			Gover	rnment Colleg	e of Engineerii	ng, Karad			
			Secon	nd Year (Sem -	- III) B. Tech.	Electrical			
			IMI331	1Foundation	of EV and Hyb	orid Vehicle			
Teachin	g Sche	me			Ŧ	Examination Sche	eme		
Lectures		02 Hrs/week				MSE	20		
Tutorials	5	00 Hrs/week				ISE	20		
Total Cr	edits	02				ESE	60		
						Duration of ESE	02 Hr	s 30 Min	
Prerequ	isite:	Basics of Elect	rical and H	Electronics.					
Course	Outco	mes (CO):Stude	ents will be	e able to					
C01	Expla	in the fundamer	ntal concer	pts, principals an	d configuration of	of electric and hybrid	d electri	c vehicle	S
CO2	Ident	ify the various	electrical	l and electronic	es components f	or advanced EV			
<u>CO3</u>	Discu	iss hybridization	1 of automo	obile.					
<u>CO4</u>	Illusti	rate the electric	drive-train	is characteristics	•			<u> </u>	
TT 24 1	T	1 4 4 1 1	. 7	Course Co	ontents				Hours
Unit I	Intro	duction to EV	V:					COI	(04)
	•	Current dema	and in EV	industry and opp	portunities of skil	lled EV engineers,			
	•	History and	evolution	n of electric vel	nicles,				
	•	Components	of an elect	tric vehicle.					
Unit 2	Elect	trical Enginee	ering for l	EV:				CO1	(04)
	•	EV classific	cation and	l their electrific	ation levels				
	• Battery technology,								
	•	Motor and	controlle	er systems,					
	•	EV numeri	ical calcu	ulation					
	•	EV chargir	ng infrast	tructure.					
Unit 3	Adva	anced Electric	· Vehicles	s:				CO2	(04)
	•	Electrical Re	quirement,	-					
	•	Power Distri	bution Spe	ecifications,					
	•	Electronic Co	omponent	System,					
	•	EV Standard	Specificat	tions					
	•	Selection of l	Electrical a	and Electronic C	components.				
Unit 4	Hyb	ridization of t	he Auton	nobile:				CO3	(04)
	•	Challenges	and Key 7	Technology of	HEVs.				
	•	Basics of H	ybrid Elec	ctric Vehicle (H	HEV)				
	•	Basics of Plu	ıg-in Hybri	id Electric Vehic	cles(PHEV)				
	•	Basics of Fu	uel Cell V	vehicles (FCVs)).				
	•	Vehicle to G	rid technol	logy					
Unit 5	Hyb	rid Electric V	ehicles:					CO3	(04)
	•	HEVs Funda	mentals,						
	•	Vehicle perfo	ormance,						
	•	Configuration	n of HEV	(Series, Parallel,	Series-parallel &	&Complex),			
	•	Power Flow	control, Ex	xamples					
	•	Operation of	HEVs						
Unit 6	Hybr	id Electric Dri	ve-trains:					CO4	(04)
	•	Basic concep	ot of hybrid	d traction,					
	•	introduction	to various	hybrid drive-tra	in topologies,				
	•	power flow c	control in h	nybrid drive-train	n topologies,				
	•	tuel efficienc	cy analysis.						
	Liect	nc prive-train	S:	ia traation					
1	•	Dasic concep	n of electri	ic traction,				1	1

	introduction to various electric drive-train topol	ogies,							
	• power flow control in electric drive-train topolo	ogies,							
	• fuel efficiency analysis.								
Tex	Text Books								
1.	1. Electric And Hybrid Electric Vehicles Braking Systems & NVH considerations, Author								
	Publisher - Sae International								
Ref	Reference Books								
1.	1. Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2nd Edition, 2								
2.	Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, M	Iodern E	lectric, Hybrid Electric and I	Fuel Cell					
	Vehicles: Fundamentals, Theory and Design, CRC Press, 20	04							
3.	James Larminie, John Lowry, "Electric Vehicle Technology	", Wiley	publications, 1st Edition, 20	03.					
4.	B D McNicol, D A J Rand, "Power Sources for Electric Veh	icles", E	lsevier publications, 1st Edit	ion, 1998					
5.	Seth Leitman, "Build Your Own Electric Vehicle" MC Grav	v Hill, 1s	t Edition, 2013						
Use	ful Links								
1.	https://archive.nptel.ac.in/courses/108/102/108102121/								
2.	https://nptel.ac.in/courses/108/103/108103009/								

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

1: Slight (Low)

2: Moderate(Medium)

3: Substantial(High)

Knowledge Level	MSE	ISE	ESE
Remember	5	5	5
Understand	5	5	20
Apply	5	5	15
Analyse	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

	Government College of Engineering, Karad										
	Second Year (Sem – IV) B. Tech. Electrical IMI3412: EV Battery Technology and Powertrain Development										
	I	MI34	2: EV Battery Technology and Powertrain Development								
Teachin	g Scheme		Examination Scheme								
Lectures	02 Hrs/v	veek	MSE 20								
Tutorial	s 00 Hrs/v	veek	ISE 20								
Total Cr	edits 02		ESE 60								
			Duration of ESE 02	Hrs 30 Min	l						
Prerequ	isite : Electrost	atics a	nd Basic Circuit Laws.								
Course	Outcomes (CO)	:Stude	ents will be able to								
CO1	Analyze the pe	rforma	ance of the batteries.								
CO2	Discuss and Ar	alyze	different energy storage technologies used for hybrid electric vehicle	es.							
CO3	Implement prop	per dri	ve configuration toelectric and hybrid vehicle.								
CO4	CO4 Visualize the working of an EV powertrain.										
			Course Contents	CO	Hours						
Unit 1	Batteries:			CO1	(04)						
	Overview of B	atterie	es,Battery Parameters,Lead acid batteries,Lithium ion batteries, Met	tal							
	air batteries, Battery Charging, Thermal runway battery management system										
	(BMS),Functio	nality	SOC/SOH estimation.								
Unit 2	Energy Storag	e Svs	tems for EV:	CO2	(04)						
	Introduction to	Ener	gy Storage Requirements in Hybrid and Electric Vehicles. Differen	nt							
	batteries for	EV.B	attery CharacterizationComparison of Different Energy Storag	e							
	Technologies f	or HE	Vs, Battery Charging Control								
Unit 3	Energy Stora	ge ar	d its analysis:	CO2	(04)						
	Battery based	energ	v storage and its analysis. Solar Photovoltaic based energy storag	e							
	system. Fuel	Cell ł	based energy storage and its analysis. Super Capacitor based energy	v							
	storage and its	analy	sis, Flywheel based energy storage and its analysis, Hybridization of	of							
	different energ	v stora	ige devices								
Unit 4	Battery Pack	Desi	gn and Modeling	CO1	(04)						
	Battery pack D	esign	Properties of Batteries, Battery Pack Assembly and Test, Therm	al							
	Analysis on B	attery	Pack, Battery Pack Modeling, The basics of charging technolog	у							
	Types of charge	ging a	rchitecture existing globally,CAN communication	-							
Unit 5	Electric Propu	llsion	unit:	CO3	(04)						
	Introduction to	elect	ic components used in hybrid and electric vehicles, Configuration and	nd							
	control of l	DC]	Motor drives, Configuration and control of Induction Mot	or							
	drives, configur	ation	and control of Permanent Magnet Motor drives, Configuration and	nd							
	control of Swit	ch Re	luctance Motor drives, Drive system efficiency	~~~	(0.4)						
Unit 6	Electric Vehic	cle Po	wertrain:	CO4	(04)						
	Introduction t	o EV	Powertrain, Special electric traction motors, Various types of	ot							
	regulations and	1 stan	dards set in the CMVR (Central Motor Vehicles Rules - 1989) fo	or							
	selecting and	manuf	acturing various components of an electric vehicle. The rules and	d							
	regulations nee	a to f	ollow while designing a retrofit powertrain model. Architecture and	0 .1							
	Components of		Powertrain, Basics of Carbon footprint of companies and understand	a							
Tort Do	how companies utilize carbon credits to reduce their carbon footprint issues										
1 UL	Text Books Image: Contract A STANDE VELODMENT DANK 2019 1 Handbook on Dottom: Energy: Storage System A STANDE VELODMENT DANK 2019										
Handbook on Battery Energy Storage System, ASIAN DEVELOPMENT BANK, 2018											
2. Handbook of Automotive Powertrain and Chassis Design											
1 In	Reference Books										
1.10	1. Iquai Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2nd Edition, 2003.										
$\begin{array}{c c} 2 & \mathbf{N} \\ \mathbf{V} \\ \mathbf{V} \end{array}$	2. Mienruau Ensani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004										
3. Ja	mes Larminie. J	ohn L	owry, "Electric Vehicle Technology". Wiley publications. 1st Edition	n, 2003.							
4. B	D McNicol, D A	JRa	nd, "Power Sources for Electric Vehicles", Elsevier publications, 1st	Edition, 199	98						

5.	Seth Leitman, "Build Your Own Electric Vehicle" MC Graw Hill, 1st Edition, 2013							
Use	Useful Links							
1.	https://nptel.ac.in/courses/108106170							
2.	 <u>https://onlinecourses.swayam2.ac.in/ntr24_ed16/preview</u> 							

PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO	PO	PO	PSO	PSO
\rightarrow										10	11	12	1	2
CO↓														
CO 1	2	2	2	-	-	2	3	2	-	-	-	2	-	-
CO 2	2	-	-	-	-	2	3	-	-	-	-	2	-	-
CO 3	2	2	2	-	-	2	3	-	-	-	-	2	-	-
CO 4	2	-	2	-	-	2	3	2	-	-	_	2	-	-
1: Slight(Low) 2: Moderate(Medium)							3: Sı	ıbstanti	al(Hig	h)				

Knowledge Level	MSE	ISE	ESE
Remember	5	5	5
Understand	5	5	20
Apply	5	5	15
Analyse	5	5	20
Evaluate	-	-	-
Create	-	-	-
TOTAL	20	20	60

			Government College of Engineering, Karad					
			Third Year (Sem – V) B. Tech. Electrical					
		IM	I3513: EV Power Electronics and Embedded System					
Teac	hing Sch	eme	Examination Scheme					
Lectu	ures	03 Hrs/week	MSE 20	1				
Tuto	rials	00 Hrs/week	ISE 20)				
Tota	l Credits	03	ESE 60)				
			Duration of ESE 02	Hrs 30 Min				
Prer	equisite	Basics of Electr	onics					
Cou	rse Outco	mes (CO):Stude	ents will be able to					
CO	1 Sele	ct proper machi	ine drive for HEVs application.					
CO	2 Con	pare differentp	ower converters topologies in HEVs					
CO	J Dev	elop the basic f	undamentals of embedded system, C++ and Linux programmi	ng.				
CO	4 Dise	russ the sensor	characteristics communication protocol and configuration	of the em	bedded			
0			characteristics, communication protocol and configuration	or the em	locuucu			
	Syst		Course Contents	CO	Harris			
TI	Course Contents							
Uni			(04)					
	Intr	Douction, BLDC	motors, Induction Motor Drives, Permanent Magnet Motor Drive	es,				
	Sw1	tched Reluctance	e Motors, Doubly Salient Permanent Magnet Machines, Design a	nd				
	S1Z1	ng of Traction N	lotors, Thermal Analysis and Modelling of Traction Motors.					
	(onl	y functional trea	atment to be given) .					
Unit	t 2 Pow	er Electronics in	n HEVs:					
	Pow	er electronics inc	cluding switching, AC-DC, DC-AC conversion, Electronic devices a	nd				
	circi	ints used for cont	trol and distribution of electric power, Thermal Management of HI	ΞV				
	Pow	er Electronics,Ge	enerator and Basics of controlling System in Hybrid Vehicle.	~~~	(0.1)			
Unit	t 3 Pow	er Converter:		CO2	(04)			
	Intro	duction, various	power electronics converter topologies and its comparisons, Cont	rol				
	of c	onvertor operatio	ns in EV and HV, EV Charging and Battery System, Emerging pov	ver				
T T •	elec	tronic devices ,PI	E in renewable energy system, PE in industrial system	004	(0.4)			
Unit		oduction to Er	ndedded System:	C04	(04)			
	Mic	rocontrollers and	microprocessors in EVs, Basics of Embedded System, Embedded					
		++ programming	, Idea about Linux, Linux in Embedded System.		(0.4)			
Unit	t 5 Sen	sor Characteri	stics and communication Protocols:	. CO4	(04)			
	Sen	sor Principal	Characteristics, Sensor-Actuator Integration System. Bas	S1C				
T T •	intr	contraction to com	munication protocols CAN bus, LIN, FlexRay.	004	(0.4)			
Unit		inguration of f	mbedded System:		(04)			
	Bul Tim	ang of Linux	-Embedded System, Application in Embedded Devices, Re-	al-				
	and	tools manageme	stems (KTOS), KTOS concepts and usage in EVS, Schedun	ng				
Ham		task manageme						
Пап	LUUUKS	1	aba umlaad722111/files 20/aunder 620261AST7IE adf					
1.	<u>nttps://a</u>	1.amobbs.com/	bbs_upload/82111/files_38/ourdev_629261AS1ZIF.pdf					
2.	Ersan K	abalci ,Power E	lectronics and Drives Used In Automotive Applications					
Refe	rence Bo	oks						
1.	Power E	ectronics: Princip	ples and Applications, Joseph Vithayathil, McGraw Hill Publication,	2010				
2.	Power E	ectronics, Cyril V	W. Lander, 3rd Edition McGraw Hill publication					
3.	3. Frank Vahid and Tony Givargis, Embedded system design: A unified hardware/Software introduction, Third							
4	edition, John Wiley & sons, 2010 4 L. Ashok Kumar, S. Albert Alexander, "Power Converters for Electric Vehicles", CRC Press, Taylor & Erancis							
	Group, 2021							
5.	Automot	ive Industry Stan	dards, India, 2015-2016					
Usef	ul Links							
1.	https://np	otel.ac.in/courses/	(108/101/108101038/ (Prof. B. G. Fernandes)					

РО	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO	PO	PO	PSO	PSO
\rightarrow										10	11	12	1	2
CO↓														
CO 1	2	1	1	-	-	1	-	-	-	-	-	2	-	-
CO 2	2	1	2	-	-	1	-	-	-	-	-	2	-	-
CO 3	2	2	2	-	3	1	-	-	-	-	2	2	-	-
CO 4	2	2	2	-	3	1	-	-	-	-	2	2	-	-
1: Slig	ht(Low)	2:1	Modera	ate(Med	dium)		3: Sı	ıbstanti	al(Hig	h)			

Knowledge Level	MSE	ISE	ESE
Remember	-	-	-
Understand	5	5	10
Apply	5	5	20
Analyse	5	5	25
Evaluate	5	5	5
Create	-	-	-
TOTAL	20	20	60

	Government College of Engineering, Karad									
		Third Year (Se	m –V) B. Tech. Electrical	Engineering	5					
		IMI3	8514: Electric Vehicle La	ab						
Labo	ratory Schem	e:		Examination	1 Scheme:					
Pract	tical	2 Hrs/week		ISE	50					
Total	Credits	1		ESE						
G				TOTAL: 50						
Course Outcomes (CO):										
Stude	nts will be able	e to								
CO1 Perform experiments by interfacing sensor with microcontroller										
CO2 Illustrate the MATLAB programming for EV systems										
CO3	Develop an	id execute the S	imulink model for differen	nt EV units						
CO4	CO4 Design the power supply EV unit on PCB									
Course Contents C										
Expe	riment 1	Introduction to	booting process of raspbe	erry pi		CO1				
Expe	riment 2	Perform experim	nent to control the speed of	f dc motor		CO1				
Expe	riment 3	Interface IR/ PIR sensor with microcontroller								
Expe	riment 4	Interface ultrase	onic sensor with microcontr	coller and find	1 distance	CO1				
Expe	riment 5	DevelopingSIM	ULINKModelsforVehicleU	nits		CO3				
Expe	riment 6	ProgrammingEV	SystemsinMATLAB			CO2				
Expe	riment 7	Application of Da	ata Analysis Techniques in E	VElectrical sy	stem	CO2				
Expe	riment 8	Design a power	supply unit and create a PO	CB design for	same.	CO4				
Expe	riment 9	Modelling and sig	mulation of EV powertrain co	omponents in N	MATLAB	CO3				
Expe	Experiment 10 Analysis of EV powertrain components in ANSYS									
Experiment 11 Battery Management System modelling C										
Expe	Experiment 12 Modelling of Li-ion battery pack using MATLAB and ANSYSCO3									
List o	of Submission:									
Minir	num number o	f Experiments: 08								

со	РО 1	PO 2	PO 3	PO 4	РО 5	PO 6	РО 7	PO 8	РО 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	1	2	3	1	3	-	1	-	2	-	2	2	-	2
CO 2	1	2	3	2	3	-	1	-	2	-	2	2	1	-
CO 3	1	2	3	3	3	-	1	-	2	-	2	2	2	-
CO 4	1	2	3	3	3	-	1	-	2	-	2	2	2	-

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

Assessment Pattern:

Skill Level	Evn 1	Exp	Ava						
(as per CAS Sheet)	Exp I	2	3	4	5	6	7	8	Avg
Task I									
Task II									

		Task III												
		ISE												
				Gove	rnmen	t Colle	ge of E	Inginee	ring, K	Karad				
				Thir	d Year	r (Sem	– VI) I	B. Tech	. Elect	rical				
			IMI3615: EV	Chargi	ing Inf	rastruo	cture, V	Vehicle	Testin	g and I	Homolo	ogation		
Tea	chin	g Sche	me						Exa	minati	on Sche	me		
Lect	tures		02 Hrs/week						MS	E		20		
Tuto	orials		00 Hrs/week						ISE	_		20		
Tota	al Cre	edits	02						ESI	<u>.</u>		60		
		• • • •							Dui	ation of	ESE	02 Hrs	s 30 Min	
Prei	requ	isite :	Basics of Power	Electror	ncs Co	nverter	S.							
Cou	irse (Digo	nes (CO): Studer	its will be	e able to	0 opport	unition	and ah	allanga	0				
	<u>)</u>	Illust	rate different F	V devel	nment	ppon metho	ds and	unit eco	nomic	5 c				
) <u>2</u>)2	Desc	ribe the EV cha	rging te	chnolo	nies st	us and andards	and pr		3				
)4	Evec	ute site selectio	nand nla	nning	infractr		design		•				
	74	LAU	ute site selectio	nanu pia			Content						CO	Hours
Uni	it 1	Fund	lamentals of F	V Mana	gemer	nt•	Jontent	6					CO1	(04)
		Introduction to EV Market, EV Design Procedure and ICE Model.												(01)
		Man	agement EV H		tion ar	nd Testi	1511 11 nσ	occuur	e and	ICL	wiodel,	LV		
Uni	it 2	t 2 Charger Manufacturing:												(04)
		FAM	F India and	Manufa	cturing	. Guid	elines	FV (ertific	ation I	Process	FV	001	(01)
		Char	ging Electric	Vehicle	and	Retro	fitting	EV C	⁷ ategor	ies an	d Pror	losed		
		Chargers										oseu		
Uni	it 3	Prod	uct Developm	ent Plan	•								CO2	(04)
		Segn	nent Selection.	Produc	t Des	ign Pl	an. Pr	oduct	Validat	ion Pl	an. Ve	hicle	001	(0.1)
		Dyna	mics Selection.	Produc	t Desig	n Valio	lation,	Product	t Select	ion Pla	n.			
Uni	it 4	Deve	lopment Meth	ods:	Ľ	, 							CO2	(04)
		Prod	uct Developme	ent Met	hods,	Product	t Deve	lopmen	t Plan	s, Uni	t Econo	omics,		
		Desig	gn feasibility, D	esign fo	r Man	ufacturi	ng.							
Uni	it 5	EV C	Charging Tech	nology:									CO3	(04)
T T •		Ove	rview, Charging	g Standa	rds.	C.L.A	•						<u> </u>	(0.4)
Uni	it 6	Chai EV	ging Infrastru	cture al	nd Site	Select	ion:	ti a m	and Di		Cofeta	, and	CO4	(04)
			Charging Inira	structur	e Desi	ign, Si	te Sele	ection	and Pl	anning	, Salety	y and		
Han	ndho	ok	lantics.											<u> </u>
1.	ht	tps://w	ww.niti.gov.in/si	tes/defau	lt/files/	2023-02	E/EV H	andbook	Final	140ct.1	odf			
2.	ht	tps://sa	repenergy.net/w	o-content	/upload	ls/2023/	07/EV-'	Fechnic	an-Hand	lbook-S	AREP.p	df		
		²												
Refe	eren	ce Boo	ks											
1.	Ele	ctric A	and Hybrid Veh	icles De	esign F	undame	entals, A	Author	Husain	Iqbal.				
2.	Mo	dern E	Electric, Hybrid	Electric	and F	uel Cell	Vehic	les ,Fur	ndamen	tals Th	eory and	d Desig	gn Autho	or
	Ehs	sani M	.,Gao Yimin , H	Emadia A	A. Crc	Press N	[ewyor]	K.						
Use	ful L	inks												
1.	ht	tps://or	linecourses.npte	l.ac.in/nc	<u>oc20_ee</u>	99/prev	iew							
2.	<u>htt</u>	<u>os://np</u>	tel.ac.in/course	<u>s/108/10</u>	3/1081	<u>103009/</u>	/ -							
3.	httr	s·//on	linecourses swa	ivam? a	n in/ntr	24 ed5	4/nrevi	ew						
	<u></u>	<u>, , , , , , , , , , , , , , , , , , , </u>		.,	····/ 11tl	<u> 003</u>		<u></u>						

РО	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO	PO	PO	PSO	PSO
\rightarrow										10	11	12	1	2
CO↓														
CO 1	1	-	-	-	-	-	2	-	-	-	3	2	-	2
CO 2	1	-	1	-	-	-	2	-	-	-	3	2	1	-
CO 3	1	2	2	-	-	2	3	-	-	-	-	2	2	-
CO 4	1	2	2	2	-	3	3	2	-	-	2	2	2	-
1: Slight(Low) 2: Moderate(Medium)							3: Sı	ıbstanti	al(Hig	h)				

Knowledge Level	MSE	ISE	ESE
Remember	-	-	-
Understand	5	5	05
Apply	5	5	20
Analyse	5	5	20
Evaluate	5	5	15
Create	-	-	-
TOTAL	20	20	60

			Government College of Engineering, Kara	d			
			Final Year (Sem – VII) B. Tech. Electrica	1			
			IMI3716: EV Vehicle Design and Analysis	8			
Tea	ching S	Scheme	Examin	ation Schem	le		
Lect	ures	02 Hrs/week	MSE		20		
Tuto	orials	00 Hrs/week	ISE		20		
Tota	l Credi	ts 02	ESE		60		
			Duration	n of ESE	02 Hrs	30 Min	
Prei	requisi	te : Semiconducto	Devices Knowledge				
Cou	rse Ou	tcomes (CO):Stude	ts will be able to				
CC	D1 A	apply the power ele	ctronics technique to diagnostics fault				
CC	D2 E	xplore the knowled	ge about analog and digital electronics				
CC) 3 [Develop the EV arc	itecture with the help of design and simulation	parameters.			
CC	04 E	Design and modelling	g the different EV units.				
			Course Contents			CO	Hours
Uni	t 1 A	Analog Electronics				CO2	(04)
	S	ensors for EV A	pplications (Temperature, Pressure, Current,	Voltage) Sig	gnal		
	C	Conditioning Circui	s (Amplifiers, Filters) Interface Circuits (A	Analog-to-Dig	gital		
	C	Converters)		0	0		
Uni	t 2 F	ower Electronics				CO1	(04)
	F	ulse Width M	Iodulation (PWM) TechniquesCurrent	and Volt	age		
	F	RegulationOvercurr	ent and Overvoltage ProtectionFault I	Detection	and		
	Г	Diagnostics					
Uni	t 3 T	Digital Electronics				CO2	(04)
• · · ·	A	nalog-to-Digital	Conversion (ADC)Sensor Types and	Characteris	tics	001	(0.)
	Ċ	Temperature. Pres	ure. Acceleration. etc.)Signal Conditioning C	CircuitsFilter	ring		
	à	nd Noise Reductio	Techniques		8		
Uni	t 4 A	utomotive Compo	nents:			CO3	(04)
	P	ower Semiconduct	ors, Trends in Power semiconductors, Bidirecti	onal Conve	rters,		` ´
	I	nverters, Interleavin	g mode in power converters, Passive Components		, i		
Uni	t 5 E	V Architecture:				CO3	(04)
	N	Aotor development	and induction motor characteristics, Simulink m	odel to calc	ulate		
	v	ehicle configuration	n,Multilevel inverter design and simulation,DC	2 –DC conve	erter,		
	N	Aotor controllers					
Uni	t6 N	Aodelling and Sim	lation of Electric Vehicles:			CO4	(04)
	N	Aodeling and sizir	g of the traction systems, Modeling and sizing	g of the sto	orage		
	S	ystems, Modeling c	EV battery and BMS, Interaction between the d	ifferent bloc	ks of		
	<u>t</u>	ne electrical Archite	cture				
Han	dbook	S El El El El E			IGDI	1.070	1 1 1 0
1.	К. Т.	Chau ,Electric Vel	icle Machines and Drives: Design, Analysis and	d Applicatio	n,ISBI	N: 978-	1-118-
	75252	2-4,August 2015,W	iley-IEEE Press				
2.	Per E	nge ,Nick Enge, St	phen Zoepf,"Electric Vehicle Engineering", 1st	Edition, Mc	Graw H	Hill pub	lication
	2021						
3.	Hand	book of Power Ele	tronics in Autonomous and Electric Vehicles				
Refe	erence	Books					
1.	M. 5	5. Tyagi, Introducti	on to Semiconductor Materials and Devices, Joh	nn Wiley &	Sons I	nc.	
2.	Mic	hael Shur, Introduc	ion to Electronic Devices, John Wiley & Sons	Inc., 2000.			
3.	R. T	. Howe and C. G. S	odini, Microelectronics: An Integrated Approac	ch, Prenticel	Hall In	c. 1997	
4.	Jaco	b Millman, and C.	C. Halkias, "Electronic devices and circuits", TM	MH Publicat	tions		
5.	Ben	G. Streetman, Soli	State Electronic Devices, PHI, 5th Ed, 2001				
Usef	ful Lin	ks					
1.	http:/	/web.iitd.ac.in/~sho	ri/eel201/lectures.php				

2.	http://www.daenotes.com/electronics/digital-electronics
3.	https://onlinecourses.nptel.ac.in/noc24_ee30/preview
4.	https://onlinecourses.nptel.ac.in/noc22_ee53/preview

PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO	PO	PO	PSO	PSO
									10	11	12	1	2
2	-	-	-	-	-	1	-	-	-	-	2	-	-
2	-	-	-	-	-	1	-	-	-	-	2	-	-
2	1	2	1	1	-	1	-	-	-	-	2	-	-
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1: Slight(Low) 2: Moderate(Medium) 3: Substantial(High)													
]	PO 1 2 2 2 2 1 (Low	PO 1 PO 2 2 - 2 - 2 1 2 1 xtt(Low) -	PO 1 PO 2 PO 3 2 - - 2 - - 2 1 2 2 1 2 it(Low) 2:1	PO 1 PO 2 PO 3 PO 4 2 - - - 2 - - - 2 1 2 1 2 1 2 1 1 2 1 2 2 1 2 1 xt(Low) 2: Modera	PO 1 PO 2 PO 3 PO 4 PO 5 2 - - - - 2 - - - - 2 - - - - 2 1 2 1 1 2 1 2 1 1 2 1 2 1 1 2 1 2 1 1 x t(Low) 2 : Moderate(Med 2 2	PO 1 PO 2 PO 3 PO 4 PO 5 PO 6 2 - - - - - - 2 - - - - - - 2 - - - - - - 2 1 2 1 1 - 2 1 2 1 1 - $xt(Low)$ 2: Moderate(Medium)	PO 1 PO 2 PO 3 PO 4 PO 5 PO 6 PO 7 2 - - - - 1 2 - - - 1 2 1 2 1 1 2 1 2 1 1 2 1 2 1 1 2 1 2 1 1 2 1 2 1 1 2 1 2 1 1 2 1 2 1 1 2 1 2 1 1	PO 1 PO 2 PO 3 PO 4 PO 5 PO 6 PO 7 PO 8 2 $ 1$ $ 2$ $ 1$ $ 2$ $ 1$ $ 2$ 1 2 1 1 $ 1$ $ 2$ 1 2 1 1 $ 1$ $ 2$ 1 2 1 1 $ 1$ $ x$ t(Low) 2 : Moderate(Medium) 3 : Su 3 : Su 3 : Su 3 : Su	PO 1 PO 2 PO 3 PO 4 PO 5 PO 6 PO 7 PO 8 PO 9 2 $ 1$ $ 2$ $ 1$ $ 2$ $ 1$ $ 2$ 1 2 1 1 $ 2$ 1 2 1 1 $ 2$ 1 2 1 1 $ xt(Low)$ 2 : Moderate(Medium) 3 : Substantiation of the set of the	PO 1 PO 2 PO 3 PO 4 PO 5 PO 6 PO 7 PO 8 PO 9 PO 10 2 $ 1$ $ -$	PO 1 PO 2 PO 3 PO 4 PO 5 PO 6 PO 7 PO 8 PO 9 PO 10 PO 11 2 - - - - 1 - - - - 2 - - - - 1 - - - - 2 - - - - 1 - - - 2 1 2 1 1 - 1 - - - 2 1 2 1 1 - 1 - - - 2 1 2 1 1 - 1 - - - 2 1 2 1 1 - 1 - - - att(Low) 2: Moderate(Medium) 3: Substantial(High) 3: Substantial(High)	PO 1 PO 2 PO 3 PO 4 PO 5 PO 6 PO 7 PO 8 PO 9 PO 10 PO 11 12 2 - - - - 1 - - - 2 2 - - - - 1 - - - 2 2 - - - - 1 - - - 2 2 1 2 1 1 - 1 - - 2 2 1 2 1 1 - 1 - - 2 2 1 2 1 1 - 1 - - 2 2 1 2 1 1 - 1 - - 2 2 1 2 1 1 - 1 - - 2 2 1 2 1 1 - 1 - - 2 tt(Low) 2: Moderate(Medi	PO 1 PO 2 PO 3 PO 4 PO 5 PO 6 PO 7 PO 8 PO 9 PO 10 PO 11 12 1 2 - - - - 1 - - - 2 - 2 - - - 1 - - - 2 - 2 - - - 1 - - - 2 - 2 1 2 1 1 - 1 - - 2 - 2 1 2 1 1 - 1 - - 2 - 2 1 2 1 1 - 1 - - 2 - 2 1 2 1 1 - 1 - - - 2 - 2 1 1 - 1 - - - 2 - 2 1 1 - 1 - - -

Knowledge Level	MSE	ISE	ESE
Remember	-	-	-
Understand	5	-	10
Apply	5	5	20
Analyse	5	5	20
Evaluate	5	5	10
Create	-	5	-
TOTAL	20	20	60

			Gov	ernment (College of E	ngineerir	ng, Karad			
			Fin	al Year (Se	em – VIII) I	B. Tech. l	Electrical			
			IM	[3817:EV]	PCB Design	& Data	Analytics			
Teac	hing Sch	eme			U		Examination Sche	me		
Lectu	ures	02 Hrs/week					MSE	20		
Tuto	rials	00 Hrs/week					ISE	20		
Tota	l Credits	02					ESE	60		
							Duration of ESE	02 Hrs	30 Min	
Prer	equisite :	Basics of Ana	log and	l Digital El	ectronics					
Cou	rse Outco	mes (CO):Stude	ents will	be able to						
CO	1 Disc	uss the basics of	of PCB	Design and	l its compone	ents.				
CO	Organize and execute hierarchical schematics of EV									
CO	3 Explore ideas about data visualization.									
CO	4 Anal	yze data for ele	ectric ai	nd autonom	ous vehicles	•				
										1
				Cou	irse Contents				CO	Hours
Unit	1Basics of PCB Design:CO1(04)									
	Overview, Basic Ideas, Different Technologies, Understanding Schematic Capture.									
Unit	2 Con	iponent Work	ing:						CO2	(04)
	Sym	bol and Nets	s, Crea	ating Hier	archical Sc	hematic,	Multi Sheet De	sign,		
	Gen	erating Netlist a	and Bill	l of Materia	ıl.					
Unit	3 Desi	gn Application	ns:						CO1	(04)
	Desi	gn for Analog	and Di	gital Circui	its, Design fo	or Power	Electronics, Design	n for		
	Mici	owave circuits	5.							
Unit	4 Data	Analytics:	C 11	. D			11 .: T		CO4	(04)
	Intro	duction, Data	a Colle	ction, Prej	processing,	Data Co	ollection Techniqu	es in		
I In:	Elec	Visualization							<u>CO3</u>	(04)
Uni	5 Dala	a visualization	1. Ma Vieu	alization T	achniqua D	ata Evolo	vertion Data Explo	ration	COS	(04)
	for F	SV	ila visu		cennique, D	ata Expl	nation, Data Explo	ration		
Unit	6 Ove	rview and Apr	olicatio	n of Data /	Analysis:				CO4	(04)
CIII	Ove	rview of Dat	ta Ana	alvsis Tec	hniques. R	egression	Analysis. Clust	ering.	001	(01)
	App	lication in EV I	Electric	al System,	Data Analys	is Platfor	m for EV System.	6,		
Han	dbook									1
1.	P-CAD	PCB User's Gui	ide			·				
Refe	rence Boo	oks								
1.	IPC-PC	B Design Desk	k Refere	ence 2022 E	Edition					
2.	PCB De	signing E- Learr	ning Boo	ok, Sai Kirar	1					
Usef	ul Links									
1.	https://res	ources.pcb.cade	nce.com	/ebooks-wh	ite-papers					

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

1: Slight(Low)

2: Moderate(Medium)

3: Substantial(High)

Knowledge Level	MSE	ISE	ESE
Remember	-	-	-
Understand	-	-	10
Apply	5	5	20
Analyse	5	5	20
Evaluate	5	5	10
Create	5	5	-
TOTAL	20	20	60