis, Digital Manufacturing and design. Finding the Bottleneck, Labor cost and zation, Inventory turns, Make to stock vs Make to order/ Reasons for Dealing with multiple flow units, The seven sources of waste, financial roductivity, Overall equipment effectiveness.	(3L) CO-5 BTL-3
Digital tec Industry o Future in I Labor utili inventory, value of pu Practical c	nnology – Roadmap to success in Digital Manufacturing and Design, pportunities A Business case for digital implementation, SWOT analysis, Digital Manufacturing and design. Finding the Bottleneck, Labor cost and zation, Inventory turns, Make to stock vs Make to order/ Reasons for Dealing with multiple flow units, The seven sources of waste, financial roductivity, Overall equipment effectiveness. omponent:	CO-5 BTL-3
Digital tec Industry o Future in I Labor utili inventory, value of pr Practical c Developm	nnology – Roadmap to success in Digital Manufacturing and Design, oportunities A Business case for digital implementation, SWOT analysis, Digital Manufacturing and design. Finding the Bottleneck, Labor cost and zation, Inventory turns, Make to stock vs Make to order/ Reasons for Dealing with multiple flow units, The seven sources of waste, financial roductivity, Overall equipment effectiveness. omponent: ent of framework for next generation tools with process analysis.	CO-5 BTL-3
Digital tec Industry o Future in I Labor utili inventory, value of pr Practical o Developm Suggested	nnology – Roadmap to success in Digital Manufacturing and Design, pportunities A Business case for digital implementation, SWOT analysis, Digital Manufacturing and design. Finding the Bottleneck, Labor cost and zation, Inventory turns, Make to stock vs Make to order/ Reasons for Dealing with multiple flow units, The seven sources of waste, financial roductivity, Overall equipment effectiveness. omponent: ent of framework for next generation tools with process analysis. Readings:	CO-5 BTL-3
Digital tec Industry o Future in I Labor utili inventory, value of pu Practical c Developm Suggested Traditiona	nnology – Roadmap to success in Digital Manufacturing and Design, pportunities A Business case for digital implementation, SWOT analysis, Digital Manufacturing and design. Finding the Bottleneck, Labor cost and zation, Inventory turns, Make to stock vs Make to order/ Reasons for Dealing with multiple flow units, The seven sources of waste, financial roductivity, Overall equipment effectiveness. omponent: ent of framework for next generation tools with process analysis. Readings: I Vs Digital Manufacturing Roles	CO-5 BTL-3
Digital tec Industry o Future in I Labor utili inventory, value of pr Practical o Developm Suggested Traditiona	nnology – Roadmap to success in Digital Manufacturing and Design, oportunities A Business case for digital implementation, SWOT analysis, Digital Manufacturing and design. Finding the Bottleneck, Labor cost and zation, Inventory turns, Make to stock vs Make to order/ Reasons for Dealing with multiple flow units, The seven sources of waste, financial roductivity, Overall equipment effectiveness. omponent: ent of framework for next generation tools with process analysis. Readings: I Vs Digital Manufacturing Roles	CO-5 BTL-3
Digital tec Industry o Future in I Labor utili inventory, value of pr Practical o Developm Suggested Traditiona TEXT BOO	 A Business case for digital Manufacturing and Design, A Business case for digital implementation, SWOT analysis, Digital Manufacturing and design. Finding the Bottleneck, Labor cost and A Business, Make to stock vs Make to order/ Reasons for Dealing with multiple flow units, The seven sources of waste, financial A Business equipment effectiveness. A Business equipment effectiveness equipment effectiveness. A Business equipment effectiveness equipment effectiveness equipment effectiveness. A Business equipment effectiveness equipment effectivenes equipment effecti	CO-5 BTL-3
Digital tec Industry o Future in I Labor utili inventory, value of pu Practical c Developm Suggested Traditiona TEXT BOO 1.	 Annology – Roadmap to success in Digital Manufacturing and Design, A portunities A Business case for digital implementation, SWOT analysis, Digital Manufacturing and design. Finding the Bottleneck, Labor cost and A tation, Inventory turns, Make to stock vs Make to order/ Reasons for Dealing with multiple flow units, The seven sources of waste, financial A roductivity, Overall equipment effectiveness. A omponent: A to framework for next generation tools with process analysis. A Readings: I Vs Digital Manufacturing Roles KS Bolton, W. (2003). Mechatronics: electronic control systems in mechanical of engineering. Pearson Education. 	CO-5 BTL-3
Digital tec Industry o Future in I Labor utili inventory, value of pr Practical c Developm Suggested Traditiona TEXT BOO 1.	 Annology – Roadmap to success in Digital Manufacturing and Design, A pportunities A Business case for digital implementation, SWOT analysis, Digital Manufacturing and design. Finding the Bottleneck, Labor cost and A cation, Inventory turns, Make to stock vs Make to order/ Reasons for Dealing with multiple flow units, The seven sources of waste, financial A coductivity, Overall equipment effectiveness. A component: A constraint of framework for next generation tools with process analysis. A Readings: I Vs Digital Manufacturing Roles KS Bolton, W. (2003). Mechatronics: electronic control systems in mechanical of engineering. Pearson Education. Regtien, P. P. (2012). Sensors for mechatronics. Elsevier. 	CO-5 BTL-3
Digital tec Industry o Future in I Labor utili inventory, value of pr Practical o Developm Suggested Traditiona TEXT BOO 1. 2 REFERENC	 Annology – Roadmap to success in Digital Manufacturing and Design, A portunities A Business case for digital implementation, SWOT analysis, Digital Manufacturing and design. Finding the Bottleneck, Labor cost and A portunities a Business case for digital implementation, SWOT analysis, Digital Manufacturing and design. Finding the Bottleneck, Labor cost and A portunities a Business case for digital implementation, SWOT analysis, Digital Manufacturing and design. Finding the Bottleneck, Labor cost and A portunities a Bottleneck, Labor cost and the seven sources of waste, financial A portunities a Bottleneck, Doverall equipment effectiveness. A portunities a Bottleneck for next generation tools with process analysis. A Readings: I Vs Digital Manufacturing Roles KS Bolton, W. (2003). Mechatronics: electronic control systems in mechanical control engineering. Pearson Education. Regtien, P. P. (2012). Sensors for mechatronics. Elsevier. E BOOKS 	CO-5 BTL-3

2	Pearson, R. S. G. P. H. (2002). <i>Microprocessor Architecture Programming and Applications</i> with the 8085, Atilim University Library, 2002: Microprocessor Architecture Programming and Applications with the 8085 (Vol. 1). Bukupedia.
E BOOK	
1.	https://libguides.newcastle.edu.au/industrial-design/ebooks
MOOC	
1	https://onlinecourses.nptel.ac.in/noc21_me120/preview
2	https://www.mooc-list.com/tags/industrial-design

COURSE TITLE	ENGINEERII	NG PROJECT MANAGEME	CREDITS	3											
COURSE CODE	MHH4377 COURSE CATEGORY		Honours	L-T-P-S	3-0-0-2										
Version	1.0	Approval Details		LEARNING LEVEL	BTL-3										
ASSESSMENT SCHEME															
First Periodic al Assessm ent	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE										
15%	15%	10%	5%	5%	50%										
Course	This course introd	This course introduces the tools to initiate a project plan, manage both stakeholders and													
Descripti	relationships, orga	relationships, organize their team, develop a project charter, and build a business case for a													
on	project														
Course Objectiv e	 Develop a project scope, schedule and budget and then status them to predict project performance. Analyze the change in management and techniques. Preparing organization charts, create a Stakeholder Register The key guidance your team needs to understand the scope, requirements and purpose for the project 														
	Upon completio	on of this course, the stude	ents will be a	ble to											
	1. Enumerate th	ne engineering concepts f	or projectide	ntification											
Course	2. Comprehend	the key deliverable bas	ed on busir	ness requirements	while managing										
Outcom	customer exp	pectations													
е	3. Apply the bu	siness case for a project a	nd calculate	Net Present Value											
	4. Build a busin	ess case on project organi	zation for a s	specific project											
	5. Estimate the	cost analysis of a specific	project												
Prerequisites: Project Management, Basics on project ideas.															
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CO, I	PO AN	ID PSC	MAP	PING											
со	PO -1	РО- 2	РО- 3	РО- 4	РО- 5	РО- 6	РО- 7	РО- 8	РО- 9	PO -10	PO- 11	РО- 12	PSO -1	PSO -2	PSO-3
CO -1	3	2	2	3	3	2	1	2	2	3	2	2	3	3	-
CO -2	2	2	3	2	2	3	2	1	2	2	2	1	2	3	-
CO -3	3	3	2	1	1	2	2	2	1	3	1	2	2	2	-
CO -4	2	2	2	3	2	1	2	1	2	3	1	2	3	2	-
CO 3 2 3 2 3 2 2 2 2 2 1 2 1 3 3 -5 3 2 3 2 2 2 2 1 2 1 3 3															
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION TO PROJECT MANAGEMENT (9L)															
Introduction to Project Management - Pre-Course Survey Developing a Project															
Charter - Project Management Plan Manage and Control Work CO-1											CO-1				
Suggested Readings: BTL-1															
Challenges in Project Management															
WIUL		Z: PRO				II (9L)				o			+6:00		
Key I			Projec		izatio	nt - Pr	ogram		ortioli nont D		ageme	ent-E	LINICS		
Drac	tical c	omno	nent.	. Orgai	11281101	IS PIOJ		anagei	nent P	locess	5				CO-3
Pren	are a	manag	emen [.]	t nortf	olio										CO-2 RTI -2
Sugg	ested	Read	ings:	e por er	0110										512 2
Proje	ect O	rganiza	ation i	n Auto	mobil	e indu	stry								
MO	DULE	3: PRO	JECT C	OMM	UNICA	TION(9L)								
Iden	tifying	g Stake	holder	rs - Sta	kehold	ler Ma	nagem	nent - F	Plan Ma	anagin	g Stak	eholde	er		
Enga	geme	ent - N	Ionitor	ing Sta	akehol	der En	gagem	ent							CO-3
Sugg	ested	l Readi	ings:												BTL-3
Proje	Project Deliverable in steel industry														
MO	DULE 4	4: PRO	JECT S	COPE	MANA	GEME	NT(9L)								
Introduction to Scope Development - Scope Development - Requirements															
Development - Scope Control Process - Time Management - Critical Path Method -															
Overview Types of Diagrams Activity on Node Example.											BTI-3				
Suggested Readings:															
Proje	ect De	velopr	nent ir	n autor	nobile	assem	bly lin	e secti	on						
MO	MODULE 5: COST ESTIMATION (9L)														

Preparing an Estimate - Estimate Bases - Type of Estimates - Cost Baseline - Forward										
Pass Diagr	am & Backward Pass Diagram - Strategies for Dealing Tools and	CO-5								
Conclusio	n.									
Suggested	Readings:	BTL-3								
Case study on cost analysis of developed product										
TEXT BOOKS										
	Nicholas, J. M., & Steyn, H. (2020). Project management for engineering, bu	siness and								
1.	technology. Routledge.									
REFERENCE BOOKS										
1	Goodman, L. J., & Ignacio, R. S. (2019). Engineering project management: th	e IPQMS method								
Ŧ	and case histories. CRC Press.									
E BOOK										
1.	https://link.springer.com/book/10.1007/978-3-319-56099-1									
MOOC										
https://www.coursera.org/learn/initiating-planning?specialization=engineering-project-										
	management									
2	https://www.coursera.org/learn/scope-time-management-cost?specializati	on=engineering-								
2	project-management									

COURSE TITLE	ADVA	NCED MANUFACTURING		CREDITS	3										
COURSE CODE	MHH4461	COURSE CATEGORY	Honours	L-T-P-S	3-0-0-2										
Version	1.0	Approval Details		LEARNIN G LEVEL	BTL-3										
	ASSESSMENT SCHEME														
First Periodic al Assessm ent	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendan ce	ESE										
15%	15%	10%	5%	5%	50%										
Course Descripti on	This course covers the details of the digitally connected advanced manufacturing practices, advanced intelligent machining, advanced metal forming processes and operational complexity of enterprises, business process optimization with the concept of integrated product-process-value chain.														

Cou Obje e	ectiv	1. S 2. S 3. F 4. C 5. R a	 Study on different tools and techniques for integration of data for manufacturing Selection on suitable components of intelligent machining Familiarize various sensing techniques in advanced manufacturing Describe computational techniques and platforms Recognition of design, planning and production scheduling of goods and services by applying product life cycle data Upon completion of this course, the students will be able to 												
		ι	Jpon co	omplet	ion of	this co	ourse, t	the stu	dents	will be	able t	0			
		1. D	escribe	e the t	ools, te	echnol	ogies,	and te	chniqu	les for	aggre	gation	and ir	itegrat	ion of data
Cou	rco		irougn	out the	e mani bo yar	utactui	ring su	opts of	iain ar Fintoll	ia enti igont r	re proo	ing	e cycle	2.	
Out	com	2. C	nnlv th	ne conc	cent of	vario	is sens	ing tea	hniqu	es in a	dvance	nig. d mar	nufactu	iring.	
e 4. Comprehendthe various computational techniques and platforms of a										advanced					
manufacturing															
5. Perform design, planning and production scheduling of goods and services															
throughdigitally connected enterprise															
Prerequisites: Manufacturing, Basics of sensors.															
CO, PO AND PSO MAPPING															
6	РО	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	РО	PO-	PO-	PSO	PSO	
0	-1	2	3	4	5	6	7	8	9	-10	11	12	-1	-2	P30-5
CO -1	3	2	2	3	3	2	1	2	2	3	2	2	3	3	-
CO -2	2	2	3	2	2	3	2	1	2	2	2	1	2	3	-
CO -3	3	3	2	1	1	2	2	2	1	3	1	2	2	2	-
CO -4	2	2	2	3	2	1	2	1	2	3	1	2	3	2	-
CO -5	3	2	3	2	3	2	2	2	2	1	2	1	3	3	-
			1: V	Veakly	relate	ed, 2: N	Aodera	ately r	elated	and 3	: Stron	gly rel	ated		
MO	DULE	1: INTF	RODUC	TION	TO AD	VANC	ED MA	NUFA	CTURI	NG EN	TERPR	ISE(9L)			
Intro	ducti	on to a	advanc	ed ma	nufact	uring e	enterpi	rise, ar	integ	rated e	enterp	rise,			
the t	ransp	arency	y of pro	oduct l	ife cyc	le data	i, adva	nced n	nanufa	icturin	g defir	ied,			
advanced manufacturing: Levels of approach. Product life cycle, advanced															
man	ufactı	uring a	doptio	n, info	rmatic	on shar	ing inf	rastru	ctures,	Produ	ıct life	cycle		BTL	1
mana	agem	ent (Pl	_IVI), Tł	ne indu	istrial l	nterne	et of Th	nings (I	IOT)						
	estec	i Kead	ings:	unition	in adv	ancod	manur	facturi	na						
		3 anu (2. INITE					manu		чВ						
INIOL	OLE .	<u> </u>				NU		96)							

Introduction to Intelligent machining, machining basics, the evolution, and									
componer	its of intelligent machining. Manufacturing and manufacturing								
systems, N	Nanufacturing trends and challenges, Manufacturing aspects,	CO-2							
selection a	and classification, description and taxonomy of the mfg. Processes	BTL-2							
Suggested	Readings:								
Applicatio	ns and new trends in 3D manufacturing								
MODULE	3: SENSORSAND SENSING TECHNIQUES	(9L)							
Introducti	on to sensors- Study of various sensor required in a typical advanced								
manufactu									
sensors. Microprocessor Technology: Signal conditioning and data acquisition,									
use of mic	roprocessor or micro controllers and its configurations.	CU-5 PTI 2							
Transform	ing data into information, Practical uses of machine learning	DIL-2							
Suggested	Readings:								
Various m	odern sensors								
MODULE	4: COMPUTATIONAL TECHNIQUES AND PLATFORMS	(9L)							
Introducti	on to computational techniques and platforms. Sensitivity analysis,								
anomaly d	etection, the computational platform, HPC and cloud computing,								
Industry 4	.0 Roadmap Determination of significant variables/factors,								
computing	platform, components, categories and capabilities. Big data, data	CO-4							
collection	considerations, data storage and data processing, data collection,	BTL-3							
data stora	ge and organization and data pre-processing.								
Suggested	Readings:								
Traditiona	l data sets versus Big data								
MODULE	5: DIGITALLY CONNECTED ENTERPRISE	(9L)							
Infrastruct	ure performance of value chains, New manufacturing paradigms,								
data secur	ity: concerns and solutions, New business models originated from								
advanced	manufacturing, Overview of data security concerns. Introduction to	CO-5							
machining	process control, adaptive control with optimization, machining								
force cont	rol, manufacturing process control: commonly used software.	BTL-3							
Suggested	Readings:								
Traditiona	l Vs Digital Manufacturing Roles in automobile industry								
TEXT BOOKS									
	Bolton, W. (2003). Mechatronics: electronic control systems in mecha	nical and electrical							
1. engineering. Pearson Education.									
2 Regtien, P. P. (2012). <i>Sensors for mechatronics</i> . Elsevier.									
REFERENCE BOOKS									
1	Norton, R. L. (2002). Cam design and manufacturing handbook. Indus	trial Press Inc							
	Pearson, R. S. G. P. H. (2002). Microprocessor Architecture Programm	ing and Applications							
2	with the 8085, Atilim University Library, 2002: Microprocessor Archite	cture Programming							
and Applications with the 8085 (Vol. 1). Bukupedia.									

E BOOK	
1.	https://link.springer.com/book/10.1007/978-3-319-56099-1
МООС	
1	https://nptel.ac.in/courses/112/107/112107078/
2	https://www.coursera.org/learn/advanced-manufacturing-process-
2	analysis?specialization=digital-manufacturing-design-technology
2	https://www.coursera.org/learn/intelligent-machining?specialization=digital-
5	manufacturing-design-technology
л	https://www.coursera.org/learn/advanced-manufacturing-enterprise?specialization=digital-
4	manufacturing-design-technology

COURSE TITLE	E ENGINEERING PROJECT MANAGEMENT - II CREDITS 3												
COURSE CODE	MHH4462	COURSE CATEGORY	Honours	L-T-P-S	3-0-0-2								
Version	1.0	Approval Details		LEARNIN G LEVEL	BTL-3								
	ASSESSMENT SCHEME												
First Periodic al Assessm ent	c Second Periodical n Assessment Seminar/ Assignments/ Project Surprise Test / Quiz Ce ESE												
15%	15% 10% 5% 5% 50%												
Course Descripti on	This course helps to explore project governance in theory and practice. Helps to learn the difference between risk and uncertainty and the role of risk register. Identifies the unique challenges of scope management in major projects and employ scope management tools and techniques that will facilitate your project planning.												
Course Objectiv e	 Familiarize and discriminate about projects, programmes and portfolios Determine the performance parameters of major engineering projects Analyze the role of stakeholders in major projects Study about the governance of major projects and its challenges Appraise the concepts of strategic risk and scope management 												
Course Outcom e	Upon complet 1. Describe the k project life cyc 2. Calculate the c	tion of this course, the stu ey characteristics of maj le cost and time performance	dents will be or engineerii e indicators c	e able to ng projects a of major proje	nd the key phases of a								
_	3. Analyze the im	portance of stakeholder a	and their mai	nagement									

4. Describe the importance of governance in project management

5. Evaluate the theory and practice of managing opportunities, risk and scope

Prerequisites: Project Management, Basics on project ideas.

CO, PO AND PSO MAPPING																
60	РО	PO-	PO-	PO-	PO-	PO-	PO-	PO-	PO-	РО	PO-	PO-	PSO	PSO	DCO 3	
0	-1	2	3	4	5	6	7	8	9	-10	11	12	-1	-2	PSO-3	
СО	2	2	2	2	2	2	1	2	2	2	2	2	2	2		
-1	5	Z	Z	5	5	2	L	2	2	5	2	2	5	5	-	
CO -2	2	2	3	2	2	3	2	1	2	2	2	1	2	3	-	
со	3	3	2	1	1	2	2	2	1	3	1	2	2	2	_	
-3																
-4	2	2	2	3	2	1	2	1	2	3	1	2	3	2	-	
CO -5	3	2	3	2	3	2	2	2	2	1	2	1	3	3	-	
1: Weakly related, 2: Moderately related and 3: Strongly related																
MODULE 1: PROJECT PERFORMANCE (9L)																
Introduction - Projects, sub-projects and operations - Project life cycle theories																
- Pro	ject n	nanage	er - Pro	ject m	anage	ment -	Proje	ct man	ageme	ent dut	ies - P	hases				
of th	e infr	astruc	ture lif	e cycle	e. Tran	sactior	n costs	– Prog	gramm	es and	l portfo	olio -				
Chal	lenge	s of pr	ogram	me ma	anagen	nent.							CO-1			
Sugg	ested	l Read	ings:										BTL-1			
Case	study	y: the l	Vilan E	хро												
Case	study	y: The	nuclea	r indus	stry in	the US	A and	South	Korea							
Anal	ysis: t	he Sou	ith Kor	ean nu	uclear	indust	ry									
MO	DULE	2: TIM	E AND	COST	ESTIM	ATION	I IN PR	OJECT	S(9L)				r			
Cost	and t	ime pe	erform	ance o	of majo	r proje	ects - C)ther r	easons	to exp	olain o	ver-				
budg	get an	d dela	y. Majo	or proj	ect - T	ypes o	f risks	are inv	volved	in maj	or proj	iects				
- Iror	n triar	ngle - E	rror an	nd inac	curacy	/ in ma	ijor pro	ojects:	the ex	ample	ot					
infrastructure projects. Optimism bias - Reduce the impact of optimism bias -												as -	CO-2			
Turner and Zolin framowork											nent.	ent. BTL-2				
Suggestea Readings:																
Case	stud	y. 10101 v: the	Tower		 											
Case	. stuu	y. une	10000		a								1			

Case stud	y: the Thames Barrier						
MODULE	3: PROJECT STAKEHOLDERS(9L)						
Introducti	on - Identifying stakeholders: public and industrial stakeholders -						
financial a	nd other stakeholders - roles of stakeholders - Internal and external						
stakehold	ers - Stakeholder management theory RACI model.	CO-3					
Suggested	Readings:	BTL-3					
Case study	r:stakeholder management Stakeholder mapping						
Case study	r: The impact of stakeholder management in HS2						
MODULE	4: PROJECT GOVERNANCE(9L)						
Governan	ce - Governance of major projects - Governance vs management -						
Muller's fo	our paradigms - Governance objectives and institutions - challenges	CO 4					
to major p	roject governance						
Suggested	Readings:	DIL-3					
Developin	g critical analysis skills						
MODULE	5: RISK AND MANAGEMENTSCOPE(9L)						
Features o	f risk management - strategic risk – uncertainty - Organizational						
involveme	nt - risk registers - Socio-technical hexagon introduction - risk						
appetite -	utility theory. Scope management: internal and external projects -	CO-5					
scope cree	ep - gold plating - cost of scope change. Work Breakdown Structure –						
design. Bu	ildings Information Modelling.	BTL-3					
Suggested	Readings:						
Case study	y: Risk analysis in food safety						
TEXT BOO	KS						
	Nicholas, J. M., & Steyn, H. (2020). Project management for engineeri	ng, business and					
1.	technology. Routledge.						
REFERENC	E BOOKS						
1	Goodman, L. J., & Ignacio, R. S. (2019). Engineering project managem	ent: the IPQMS method					
	and case histories. CRC Press.						
E BOOK							
1.	https://link.springer.com/book/10.1007/978-3-319-56099-1						
моос							
1	https://www.coursera.org/learn/major-engineering-project-						
±	performance?specialization=managing-major-engineering-projects						
2	https://www.coursera.org/learn/major-engineering-projects?speciali	zation=managing-					
2	² major-engineering-projects						

MINORS COURSE

COU TIT	RSE LE	E DIGITAL MANUFACTURING CREDITS 3												}		
COU CO	RSE DE	Μ	HM42	61	CO	URSE C	ATEG	ORY	Mir	nors	L-T-	-P-S		3-0-	0-2	
Vers	sion		1.0		A	oprova	l Deta	ils			LEAF G LI	RNIN EVEL		BTL-3		
						Α	SSESS	MENT	SCHEN	ΛE						
Fir Perio a Asse er	rst odic I Issm	Pe As	Secono eriodio sessmo	d :al ent	Seminar/ Assignments/ Project Quiz					orise st / uiz	Atte	ndan e		ES	Έ	
15	%	15% 10% 5% 5% 50%												%		
Cou Desc o	irse ripti n	This course will expose you to the transformation taking place, throughout the world, in the way that products are being designed and manufactured. The transformation is happening through digital manufacturing and design (DM&D) – a shift from paper-based processes to digital processes in the manufacturing industry.												orld, in the appening cesses to		
Cou Obje e	irse ectiv	 Highlight the factors and trends motivating the transition from the current state manufacturing to a DMD model. Exposeto learners on the multiple components that integrate to create a future manufacturing enterprise. Study on different strategies and components affecting data storage in the enterprise. Familiarizing the factors that influence the sharing of data both internally and externall 											nt state of e a future terprise. externally.			
Cou Outo e	Ourse utcom eUpon completion of this course, the students will be able to1. Describe the importance of manufacturing technology.2. Recommend the importance of digital thread inmanufacturing3. Enumerate the differenttechnologies in digital storage.4. Comprehend the various technologyimplemented in digital thread.5. Compare various manufacturing design and its types.															
Prere	equisi	tes: IV	lanuta	cturing	, Basic	s of Da	ata sto	rage.								
						со,	ΡΟ ΑΝ	ID PSC		PING						
со	PO -1	РО- 2	РО- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO-	PO- 12	PSO -1	PSO -2	PSO-3	
CO -1	3	2	2	3	3	2	1	2	2	3	2	2	3	3	-	
СО	2	2	3	2	2	3	2	1	2	2	2	1	2	3	-	

-2																	
со	-	-				-		-		-			2				
-3	3	3	2	1	1	2	2	2	1	3	1	2	2	2	-		
со	2	2	2	3	2	1	2	1	2	3	1	2	3	2	-		
-4																	
-5	3	2	3	2	3	2	2	2	2	1	2	1	3	3	-		
			1: V	Veakly	relate	d, 2: N	/lodera	ately r	elated	and 3	: Stron	gly rel	ated				
MO	DULE	1: INTF	RODUC	TION	to dig		MANU	FACTU	RING(9L)							
Digit	al Ma	nufact	uring a	and De	sign In	npact o	on Mai	nufacti	uring-C	Careers	5						
Adva	Advantages of Digital Manufacturing and Design Information-Sharing in the																
Digit	Digital Thread-Multiple Organizations in the Manufacturing Process Transition													cc)-1		
to Di	gital I	Manufa	acturir	ng and	Desigr	Data	Procur	ement	t Stand	ards				BT	 L-1		
Man	ufactu	uring S	upply	Chains	•												
Sugg	Suggested Readings:																
Man	Manufacturing settings and data collection																
MODULE 2: INTRODUCTION TO DIGITAL THREAD (9L)																	
Intro	Introduction to Digital Thread-The Vision of Digital Manufacturing and Design																
The Diffusion of Innovation Motivating-Factors Digital Thread Business-													CO-2				
Syste	ems S	Laying	Releva	int; ве	ing a P	layer i		Dinus	SION OI	Innova	ation.		BTL-2				
Desi	gn of	hasic i	m ac hii	ne ele	ments												
MO		B: DAT	A STO	RAGE(9L)												
Intro	ducti	on to E	Digital	storag	e-Data	Singu	arity V	/ersion	-Contr	ol Data	a Secu	rity					
and	Disast	er Rec	overy	Intero	perabil	ity - Se	emanti	c Data	Techn	ical Da	ata						
Pack	ages-	4.0 Ro	ad ma	p to Sı	access.									CC	-3		
Sugg	ested	Readi	ings:											BI	L-2		
Best	pract	ices fo	r Cybe	r secu	rity sta	ndards	s in da	ta stor	age.								
MO	OULE 4	4: IMP	LEMEN	ITATIC	ON OF	DIGITA	L THR	EAD					(9	L)			
Intro	ducti	on Digi	ital Thi	read: I	mplem	entati	on - A	Busine	ess Cas	e for tl	ne Digi	tal					
Thre	ad Tra	ansitio	ning to	the D	igital T	hread	Challe	nges a	nd Bei	nefits o	of						
Impl	emen	ting th	e Digit	al Thre	ead Co	mputiı	ng Res	ource '	Virtual	ization	n Resou	urces		CC)-4		
for C	loud-	based	Compu	uting.										BT	L-3		
Sugg	ested	Readi	ings:														
Cyber infrastructure in digital thread																	
MODULE 5: DESIGN PROCESS (9L)											(9L)						
Finit	e Elen	nent A	nalysis	- Com	putati	onal Fl	uid Dy	namic	s - Mo	d Desi	gn -		CO-5				
Addi	tive N	1anufa	cturin	g - Digi	tal Wo	ork Inst	ructio	ns - Di	gital Do	ocume	nts an	d					
Records - Digital Metrology Approaches.												BTL-3					
Sugg	ested	Readi	ings:														

Digital Wo	ork Instructions, Drawings and Revision Control									
TEXT BOO	KS									
	Zhou, Z., Xie, S., & Chen, D. (2012). Fundamentals of digital manufact	uring science. London,								
1.	UK:: Springer.									
REFERENCE BOOKS										
1	Ian Gibson, I.G.(2015). Additive manufacturing technologies 3D printing, rapid prototyping,									
1	and direct digital manufacturing. London, UK:: Springer.									
E BOOK										
1.	http://www.uou.ac.in/sites/default/files/slm/Introduction-cyber-sec	urity.pdf								
MOOC										
1	https://www.coursera.org/learn/digital-manufacturing-design?specia	alization=digital-								
	manufacturing-design-technology									
2	https://www.coursera.org/learn/digital-thread-components?speciali	zation=digital-								
manufacturing-design-technology										
3	https://www.coursera.org/learn/digital-thread-implementation?specialization=digital-									
5	manufacturing-design-technology									

COURSE TITLE	INT	ELLIGENT MACHINING		CREDITS	3			
COURSE CODE	MHM4276	COURSE CATEGORY	Minors	L-T-P-S	3-0-0-2			
Version	1.0	Approval Details		LEARNIN G LEVEL	BTL-3			
		ASSESSMENT	SCHEME					
First Periodic al Assessm ent	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendan ce	ESE			
15%	15%	10%	5%	5%	50%			
Course Descripti on	Manufacturers are increasingly utilizing machine tools that are self-aware, they perceive their own states and the state of the surrounding environment, and are able to make decisions related to machine activity processes. This is called intelligent machining, and through this course students will receive a primer on its background, tools and related terminology.							
Course Objectiv e	 Study on data Awareness on Explore the in Study on oper 	preparation and data and advanced analysis in mar tegration of smart sensor n architecture systems in i	Ilyze. nufacturing p s and control ntelligent ma	rocesses. Is in manufac achining.	turing.			

		5. Comprehend various manufacturing management tools used in industry.													
Cou Oute	irse com	1. 2. 3. 4. 5.	 Upon completion of this course, the students will be able to 1. Describe the concepts onadvanced machining paradigm. 2. Comprehendthe importance on intelligent machining. 3. Study on suitable process controls inmanufacturing processes. 4. Analyze the challenges and opportunities of advanced manufacturing enterprise. 5. Evaluate the tools and techniques on product life-cycle in manufacturing 												
Prer	equisi	tes: N	lanufa	cturing	g, Basic	s of Da	ata sto	rage.							
CO, I	PO AN	ID PSO	Ο ΜΑΡ	PING											
со	РО -1	РО- 2	РО- 3	РО- 4	РО- 5	РО- 6	РО- 7	РО- 8	РО- 9	РО -10	РО- 11	РО- 12	PSO -1	PSO -2	PSO-3
CO -1	3	2	2	3	3	2	1	2	2	3	2	2	3	3	-
CO -2	2	2	3	2	2	3	2	1	2	2	2	1	2	3	-
CO -3	3	3	2	1	1	2	2	2	1	3	1	2	2	2	-
CO -4	2	2	2	3	2	1	2	1	2	3	1	2	3	2	-
CO -5	3	2	3	2	3	2	2	2	2	1	2	1	3	3	-
			1: V	Veakly	relate	ed, 2: N	Aodera	ately r	elated	and 3	: Stron	gly rel	ated		
MO	MODULE 1: INTRODUCTION TO ADVANCED MANUFACTURING PROCESS (9L)														
Data	Data Analysis Process Data Collection in Different Manufacturing Settings -														
DIVIL Man	VD Dialogue Discrete Part Manufacturing DMD Dialogue - Continuous														
Com	putati	tational Platform HPC and Cloud Computing High Performance and													
Clou	Cloud Computing. BTL-1								1						
Sugg	Suggested Readings:														
Man	Manufacturing Settings And Data Collection														
MO	DULE 2	2: INT	RODUC	TION	ΤΟ ΙΝΤ	ELLIG	ENT M	ACHIN	ING				(9	L)	
Mac	hining 	Basic	s - Evo	lution	of Inte	lligent	Machi _	ning C	ompor	nents o	of				
Intel	ntelligent Machining - Signal Processing - Transforming Data into Information CO-2								-2						
Prac	Practical - Uses of Machine Learning BTL-2								-2						
Mac	Suggested Readings: Machining process through machine learning														
MOL	DULE	3: PRC	CESS (CONTR	OL(9L)		8								
					()										

Programm	Programmable logic control - Closed Loop Process Control Systems -								
Introducti	ntroduction to Adaptive Control - Commercially Available Software -								
Machining Force Control.									
Suggested	Suggested Readings:								
Manufacturing Process Control: Commonly Used Software									
MODULE 4: ADVANCED MANUFACTURING ENTERPRISE (9L)									
Introducti	Introduction to advanced manufacturing enterprise - Integrated Enterprise -								
Transpare	ncy of Product Life Cycle - Data Advanced Manufacturing: Levels of								
Approach	Resilient and Adaptable Enterprise - Four Levels of Approach - New	CO-4							
Manufact	uring Paradigms.	BTL-3							
Suggested	Readings:								
Advanced	Manufacturing approaches								
MODULE	5: PRODUCT LIFE CYCLE (9L)								
Introducti	on to product life cycle - Challenges and Opportunities In Advanced								
Manufact	uring - Adoption Product Life cycle Management (PLM) - System								
Manufact	uring Process - Management Manufacturing Execution Systems -	CO-5							
Enterprise	Resource Planning (ERP) - Performance of Value Chains.	BTI -3							
Suggested	Readings:	DTE-5							
Overview of Data Security Concerns in product life cycle.									
TEXT BOO	KS								
	Özel, T., &Davim, J. P. (Eds.). (2009). Intelligent Machining: Modeling and Optimization of								
1.	the Machining Processes and Systems. ISTE.								
REFERENC	E BOOKS								
1	Bonvillian, W. B., & Singer, P. L. (2018). <i>Advanced Manufacturing: The New American</i>								
Innovation Policies. Will Press.									
L DOOK									
1.	1. https://link.springer.com/book/10.1007/978-3-319-56099-1								
MOOC									
1	https://www.coursera.org/learn/advanced-manufacturing-process-								
±	analysis?specialization=digital-manufacturing-design-technology								
2	https://www.coursera.org/learn/intelligent-machining?specialization	=digital-							
۷	manufacturing-design-technology								
2	https://www.coursera.org/learn/advanced-manufacturing-enterprise?specialization=digital-								
3	manufacturing-design-technology								

COURSE TITLE	MECHA	TRONICS SYSTEM DESIG	CREDITS	3	
COURSE CODE	MHM4361	COURSE CATEGORY	Minors	L-T-P-S	3-0-0-2

Versio	n	1.0				prova	l Deta	ails			LEAR LE	NING /EL	I	BTL-3	
ASSESSMENT SCHEME															
First Periodic Assessme	al ent	Second Periodical AssessmentSeminar/ Assignments/ ProjectSurprise Test / QuizAttendanceESE													
15%		1	15% 10% 5% 5% 50%						50%						
Course Descripti	e ion	This course is geared towards developing skills of candidates towards conceiving new mechatronics products based on raw ideas and develop them. The course focuses on hands-on experience along with a project and offers a lot of practical tips to make theory work in practice. Furthermore, the course catalyzes integrated thinking in mechanical and electronics domain, which is crucial to successful product design and development													
Course Objectiv	e ve	 Study on mechatronics system and system modelling Highlight theimportance of controller in system integration Familiarize the mathematical modelling indynamic system. Study onstability analysis in mechatronic system Comprehend the implementation of dynamic control system 													
Course Outcom	e ie	 Upon completion of this course, the students will be able to Compare traditional and mechatronics system Recommendappropriate controllers for electro mechanical systems Describe the dynamics and control in mechatronics system Analyze the stability, controland dynamics of an linear systems Evaluate theconcept signal processing for specific measurement applications. 													
				1 301130				•							
CO	PO -1	PO- 2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO - 10	PO- 11	PO- 12	PSO- 1	PS O- 2	PS O- 3
CO-1	3	2	2	3	3	2	1	2	2	3	2	2	3	3	-
CO-2	2	2	3	2	2	3	2	1	2	2	2	1	2	3	-
CO-3	3	3	2	1	1	2	2	2	1	3	1	2	2	2	_
CO-4	2	2	2	3	2	1	2	1	2	3	1	2	3	2	-
CO-5	3	2	3	2	3	2	2	2	2	1	2	1	3	3	-
		1: \	Weak	y rela	ted, 2	: Mod	lerate	ly rela	ated a	nd 3: Str	ongly re	elated			
MODULE	MODULE 1: INTRODUCTION TO ELEMENTS OF MECHATRONICS SYSTEM(9L)														

Introduction: Elements of mechatronics system: Sensor, actuator, plant, and	
controller. Applications of mechatronics system. Integrated mechanical-electronics	
design philosophy. Examples of real life systems. Smart sensor concept and utility of	CO 1
compliant mechanisms in mechatronics.	CO-1 RTI 1
Suggested Readings:	DIL-1
Study of Systems like CDROM, scanner	
Study of open and closed loop systems	
MODULE 2: CONTROLLERS (9L)	
Microprocessor building blocks, combinational and sequential logic elements,	
memory, timing and instruction execution fundamentals with example of primitive	
microprocessor. Microcontrollers for mechatronics: Philosophy of programming	
interfaces, setting sampling time, and getting started with TIVA programming.	CO- 2
Microcontroller programming philosophy emphasis on TIVA, programming different	RTI 2
interfaces PWM, QEI etc. Mathematical modeling of mechatronic systems	DTL-2
Suggested Readings:	
Study of embedded systems role in mechatronics	
Study of interfacing programs with microcontrollers	
MODULE 3: SYSTEM DYNAMICS(9L)	
Modeling friction, DC motor, Lagrange formulation for system dynamics. Dynamics	
of 2R manipulator, Simulation using MATLAB, Selection of sensors and actuators.	
Concept of feedback and closed loop control, mathematical representations of	CO 3
systems and control design in linear domain	BTI -2
Suggested Readings:	DTL-2
Study of mathematical modelling of system.	
Study of linear system control.	
MODULE 4: DYNAMICS ANALYSIS(9L)	
Basics of Lyapunov theory for nonlinear control, notions of stability, Lyapunov	
theorems and their application. Trajectory tracking control development based on	
Lyapunov theory.	CO-4
Suggested Readings:	BTL-3
Study of nonlinear systems control	
Study of stability issues in systems	
MODULE 5: IMPLEMENTATION (9L)	
Basics of sampling of a signal, and signal processing. Digital systems and filters for	
practical mechatronic system implementation.	CO-5
Suggested Readings:	
Research example/ case studies of development of novel mechatronics system	BTL-3
Study of 3D micro-printer, Hele Shaw system for microfabrication.	
TEXT BOOKS	

1.	Shetty, D., & Kolk, R. A. (2010). Mechatronics system design. Cengage Learning.
	Janschek, K. (2011). Mechatronic systems design: methods, models, concepts. Springer
2.	Science & Business Media.
REFERENCE B	OOKS
1	Bolton, W. (2003). Mechatronics: electronic control systems in mechanical and electrical
1.	engineering. Pearson Education.
2.	Cetinkunt, S. (2015). Mechatronics with experiments. John Wiley & Sons.
E BOOKS	
	https://www.intechopen.com/books/5715
1.	
	https://www.google.co.in/books/edition/Mechatronics_in_Engineering_Design_and
2.	_P/632Gy64SP4MC?hl=en&gbpv=0
MOOC	
1	https://onlinecourses.nptel.ac.in/noc21_me129/preview