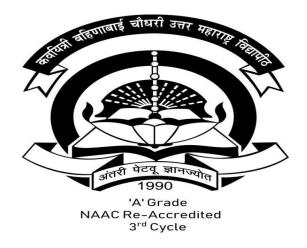
KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY,

JALGAON (M.S.)

Final Year Engineering (Chemical Engineering) Faculty of Science and Technology



B.E. Chemical Engineering Syllabus

W.E.F. 2020 – 21

Semester – VII

			Taashing	Sahama			Eva	aluation Sc	heme		
		Teaching Scheme				Theory		Practical			
Name of the Course	Group	Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE	Total	Credits
Process Control	D	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – III	Е	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – IV	Е	3	-	-	3	40	60	-	-	100	3
Open Elective Course – III	F	3	-	-	3	40	60	-	-	100	3
Process Control Lab	D	-	-	2	2	-	-	25	25 (OR)	50	1
Instrumentation and Control Lab	D	1	-	2	3	-	-	25	25 (OR)	50	2
Project (Stage - I)	G	-	-	12	12	-	-	50	50 (OR)	100	6
Essence of Indian Traditional Knowledge		-	-	-	-	-	-	-	-	-	-
		13		16	29	160	240	100	100	600	21

Syllabus Structure for Fourth Year Engineering (Semester – VII) Chemical Engineering (w.e.f. 2020 – 21)

ISE: Internal Sessional Examination

ESE: End Semester Examination

ICA: Internal Continuous Assessment

Professional Elective Course – III	Professional Elective Course – IV	Open Elective Course – III
Transport Phenomenon	Computer Aided Process Equipment Design	Plant Utility
Sustainability Engineering	Modeling & Simulation	Solar Power
Optimization Methods	Nanoscience and Nanotechnology	Enzyme Engineering
Safety Assessment for Chemical Processes	Computational Fluid Dynamics	Internet of Things

		Teaching Scheme				Evaluation Scheme						
						Theory		Practical				
Name of the Course	Group	Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE	Total	Credits	
Process Technology and Economics	D	3	-	-	3	40	60	-	-	100	3	
Professional Elective Course – V	Е	3	-	-	3	40	60	-	-	100	3	
Professional Elective Course – VI	Е	3	-	-	3	40	60	-	-	100	3	
Open Elective Course – IV	F	3	-	-	3	40	60	-	-	100	3	
Process Technology and Economics Lab	D	-	-	2	2	-	-	25	25 (OR)	50	1	
Design and Simulation Lab	D	2	-	2	4	-	-	25	25 (OR)	50	3	
Project	G		-	6	6	-	-	50	50 (OR)	100	3	
		14	0	10	24	160	240	100	100	600	19	

Syllabus Structure for Fourth Year Engineering (Semester – VIII) Chemical Engineering (w.e.f. 2020 – 21)

ISE: Internal Sessional Examination

ESE: End Semester Examination

ICA: Internal Continuous Assessment

Professional Elective Course – V	Professional Elective Course – VI	Open Elective Course – IV
Chemical Plant Design and Project Engineering	Petrochemical Technology	Energy Conservation and Management
Piping Design	Environmental Pollution and Control	Material Technology
Advanced Separation Processes	Water Conservation and Management	Biostatistics
Research Methodology	Renewable Energy	Cyber Security

				Control				
			COURSE	OUTLIN				
Course Title:	Process (Control			Short Title:	PC	Cours Code:	e
Course of	lescription	n:						
process science a	operations and chemic	es fundament and control. cal engineering control struct	The objective ob	ve of the atic and d	course ynamic	is to app model of	ly the pri	nciples of
Lecture		Hours/week	No. of v	weeks	Total	hours	Semes credits	
		3	1	4		42		3
	isite cours	e(s): Iaterial and E						
 To de lineariz To dev To des To des To des process Course o After suc After suc I. Unders express plots. 2. Unders 3. Capabl 4. To fundamentary	velop inpr zation conc elop transf ign a contr ign and an s informati <u>outcomes:</u> cessful con tand process them, income tand the m e to analyz ction along	Fer functions a ol system to n nalyze block	del of vario nd study the oneet desired n diagrams and <u>is course the</u> and various ential equation and advanced tune various sciplinary tea	bus proce dynamic b leeds of ch d dynamic student w s forms of ons, transf multivaria control sy ms	esses by pehavior nemical c behav <u>ill be ab</u> of math fer funct	y mathem of various engineerin ior of fee le to: ematical ions, and	natical m s systems ng process odback co models r	odels and s. ntrol from equired to
			COURSE	CONTEN	T			
Process	Control			Semeste			V	I
Teachin	g Scheme:			Examina	ation sc	heme		
Lectures	S:	3 hours/v	week			xam (ESE	E):	60 marks
				Duration Internal		E: nal Exams	s (ISE):	03 hours 40 marks
	Unit–I:		No. of Lectu	res: 09 H	ours]	Marks: 1	
State V	ristics of C ariables a	Chemical Proc nd State Eq n linear syster	ess Control, I uation for	Mathemat Chemical	ical Mo Proces	deling of (ses. Inpu	Chemical it –Outp	Processes,

Unit–II:	No. of Lectures: 08 Hours	Marks: 12							
Dynamic behavior of first order system, Pure capacity process, First order system with									
variable Time constant and gain, Response of first order system in series: Interacting and									
Non-interacting. Second order	system and their transfer function	on.							
Unit–III:	No. of Lectures: 09 Hours	Marks: 12							
•	order system: under damped a	1 .							
1 1 1	on lag. Higher order systems. Ir								
•	l control element. Block diagran	m of chemical reactant control							
systems.									
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12							
	control processes: P, PD, PI, an	0							
	a, selection of type of controller,	6							
controller. Stability analysis by	y Routh criteria, Root Locus Dia	gram.							
T T 9 4 T 7									
Unit–V:	No. of Lectures: 08 Hours	Marks: 12							
Frequency response analysis	of linear processes: Bode's diag	gram, Nyquist plots. Design of							
Frequency response analysis feedback control system using	of linear processes: Bode's diag g frequency response technique:	gram, Nyquist plots. Design of Bode's stability criteria, gain							
Frequency response analysis feedback control system using and phase margin. Ziegler – N	of linear processes: Bode's diag g frequency response technique: lichols tuning technique. Control	gram, Nyquist plots. Design of Bode's stability criteria, gain Systems with Multiple Loops:							
Frequency response analysis feedback control system using and phase margin. Ziegler – N Feed forward, Cascade, Ratio	of linear processes: Bode's diag g frequency response technique:	gram, Nyquist plots. Design of Bode's stability criteria, gain Systems with Multiple Loops:							
Frequency response analysis feedback control system using and phase margin. Ziegler – N	of linear processes: Bode's diag g frequency response technique: lichols tuning technique. Control	gram, Nyquist plots. Design of Bode's stability criteria, gain Systems with Multiple Loops:							
Frequency response analysis feedback control system using and phase margin. Ziegler – N Feed forward, Cascade, Ratio Variable Control.	of linear processes: Bode's diag g frequency response technique: lichols tuning technique. Control	gram, Nyquist plots. Design of Bode's stability criteria, gain Systems with Multiple Loops:							
Frequency response analysis feedback control system using and phase margin. Ziegler – N Feed forward, Cascade, Ratio Variable Control. Text Books:	of linear processes: Bode's diag g frequency response technique: lichols tuning technique. Control , selective, split range, Adaptive	gram, Nyquist plots. Design of Bode's stability criteria, gain Systems with Multiple Loops: e and Inferential control. Multi							
Frequency response analysis feedback control system using and phase margin. Ziegler – N Feed forward, Cascade, Ratio Variable Control. Text Books: 1. George Stephanpolous, Cher	of linear processes: Bode's diag g frequency response technique: lichols tuning technique. Control , selective, split range, Adaptive mical Process Control, Prentice H	gram, Nyquist plots. Design of Bode's stability criteria, gain Systems with Multiple Loops: e and Inferential control. Multi Hall of India.							
Frequency response analysis feedback control system using and phase margin. Ziegler – N Feed forward, Cascade, Ratio Variable Control. Text Books: 1. George Stephanpolous, Cher 2. D.R. Coughnour, Process Sy	of linear processes: Bode's diag g frequency response technique: lichols tuning technique. Control , selective, split range, Adaptive mical Process Control, Prentice H ystem Analysis and Control, McC	gram, Nyquist plots. Design of Bode's stability criteria, gain Systems with Multiple Loops: and Inferential control. Multi Hall of India. Graw-Hill.							
Frequency response analysis feedback control system using and phase margin. Ziegler – N Feed forward, Cascade, Ratio Variable Control. Text Books: 1. George Stephanpolous, Cher 2. D.R. Coughnour, Process Sy 3. R.P. Vyas, Process Control a	of linear processes: Bode's diag g frequency response technique: lichols tuning technique. Control , selective, split range, Adaptive mical Process Control, Prentice H	gram, Nyquist plots. Design of Bode's stability criteria, gain Systems with Multiple Loops: and Inferential control. Multi Hall of India. Graw-Hill.							
Frequency response analysis feedback control system using and phase margin. Ziegler – N Feed forward, Cascade, Ratio Variable Control. Text Books: 1. George Stephanpolous, Cher 2. D.R. Coughnour, Process Sy	of linear processes: Bode's diag g frequency response technique: lichols tuning technique. Control , selective, split range, Adaptive mical Process Control, Prentice H ystem Analysis and Control, McC	gram, Nyquist plots. Design of Bode's stability criteria, gain Systems with Multiple Loops: and Inferential control. Multi Hall of India. Graw-Hill.							
Frequency response analysis feedback control system using and phase margin. Ziegler – N Feed forward, Cascade, Ratio Variable Control. Text Books: 1. George Stephanpolous, Cher 2. D.R. Coughnour, Process Sy 3. R.P. Vyas, Process Control & Nagpur.	of linear processes: Bode's diag g frequency response technique: lichols tuning technique. Control , selective, split range, Adaptive mical Process Control, Prentice H ystem Analysis and Control, McC	gram, Nyquist plots. Design of Bode's stability criteria, gain Systems with Multiple Loops: and Inferential control. Multi Hall of India. Graw-Hill.							
Frequency response analysis feedback control system using and phase margin. Ziegler – N Feed forward, Cascade, Ratio Variable Control. Text Books: 1. George Stephanpolous, Cher 2. D.R. Coughnour, Process Sy 3. R.P. Vyas, Process Control & Nagpur. Reference Book:	of linear processes: Bode's diag g frequency response technique: lichols tuning technique. Control , selective, split range, Adaptive mical Process Control, Prentice H ystem Analysis and Control, McC & Instrumentation (2nd edition).	gram, Nyquist plots. Design of Bode's stability criteria, gain Systems with Multiple Loops: and Inferential control. Multi Hall of India. Graw-Hill. Central Techno publication,							
Frequency response analysis of feedback control system using and phase margin. Ziegler – N Feed forward, Cascade, Ratio Variable Control. Text Books: 1. George Stephanpolous, Cher 2. D.R. Coughnour, Process Sy 3. R.P. Vyas, Process Control & Nagpur. Reference Book:	of linear processes: Bode's diag g frequency response technique: lichols tuning technique. Control , selective, split range, Adaptive mical Process Control, Prentice H ystem Analysis and Control, McC	gram, Nyquist plots. Design of Bode's stability criteria, gain Systems with Multiple Loops: and Inferential control. Multi Hall of India. Graw-Hill. Central Techno publication,							

		Profe	ssional Elec	ctive Co	urse – Il	I			
]	Fransport P						
~			COURSE	OUTLI					
Course	Transpor	rt Phenomenon	l					se	
Title:					Title:		Code		
	lescription			C (1 C	11 64	. 1		1'	•
		give a balanced							
		eories of the su							
problems	s and elabo	rate conceptual	and mathem	natical m	odels, fr	om conse	ervation p	rinc	iples.
Lecture		Hours/week	No of w	aalra	Tatal		Seme	atom	
Lecture			credit						
		3	14	1		42	crean	<u>s</u> 3	
D	••	_	12	+		42		3	
	isite cours		5.1	9		T T	<u> </u>	-	
		Iaterial and Ene					isfer, Mas	s Tr	ansfer I
& II, The	ermodynan	nics I & II, Cher	nical Reacti	on Engir	neering-l	& II.			
Course of	objectives:								
		oility to apply l	knowledge o	of mathe	matics,	interdisci	iplinary s	cien	ce, and
		e field of transpo			,		1 0		,
0	U	um and non equ	-						
		ental laws of co			v to und	lerstand l	behavior o	of tr	ansport
process	-			and app					mpor
-		nentum, energy	and mass ba	alances i	n chemia	al proces	sses		
		ion of motion us				-			
10 401	erop equal		ing equation		indity diff	equation	or energy.		
Course	outcomes:								
		mpletion of this	course the s	tudent u	vill be ab	le to:			
		g principles and					ort nhana	mat	
		cs, science, and	i engineern	ig princi	pies to	allaryze i	lansport	phe	Iomena
problem		1 • 11 • 7		,	1 .				
-	-	hysically interp	-	-				1	
	-	urious transport	operations	and coll	ective e	fect of r	nomentur	n, h	eat and
mass tr									
5. Display	y skill of va	arious equation	uses in mon	nentum t	ransfer.				
			COURSE (ONTE	NT				
Transpo	rt Phenon			Semest			V	ΊI	
-	g Scheme:				nation so	heme			
Lectures	0	3 hours/we	ek.			xam (ES	(F)•	60	
Lectures	7 •	5 HUUI 5/ W	un	Enu sel		Aann (E'O	, <u>,</u>		arks
				Duroti	on of ES	F.			hours
					al Sessio	nal Exan	ns	40	
		ı		(ISE):					arks
	Unit–I:		o. of Lectur				Marks:		
Introduct	tion. Trans	port phenomen	on and Uni	t Operat	ion. Equ	ilibrium	and Rate	Pro	ocesses.
Fundame	ental varia	bles. The role	of Intermol	ecular f	orces. S	imple Ba	alance: M	ater	ial and
Energy.						-			

Molecular transport Mechanism:

The Analogy. The Case of Heat Transfer. The Case of Mass Transfer. The Case of Momentum Transfer. The Analogues forms. Heat, Mass, Momentum Diffusivities. Thermal Conductivity. Diffusion Coefficient. Viscosity.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Viscosity and Mechanism of M	lomentum Transport. Velocity D	Distribution in Laminar Flow.

Unit–III:No. of Lectures: 09 HoursMarks: 12Thermal Conductivity and The Mechanism of Energy Transport. Temperature Distribution in
Solids and in laminar Flow.

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12
Diffusivity and Mechanism of	mass Transport. Concentration	Distribution in Solids and in
Laminar Flow.		

Unit–V:	No. of Lectures: 08 Hours	Marks: 12
The Equation of Change for Ise	othermal System. The Equation	of Change for Non-Isothermal
System.		

Text Books:

- 1. R.B. Bird; W.E. Stewart; E.N. Lightfoot, Transport Phenomenon, John Wiley & Sons1994;Singapore
- 2. R.S. Brodsky & H.C. Hershey, Transport Phenomenon, McGraw-Hill (International edition)

Reference Books:

1. C.O. Bennett & J.E. Myers; Momentum, Heat & Mass Transfer; McGraw-Hill, 1982.

2. James R. Welly, Charles E. Wicks & Robert E. Wilson; Fundamentals of Momentum, Heat& Mass Transfer (3rdedition). John Wiley & Sons; Singapore.

		P	rofessi	onal Elec	ctive Cou	ırse – II	I			
				ainability						
				OURSE	<u> </u>	<u> </u>				
Course Title:	Sustaina	ability Engineering				Short Title:	SE	Cour Code		
Course d	lescriptio	n:								
		nded for the	knowl	edge of s	tudents a	bout the	sustai	nable devel	opm	nent and
		g this. It will		-					-	
environm	ent .The	students will	also le	earn abou	t waste n	ninimiza	tion.		-	
Lecture		Hours/week No. of weeks Total hours Seme					•			
	-	3		1	4		42		3	
Prerequi	isite cours	se(s):	l							
		Material and	Energy	v Balance	Comput	ations I	Jeat Tr	ansfer Ma	с T.	ansfer I
		mics I & II, (ansier, wia	55 11	ansier r
Course o	bjectives	:								
		creased awa	reness	among st	udents of	n issues	in areas	s of sustain	abili	ty
		s understand								
		nd social ind			8	8	5 F	r ,		- ,
		dents the kno			ronment-	related 1	egislati	on.		
		udents an ur							evel	opment
		cycle assessi				···· ··· ··· ··· ··· ··· ··· ··· ··· ·				· r · · · · ·
		stainable so		of energy:	econom	ic and so	ocial fac	ctors affect	ing	
sustain				8,,,					0	
	outcomes	:								
		mpletion of	this co	ourse the s	student w	vill be ab	le to:			
		ness on issue								
		ole of engine				-	ainable	e developm	ent	
		en chemistry	-				umuon	, ao (cropin	0110.	
	-	ronmental in		•			project	ts		
		olid waste m	-			iopinent	project			
o. onders		ond waste n	iunugei							
			C	OURSE	CONTE	NT				
Sustaina	bility Eng	gineering			Semest			, T	VII	
Teaching	g Scheme	•			Examir	nation so	cheme			
Lectures	:	3 hour	s/weeł	Σ.	End ser	mester e	xam (I	ESE):	60)
							Ň	,	m	arks
					Duratio	on of ES	E:		03	3 hours
					Interna	al Sessio	nal Ex	ams	4()
					(ISE):					arks
	Unit–I:		No.	of Lectu	· · ·	Iours		Marks:		
Introduct		e idea of s					magn			nability
		ment-related								
		revention, re								
	Unit–II	:	No.	of Lectu	res: 08 H	Iours		Marks:	12	
		•	110					1.1001130		

Solid waste management; collection and transportation systems, landfiling, combustion, resource recovery incineration technologies, pyrolysis, composting source reduction, recycling and reuse of plastic and glass bottles, integrated waste management, local and global environmental challenges.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12			
Climate change; tools used to ensure sustainability in engineering activities, environmental					
management systems and environmental impact assessment; risk assessment, life cycle					
assessment, life cycle assessme	ent tools, sustainable transportati	on.			
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12			
Sustainable engineering design	n principles, economic, enviror	nmental and social indicators,			
green buildings; green chemist	ry; green sustainable materials,	sustainable cities; sustainable			
transportation; waste minimi	zation, case studies on wast	e minimization and cleaner			
technologies of chemical proce					
Unit–V:	No. of Lectures: 09 Hours	Marks: 12			
Sustainable sources of energy:	economic and social factors a	ffecting sustainability, cleaner			
technologies of industrial pro-	oduction, case studies such a	s biofuels for transportation,			
sustainable transportation, sustainable	ainable cities, green buildings.	_			
Text Books:					
	· · · · · · · · · · · · · · · · · · ·	TT 11 CT 1' D' / T' '/ 1			

1. R.T. Wright, B.J. Nebel "Environmental Science" Prentice Hall of India Private Limited, New Delhi

2. D.T. Allen , D.R. Shonnard,"Sustainable Engineering" Prentice Hall Limited, Boston

3. U. Rathore, "Energy Management"S. K. Kataria & sons, New Delhi.

Reference Book:

H.M. Neal, J.R. Schubel "Solid Waste Management and the Environment" Prentice Hall Inc., New Jersey, 1987.

		Profess	ional Elective Cou	urse – II	Ι	
		0	ptimization Meth	ods		
		(COURSE OUTLIN	NE		
Course Title:	L Contraction of the second se				OMS	Course Code:
Title: Title: Code: Course description: Code: Code:						
This cour	rse descri	ibes how to use app	propriate optimizati	ion meth	ods for va	arious application in
						equipment design. It
illustrates	s the app	lication of unconstr	ained and constrain	ned optin	nization to	echniques.
Lastana		Hannalmaak	No. of weeks	Total houng Somoston		Comoston
Lecture		Hours/week	INO. OI WEEKS			Semester credits
		3	14		42	3
Prerequi	isite cou	rse(s):				
Applied]	Mathema	tics I, & II, Applie	d Physics I & II,	Fluid Me	echanics, I	Material and Energy
						nodynamics I & II,
		n Engineering-I &			,	
Chennea	I ICactio	II Lingilieering-1 &	11.			
Course o	biective	s:				
	<u> </u>		n terms of optimizi	ng recov	very of wa	ste heat, Optimizing
						straints, constraints
surface		i and problem sta	uement, design w	cetor, ut	Sign Con	istraints, constraints
		how for alogical	antionization ain al		a	anishla antimization
						ariable optimization
		nts, multivariable o				
						of a system of linear
		uation and simplex				
4. To unc	lerstand	the unconstrained	optimization tech	niques,	random s	search method, grid
search,	univaria	ate method and co	onstrained optimization	ation tec	chniques,	characteristics of a
constra	ined prob	olem, complex met	hod.			
5. To den	nonstrate	skill of the dynam	ic programming, r	nultistag	e decision	n processes, concept
		tion, principle of or		-		1 / 1
	1				0	
Course o					-	
		ompletion of this c				
			· · ·		•	changer and problem
			constraints, constra	ints sur	face in a	competitive manner
how to	optimize					
2. Demon	strate the	e ability to perform	the task by identia	ifying, f	ormulating	g, and providing the
solution	n to vari	ous chemical engin	neering problems	associate	d with cl	assical optimization
						ariable optimization
	uality co				,	1
-						
			he solution to va	rious ch	emical er	gineering problems
associa		late and provide t				
	te with th	late and provide t ne nonlinear progra	mming, LPP, linea	r simulta	neous equ	uation.
4. Unders	te with th tand prof	late and provide t ne nonlinear progra fessional and ethica	mming, LPP, linea al responsibilities f	r simulta formally	aneous equand and inform	uation. mally show the skill
4. Unders the unc	te with th tand prof constraine	late and provide the nonlinear progra fessional and ethicated optimization tec	mming, LPP, linea al responsibilities f chniques, random s	r simulta formally	aneous equand and inform	uation. mally show the skill
4. Unders the unc method	te with th tand prof constrained and con	late and provide t ne nonlinear progra fessional and ethica ed optimization tec strained optimizatio	mming, LPP, linea al responsibilities f chniques, random s on techniques.	r simulta formally search m	aneous equ and informethod, gri	uation. mally show the skill id search, univariate
 Unders the unc method Display 	te with th tand prof constrained and con y the skill	late and provide the nonlinear progra fessional and ethicated optimization tectors strained optimization ll about dynamic p	mming, LPP, linea al responsibilities f chniques, random s on techniques. programming, mult	r simulta formally search m	aneous equ and informethod, gri	uation. mally show the skill id search, univariate
 Unders the unc method Display 	te with th tand prof constrained and con y the skill	late and provide t ne nonlinear progra fessional and ethica ed optimization tec strained optimizatio	mming, LPP, linea al responsibilities f chniques, random s on techniques. programming, mult	r simulta formally search m	aneous equ and informethod, gri	ngineering problems uation. mally show the skill id search, univariate rocesses, concept of

		COURSE	CONTENT			
Optimization Method	S		Semester:		V	II
Teaching Scheme:			Examination s	cheme		
Lectures:	3 hour	s/week	End semester	End semester exam (ESE):		60
					marks	
			Duration of ES			03 hours
				onal Exa	ams	40
Unit–I:		No of Loctu	(ISE): res: 09 Hours		Marks: 1	marks
Introduction to Optimi	zation			nization		
of waste heat, Optimi						
Vector, Design Const						
surface classification:	based o	n existence of	constraints and l	based of	n nature of	the design
variables, optimization						-
		1				
Unit–II:			res: 08 Hours		Marks: 1	
Classical optimization						
multivariable optimiza						
method of constrains optimization with inequ		•	of Lagrange	muniph	ers and m	univariable
optimization with meq		nistramts.				
				[
Unit–III:			res: 09 Hours	G 1 4	Marks: 1	
Introduction: Nonlinear						
Simultaneous equation		nlaw mathod	Two phagas of	f cimpl		1 Cimpler
Algorithm, LP Applica		plex method,	Two phases of	f simpl	ex method	l, Simplex
Algorithm, LP Applica		-		f simpl		
Algorithm, LP Applica Unit–IV:	tions.	No. of Lectu	res: 08 Hours		Marks: 1	12
Algorithm, LP Applica	tions.	No. of Lectu ptimization tecl	res: 08 Hours	n search	Marks: 1 method, G	12 Brid search,
Algorithm, LP Applica Unit–IV: Introduction: Unconstr	tions. ained o conjugat	No. of Lectu ptimization tecl te search dire	res: 08 Hours iniques, Random ctions, Steepest	n search	Marks: 1 method, G nt (Cauchy	12 Grid search, () method;
Algorithm, LP Applica Unit–IV: Introduction: Unconstr Univariate method, o	tions. ained o conjugat	No. of Lectu ptimization tecl te search dire	res: 08 Hours iniques, Random ctions, Steepest	n search	Marks: 1 method, G nt (Cauchy	12 Grid search, () method;
Algorithm, LP Applica Unit–IV: Introduction: Unconstr Univariate method, of Constrained optimizati method.	tions. ained o conjugat	No. of Lectu ptimization tecl te search dire nniques: Charac	res: 08 Hours nniques, Random ctions, Steepest eteristics of a co	n search	Marks: 1 method, G nt (Cauchy ed problem	12 Grid search, () method; () Complex
Algorithm, LP Applica Unit–IV: Introduction: Unconstr Univariate method, of Constrained optimization method. Unit–V:	tions. ained o conjugat ion tech	No. of Lectu ptimization tecl te search dire nniques: Charac No. of Lectu	res: 08 Hours nniques, Random ctions, Steepest eteristics of a co res: 08 Hours	n search Decer onstrain	Marks: 1 method, G nt (Cauchy ed problem Marks: 1	12 brid search, y) method; h, Complex 12
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	Profess	ional Elective Cou	ırse – II	[
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		COURSE OUTLIN		C A C D	G					
•	Assessment for Ch	iemical	Short Title:	SACP	Course					
					Code:					
Course descrip		monuisto nigle agoog	amont m	athoda for	vonious annlis	otion				
	cribes how to use approvide									
	dustry to provide e identification of de					aking				
			1550551110	it with pla	unt safety.					
Lecture	Hours/week	No. of weeks	Total l	ours	Semester					
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	3	14		42	3					
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	I & II, Material & E									
Mass Transfer	I & II, Process Heat	t Transfer. Thermo	odvnamic	s I & II.	Chemical Rea	ction				
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Engineering-I &	/ 11.									
Course objectiv	ves:									
1. To accustom	basic terminology	in loss preven	tion. pr	ocedure f	for process s	afety				
	and theoretical consi				process s	, and end				
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2. To understand	l basic assessment te	est methods for kg	g-scale p	ocesses a	nd methods for	or the				
investigation a	and assessment of che	emical reactions.								
	estigation and assess		onerating	condition	ns for safe no	ormal				
						Jimai				
-	e cooled CSTR, PFI									
4. To display sk	ill about special pro	blems in the asses	sment of	normal o	perating cond	itions				
and investigat	ion methods for the c	characterization of	normal o	perating co	onditions.					
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analysis, what	if' method, HAZOP	analysis.				azard				
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Course outcom						azard				
After successful	completion of this c	ourse the student w	vill be ab	le to:		azard				
1. Demonstrate	the basic terminolo	ory in loss preve				azard				
		jgy ill loss pieve	ntion, p	rocedure	for process s					
	and theoretical consi	••••••	-		for process s					
U		iderations for labor	atory pro	cesses.	-	afety				
2. Analyze basi	c assessment test r	iderations for labor nethods for kg-sc	atory pro	cesses.	-	afety				
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		Duration of E	SE:	03 hours
		Internal Session	onal Exams	40
		(ISE):		marks
Unit–I:		res: 09 Hours	Marks:	12
Basic Terminology in Loss Pro- General Safety Terms: Hazard for Plant/Process Operation. Procedure for Process Safety Scope of Investigation in its Definition of Significant F Corresponding to the Life Cycle Test Methods For The Therm Theoretical Considerations For Processes: Difference Therm (DSC), The Carius Tube Test, Unit–II: Basic Assessment Test Meth Test on The Ignitability of Soli Partial Testing for Explosion F Methods for the Investigation Reaction Engineering Fundam Ideal Reactor Models, Introdu Reactors, Sample Solutions fo of Cooled Ideal Reactors.	I Potential and I Investigations Dependence o Plant or Proce le Progress. nal Stability Ass or Laboratory H al Analysis (D The Miniautocla No. of Lectur nods For kg-Sc ds, Flash-point of tisk,Deflagration n and Assessme entals: Stoichio action of Charac	n the antonym ss Modification sessment of Sub Processes, Scree TA) and Diffe we Test, Open C res: 08 Hours ale Processes: ' of Liquids, Ignition Testing. nt of Chemical metry and Exten- teristic Number	Process Developm ns, Types of inv ostances And Mixt ening -Methods For rential Scanning C up Measuring Tech Marks: The Burning Test fon Temperature of Reactions nt of Reaction, Rea s, Mass Balances of	nent Stage, vestigations or kg-Scale Calorimetry miques. 12 For Solids Liquids
Unit–III:	No. of Lectur	res: 08 Hours	Marks:	12
Investigation And Assessmen				14
The Safety Technical Assessm of The Cooled CSTR, Safe No Cooled Batch Reactors, Safe N	nent of Normal rmal Operation of	Operating Cond of the Cooled PF	itions: Safe Norma TR, Safe Normal C	-
Unit–IV:	No. of Lectu	res: 08 Hours	Marks:	12
Special Problems In The Ass				
Safe Normal Operation of Rea Reactions.	ctions Under Re	flux, Safe Norm	al Operation of Poly	
Investigation Methods for Fundamentals of Thermokin Reaction Calorimetric Measure	etics, Reaction		. 0	
Unit–V: Methods For The Identificati		res: 09 Hours	Marks:	12

Special Problem - The Concept of The Credible Worst Case, The Procedure.

Text Book:

Jorg Steinbach, Safety Assessment for Chemical Processes, Wiley – VCH, Publication.

Reference Book:

R.K. Jain, S.S. Rao, "Industrial Safety, Health and Environment Management Systems", Khanna Publishers, New Delhi.

			Aided Process Equ		Design			
<u>a</u>	a		COURSE OUTLI	1	G (555			
Course			CAPED	Course Code:				
	DesignCourse description:					Coue:		
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Lecture		Hours/week No. of weeks Total hours		Semester				
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			Energy Balance Co					
Mass T	ransfer l	& II, Heat Tr	ansfer, Thermody	namics	I & II, C	Chemical Rea	actio	
Engineer	ring-I & I	I.						
	objective							
	-	U	of shell and tube		changer and	d Batch Rea	ctor	
			ating and Cooling r					
. To app	ply knov	whow for comput	ter aided design of	of the S	ingle Effect	et Evaporator	r ai	
Distilla	ation Colu	umn.						
. To und	lerstand c	computer aided des	sign of the absorption	on colum	n and rotary	y dryer.		
. To eva	luate the	module for comp	uter aided design o	of vessel	under interi	nal pressure,	hea	
and clo	sures and	d vessel under exte	ernal pressure and r	rectangula	ar storage ta	ink.		
. To den	nonstrate	skill of the modul	le consideration for	r compute	er aided des	sign of tall ve	esse	
thick-v	valled hig	gh pressure vessel,	Skirt support, Lug	support a	and Saddle	o demonstrate skill of the module consideration for computer aided design of tall ves nick-walled high pressure vessel, Skirt support, Lug support and Saddle supports.		
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		COURSE	CONTENT			
Computer Aided Pro Design	cess Equ		Semester:		V	II
Teaching Scheme:			Examination s	scheme		
Lectures:	3 hour	s/week	End semester exam (ESE): 60		60	
					marks	
	Duration of E		SE:		03 hours	
			Internal Session	onal Exa	ams	40
				1		marks
Unit–I:No. of Lectures: 09 HoursMarks:Computer Aided Design:				12		
Shell and Tube Hea characteristics and app heat exchanger. Flow tube side Design. Tota arrangement, standard Double pipe heat excha Batch Reactor -Isother	blication sheet of al pressu coding anger. L	The rating and optimal design are drop Delta I and its layout, MTD and correct	l sizing method of heat exchang P _T , shell side pro- Fluids in a short ction factor and y	and vari er. Kerr essure d ell and writing c	ious steps on Methods of Irop, Baffles tube Heat of C ++Prog	of design of of shell and s and Tube exchanger.
Unit–II:		No. of Lectu	res: 08 Hours		Marks: 1	12
Computer Aided Desig	gn:					
Single Effect Evaporat		E) Boiling point	rise and duhring	g Rule, ł	nydrostatic l	head effect,
Use of vacuum in e	evaporat	or system. Typ	bes of evaporat	tor- sin	gle effect	evaporator.
Assumption of evapor	ator. Nu	merical based o	n single effect e	vaporate	or with C++	nrograms
difference of SEE and	Multiple	00				- programs,
difference of SEE and Multiple effect evaporators MEE).						
Distillation Column: Steps of distillation column, material and energy balance, dew point						
and bubble point, ME	Steps of ESH equ	distillation colu ation, Ideal bir	mn, material a anary distillation	column	gy balance, , multicom	dew point ponent non
and bubble point, ME ideal distillation colum	Steps of ESH equin, batch	distillation colu- ation, Ideal bir distillation with	umn, material a nary distillation h hold up, Relat	column ive vola	gy balance, , multicomj tility, Smok	dew point ponent non
and bubble point, ME	Steps of ESH equin, batch	distillation colu- ation, Ideal bir distillation with	umn, material a nary distillation h hold up, Relat	column ive vola	gy balance, , multicomj tility, Smok	dew point ponent non
and bubble point, ME ideal distillation colum and MacCabe- Thiele o Unit-III:	Steps of ESH equ n, batch diagram,	distillation colu ation, Ideal bir distillation with q-line equation	umn, material a nary distillation h hold up, Relat	column ive vola	gy balance, , multicomj tility, Smok	dew point ponent non er equation
and bubble point, ME ideal distillation colum and MacCabe- Thiele of Unit–III: Computer Aided Desig	Steps of ESH equ nn, batch diagram, gn:	distillation colu ation, Ideal bir distillation with q-line equation No. of Lectu	umn , material a hary distillation h hold up, Relati s and numerical res: 08 Hours	column ive volat on C++	gy balance, , multicom tility, Smok program. Marks: 1	dew point ponent non er equation 12
and bubble point, ME ideal distillation colum and MacCabe- Thiele d Unit–III: Computer Aided Desig Absorption Column: I	Steps of ESH equin, batch diagram, gn: ntroduct	distillation colu ation, Ideal bir distillation with q-line equation No. of Lectu ion, steps of de	imn , material a hary distillation h hold up, Relati s and numerical res: 08 Hours signing absorpti	column ive volat on C++	gy balance, , multicomj tility, Smok program. <u>Marks: 1</u> mn. Types o	dew point ponent non er equation 12 of packing,
and bubble point, ME ideal distillation colum and MacCabe- Thiele d Unit–III: Computer Aided Desig Absorption Column: I Rate of absorption, H	Steps of ESH equ in, batch diagram, gn: ntroduct feight of	distillation colu ation, Ideal bir distillation with q-line equation No. of Lectu ion, steps of de column based	umn , material a hary distillation h hold up, Relat s and numerical res: 08 Hours signing absorpti on liquid film	column ive volat on C++	gy balance, , multicomj tility, Smok program. <u>Marks: 1</u> mn. Types o	dew point ponent non er equation 12 of packing,
and bubble point, ME ideal distillation colum and MacCabe- Thiele d Unit–III: Computer Aided Desig Absorption Column: I Rate of absorption, H flooding co relation. N	Steps of ESH equals an, batch diagram gn: ntroduct eight of umerica	distillation colu lation, Ideal bir distillation with q-line equation No. of Lectur ion, steps of de column based l based on C++	umn , material a hary distillation h hold up, Relati s and numerical res: 08 Hours signing absorpti on liquid film program	column ive volat on C++ on colut conditio	gy balance, , multicom tility, Smok program. Marks: 1 mn. Types ons, pressure	dew point ponent non er equation 12 of packing, e drop and
and bubble point, ME ideal distillation colum and MacCabe- Thiele d Unit–III: Computer Aided Desig Absorption Column: I Rate of absorption, H flooding co relation. N Rotary Dryer: Classifi	Steps of ESH equin, batch diagram, gn: ntroduct eight of umerica ication t	distillation colu ation, Ideal bir distillation with q-line equation No. of Lectur ion, steps of de column based l based on C++ ypes of rotary	imn , material a hary distillation h hold up, Relati s and numerical res: 08 Hours signing absorpti on liquid film program dryers, rates of	column ive volat on C++ on colut conditio drying,	gy balance, , multicomp tility, Smok program. Marks: 1 mn. Types ons, pressure Material B	dew point ponent non er equation 12 of packing, e drop and
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Computer Aided Design: Vertical supports for chemical process plant Skirt support, Lug support. Numerical based on C++ program. Computer Aided Design: Saddle supports. Numerical based on C++ program.

Text Books:

- 1. W. L. Luyben, Process Modeling Simulation and Control for Chemical Engineers; McGraw Hill 1988.
- 2. B.C. Bhattacharya, C. M. Narayan, Computer Aided Design of Chemical Process Equipment: 1st Edition, 1992, New Central Book Agency (P) Ltd. Calcutta.

Reference Books:

- 1. S.D. Dawande, Process Equipment Design (Vol. I & II), Denett & Co., Nagpur.
- V.V.Mahajani, S.B.Umarji, Joshi's Process Equipment Design, Trinity Press, Fifth Edition.
 J.H. Perry, Chemical Engineer's Hand Book, McGrawhill, New Delhi.
- 4. Lloyed E. Brownell, Edwin H. Young, Process Equipment Design, John Wiley & Sons.
- 5. R.W.Gaikwad, Dr.Dhirendra, Process Modelling and Simulation, Central Techno Publication, Nagpur. First Edition.

				ourse – IV		
			odeling & Simula			
		0	COURSE OUTLI	INE		
Course Title:	8			Short MS Title:		Course Code:
Course	description	on:		1		
equipme	nt design					ry out the for process principles associated
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		3	14		42	3
Prereau	isite cou	rse(s):	J	1		I
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Teaching Schem	ie:		Examination s	cheme	
Lectures:	3 hour	s/week	End semester exam (ESE):		60 marks
			Duration of E	SE:	03 hours
			Internal Sessio	onal Exams	40
			(ISE):		marks
Unit–	I:	No. of Lec	tures: 09 Hours	Marks:	12

Introduction of modeling and simulation:

Definition, conservation principle, model representation, types of modeling equations, types of mathematical models, computer simulation, use of simulated process model. Numerical Methods:

Interative convergence methods – Bisection method (Interval halving), Secant method, Newton-Raphson Method, Muller method.

	Unit–II:			N	No. of Lectures: 09 Hours			rs	Marks: 12		
Batch	reactor:	The	process	and	the	model	_	Process	description.	mathematical	model,

Batch reactor: The process and the model – Process description, mathematical model, application of control algorithm.

Semi-batch rector: Mathematical model.

Continuous stirred tank react: The process and the model – Process description, mathematical model.

Multi steady states: Representative process, steady state solution, Multi steady states behavior pH Neutralization rector: Process description, mathematical model.

Bioreactor: Chemical engineering in bioprocess industry, operation stages in a bioprocess, Biochemical reactor, Continuous stirred tank bio reactor: Process description, mathematical model.

Unit–III:	No.	of Lectures: 08	Hours		Marks:	12
Compartmental dist	tillation model	: Introduction,	an ove	erview,	Process	description,
mathematical model.						
Ideal binary distilla	tion column:	Introduction, th	e proces	s and t	the model	l – Process

description, mathematical model.

Activity coefficient models: Introduction, Activity coefficient models for liquid mixtures – The Margules model, The Van Laar model, The Wilson model.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
Binary batch distillation colum	nn: Introduction, features of batc	ch distillation column, start up
procedure of a batch column –	simulation procedure for the init	ial filling.

An example of process and model ; Material and energy balance equations, entahlphy calculation, tray hydraulics, murphree vapour-phase tray efficiency, molecular weight and density of the tray liquid and vapour-liquid equilibrium.

Software sensor : Development of soft-sensor for distillation column.

Binary continuous distillation column: Introduction, The process and the model – Material and energy balance.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12			
Multicomponent batch distillat	tion column: Introduction, The p	rocess and the model, Material			
and energy balance equations, Enthalpy calculation, molecular weight and density of the tray					
liquid and equilibrium relationship.					
Equilibrium flash vaporization	: Introduction, isothermal flash, i	deal mixtures.			

Adiabatic flash: First set of problem, second set of problem.

Text Book:

Amiya K.Jana, Chemical process modeling and simulation, PHI Learning Private Limited, Delhi Second Edition.

Reference Books:

- 1. W. L. Luyben, Process Modeling Simulation and Control for Chemical Engineers; McGraw Hill 1988.
- 2. B.C. Bhattacharya, C. M. Narayan, Computer Aided Design of Chemical Process Equipment: 1st Edition, 1992, New Central Book Agency (P) Ltd. Calcutta.
- 3. R.W.Gaikwad, Dr.Dhirendra, Process Modelling and Simulation, Central Techno Publication, Nagpur. First Edition.

		Pı	rofessi	onal Elec	tive Co	urse – IV	V		
				ence and					
				OURSE					
Course Title:	Nanoscie	ence and Na	notecl	nnology		Short Title:	NSNT	Course Code:	e
Course of	lescriptio	n:							
nanotech	nology, t	esigned to through nat omaterial for	nomate	erial prep	paration,				
Lecture		Hours/weel	Ś	No. of w	reeks	Total l	hours	Semest credits	
	F	3		14	4		42		3
Prerequ	isite cours	se(s):				1		I	
Applied	Physics I d	& II, Applied	d Chen	nistry I &	II.				
	objectives								
	-	iminaries of a synthesis of							
		e synthesis c							
		racterization							
		dge for reco					cific applic	ations.	
Course	outcomes	s: After succ	essful	completio	on of this	course	the student	will be a	ble to:
2. Learn s 3. Learn s 4. Analyz	synthesis of synthesis of synthesis of the char	asic aspects of nanomater of nanomater acterization	ials by ials by technic	y physical y chemica ques for n	methods l method anomate	s. ls. rials.			
5. Demor	istrate the	ability in sel				-	fic applica	tions.	
Comment	an Aidad	Due e e a E au		OURSE (371	T
Comput Design	er Aldea	Process Equ	upmer	10	Semest	er:		VI	1
	g Scheme	•			Exami	nation so	heme		
Lectures	_	3 hour	s/week	7			eneme exam (ESE	•('	60
Lecture	•	5 nour	5/ 11 CCL	•	Linu se				marks
					Durati	on of ES	E:		03 hours
					Interna	al Sessio	nal Exams	6	40
					(ISE):				marks
	Unit–I:		No.	of Lectur	res: 09 H	Iours	Ι	Marks: 12	2
clustrers	type of s, melting	ry and scope clusters, pr of nanopart	opertie	es of nar	omateria	als: mec	hanical pr	operties,	structural
	Unit–II:	•	No.	of Lectur	res: 08 F	Iours	7	Marks: 12	2
Synthesi		materials by							
physical	vapour de	eposition, las	ser pyi	olysis, sp	outter de				

Unit–III:	No. of Lectures: 09 Hours	Marks: 12
Synthesis of nanomaterials by		
of colloids, growth of nanop Blodgett method, microemula	, 1	
synthesis, lab-on -chip.		•

Unit–IV:		No. of Lect	tures: 08 Hours		Marks: 1	.2
Nanoscale measuren	nent and cha	aracterization	n;: X-Ray Diffracti	on (XRD), Small A	ngle X-ray
Scattering(SAXS),	Scanning	Electron	Microscopy(SEM	1), Trai	nsmission	Electron
Microscopy(TEM),	Atomic	Force	Microscopy(AFM	I), Sca	anning	Tunneling
Microscopy(STM),	Field Ion	Microscope((FIM), Three Dime	ensional A	Atom Pro	be(3DAP),
Nanoindentation.						

Unit–V:	No. of Lectures: 08 Hours	Marks: 12
Special nanomaterials: Carbone		

Carbon Nanotubes (CNTs): types and synthesis, Graphene, Porous silicon: preparation, mechanism and properties, Aerogels: Types and properties, Zeolites: synthesis and properties.

Text Book:

B.S.Murty, P Shankar, Baldev Raj, B B Rath, James Murday., "Textbook of Nanoscience and Nanotechnology,", University Press (India) Pvt. Ltd. 2012

Reference Book:

Sulabha K. Kulkarni, "Nanotechnology: Principles and Practices", Capital Publishing Compony, New Delhi, 2011

Professional Elective Course – IV					
	Computational Fluid Dynamics				
	COURSE OUTLINE				
Course	Computational Fluid Dynamics	Short	CFD	Course	
Title:	· ·				
Course	description:				

The incorporation of CFD (Computational Fluid Dynamics) as a possible solution to modern day fluid mechanic problems has become part of the daily lives of many engineers along with the companies they work for. Usually, the main objective is to quantitatively estimate forces produced by flows around a specific structural component or to optimize the design of an individual part responding to forces originating from fluid dynamics.

These skills imply a high degree of multidisciplinary competence in order to accurately define and resolve specific problems. A profound knowledge is needed in different key areas such as CAD to properly discretize the problem, fluid mechanics to properly understand the governing phenomena behind the problem, numerical methods to understand how these fluid dynamic problems are numerically solved and finally, experimental techniques in fluid mechanics to understand the underlying errors in reference values used for validation.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	14	42	3

Prerequisite course(s):

Fluid Mechanics, Applied Physics I & II, Material & Energy Balance Computations, Applied Chemistry I & II, Mass Transfer I & II, Heat Transfer, Thermodynamics I & II, Chemical Reaction Engineering-I & II.

Course objectives:

- 1. To understand the philosophy of computational fluid dynamics and conservation principles and classification of flows & characteristics of simple turbulent flows, free turbulent flows.
- 2. To study different models such as turbulence models, mixing length model, the k-e model and their algebraic stress equations and Grid Generation.
- 3. To understand discretization of ordinary and partial differential equations.
- 4. To study approximation of first, second and mixed derivatives & its implementation on boundary conditions.
- 5. To understand heat transfer in a complex tubes and channels.

Course outcomes:

After successful completion of this course the student will be able to:

- 1. Accustom the philosophy of computational fluid dynamics and conservation principles and classification of flows & characteristics of simple turbulent flows, free turbulent flows.
- 2. Understand different models such as turbulence models, mixing length model, the k-e model and their algebraic stress equations and Grid Generation.
- 3. Display the skill about discretization of ordinary and partial differential equations.
- 4. Analyze approximation of first, second and mixed derivatives & its implementation on boundary conditions.
- 5. Demonstrate use of heat transfer in a complex tubes and channels.

			CONTENT			
Computational Fluid	Dynami	ics	Semester:		V	II
Teaching Scheme:			Examination s	cheme		
Lectures:	3 hour	s/week	End semester exam (ESE):		60 marks	
			Duration of ES	SE:		03 hours
			Internal Sessio	onal Exa	ams	40
			(ISE):			marks
Unit–I:	. 1.		ures: 09 HoursMarkss, conservation principles of mass.			
momentum, simplified classification of flows. Effect of turbulence of turbulent flows, Free tu	l flow n on time-	nodels such as averaged Navio	incompressible,	potentia	al and cree	ping flows
Unit–II:		No. of Lectu	res: 08 Hours		Marks:	12
Grid Generation: Struc equations, some mod problems. Finite Differ	lern dev	velopments in	U , .			
Unit–III:		No. of Lectu	res: 09 Hours		Marks:	12
Discretization of ordin		partial differen	tial equations, a		nation of f	irst, second
Discretization of ordin and mixed derivative applications to the engi	es, impl	partial different lementation of problems.	tial equations, a boundary cond		nation of fi discretizat	irst, second ion errors
Discretization of ordin and mixed derivative applications to the engi Unit–IV:	es, impl ineering	partial different lementation of problems. No. of Lectu	tial equations, a boundary cond	ditions,	nation of fi discretizat Marks:	irst, second ion errors 12
Discretization of ordin and mixed derivative applications to the engine Unit–IV: Discretisation method	es, impl ineering ls, app fferentia	partial different lementation of problems. No. of Lectu roximations of tion practices,	tial equations, a boundary cond res: 08 Hours f surface integ implementatio	ditions, grals and an of	nation of fi discretizat Marks: 1 nd volume boundary	irst, second ion errors 12 integrals conditions
Discretization of ordin and mixed derivative applications to the enginitation of the e	es, impl ineering ls, app fferentia	partial different lementation of problems. No. of Lectu roximations of tion practices, problems. One-	tial equations, a boundary cond res: 08 Hours f surface integ implementatio dimensional uns	ditions, grals and an of	nation of fi discretizat Marks: 1 nd volume boundary eat conducti	irst, second ion errors 12 integrals conditions on.
Discretization of ordin and mixed derivative applications to the engination Unit–IV: Discretisation method interpolation and dir applications to the engination Unit–V:	es, impl ineering ds, app fferentia ineering contract	partial different lementation of problems. No. of Lectu roximations of tion practices, problems. One- No. of Lectu ion / expansion	tial equations, a boundary cond res: 08 Hours f surface integ implementatio dimensional uns res: 08 Hours , flow and heat tr	ditions, grals an on of teady he ransfer i	Marks: 7 Marks: 7 Marks: 7 Nd volume boundary eat conducti Marks: 7 in a comple	irst, second ion errors 12 integrals conditions ion. 12
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Discretization of ordin and mixed derivative applications to the engining Unit–IV: Discretisation method interpolation and di applications to the enginite Unit–V: Flow in a sudden pipe channels, reactive flow Text Books: 1. Anderson Jr J. D., McGraw Hill. 1995. 2. Muralidhar K. and Su Publishing House, 20 3. H. K. Versteeg and the finite volume meth 4. Ranade V. V, "Comp Press. 2002.	es, impl ineering ds, app fferentia ineering contract r, multip "Comp undarara 003. W. Mala thod", L	partial different lementation of problems. No. of Lectu roximations of tion practices, problems. One- No. of Lectu ion / expansion hase flow, and t utational Fluid jan T. "Computal alasekera, "An ongman scientif	tial equations, a boundary cond res: 08 Hours f surface integ implementatio dimensional uns res: 08 Hours , flow and heat tr urbulent flow pro Dynamics: The tational Fluid Flo introduction to c	ditions, grals an on of teady he ransfer i ocesses. e Basic ow and l computa	Marks: 1 Marks: 1 Marks: 1 nd volume boundary eat conducti Marks: 1 in a comple rs with Ap Heat Transf ational fluid s, 2007.	irst, second ion errors 12 integrals conditions on. 12 x tubes and plications" èr", Narosa I dynamics
Discretization of ordin and mixed derivative applications to the enginitations to the enginitation of the	es, impl ineering ds, app fferentia ineering contract r, multip "Comp undarara 003. W. Mali thod", L putation	partial different lementation of problems. No. of Lectu roximations of tion practices, problems. One- No. of Lectu ion / expansion hase flow, and t utational Fluid jan T. "Comput alasekera, "An ongman scientif Flow Modeling	tial equations, a boundary cond res: 08 Hours f surface integ implementatio dimensional uns res: 08 Hours , flow and heat tr urbulent flow pro Dynamics: The tational Fluid Flo introduction to c fic & technical pu for Chemical Re	ditions, grals an on of teady he ransfer i occesses. e Basic ow and I computa ublisher eactor En	Marks: 1 Marks: 1 Marks: 1 nd volume boundary eat conducti Marks: 1 in a comple s with Ap Heat Transf ational fluid s, 2007. ngineering"	irst, second ion errors 12 integrals conditions on. 12 x tubes and plications" er", Narosa I dynamics , Academic

		ope	en Elective Course	e – III			
			Plant Utility				
~			COURSE OUTLI	1			
Course	Plant U	Jtility		Short	PU	Course	•
Title:			Title:		Code:		
	descriptio						
generation air and the raw mate Refriger	on and its refrigerati erial to pr ation is ir	s the requirement effective utilizatio on. Steam and nor oducts in reactors a nportant to mainta	n. Main utilities re n- steam heating r and to elevate the in the temperature	equired f nedia are temperat in the p	or process e importat ure in the rocess pla	tes are wat nt for conv chemical p nt. Compr	er, steam version corrocesses ressed air
-	air is used	in processes & in	1	_		1	
Lecture		Hours/week	No. of weeks	Total	nours	Semest credits	er
		3	14		42		3
Prereau	isite cour	se(s):					
 To ac develo To uno To uno To stud To stud Course of After suo Displa 	custom v pment. lerstand c lerstand in dy Proper outcomes ccessful c y the skill t the know pment.	ompletion of this c of steam generation whow about types of	hpressors and vac frigeration systemating the process equi and methods of gen ourse the student von and its application	cuum pu & produc ipment re eration c vill be at on in che d vacuum	tion of liq equiremen of inert gas elle to: emical pro n pumps &	method of uid N_2 and t. ses. cess plants z method o	I O ₂ .
develo 3. Analyz 4. Demon 5. Identif	nstrate use y formula	e of insulation for n ating, designing a	neeting the process nd providing the	s equipm	ent requir	ement.	urces an
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develo . Analyz . Demoi . Identif methoo Plant Ut	nstrate use y formula ds of gene tillity g Scheme	e of insulation for mating, designing a bration of inert gase	neeting the process nd providing the es. OURSE CONTE Semest Examin k End se Durati	s equipm various NT ter: nation se mester e on of ES al Sessio	ent require properties cheme exam (ESI E: nal Exam	ement. s, use, sou VI E):	I 60 marks 03 hour 40 marks

steam heating systems, Steam economy, condensate utilization, steam traps, Selection and application, waste heat utilization.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12			
Compressors And Vacuum Pu	mps: Types of compressors and	d vacuum pumps, Methods of			
vacuum development and their limitations, Materials handling under vacuum, piping systems,					
Lubrication in compressors and	l pumps.				

Unit–III:	No. of Lectures: 08 Hour	rs Marks: 12
Refrigeration Systems: Refrig	geration system and their	r characteristics, cryogenics, the
characteristics and production	of liquid N ₂ and O ₂ . Load of	calculation, humidification and de-
humidification equipments. Dry	ying and cooling tower.	

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
-	ation for meeting for the process	
thickness.	ate, low temperatures .Determi	nation of optimum insulation

Unit–V:			I	No. of Lectures: 08 Hours				Marks: 12				
Inert	Gases: Properties	of	inert	gases	&	their	use,	Sources	and	methods	of	generation.

Comparison of nitro generation routes .Operational, maintenance and safety aspects.

Text Books:

- 1. Jack Broughton, Process utility systems, Institution of Chemical Engineers U.K.
- 2. Reid, Prausnitz Poling; The properties of gases & liquids, Fourth edition, McGraw Hill international edition.
- 3. S.C. Arora& S. Domkumdwar; A course in refrigeration and air conditioning; Dhanpat Rai & Co. (P) Ltd.
- 4. Stoccker, W.F., Refrigeration and Air Conditioning, Mc-Graw Hill, 1983.
- 5. Jorgenson, R., Fan Engineering, Buffalo Rorge Co., 1983.

Reference Book:

Lyle, O., Efficient Use of Steam, HMSO, 1974.

		One	n Elective Cours	e – III			
		~PC	Solar Power				
		С	OURSE OUTLI	NE			
Course Title:	Solar Pow	er		Short Title:	SP	Cours Code:	e
Course	description:			1			
arrays, I covers F	PV modules Power condi	, PV generators tioning and ma	c (PV) systems, S , Energy storage ximum power po er at different po	alternat	ives for it	PV system PT) algor	ns. It also ithms and
Lecture	Н	lours/week	No. of weeks	Total	iours	Semes credits	
		3	14		42		3
Prerequ	isite course	(s):				I	
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	V system.		OURSE CONTE				
Solar Po	wer		Semes			V	Π
	g Scheme:			nation so	heme	, ,	
Lecture	-	3 hours/weel			xam (ES	E):	60 marks
			Durati	ion of ES	E:		03 hours
			Intern (ISE):	al Sessio	nal Exan	ıs	40 marks
	Unit–I:	No.	of Lectures: 09 l	Hours		Marks: 1	2
Introduc	tion to photo	\mathbf{v}	tama Ilistanias I		CDI	-	

conversion of solar energy into electrical energy, behavior of solar cells, Solar cells, basic structure and characteristics: Single-crystalline, multicrystalline, thin film silicon solar cells, emerging new technologies.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12
Electrical characteristics of the	solar cell, equivalent circuit, me	odeling of solar cells including
the effects of temperature, irrad	diation and series/shunt resistant	ces on the open-circuit voltage
and short-circuit current, Solar	cell arrays, PV modules, PV g	generators, shadow effects and
bypass diodes, hot spot proble	em in a PV module and safe of	operating area. Terrestrial PV
module modeling, Interfacing	PV modules to loads, direct	t connection of loads to PV
modules, connection of PV mo	dules to a battery and load toget	her.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12		
Energy storage alternatives fo	r PV systems Storage batterie	s lead-acid nickel-cadmium		

Energy storage alternatives for PV systems. Storage batteries, lead-acid, nickel-cadmium, nickel-metal-hydride and lithium type batteries. Small storage systems employing ultracapacitors, charging and discharging properties and modeling of batteries.

Unit–IV:No. of Lectures: 08 HoursMarks: 12Power conditioning and maximum power point tracking (MPPT) algorithms based on buck-
and boost-converter topologies Maximum power point tracking (MPPT) algorithms, Inverter
control topologies for stand-alone and grid-connected operation. Analysis of inverter at
fundamental frequency and at switching frequency.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12								
Feasible operating region of inverter at different power factor values for grid-connected										
systems, Stand-alone PV syst	ems. Consumer applications, r	residential systems, PV water								
pumping, PV powered lighting	g, rural electrification, etc., Grid	-connected (utility interactive)								
PV systems. Active power file	tering with real power injection	n, Modeling and simulation of								
stand-alone and grid-connected	PV systems.									

Text Books:

- 1. R. Messenger, J. Ventre, Photovoltaic Systems Engineering, 2nd ed., CRC Press, 2004.
- 2. M. R. Patel, Wind and Solar Power Systems, CRC Press, 1999.

Reference Books:

- 1. A. Goetzberger, V. U. Hoffmann, Photovoltaic Solar Energy Generation, Springer-Verlag, 2005.
- 2. L. Castaner, S. Silvestre, Modeling Photovoltaic Systems Using PSpice, John Wiley & Sons, 2002.
- 3. R. J. Komp, Practical photovoltaics: electricity from solar cells, 3rd ed., Aatec Publications, 2001.
- 4. R. H. Bube, Photovoltaic Materials, Imperial College Press, 1998.
- 5. T. Markvart, Solar Electricity, John Wiley & Sons, 1994.

		0	pen Elective Co	urse – III			
			Enzyme Engin				
			COURSE OUT	CLINE Short	1		
Course	Enzyme Eng	ne Engineering			ENZE	Course	e
Title:				Title:		Code:	
	lescription:						
			rning the basic				
undergra	duate student	s. The goals	s of the course a	are to under	stand the	basic kno	wledge of
Enzymes	s, their classi	fication, pro	oduction, purific	ation and	Immobiliz	ation to l	be use ir
different	areas						
T 4		·		weeks Total hour			
Lecture	HO	urs/week	No. of weeks	S I otal	nours	Semest credits	
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Duanagu		_	14		42		5
	isite course(s		autotiona Annlia	d Chamister	. I 0- II NA	laga Trong	for I for II
			outations, Applie				ier I & II
Heat Tra	nster, Thermo	odynamics I	& II, Chemical F	Reaction Eng	ineering-I	& II.	
<u> </u>	7 •						
	objectives:		1 101 1				
. Get kn	owledge of e	nzyme & its	s classification &	k its role in	metaboli	c pathway	of living
system	s.						
. Will g	et knowledge	e of enzym	e kinetics and	its applicati	on in pro	duction of	of desired
produc	ts.						
. Ability	to design and	d conduct ex	periments to ana	lyze and int	erpret enzy	yme kinet	ic data for
•	-		production of va	•		•	
	•		ical techniques for	-		nzvmes	
	•	•	enzymes in vari			•	ufacturing
	broducts for th				05 0500 10	i the man	araotarrit
			sourcey.				
Course	outcomes:						
		letion of this	course the stude	nt will be al	ole to:		
	*		their working m				
	• •		d activity by per		0110 000000		
	•		• • •	-	ous assays	•	
		•	ng modern equip		. 1 1		
Lange of			nmobilization te	children for	beller stat	onity and	
	to reduce the	ir losses duri	ing lise				activity as
well as			•	. 1.00	. 1 1	.1	-
well as			arious enzymes	in different	metabolic	pathways.	-
well as			various enzymes		metabolic	pathways.	-
well as 5. Apply	molecular me		course con		metabolic j	pathways.	
well as 5. Apply Enzyme			Arious enzymes COURSE CON Ser	TENT			
well as 5. Apply Enzyme Teachin	molecular me Engineering g Scheme:		COURSE CON Ser Exa	TENT nester: amination s	cheme	VI	
well as 5. Apply Enzyme Teachin	molecular me Engineering g Scheme:	chanism of v	COURSE CON Ser Exa	TENT nester:	cheme	VI E):	I
well as 5. Apply Enzyme	molecular me Engineering g Scheme:	chanism of v	COURSE CON Ser Exa eek End	TENT nester: amination s	cheme exam (ESI	VI E):	I 60
well as 5. Apply Enzyme Teachin	molecular me Engineering g Scheme:	chanism of v	COURSE CON Ser Exa eek End Du	TENT nester: amination s d semester o	cheme exam (ESI SE:	VI E):	I 60 marks
well as 5. Apply Enzyme Teachin	molecular me Engineering g Scheme:	chanism of v	COURSE CON Ser Exa eek End Du	TENT nester: amination s d semester o ration of ES ernal Sessio	cheme exam (ESI SE:	VI E): s	I 60 marks 03 hours
well as . Apply Enzyme Teachin	molecular me Engineering g Scheme:	chanism of v	COURSE CON Ser Exa eek End Du Int	TENT nester: amination s d semester o ration of ES ernal Sessio E):	cheme exam (ESI SE: nal Exam	VI E): s	I 60 marks 03 hours 40 marks
well as Apply Enzyme Teachin	molecular me Engineering g Scheme: s: Unit–I:	chanism of v	COURSE CON Ser Exa eek End Du Int (IS	TENT nester: amination s d semester o ration of ES ernal Sessio E):	cheme exam (ESI SE: nal Exam	VI E): s	I 60 marks 03 hours 40 marks

Classification, nomenclature, International units and types of enzymes, General characters of enzymes: characters such as specificity, catalysis and regulation and localization of enzymes in the cell, Structure of enzymes: Primary, secondary and tertiary structure of enzyme, Models of enzyme activity: Lock and key model, Induced fit, Substrate Strain model. Isoenzyme, with example and its application.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Enzyme Kinetics:		
	ation energy, transition state the	
	on, Rate of reaction, First orde	
-	(Steady state kinetics) and Halo	1 0
	or Double – reciprocal plot, Eac	he- Hoistee plot, Hanes plot,
Turnover number, Specificity of	constant, Bisubstrate reaction.	
Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Enzyme inhibition, its kinetic		
•	le and irreversible inhibition, K	inetics of inhibition. Catalytic
• 1	entation effects, distortion or str	
• • •	and covalent catalysis and m	
mechanism of action of chy	motrypsin, Lysozyme, Chemic	al modification of enzymes,
Bisubstrate or Multisubstrate re	eaction: Ping – Pong mechanism	, sequential mechanism.
Unit–IV:	No. of Lectures: 09 Hours	Marks: 12
Allosteric and regulatory enz	zyme, enzyme production and p	ourification:
Binding of ligands to Protein,	Co-operativity models- MWC an	nd KNF model, Regulations by
	anisms of enzyme regulation-en	
	ources of enzymes-animal plant	
	pasic methodology of production	_
enzymes, Enzyme production a	and recombinant DNA technolog	y.
Unit–V:	No. of Lectures: 08 Hours	Marks: 12
Enzyme immobilization and		Marks. 12
-	onic bonding, adsorption, covaled	nt handing (based on R groups
	ncapsulation and gel entrapment	
	nobilized enzymes. Application	
• • • • • • • • • • • • • • • • • • • •	tc., Uses of enzymes in drug,	• •
	and peptides, Legislative and saf	
childrines to make annio ucrus	and populaes, Degisiative and sar	ety aspects.
Text Books:		
	Principles of Biochemistry – Mac	millan publishers.
2. Palmer, Enzymes, Oxford Un	1 0	1
	2 I	
Reference Books:		
1. Voet and Voet, Biochemistry	, Wiley publisher.	
2. Biotol series, Principles of	Cell energetics, Butterworth-	Heinemann Ltd, Jordan Hill,
Oxford.		
3. Biotol Series, Principles of	f enzymology and its applicati	on, Butterworth- Heinemann
Ltd,Jordan Hill, Oxford.		
4 Murray moo-young Compre	hensive Biotechnology Pergemo	n Press(Vol 2)

- 5. Nicholascprice and Tewis stereous, Fundamentals of Enzymology, Oxford University press.
- 6. Michael L. Shuler, Fikret Kargi, Bioprocess Engineering, Basic concepts, Prentice Hall India Pvt. Ltd., New Delhi.

			Open Electiv					
				of Thing	,			
0	T ()		COURSE	OUTLI		TOT	G	
	Internet	of Things			Short IOT Title:		Course	e
Title:							Code:	
	descriptio				1 1	.1 .	1	ı •
		lops a founda						
		gement concep						
		nanagement co			-	-		
organize	d approad	ch for managi	ing the unce	rtainties	that can	lead to	undesirab	ole projec
outcome	s. Course	topics include:	Project proc	urement r	nanagen	nent and po	ost project	t analysis.
Lecture		Hours/week	No. of v	weeks	Total l	nours	Semest	ter
							credits	5
		3]	14		42		3
Prerequ	isite cour	se(s):						
		mputer Program	mming.					
		1	6					
Course	bjectives	•						
	0	t internet of th	ings and dasi	an princi	plan for	onnocted	davioas	
			-		-			1
		principles for						
. Accust	om about	data acquiring	g, organizing	, processi	ing and	analytics	and data	collectior
storage	and com	puting using cl	oud platform	•				
. Display	v the skill	about sensors,	participator	v sensing		and reviewal		
					KUDS,	and wirel	ess sensor	r network
			devices for Ia			and wirei	ess sensoi	r network
			devices for Io	oT and M	2M.			
		ating, providir	ng the proto	oT and M2 otyping a	2M. nd desig	gning the		
			ng the proto	oT and M2 otyping a	2M. nd desig	gning the		
applica	tions and	ating, providir LoT privacy, s	ng the proto	oT and M2 otyping a	2M. nd desig	gning the		
applica	tions and	ating, providir LoT privacy, s	ng the proto security and v	oT and M2 otyping an vulnerabili	2M. nd desig ities solu	gning the itions.		
applica Course of After suc	tions and outcomes ccessful co	ating, providir LoT privacy, s mpletion of th	ng the proto security and v	oT and M2 otyping an vulnerability student w	2M. nd desig ities solu vill be ab	gning the itions.		
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applica Course of After suc Underse Underse Analyz Underse Design Internet	butcomest ccessful co stand the d stand the d stand the d stand the v stand the v stand the v	ating, providir LoT privacy, s ompletion of th lesign principle cepts of knowle vide variety of are for IoT app s	is course the es for connec es of Internet edge acquirir sensors. plications.	T and M2 otyping and vulnerability student we ted device connective g, manage CONTE	2M. nd desig ities solu <u>vill be ab</u> es. vity. ing and s NT	gning the ations.	software	e for Lo
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Design Principles for Connected Devices: IoT/M2M Systems Layers and Designs Standardization, Communication Technologies, Data Enrichment, Data Consolidation and Device Management at Gateway, Ease of Designing and Affordability.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12
	Connectivity: Web Communica	
	ation Protocols for Connected I	
Connected-Device a Network	k using Gateway, SOAP, RES	T, HTTP RESTful and Web
Sockets.		
	ples: Internet Connectivity, Inter	
Addressing in the IoT, Media	Access Control, Application La	yer Protocols: HTTP, HTTPS,
FTP, Telnet and Others.		
Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Data Acquiring, Organizing	g, Processing and Analytics:	Data Acquiring and Storage,
Organizing the Data, Transact	tions, Business Processes, Integ	ration and Enterprise System,
Analytics, Knowledge Acquirit	ng, Managing and Storing Proce	sses.
Data Collection, Storage an	nd Computing Using Cloud	Platform: Cloud Computing
Paradigm for Data Collection,	, Storage and Computing, Every	ything as a Service and Cloud
service Models, IoT Cloud-Bas	sed Services using the Xively, N	imbits and Other Platforms.
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
Sensors, Participatory Sen	sing, RCIDs, and Wireless	Sensor networks: Sensor
Technology, Participatory Ser	nsing, Industrial IoT and Auto	motive IoT, Actuator, Sensor
Data Communication Protocol	s, Radio Frequency Identification	n Technology, Wireless Sensor
Networks Technology.		
Prototyping the Embedded	Devices for IoT and M2M:	Embedded Computing Basics,
••• •	typing, Things Always Connecte	1 0
Unit–V:	No. of Lectures: 08 Hours	Marks: 12
Prototyping and Designing	the software for IoT Applica	tions: Prototyping Embedded
	Gateways, Internet and We	
	ine Component APIs and Web A	
1 1	nd Vulnerabilities Solution	
•	lysis, Use Cases and Misuse Ca	
-	Identity Management and Estab	
	on, Security Models, Profiles and	
Text Book:		
	s: Architecture and Design", Mc	Graw Hill.
Reference Book:		
	s", Khanna Publishing House, D	elhi
jeeva jose, internet of Thing	s, Khanna Puolisning House, D	eiiii.

			Process Cor					
Course	Duo ooga	LA Control Lab	B COURSE		<u>hort</u>	PC Lab	Cours	
Title:	Process	Control Lab			itle:	PC LaD	Cours Code:	
	descriptio	n •		1	nne.		Couc.	
		ates practical aspe	ect of process	s control ar	nd its	application	to chem	nical
		scribes various sys						
Laborat	orv	Hours/week	No. of we	eks T	Total hours		Semester	
	5						credits	
		2	14			28		1
		am (ESE) Patter	n:	Practical ((PR)			
	isite cour							
		y Balance Compu						fer I & I
Heat Tra	nsfer, The	ermodynamics I &	z II, Chemica	al Reaction	n Eng	ineering-I &	& II.	
Course	objective	s:						
		namic behavior of	first order sy	ystem.				
		namic behavior of						
		various controller		5				
		students with fund		oretical co	ncept	s and pract	tical ana	lvsis skil
-		process control de			F	F		- <i>j</i>
		losed loop control						
			<i>s</i> ystem:					
Course	outcomes	:						
		completion of lab (Course, stude	ent will be	able	0:		
		ledge of control th					ocesses (carried o
in the (Themical	Engineering Indu	strv	aoistailaili	5	various pre		Juillea
		eir ability of under		nrocess c	ontro	l and its an	nlication	hy virt
	erimentati	-	istanding the	process c	onno	i and its ap	prication	i by viit
1		ledge of first orde	r control ever	tom				
		ledge of second of	•					
5. Apply	the know.	ledge of Final Cor	itroi Elemen	t system.				
			B COURSE		NT	•		
Process	Control 1	Lab	S	Semester:			VI	I
Teachin	g Scheme	2:	Ι	Examinati	on sc	heme		
Practica	1:	2 hours/wee	ek I	End semes	ter e	xam (ESE)):	25
								marks
				Internal C				25
			A	Assessmen	t (IC	A):		marks
(Am	ongst the	following any eig	ght experim	ents / assig	gnme	nts are to	be perfo	rmed)
	-	vior of Mercury Th		·			-	
•		vior of Single Tanl						
-		vior of C.S.T.R.	-					

- 3. Dynamic behavior of C.S.T.R.
- Dynamic behavior of two tank non-interacting system.
 Dynamic behavior of two tank interacting system.
- 6. Dynamic behavior of Mercury Manometer Second order system.

- 7. Dynamic behavior of Final Control Element.
- 8. Study of Controllers.
- 9. Study of closed loop control system.
- 10. Study of flow, temperature and pressure control systems.

Text Books:

- 1. George Stephanpolous, Chemical Process Control, Prentice Hall of India.
- 2. D.R. Coughnour, Process System Analysis and Control, McGraw-Hill.
- 3. R.P. Vyas, Process Control & Instrumentation (2nd edition). Central Techno publication, Nagpur.

Reference Book:

Designed Standard College Laboratory Manual and Instruction Manuals of the Laboratory Equipment Suppliers.

Guide lines for ICA:

Internal Continuous Assessment shall be based on continuous evaluation of Student performance throughout semester and practical / assignments submitted by the student in the form of journal.

Guidelines for ESE: End Semester Examination shall be based on practical / oral evaluation of Student performance and practical / assignments submitted by the student in the form of journal.

			imentation and Co AB COURSE OUT		-	
Course Title:	Instrun	nentation and Co			IC Lab	Course Code:
Course	lescripti	on:				
			ce of instrumentati	on in the f	field of che	emical engineeri
By instru	mental a	nalysis, different	materials and their raw materials and f	properties	can be stu	idied and measu
····················				F-		j.
Laborat	Laboratory Hours		No. of weeks	Total h	ours	Semester credits
		2	14		28	1
End Sen	nester Ex	am (ESE) Patter	rn: Oral (OR)		1
Prerequ	isite cou	rse(s):				
 To dev To und To acc To acc Upon suc Develo Deliver Demor Unders 	elop anal erstand u istom ref outcomes ccessful c p experti the skill strate ana tand use	se chromatograph fractive index. completion of lab se in handling lab in calibration of alytical skills in st chromatography.	Course, student wi	ll be able t s with due	o: care & pre	
5. Evalua	te refract	ive index.				
		T.A	B COURSE CON	TENT		
Instrum	entation	and Control Lab				VII
Teachin	g Schem	e:	Exam	ination sc	heme	
Practica	l:	2 hours/we	eek End s	emester e	xam (ESE): 25 marks
		1	Interr	al Contin	uous	25
			Assess	ment (IC	A):	marks
	-	e following any ei sponse of bimetal	ght experiments / lic thermometer.	assignme	nts are to	be performed)

- 4. To measure the conductance of given solution.
- 5. To investigate the conductometric titration of strong acid and strong base.
- 6. To determine concentration of given solution by colorimeter.
- 7. To study separation of components present in given mixture by thin layer chromatography.
- 8. To study separation of components present in given sample by paper chromatography.

9. To determine refractive index of liquids by Abbey's refractometer. 10. To identify the given sample by FTIR.

Text Book:

Designed Standard College Laboratory Manual and Instruction Manuals of the Laboratory Equipment Suppliers.

Reference Book:

Patranabis D. Industrial Instrumentation, Tata – McGraw Hill Publications, New Delhi.

Guide lines for ICA:

Internal Continuous Assessment shall be based on continuous evaluation of Student performance throughout semester and practical / assignments submitted by the student in the form of journal.

Guidelines for ESE:

End Semester Examination shall be based on practical / oral evaluation of student performance and practical / assignments submitted by the student in the form of journal.

Course Title:ProjCourse description:Project (Stage-I) represent the degree. The project (Stage-I) o throughout the program. The e technical, project management atLaboratoryHEnd Semester Exam (ESE) Pat Prerequisite course(s):Material & Energy BalanceCor Heat Transfer, ThermodynamicsCourse objectives:1.1.To understand the basic conce	ffers the opp emphasis is nd presentation lours/week 12 ttern: mputations, A I & II, Chem epts & broad hieving perfe	I) of stud portunit necessa on sphe No. of weeks 1 Applied nical Re principl ection in	y towa y towa y to ap rily or res. 4 ORA Chem action es of p projec	nort itle: ards th pply a n faci Tot hou AL (O istry I Engin	al rs 168 R) & II, Mas eering-I & s. lementatio	Code or of En 1 materia udent lea Semeste credits ss Transf z II.	e: gineeri il learr arning er 6 Čer I &	II,
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End Semester Exam (ESE) Pat Prerequisite course(s): Material & Energy Balance Con Heat Transfer, Thermodynamics Course objectives: 1. To understand the basic conce	12 ttern: mputations, A I & II, Chen epts & broad hieving perfe	weeks 1 Applied nical Re principl ection in	4 Chem action es of p projec	hou AL (O istry I Engin project ct impl	rs 168 R) & II, Mas eering-I & s. lementatio	credits ss Transf z II. n & com	6 Fer I &	1.
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Material & Energy Balance Con Heat Transfer, Thermodynamics Course objectives: 1. To understand the basic conce	I & II, Chen epts & broad hieving perfe	principlection in	action es of p projec	Engin project	eering-I &	z II.	pletior	1.
Heat Transfer, Thermodynamics Course objectives: 1. To understand the basic conce	I & II, Chen epts & broad hieving perfe	principlection in	action es of p projec	Engin project	eering-I &	z II.	pletior	1.
 To understand the value of acl To apply the theoretical conc approach. To demonstrate professionali relate engineering issues to br To develop ability of extrate comprehensively and exhausting 	sm with ethicoader societacting the ma	ics; pre al contez aterial f	sent ef kt. From t	fective he dif	e commur	nication s	skills a	und
Course outcomes:								
Upon successful completion of la								
 Demonstrate a sound technical Undertake problem identificati Design engineering solutions to Conduct an engineering projec Demonstrate the knowledge, sk 	on, formulati o complex pr t.	ion and oblems	solutic utilizii	on. ng a sy	/stems app			
	LAB COUR	SE CO	NTEN	T				
Project (Stage – I)			Semest			VI	I	
Teaching Scheme:]	Exami	nation	scheme:			
		1	End se	meste	r exam (E	(SE):	50 mark	s
Practical:	12 hours/v				tinuous ICA):		50 mark	(S

At final year the students shall carry out a project (Stage-I) in a group of maximum up to 5 students. The project work spans both the semesters. By the end of Semester – VII the students shall complete the partial work, and by the end of Semester – VIII the students shall complete remaining part of the project. Assessment for the project shall also include presentation by the students. Each teacher can guide maximum 04 groups of projects.

The students should take project work, as specified in the curriculum, based on the knowledge acquired by the students during the degree course till Semester – VI. The project may be either fully theoretical / practical or involving both theoretical and practical work to be assigned by the Department. The work may also be Study / Survey / Design.

Project (Stage – I) may involve literature survey, problem identification, design methodology, collection of data etc. The project work shall involve sufficient work so that students get acquainted with different aspects of design and analysis. Approximately more than 50% work should be completed by the end of Semester – VII. Each student group should submit partial project report in the form of thermal bound at the end of Semester –VII.

Each student group is required to maintain separate log book for documenting various activities of the project.

Suggestive outline for the partial project report is as follows.

Abstract

Chapter 1. Introduction

Chapter 2. Literature Survey

Chapter 3. Methodology

Chapter 4. Results & Discussion

Chapter 5. Conclusion

Bibliography/ References

Index

Appendix

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The

assessment for Project (stage -I) in Semester -VII shall be as per the guidelines given in Table -A.

				Tal	ble – A				
			Assessm	nent by G	uide		Assessm	nent by	
							Departr	nental	
							Comm		
Sr	Nam	Attenda	Problem	Literat	Rep	Depth of	Presenta	Tot	
	e of	nce /	Identifica	ure	ort	Understan	tion	al	
Ν	the	nce / Identifica ure logy / ort Participa tion / Surve Design					ding		
0.	Stud	tion	Project	у					
	ent		Objectiv						
			es						
	Marks	5	5	5	5	5	10	15	50
	•	•	•	•	•	•	•	•	• • •

Guidelines for ESE:

In End Semester Examination (ESE), the student may be asked for presentation / demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

Essence of Indian Traditional Knowledge

Course objective:

The course aims at imparting basic principles of thought process, reasoning and inferencing, sustainability is at the core of Indian traditional knowledge system connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. The course focuses on introduction to Indian knowledge systems, Indian perspective of modern scientific world-view, and basic principles of yoga and holistic health care system, Indian artistic tradition.

Outcomes:

Ability to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.

Course Contents:

Introduction to:

- 1. Ayurveda, Charaka Samhita, Sushruta Samhita Principles and Terminology: Vatha, Pitha, Kapha, Ether, Earth, Water, fire and Air Tatva, Influence of these on human health.
- 2. Architecture: Temple Architecture, Indo Islamic Architecture, Mughal Architecture, Indian Rock Cut Architecture, Vastu Shastra.
- 3. Importance of Yoga for Physical and Mental health, Yoga Sutras of Patanjali, Meditation, International day of Yoga.
- 4. Indian Classical Music, Hindustani and Carnatic Music, Raga, Tala, Dhrupad, Khyal, Tarana and Thumri, Sangitaratnakara, Work of Tansen, Purandara Dasa, Bhimsen Joshi, Ustad Bismillah Khan, Bal Gandharva etc.

Folk Music and Dances such as Rajasthani, Marathi, Gujrati, Punjabi etc.

5. Indian Classical Dances: Shastriya Nritya, Natya Shastra, Bharatanatyam, Kathak, Kuchipudi, Odissi, Kathakali, Sattriya, Manipuri, Mohiniyattam and Chhau dance forms.

References:

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- 2. Basanta Kumar Malhotra, "Traditional Knowledge System and Technology in India", Pratibha Prakashan, ISBN 8177-023101
- 3. Nitin Singhania, "Indian Art and Culture", McGraw Will Publication.
- 4. Dr. Bramhand Tripathi, "Charak Sanhita", Chaukhambha Surbharti Prakashan, ISBN: 9381-4847-59
- 5. Dr. Anantram Sharma, "Sushrut Samhita"
- 6. Valiatham M.S., "An Introduction to Ayurveda" Orient Bkackswan Publication.
- 7. Valiathan M.S., "The legacy of Charaka" University Press.
- 8. Valiathan M.S., "The legacy of Susruta" University Press.
- 9. Garg Maheshwari, "Ancient Indian Architecture", CBS Publisher and Distributors
- 10. Sharmin Khan, "History of Indian Architecture", CBS Publisher and Distributors.
- 11. Bindia Thapar, Surat ku. Manto, Suparana Bhalla, "Introduction to Indian

Architecture", Periplus Editions Ltd.

- 12. Vijay Prakash Singh, "An Introduction to Hindustani Classical Music", Lotus Publisher
- 13. Leeta Venkataraman, Avinash Pasricha, "Indian Classical Dance" Lustre Publisher
- 14. Shovana Narayan, "Indian Classical Dances" New Dawn Press
- 15. Kapila Vatsyayan, "Indian Classical Dance", Ministry of Information and Broadcasting, Govt of India.
- 16. Mahadevan Ramesh, "A Gentle introduction to Carnatic Music", Oxygen books Publisher.

KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY,

JALGAON (M.S.)

Final Year Engineering (Chemical Engineering) Faculty of Science and Technology



B.E. Chemical Engineering Syllabus

W.E.F. 2020 – 21

Semester – VIII

		Process Te	chnology and Ec	onomic	6		
		CO	URSE OUTLIN	E			
Course Title:	Process Te	echnology and Eco	onomics	Short Title:	PTE	Cours Code:	
Course d	lescription:						
The purp	ose of this c	course is to equip th	he students with f	undame	ntal con	cepts and p	rinciples
		hrough the econom					-
	0	rially important che			5		
Lecture		Hours/week	No. of weeks	Total l	nours	Seme	ster
						credit	s
Lecture		03	14		42		04
	isite course						
Material	& Energy B	Balance Computati	ions, Applied Che	emistry]	[& II,]	Mass Trans	fer I & II,
		nodynamics I & II,					
		•		U	U		
Course of	objectives:						
	v	lents with manufact	turing aspects of i	ndustria	lly relev	vant chemic	als.
		s of manufacturing	- -		•		
		gineering problems					with
		propriate solutions.		01			
		is components of co		and their	· estima	tion.	
		owledge of students					
5. 10 dev	crop the kild	owiedge of students	s doodt 7 marysis o	n nojee			
	outcomes:						
		pletion of this cour					
1. Describ	be sources a	nd processes of ma	nufacture of vario	ous indus	strially	important c	hemicals.
2. Draw b	lock diagram	ms/ process flow di	iagrams of the pro	ocesses u	ised for	manufactu	re of
industr	ially import	ant inorganic chem	icals.				
3. Identify	y the major (engineering proble	ms involved in ma	anufactu	ring an	d provide b	est
possibl	e solutions f	for the same.					
4. Explain	n and calcula	ate economic aspec	cts of Projects invo	olved in	manufa	acturing of (Chemical
5. Analyz	e the projec	ts through econom	ical evaluation of	manufa	cturing	practices.	
D	T. 1. 1.		URSE CONTEN				
	0.	and Economics	Semes			VI	11
	g Scheme:	I		ination			
Lectures	S:	3 hours/week	End se	emester	exam ((ESE):	60
							marks
			Durat	ion of E	SE:		03
							hours
			Intern	nal Sessi	onal Ex	xams	40
			(ISE):				marks
				1180		Maulta, 1	<u> </u>
	Unit–I:	No. of	Lectures: 09 Ho	uis		Marks: 1	2
Descripti		naterial and energy			tions, o		
-	on, raw m		y sources and c	onsump		operating c	onditions,
catalysts,	on, raw m , basic bloc	aterial and energy	y sources and c plified process f	onsump low diag	gram fo	operating c r the manu	onditions, facture of

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Nitrogen industries & in-	organic acids: Synthetic ammonia proc	cess for ammonia production
	nitrate, Urea, Hydrochloric acid manufa	
Sulfur industries: Manufa	acture of elemental sulfur by Frasch &	Finnisch process, production
of sulfuric acid.		
Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Phosphorous Industries:	Elemental phosphorous, Wet process a	& electric furnace process for
phosphoric acid produc	tion, Manufacturing of ammonium	phosphate, Baking powder
Manufacturing of Supe	rphosphate & Triple Superphosphat	e, Notrophosphates, sodiun
phosphate, Fire retardant		
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
Coal & Coal Chemicals:	coal as energy source, nature & occurre	ence of coal, mining, uses of
	ification of coal, hydrogenation of coal,	
	istillation, Uses of coal tar,	
-	Efficiency of Fuel cells, Kinds of Fue	l cells & advantages of Fue
cells.		
Unit–V:	No. of Lectures: 09 Hours	Marks: 12
Introduction to project co	st and cost of production, Various com	ponents of cost of production
Introduction to project co and their estimation, Var		ponents of cost of production
Introduction to project co and their estimation, Var working capital.	ost and cost of production, Various com ious components of project cost and the	ponents of cost of production eir estimation. Estimation of
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		Chemical Plan	nt Design and Pro		ineering		
			COURSE OUTL				
Course Title:	Chemica Enginee	al Plant Design ar Tring	nd Project	Short Title:	CPDPE	E Cours Code:	e
	descriptio			THU:		Couc.	
This cou engineer	irse descri ing for po	ibes to use appropossible commercia cal plant design as	lization of chemi	cal plant.	It illustra	0	1 5
Lecture		Hours/week	No. of weeks	No. of weeks Total hours		Semes credits	
	-	3	14		42		3
Prereau	isite cour	rse(s):	1	_1		I	
1. To lea project	t.	e of Chemical Eng			-	-	
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Proces flow sl 3. To disp 4. To stut technic 5. To con Course After suc 1. Exhibi project 2. Apply process of proc 3. Develo	s Equipme heet. play skill o dy the S ques (PER nply requi outcomes ccessful co t the role t. requisite sing Proce cess flow s op the Plar	ents and Materials of the Plant Layou ite preparations a T & CPM). rement of the Proc <u>:</u> ompletion of this c of Chemical Engi skill of the Proc ess Equipments and sheet. nt Layout and under	Selection Scale and Location of and Structures an cess Auxiliaries. course the student ineer in Chemical cess Design: Cho d Materials Select erstand about Loca	up metho Chemical d New E will be ab Plant De vice of pr ion Scale ation of C	d and der Plant. Developm le to: sign and rocess co e up met hemical 1	velopment nent in Ma Developm ontinuous hod and de Plant.	of process anagement nent of the Vs. Batch velopment
Proces flow sl 3. To disj 4. To stut technic 5. To con Course of After suc 1. Exhibit project 2. Apply process of proc 3. Develo 4. Unders adoptin CPM r 5. Demon	s Equipme heet. play skill of dy the S ques (PER nply requi outcomes ccessful co t the role t. requisite sing Proce cess flow s op the Plan stand the ng the too hetwork an	ents and Materials of the Plant Layou ite preparations a T & CPM). Terment of the Processing ompletion of this construction of Chemical Enginess skill of the Process skill of the Process sheet. Int Layout and under Site Preparations of of management nalysis e of the Process A stainable plant dest	Selection Scale and Location of and Structures an cess Auxiliaries. course the student ineer in Chemical cess Design: Che d Materials Select erstand about Loca and Structures for planning, sch Auxiliaries for re- ign.	up metho Chemical d New E will be ab Plant De bice of pr ion Scale ation of C requires in eduling an ducing the	d and der Plant. Developm le to: sign and rocess co e up met hemical l n the ch nd contro	velopment nent in Ma Developm ontinuous hod and de Plant. nemical ind olling like	of process anagement nent of the Vs. Batch velopment dustry and PERT and
Proces flow sl 3. To disj 4. To stut technic 5. To con Course After suc 1. Exhibi project 2. Apply process of proc 3. Develo 4. Unders adoptin CPM r 5. Demon safety	s Equipme heet. play skill of dy the S ques (PER nply requi outcomes ccessful co t the role t. requisite sing Proce cess flow s op the Plan stand the ng the too hetwork an hstrate use for the sus	ents and Materials of the Plant Layou ite preparations a T & CPM). Terement of the Process of Chemical Enginess skill of the Process skill of the Process sheet. In Layout and under Site Preparations of management halysis e of the Process A stainable plant designed	Selection Scale and Location of and Structures an cess Auxiliaries. <u>course the student</u> ineer in Chemical cess Design: Cho d Materials Select erstand about Loca and Structures for planning, sch Auxiliaries for re- ign.	up metho Chemical d New E will be ab Plant De bice of prion Scale ation of C requires i eduling an ducing the ENT	d and der Plant. Developm le to: sign and rocess co e up met hemical l n the ch nd contro	velopment nent in Ma Developm ontinuous hod and de Plant. nemical inco olling like f piping w	of process anagement nent of the Vs. Batch velopment dustry and PERT and ith overall
Process flow sl 3. To disp 4. To stut technic 5. To con Course of After suc 1. Exhibit project 2. Apply process of proc 3. Develo 4. Underst adoptin CPM r 5. Demon safety	s Equipme neet. play skill of idy the S ques (PER nply requi outcomes ccessful co t the role t. requisite sing Proce cess flow s op the Plan stand the ng the too network ar nstrate use for the sus	ents and Materials of the Plant Layou ite preparations a T & CPM). Terment of the Processing ompletion of this construction of Chemical Enginess skill of the Process skill of the Process sheet. Int Layout and under Site Preparations of of management nalysis e of the Process A stainable plant dest	Selection Scale and Location of and Structures an cess Auxiliaries. <u>course the student</u> ineer in Chemical cess Design: Cho d Materials Select erstand about Loca and Structures for planning, sch Auxiliaries for re- ign.	up metho Chemical d New E will be ab Plant De bice of prion Scale ation of C requires i eduling an ducing the ENT	d and der Plant. Developm le to: sign and rocess co e up met hemical l n the ch nd contro	velopment nent in Ma Developm ontinuous hod and de Plant. nemical ind olling like	of process anagement nent of the Vs. Batch velopment dustry and PERT and ith overall
Proces flow sl 3. To disj 4. To stut technic 5. To con Course of After suc 1. Exhibi project 2. Apply proces of proc 3. Develo 4. Unders adoptin CPM r 5. Demon safety Chemica Enginee	s Equipme neet. play skill of idy the S ques (PER nply requi outcomes ccessful co t the role t. requisite sing Proce cess flow s op the Plan stand the ng the too network ar nstrate use for the sus	ents and Materials of the Plant Layou ite preparations a CT & CPM). Terement of the Proceed is a completion of this completion of this complete of Chemical Enginessian skill of the Process and sheet. In Layout and under Site Preparations of of management nalysis e of the Process a stainable plant descent completion and Projec	Selection Scale t and Location of and Structures an cess Auxiliaries. course the student ineer in Chemical cess Design: Cho d Materials Select erstand about Loca and Structures in for planning, sch Auxiliaries for re- ign. COURSE CONTI t Semes	up metho Chemical d New E will be ab Plant De bice of prion Scale ation of C requires i eduling an ducing the ENT	d and der Plant. Developm le to: sign and rocess co e up mether hemical l n the ch nd contro e cost of	velopment nent in Ma Developm ontinuous hod and de Plant. nemical inco olling like f piping w	of process anagement nent of the Vs. Batch velopment dustry and PERT and ith overall

		Duration of E	SE:	03 hours
		Internal Session	onal Exams	40
		(ISE):		marks
Unit–I:	No. of Lectu	res: 09 Hours	Marks:	12
Introduction to Chemical Eng Chemical Engineer in Chemica Design, Process Design. Development of the project: E process development, prelimir commercial plant and commerce Technical factors, economic information.	al Plant Design. Evaluation of a phary engineering stal plant design	Chemical Engin process, process g studies, pilot factors.	neering Design, nee research, research plant, semi-comme	ed for Plan evaluation rcial plant
Unit–II:	No. of Lectu	res: 09 Hours	Marks:	12
Process Equipments and Mater Selection of Process Equipme equipment. Scale up method, process information.	nts, Equipment	selection proce	dures, standard ver	sus special
Unit–III:	No. of Lectu	res: 08 Hours	Marks: 1	12
Benzene Hexachloride process. Locating the Chemical Plant: I location, plant location factors fuel, water supply, temperature federal pollution act, climate, la	Introduction, su s, raw material e, plant measur	supply, market es for conservat	and transportation, ion of water, legal	power and restriction
Unit–IV:	No of Lectu	res: 08 Hours	Marks:	12
Site preparations and Struct Foundation and Shape of Fou Outdoor Plants, Selection Buil safety and higher protection c Plant Sites and Structures New Development in Managen	tures: Introduc undation, Mach ding types, Buil onditioning , he	tion, Site Prep inery and Equip lding design prir eating and venti	paration, Surface pment Foundations nciples, Flooring, v lation. Cost Consid	Evaluation , Supports valls, Roof
Unit–V:		res: 08 Hours	Marks:	
Process Auxiliaries : Introduct strength, Wall thickness, Nom sizing by ID, Choosing the f insulation, methods of providin	inal Pipe Size (final pipe size,	NPS), Criteria fo Process steam	or Selection of Mat	erials, Pipe
Text Books:				
 F.C. Vilbrandt and C.E. Dryc Delhi. Peter M. S. and K.D. Timme McGraw Hill. 			-	

3. Modes J. and Philips, Rheinhold, Project Engineering with CPM and PERT, Van Nostrand Reinhold Co., 1970

Reference Book:

Perry's Chemical Engineer's handbook, McGraw-Hill: New York, 2008

		Р	rofessional Ele	ctive Co	urse – V	7		
				Design				
			COURSE	OUTLIN				
	Piping De	esign			Short	PIPD	Cours	
Title:	escription				Title:		Code:	
	-		red to raise the	level of	avnertis	in ninin	a enginee	ring and to
			in the present					
			ystem designs,					
	plant layou		journ coorgino,	ar i cropi				
Lecture	I	Hours/weel	x No. of w	reeks	Total l	ours	Semes	
		3	1	4		42	credit	
D •	•	-	1	ł		42		3
Prerequi	site cours	e(s):		nulia 1 Cl	homistr	T 0_ TT N		afan I 0. II
			omputations, A s I & II, Chemi					sier I & II,
neat ITal	ister, Ther	mouynamic	is I & II, Chenn	cal React	IOII EIIg	meening-	1 & 11.	
Course o	bjectives:							
	<u>v</u>		g engineer and	the scope	of pipir	ng engine	ering	
			ection of pipe jo		or pipi			
			the construction		es criteri	a for sele	ction and	pressure
	g devices.							r
	0	ill about the	e pipe rack spac	ing, draw	ing and	the pipin	g systems	for plant
utilities	-			C.	U			-
5. To disp	lay skill at	bout the PFI	D, P&ID and ut	ility flow	diagran	1.		
Course o								
			this course the					
			emical engineer		g engine	er, the sc	cope.	
			e various pipes	•				
	-		Design calculation	ons invol	ved like	frictiona	l losses ar	nd pressure
1 '		ves to be us		nation fo				
-		system wit	h their constr	iction le	eatures,	piping s	upports 1	or utilities
pipeline		of how to d	lraw drawings l	the DED		nd Utilita	, flow diag	rom
J. Demon	Suale Skill		naw urawnigs i	ike I I D,	I QID a		now ulag	<u>g</u> ram.
			COURSE			1		
Piping D	esign			Semest	er:		V]	III
Teaching	Scheme:			Examir	nation s	cheme		
Lectures		3 hour	s/week	End ser	mester e	exam (ES	SE):	60
								marks
				Duratio	on of ES	E :		03 hours
				Interna	l Sessio	nal Exar	ns	40
				(ISE):				marks
	T T 1 / T		NT 07	0.0				
	Unit–I:		No. of Lectu				Marks: 1	
Role of r	oping eng	ineer, Scop	e of piping eng	gineering	, Respon	nsibilities	s of piping	rengineer

Inputs received by piping engineers and output given by them, Interactions of piping engineers with other disciplines such as process engineering, instrumentation engineering etc.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Pipes and pipe fittings – standa	ards and specification, steel pipe	es, steel pipe fittings, cast iron
pipes, cast iron fittings, joining	g of cast iron pipes, tubes of oth	er materials, design of flanges
and flange joints.		

	Unit–Il	I:		N). of]	Lect	tures: 0	8 Hou	rs			Ma	rks: 12		
н	6 37 1	0	1	T 7 1	C	C ,	T 7 1	0		, •	1	C ,	α.,	•	C

Types of Valves, Control Valves, Safety Valves, Constructional features, Criteria for selection, Piping components, Safety valves and other pressure relieving devices, Constructional features, Selection criteria.

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12
Pipe Rack Spacing, Drawing	pipe in the rack, Pipe insular	tion shoes, Pipe guides, Pipe
Flexibility, Pipe Supports, Fie	ld supports, Dummy supports,	Hanger rods, Spring hangers,
Pick-up pipe supports, Plant u	tilities, Control valve manifold	ls, Utility stations, Sewer and
underground piping system.		

Unit–V:	No. of Lectures: 08	Hours		Marks: 12				
Introduction to PFD, P&ID, U	Jtility flow diagrams,	Piping	symbols,	Line symbols,	Valve			
symbols, Equipment Symbols,	Plant layout.							

Text Books:

- 1. Design of Piping system, M.W. Kellogg Co. 1976 (2ndEdition).
- 2. G. K. Sahu, Handbook of Piping Design.
- 3. Sam Kannapan, P.E. Pipe Stress Analysis, Willey-Interscience Publications.
- 4. Roy A. Parisher, Robert A. Rhea, Pipe Drafting and Design, Gulf Professional Publishing, 3rd Edition.
- 5. Thakore, Bhatt, Introduction to Process Engineering and Design, Tata McGraw-Hill Education, 2007
- 6. D. J. Deutsch, Process piping systems, Chemical Engineering Magazine. McGraw Hill.

Reference Books:

- 1. M. L. Nayyar, P.E , Piping Handbook, 6 th edition, McGraw-Hill, Inc
- 2. Johan J McKetta, Piping Design Handbook, CRC Press, 1992.

				sional Elec			r			
				iced Separ						
~				COURSE	OUTLI					
Course	Advanc	ed Separat	ion Pro	ocesses		Short	ASP	Cou		
Title:						Title:		Coc	le:	
Course d	_									
5		he course is separation	U	U		0		U	1 2	
course is	to transi	mit the esse	ntial kr	nowledge f	for critic	ally eval	uating	the perfor	rmance	of an
analytical	procedu	are during cl	nemical	l separation	ns.					
Lecture		Hours/we	ek	No. of w	eeks	Total k	ours	Sen crea	nester lits	
		3		14	Ļ		42		3	
Prerequi	site cou	rse(s):								
		y Balance	Compu	tations. Ar	pplied C	hemistrv	I & II	, Mass Tr	ansfer	I & II
	-	ermodynam	-	-	-	-				11
ficut ffui	15101, 111	ennouynum		n, enemi	ui iteae		meerm	5101		
Course o	hiective	ç.								
		sics of separ	ration n	rocaccac a	nd Mach	onism of	Soporat	ion		
		-	-				-			
		opic Distilla								
		oncept in su	+				-			
		out Ultra fil			ations ar	nd Gas- S	Separat	ions mem	branes.	
5. To stud	y Bioche	emical separ	ation p	rocesses.						
Course o	utcomes	5:								
After suc	cessful c	ompletion c	of this c	ourse the s	tudent w	vill be ab	le to:			
		basis of						s of equ	ilibriun	n and
		driving for								
		on, extracti								ior to
		c methods.	on, un	a sona pi	iuse ent	auction	ioi sui	inpic cicu	nup pi	101 1
		al knowledg	e skill	of experin	nental m	nethods a	nd ana	lytical in	trumer	ntation
	-	analytical s		-				•	, unici	itatioi
		iate skill of	-	00	•	-		- 1 •	blome	
		e use Bioche	-			-	orical	wond pro	Joienns.	
J. Demon	suale life	e use bioche		separation	processe	5.				
				COURSE (T		
Advance	d Separa	ation Proce	sses		Semest	er:			VIII	
Teaching	g Schem	e:			Exami	nation s	cheme			
Lectures	:	3 hou	irs/wee	k	End se	mester e	xam (l	ESE):	60	
							(-	/	ma	rks
		I			Duratio	on of ES	E:			hours
						al Sessio		ome	40	
						ai 388810	nai Ex	allis	4V	
					(ICE).					nlza
	TI	r.	N T -	of I4-	(ISE):	Tours		N/1		rks
Correct	Unit–I			. of Lectur	res: 09 E		e e f o	Marks		rks
-	n Proces	ses: Industr	ial Che	mical Proc	res: 09 H esses, M	Iechanisi		paration.	: 12	
Separatio	n Proces n by pha		ial Che	mical Proc eation. Sep	esses, Maration	lechanisi by barrie	er. Sep	paration. aration by	: 12	agent

Separation power. Selection of feasible separation processes. Crystallization from the melt: Introduction. Progressive freezing: component Separation by progressive freezing, Pertinent variables in progressive freezing. Applications. **Unit–II:** No. of Lectures: 08 Hours Marks: 12 Enhanced distillation: Introduction. Azeotropism. Azeotropic distillation: Introduction, exploitation of homogeneous azeotropes, exploitation of pressure sensitivity, exploitation of boundary curvature, Exploitation of azeotropy and liquid Extractive distillation: Introduction, solvent effect in extractive distillation, extractive distillation, design and optimization, solvent screening and selection extractive distillation by salt effects. Reactive distillation: Introduction, simulation, modeling and design feasibility, Mechanical design and implementation issues, process applications. Unit–III: No. of Lectures: 08 Hours Marks: 12 Supercritical fluid separation processes: Introduction. Physical properties of pure supercritical fluids; thermodynamic properties and transport properties. Process concept in super critical fluid extraction. Phase equilibria: Liquid- Fluid equilibria, Solid- Fluid equilibria, Polymer-Fluid equilibria and the Glass Transition, Cosolvents and surfactants, phase equilibria models. Unit–IV: No. of Lectures: 09 Hours Marks: 12 Ultra filtration: Process description, UF membranes, membrane characterization, process limitations, process configurations, Energy requirements, Design and economics. Microfiltrations: process description, Examples, MF membranes, membrane characterization, process limitations, Equipments configurations, process Applications and Economics. Gas- Separations membranes: Process descriptions, examples, Basic principles of operations, selectivity and permeability, Gas- Separation membranes, membrane system design features, energy requirements and economics. No. of Lectures: 08 Hours Unit–V: Marks: 12 Biochemical separation processes: Introduction. Initial product harvest and concentration: centrifugation, Filtration, Selection of cell separation, Unit operation, Cell disruption, protein refolding. Initial purification: Precipitation, Extraction, Adsorption, Membrane processes. Final Purification and product formulation: Chromatography, Lyophilization and drying. Integration of fermentation and downstream processing operations. **Text Book:** Richardson and Coulson, Chemical Engineering, Vol. II, Butterworth-Heinmann (Elsevier) (Fifth Edition). **Reference Books:** 1. Perry Robert H. and Green Don W. Perry's chemical Engineers Handbook 7th edition. McGraw Hill Publication, New York. 2. Seader J. D. and Henley Ernest J, Separation Process Principles. John Wiley and Sons, Inc.New York. 3. Ladisch Michael R., Bioseparations Engineering, Principles, Practice and Economics,

Wiley. Interscience, John Wiley and Sons, Inc. Publications New York. 4. Long Robert B. Separation Process in Waste Minimization .Marcel Dekker, Inc, New York.

		Р	rofessional El	ective Co	urse – V	T		
			Research	Methodol	ogy			
			COURSE	OUTLIN	NE			
Course Title:	Research	Methodol	ogy		Short Title:	RM	Cours Code:	
Course o	lescription	:						
	-		indamental of	research	, formu	lation of	of problem	n, research
developm	nent. Use	of mathem	natics and stat	tics, and	know o	f sampl	ing / data	collection
			e of computer a					
Lecture	E	Iours/weel	x No. of	weeks	eeks Total hours Seme credit			
		3		4 42 3				3
Prerequ	Prerequisite course(s):							
	Mathematic							
Course of	objectives:							
1. To und	erstand fun	damental o	f research and	formulation	on of res	earch pr	oblem.	
	-	0	nd formulation	• 1	nesis skil	lls.		
			nathematics ar					
			ing methods ar					
 To app 	ly the Role	of compute	er in Research	and Resea	rch writ	ing skill	5.	
Course of	outcomes:							
After suc	cessful con	npletion of	this course the	student w	ill be ab	le to:		
1. Demon	strate form	ulation of r	esearch proble	m on the b	oasis fun	damenta	d of researce	ch.
2. Display	y about perf	forming the	task with mul	tidisciplin	ary tean	ns by ide	ntifying, fo	ormulating,
			mulation of hy					
			d ethical resp					
-	• •	-	et economical	and socie	etal requ	irement	s on the b	asis of the
	nental of ma							
		ability of	using the skill	l of Sam	pling m	ethods	and metho	ds of data
collecti		c	· D 1	1 D	1	1 .11		
5. Exhibit	t the Role of	f computer	in Research a	nd Researc	ch writin	g skills.		
			COURSE	CONTE	NT			
Research	h Methodo	logy		Semest	er:		V	III
Teachin	g Scheme:			Examir	nation s	cheme		
Lectures	5:	3 hour	s/week	End ser	mester e	exam (E	SE):	60
				-	<u> </u>			marks
					on of ES			03 hours
					al Sessio	nal Exa	ms	40
	Unit–I:		No of Lost	(ISE):	lours		Marks: 1	marks
Fundam		acaarah a	No. of Lecture nd Formulation			nrahlar		
			motivation; Ty					
			oblem, import					
		-	and Conceptu					
Develop			and conceptu		, orn, th	• 1011III		<i>sejeeuves</i> ,

Difficulties in research, Linking research to practice, Steps in research Process, Research Ethics.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
0	ulation of Hypothesis: Resea	
	cepts relating to research desig	•••
	agnostic, Experimental), Basic	e Principles of experimental
Designs, Factors affecting resea		
Formulation of Hypothesis: In	troduction, Basic concept, proc	cedure for Hypothesis testing,
Flow diagram for Hypothesis to	esting, Limitations of the test of	Hypotheses.
Unit–III:	No. of Lectures: 09 Hours	Marks: 12
Fundamental of mathemat	ics and Statics: Introduction	, Types of Averages: The
	rithmetic mean, Median, Mode	
-	Measuring Dispersion: the rar	-
standard deviation, coefficient	• •	
	iniques: Measurement in Resear	ch. Scales. Source of error in
	oping, Measurement tools, Sca	
basis for scales, Important Scal		ing, meaning, chapping and
busis for searces, important sear	ing reeninques.	
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
	ods of data collection :Samplin	
	Sampling design, Criteria of se	
1 0 1	le design, Types of sample desig	
0 1		
	Collection of Primary data, Ob	
	ough questionnaires, and schedu	
survey method, Field Study, se	lection of appropriate method fo	r data collection.
Unit–V:	No. of Lectures: 08 Hours	Marks: 12
	Report Writing: Significance, D	
	riting a research report, Precau	
	U	· •
• • •	aphy, Developing an Outlines, W	anting about a variable, tables,
figures, conclusions, appendice		
-	rch: The computer and com	
	blications, Computers and res	earchers Software for paper
formatting like LaTeX/ MS Of	fice	
Text Books:		
-	ethodology: A Step-by-step G	uide for Beginners", Pearson,
Second Edition		
2. C.R. Kothari, Research Met	hodology: Methods and Techni	ques", New age International
publishers.		
3. Dr. Prasant Sarangi, Research	n Methodology, Taxmann Public	ation
Reference Book:		
	kinson, Methodology and Tec	hniques of Social Research.
Himalaya Publishing House		•

		Pr	ofessional H Petrochem	Elective Con nical Techn		I			
				SE OUTLI					
Course Title:	Petroch	emical Tech			Short Title:	РСТ	Cou Coo	ırse le:	
Course o	lescriptio	n:							
		bes the unit y important p			ocesses i	nvolved	in the n	nanut	facturing
Lecture		Hours/week	No. o	f weeks	Total l	nours	Sen cree	neste lits	r
		3		14		42			3
Prerequ	isite cour:	se(s):							
. To stuc 2. To dev 3. To und 4. To lea derivat	elop know erstand sa rn general ives.	status of petr vledge of diff ifety and poll characterist sis gas and sy	erent refinin ution contro ics and pro	g processes l aspects in duction of	the refin ethane-	ethylen	e-Acetyle	ene a	and their
After suc 1. Unders 2. Apply 3. Displa 4. Unders chemic 5. Demon	tand the c the knowl y the know tand the als.	ompletion of t ourrent status edge for refir wledge for co significance chniques for	and challeng ning of crude ontrolling po of unit ope	ges of petrol e oil through llution in the erations and	leum refi n fractior le petrocl l unit pr	nery wo nation. nemical rocesses	refineries in man	s. ufact	uring of
			COURS	E CONTE	NT				
Petroche	emical Te	chnology		Semest				VIII	[
	g Scheme	21			nation s	cheme			
Lectures	-	3 hours	s/week		mester e		CSE):		0 narks
				Durati	on of ES	SE:		0	3 hours
				Interna (ISE):	al Sessio	nal Exa	ams	4 n	0 narks
	Unit–I:			ctures: 09 H			Marks		
Chemica	ls from n	ustry in India nethane: Ma l fuels from n	nufacture of	f methanol,	formal	dehyde,			

— • —		
Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Chemicals from ethane- ethyle		
	of ethane, Nitroethane and or	-
production, production of ethy	lene derivatives like vinyl aceta	ate monomer, ethylene oxide,
ethylene diamine, ethanol and	acetaldehyde.	
Chemicals from acetylene: acr	vlic acid, vinyl chloride, vinyl ac	etate and Acetonitrile.
Unit–III:	No. of Lectures: 09 Hours	Marks: 12
Chemicals from C ₃ , C ₄ and hig	her carbon atoms:	
Products from propane. Dehyd	rogenation of propane and higher	paraffin's.
Chemicals from propylene: Is	opropyl alcohol, acetone, propy	lene glycol, acrylic acid and
ester, Phenol.		
Dehydrogenation of butanes. 1	Production of Iso and n- butano	l. Production of methyl -tert-
butyl ether [MTBE], Adipic ac	id. Derivatives from hydrocarbor	as higher than butane.
	-	-
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
Synthesis gas and chemicals:	· · · · ·	
Synthesis gas. Steam reforming	ng of hydrocarbons. Production	of synthesis gas. Chemicals
from synthesis gas. Oxo synthe	esis, vinyl acetate, acetic acid.	
Fischor- Tropsch synthesis: cat	alysts and the products.	
LPG: sources, properties grade	s of LPG. Supply of LPG to con	sumers, the storage and use of
LPG.		C C
Unit–V:	No. of Lectures: 08 Hours	Marks: 12
Petroleum gromatice: Produc		
renoieum aromanes. riouue	tion of BTX. Benzene deriv	atives like Aniline, phenol,
alkylation of benzene.	tion of BTX. Benzene deriv	atives like Aniline, phenol,
alkylation of benzene.		
alkylation of benzene. Products from toluene: Ch	lorotoluenes, O- Cresols, Di	
alkylation of benzene.	lorotoluenes, O- Cresols, Di	
alkylation of benzene. Products from toluene: Ch caprolactum, Terephthalic acid	lorotoluenes, O- Cresols, Di	
alkylation of benzene. Products from toluene: Ch caprolactum, Terephthalic acid Text Books:	lorotoluenes, O- Cresols, Di	nitrotoluenes, Benzaldehyde,
alkylation of benzene. Products from toluene: Ch caprolactum, Terephthalic acid Text Books: 1. Bhaskararao B.K. "A Text or	lorotoluenes, O- Cresols, Di 1 Petrochemicals", Khanna Publi	nitrotoluenes, Benzaldehyde,
alkylation of benzene. Products from toluene: Ch caprolactum, Terephthalic acid Text Books: 1. Bhaskararao B.K. "A Text or	lorotoluenes, O- Cresols, Di	nitrotoluenes, Benzaldehyde,
alkylation of benzene. Products from toluene: Ch caprolactum, Terephthalic acid Text Books: 1. Bhaskararao B.K. "A Text of 2. Sarkar G.N. "Advanced Petro	lorotoluenes, O- Cresols, Di 1 Petrochemicals", Khanna Publi	nitrotoluenes, Benzaldehyde,
alkylation of benzene. Products from toluene: Ch caprolactum, Terephthalic acid Text Books: 1. Bhaskararao B.K. "A Text of 2. Sarkar G.N. "Advanced Petro Reference Book:	lorotoluenes, O- Cresols, Di n Petrochemicals", Khanna Publi ochemicals" Khanna Publishers, T	nitrotoluenes, Benzaldehyde, shers, New Delhi New Delhi
alkylation of benzene. Products from toluene: Ch caprolactum, Terephthalic acid Text Books: 1. Bhaskararao B.K. "A Text of 2. Sarkar G.N. "Advanced Petro Reference Book:	lorotoluenes, O- Cresols, Di 1 Petrochemicals", Khanna Publi	nitrotoluenes, Benzaldehyde, shers, New Delhi New Delhi

		P	rofessio	onal Elec	tive Cou	urse – V	Ι		
		Env	-	ental Pol			rol		
				OURSE (
Course Title:	Enviror	nmental Pol	lution a	and Cont	rol	Short Title:	EPC	Cour Code	
Course d	escriptio	n:							·
This cou	rse desci	ribes Indust	rial Po	llution a	nd its c	control b	oy vario	us metho	ds such as
1		and biologi					0	0	•
		lution) Act,							ct, 1981.The
design of	water and	d air pollutio	on contr	ol equipn	nent is ii	ncluded i	in this co	urse	
Lecture	cture Hours/week No. of weeks Total hours Semes					ester			
Lecture			n –	1 10. 01 w	LUND			credi	
	-	3		14			42		3
Prerequi	site cours	se(s):				1			
		Balance C	omputa	ations, Ap	plied C	hemistry	I & II, I	Mass Trai	nsfer I & II,
Heat Trai	nsfer, The	ermodynamic	cs I & I	I, Chemic	al React	tion Eng	ineering-	I & II.	
Course o	U								
		f environme							
				Control o	f Pollut	ion) Act	t, 1997,	Air (Pre	vention and
		ion) Act, 198							
		Water Treatr			4 1				
		r pollution p							
5. 10 unu	erstand po	ollution cont		nenncai p	Tocess II	ndustry.			
Course o	utcomes	:							
After suc	cessful co	ompletion of	this co	urse the s	tudent w	vill be ab	le to:		
1. Demon	strate the	e processes	of pol	lution pr	evention	and w	aste mar	nagement	techniques
	s used in	•							
2. Display	the types	s of processe	es that t	ake place	in indu	stry and	review tl	he types o	of emissions
	occur.								
		methods by			d air pol	lution is	controlle	ed.	
		ste managen			1	• 1			
5. Display	pollutior	n control tecl	nniques	in chemi	cal proc	ess indu	stry.		
			CC	OURSE (CONTE	NT			
Environ	nental Po	ollution and	Contr	ol	Semest	er:		V	III
Teaching	g Scheme				Exami	nation s	cheme		
Lectures	•	3 hour	s/week		End se	mester e	xam (ES	SE):	60
									marks
					Durati	on of ES	E:		03 hours
					Interna	al Sessio	nal Exar	ns	40
			1		(ISE):				marks
<u> </u>	Unit–I:			of Lectur				Marks:	
	• •	of pollution			-		-		
	s, Enviror	nmental Legi	slation	: Water (I	reventio	on and C	ontrol of	· Pollution	$A \to 1007$
A • / ~	, •	and control	C						

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Removal of particulate matter:	and interaction products, prev Introduction to removal of part separators, fibre filters, fabric filt and ESP.	iculate matter, Gravity settling
Unit–III:	No. of Lectures: 09 Hours	Marks: 12
treatment methods; Introduction Sludge Process; Trickling Treatment. Numerical Examp Introduction to removal of	ampling and analysis, primary, see on to removal of BOD, Biologi Biological Filters; Waste Sta ples based on removal of BC Chromium. Control Methods, ime coagulation and adsorption.	cal oxidation units: Activated bilisation Ponds. Anaerobic DD. Removal of Chromium Reduction precipitation, Ior
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
incineration, composting and	sanitary landfilling; Removal	•
incineration, composting and removal of mercury, Measurer of ammonia/urea: Introduction nitrogen, Physico-chemical pro-	sanitary landfilling; Removal ment of Mercury, Ventron mercu on to removal of ammonia/ur	of Mercury: Introduction of ury removal process. Remova
incineration, composting and removal of mercury, Measurer of ammonia/urea: Introduction nitrogen, Physico-chemical pro- Unit-V:	sanitary landfilling; Removal ment of Mercury, Ventron merco on to removal of ammonia/ur ocesses, Biological methods. No. of Lectures: 08 Hours	of Mercury: Introduction of ury removal process. Removal ea, Methods for removal of Marks: 12
incineration, composting and removal of mercury, Measurer of ammonia/urea: Introduction nitrogen, Physico-chemical pro- Unit–V: Pollution control in chemical control aspects of fertilizer in Removal of carbon in ammo filtration, Removal of oil in ammonia plant effluents. Pollu Refinery Liquid based treatm	sanitary landfilling; Removal ment of Mercury, Ventron mercury on to removal of ammonia/un- ocesses, Biological methods. No. of Lectures: 08 Hours process industry. Introduction dustry: Introduction to pollution dustry: Introduction to pollution mia plant effluents by scrubbin ammonia plant effluents, Remo- tion control in petroleum and per- ent methods: Oxidation pond to	of Mercury: Introduction of ury removal process. Removal ea, Methods for removal of Marks: 12 to pollution control, Pollution a control in fertilizer industry g with liquids using vacuum oval of hydrogen sulphide in trochemical units: Introduction
incineration, composting and removal of mercury, Measurer of ammonia/urea: Introduction nitrogen, Physico-chemical pro- Unit–V: Pollution control in chemical control aspects of fertilizer in Removal of carbon in ammo filtration, Removal of oil in ammonia plant effluents. Pollu	sanitary landfilling; Removal ment of Mercury, Ventron mercury on to removal of ammonia/un- ocesses, Biological methods. No. of Lectures: 08 Hours process industry. Introduction dustry: Introduction to pollution dustry: Introduction to pollution mia plant effluents by scrubbin ammonia plant effluents, Remo- tion control in petroleum and per- ent methods: Oxidation pond to	of Mercury: Introduction of ury removal process. Removal ea, Methods for removal of Marks: 12 to pollution control, Pollution a control in fertilizer industry g with liquids using vacuum oval of hydrogen sulphide in trochemical units: Introduction
incineration, composting and removal of mercury, Measurer of ammonia/urea: Introduction nitrogen, Physico-chemical pro- Unit–V: Pollution control in chemical control aspects of fertilizer in Removal of carbon in ammo filtration, Removal of oil in ammonia plant effluents. Pollu Refinery Liquid based treatm Treatment of liquid effluents for Text Book:	sanitary landfilling; Removal ment of Mercury, Ventron mercury on to removal of ammonia/un- ocesses, Biological methods. No. of Lectures: 08 Hours process industry. Introduction dustry: Introduction to pollution dustry: Introduction to pollution mia plant effluents by scrubbin ammonia plant effluents, Remo- tion control in petroleum and per- ent methods: Oxidation pond to	of Mercury: Introduction of ury removal process. Removal ea, Methods for removal of Marks: 12 to pollution control, Pollution a control in fertilizer industry g with liquids using vacuum oval of hydrogen sulphide in trochemical units: Introduction reatment, disposal of sludges
incineration, composting and removal of mercury, Measurer of ammonia/urea: Introduction nitrogen, Physico-chemical pro- Unit–V: Pollution control in chemical control aspects of fertilizer in Removal of carbon in ammo filtration, Removal of oil in ammonia plant effluents. Pollu Refinery Liquid based treatm Treatment of liquid effluents for Text Book: S.P.Mahajan "Pollution Control	sanitary landfilling; Removal ment of Mercury, Ventron mercuron to removal of ammonia/un- ocesses, Biological methods. No. of Lectures: 08 Hours process industry. Introduction dustry: Introduction to pollution dustry: Introduction to pollution and plant effluents by scrubbin ammonia plant effluents, Rema- tion control in petroleum and per- ent methods: Oxidation pond the rom petrochemical industries.	of Mercury: Introduction o ury removal process. Remova ea, Methods for removal o Marks: 12 to pollution control, Pollution a control in fertilizer industry g with liquids using vacuum oval of hydrogen sulphide in trochemical units: Introduction reatment, disposal of sludges

		P	rofess	ional Elec	ctive Co	urse – V	I		
		Wat		nservatio		0	ent		
			0	COURSE	OUTLI	NE			
Course Title:	Water	Conservatio	n and	Manager	nent	Short Title:	WCM	Cour Code	
Course d	lescriptio	on:							·
This cou	rse will t	each how to	conse	rve this p	recious r	resource	in vario	ous situation	ns from the
home env	vironmen	t to industry.							
Lecture		Hours/weel	k	No. of w	reeks	Total h	ours	Seme	
		3		14	4		42	creui	3
Prerequi	isite cour	se(s):							
 To und To kno To lear To und To und Course of After succ Display Unders Unders 	erstand te erstand w w about t n measur erstand tr putcomes <u>ccessful co</u> the know tand meth tand anal	erminology u vater flow, qu esting water es for reshap reatment of w	ality c and pr ing loo vater. <u>this co</u> er cycl r conse	control. reserving v cal water b ourse the s le, water s ervation &	water qu balance. <u>student v</u> torage an c manage	ality. vill be ab nd water ement.	le to: quality		
		treatment of		urennenn,	water qu	unty con	und und	proventive	e methods
			C	OURSE	CONTE	NT			
					Semest	ter:		V	III
Teaching	g Scheme	2:			Exami	nation se	cheme		
Lectures	:	3 hour	rs/wee	k		mester e	Ì	CSE):	60 marks
					Durati	on of ES	E:		03 hours
					Interna (ISE):	al Sessio	nal Exa	ams	40 marks
	Unit–I	:	No.	of Lectu	res: 09 I	Iours		Marks:	12
water su water, w	pplies, in ater requ	er cycle, war nportance of nirement for and managem	f wate build	r supply, ings ,trea	water contract tracted the second sec	onservati	ion in l	ouildings;	sources of
1	Unit–Il			of Lectu	-	Iours		Marks:	12
measurer	anagemer nent, wat	nt-water qual er quality con analysis of w	ity, co ntrol, j	ntrolling ι preventive	use and c method	juality of ls, impur	ities in	water flow water, rease	ons for the

Unit–III:	No. of Lectures: 09 Hours	Marks: 12
• • •	ving water quality, minimising eva	-
	purposes, drinking water standards	
	hardness, purpose of water softeni	ng, removal of temporary
and permanent hardness.		
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
1 0	l water balance, use and conservati	
e e	water conservation in process indus	stry; water conservation in
	conservation in service industry	NA 1 10
Unit–V:	No. of Lectures: 08 Hours	Marks: 12
	presedimentation, coagulation of w	
		1 11 ("14 4"
of water, theories of filtration		s, double filtration,
of water, theories of filtration disinfection of water, method		s, double filtration,
disinfection of water, method		s, double filtration,
disinfection of water, method Text Book:	ls	
disinfection of water, method Text Book: S.C. Rangwala, "Water Sup		
disinfection of water, method Text Book:	ls	
disinfection of water, method Text Book: S.C. Rangwala, "Water Sup Ltd. Anand.	ls	
disinfection of water, method Text Book: S.C. Rangwala, "Water Sup Ltd. Anand. Reference Book:	ls oply and Sanitary Engineering" Ch	arotar Publishing House Pvt
disinfection of water, method Text Book: S.C. Rangwala, "Water Sup Ltd. Anand. Reference Book:	ls	arotar Publishing House Pvt
disinfection of water, method Text Book: S.C. Rangwala, "Water Sup Ltd. Anand. Reference Book:	ls oply and Sanitary Engineering" Ch	arotar Publishing House Pv

		Profe	ssional Ele			Ι		
				le Energy				
~	<u> </u>		COURSE	OUTLIN				
Course	Renewabl	e Energy			Short	RE	Cours	
Title:					Title:		Code	
Course o	lescription:							
This cou	rse describ	es the various	s renewable	e energy	sources	such as	solar en	ergy, win
energy, b	iomass ener	gy etc. and the	eir applicati	ons.				
Lecture	Н	ours/week	No. of v	veeks	Total h	ours	Seme: credit	
		3	1	4		42		3
Prerequ	isite course	(s):						
Heat tran	sfer, Mass t	ransfer-I and I s I and II, Intro					physics I	and II,
	bjectives:							
		ept of various			U .			
		ewable energy						
3. To le	arn the env	vironmental a	ind cost ec	onomics	of usin	g renewa	able ener	gy source
compared	d to fossil fu	els.						
4. To ide	ntify biomas	ss resources ar	nd energy.					
5. To uno	lerstand bio	mass conversi	on technolo	gies Tidal	energy	; geotherr	nal energ	у.
	outcomes:							
		pletion of this						
		mmercial ener				rces.		
		ng principle o			ems.			
		; geothermal e		ledge.				
		ss resources a	0.	_		_		
5. Demoi	nstrate the a	bility for prov	iding solution	ons for pro	oblems of	of renewa	ble energ	у.
			COURSE	CONTEN	T			
Renewal	ole Energy			Semeste	er:		V	III
Teaching	g Scheme:			Examin	ation so	cheme		
Lectures	2	3 hours/w	eek	End sen	nester e	xam (ES	E):	60
	•	e nours, w	cen				_)•	marks
				Duratio	n of ES	E:		03 hours
						nal Exan	16	40
				(ISE):	1 308810	nai exali	15	40 marks
	Unit–I:	•	lo of I ant				Marks: 1	
Intro d ·			lo. of Lectu					
		energy status, or ergy and susta						
	Unit–II:	N	o. of Lectu	res: 08 H	ours		Marks: 1	12
								-
Solar ene	rgy basic c	oncepts, flat p	late and cor		g collect	ors, types	s, solar de	salination

Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Wind energy ,availability, wind	d power plants, wind energy con	version systems, site
characteristics, types of wind tu	urbines, applications	
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
Energy from biomass, bioma	ass resources, biomass conver	sion technologies - direction
combustion, pyrolysis, gasifica	tion, anaerobic digestion: princi	iple and applications
Unit–V:	No. of Lectures: 09 Hours	Marks: 12
Bioethanol and biodiesel produ	ction, commercial applications	,Other Renewable Sources ,
Tidal energy: principle and app	plications, geothermal energy: pr	inciple and applications,
hydroelectric energy: principle	, design and applications	
Text Books:		
1. S. Rao ,Dr. B.B. Parulekar "	Energy Technology" Khanna Pu	blishers, New Delhi
2. G.D. Rai" Energy Sources"	Khanna Publishers, New Delhi	
Reference Book:		
Kishore V.V.N., "Renewable l	Energy Engineering and Techno	ology", Teri Press, New Delhi,
2012.		

		On	en Elective	- Course	- IV			
		^	onservatio			nent		
			COURSE					
Course Title:	Energy Co	nservation an			Short Title:	ECM	Cour Code	
	lescription:				11110.		Coue	•
		the various En	ergy Conse	ervation	and Ma	nagemen	t methods	and energy
audit. Th	e objective o	of the course	is to apply	the prin	nciples o	of scienc	e and eng	
		ergy conservat						
Lecture	Но	urs/week	No. of w	eeks	Total ł	iours	Seme credit	
		3	14	ŀ		42		3
Prerequi	isite course(s	s):						
 B. To lear Course of After succession Learn et 2. Unders Accust 	n energy inde erstand mater n waste heat : outcomes: cessful comp energy conser tand Indian e tand economi om waste hea	letion of this c vation, manag nergy conserv- ics of efficient	y balance.	tudent w audit.	vill be ab	le to:	nnology.	
		(COURSE (CONTE	NT			
Energy (Conservation	and Manage		Semest			V	III
Teaching	g Scheme:			Examir	nation s	cheme		
Lectures		3 hours/wee	ek	End ser	mester e	exam (ES	SE):	60 marks
		1		Duratio	on of ES	E:		03 hours
			-	Interna	l Sessio	nal Exar	ns	40
				(ISE):		nui LAu		marks
	Unit–I:	No	o. of Lectur	· /	lours		Marks:	
steps of	Conservation Energy Ma	and Energy I nagement pro- energy conser	Managemer gramme, g	nt, Scop general 1	e of En	•••	nagement	, necessary
	Unit–II:	No	. of Lectur	es: 08 H	lours		Marks:	12
	ion, objectiv	ves of energy s, energy inde	y audit, c	ontrol o	of energ		of ener	gy, energy
		juestionnaire e				/r ··· ••	- 0, 4	-,6

Unit–III:	No. of Lectures: 09 Hours	Marks: 12
Energy conservation, Indian e	energy conservation act 2001, E	Electricity Act 2003, rules for
efficiency, energy conservation	n of energy and materials, Techn	ology for energy conservation
,design of energy conservation	on, energy flow network, critica	al assessment of energy use,
formulation of objectives and c	constraints.	
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
Energy management, material	and energy balance, basic con	ncepts of material and energy
balance, economics of efficient	energy use and energy efficient	technology.
Unit–V:	No. of Lectures: 08 Hours	Marks: 12
	trial sectors, energy saving tech air preheaters and economizers ctron beam welding.	
Text Books:		
1. U. Rathore, Energy Managen	nent, S.K.Kataria and Sons New	Delhi.
2. K.V. Sharma and P. Ven	kataseshaiah I.K, Energy Ma	nagement and Conservation,
International Publishing Hou	se Ltd, New Delhi.	
Reference Books:		
Kishore V.V.N., "Renewable E 2012	Energy Engineering and Technology	ogy", Teri Press, New Delhi,

		0	pen Electiv	e Course	e – IV			
		-	Material T					
			COURSE	OUTLIN	1			
Course Title:	Material 7	Fechnology			Short Title:	MT	Cours Code	
Course of	lescription:				•			
	nding how	es an overvie structural pro						
Lecture	H	ours/week	No. of w	eeks	Total l	ours	Seme	
		3	14	1		42		3
Prereau	isite course	(s):	I		1		I	
 To des different Give au of a mod Give and Give and To app within Course of After succ Identify mechant Demont Interpro- materia Select and 	cribe the dif nces. n introduction of the introduction oraise the st the framewor outcomes: ccessful com y various nisms. nistrate under et Iron-Iron als at different appropriate l	and chemistry ferent types of on to metals, c of understandin on to the relation udents about ork of this cour pletion of this crystal imper standing of me carbide phas nt conditions. heat treatment lloying elemen	f bonding in eramics, po g of bondin on between p recent deverse. <u>course the s</u> fections, d etallurgical p se diagram, process for	a solids, lymers, a g. processir lopments student w eformati propertie and di specific	and the pand electing, struct s in material of the second	physical i ronic mat ure, and p rerials sci le to: hanisms, erials. phases in	mplication terials in physical prence & e ence & e and str	ons of these the context properties. engineering rengthening
			COURSE	CONTE	NT			
Materia	l Technolog	У		Semest	er:		V	III
Teachin	g Scheme:			Examir	nation s	cheme		
Lectures	S:	3 hours/we	eek	End se	mester e	exam (ES	E):	60 marks
		1		Durati	on of ES	E:		03 hours
				Interna (ISE):	al Sessio	nal Exam	ıs	40 marks
	Unit–I:	Ν	o. of Lectu	· · · ·	Iours		Marks: 1	
Introduct			erials, select	tion of r	naterials			

diffraction, structure of NaCl and diamond, Crystal defects, alloy formation, solid solution types, solidification of castings, structural examination using microscopy

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Metallurgical Properties of Ma		tio system Diffusion Fields
	n, eutectic, eutectoid and parata	
	tension test, hardness test - bri pe. Impact test, fracture - grifit	
	gue and creep. Strengthening me	•
emonuement phenomena. Fat	igue and creep. Strengthening me	
Unit-III:	No. of Lectures: 09 Hours	Marks: 12
Types of Materials :		
	phase diagram, heat treatmen	nt, TTT curves, ausforming,
	ormalizing, tempering, hardening	
• • • • •	iron - malleable and ductile typ	• • •
its alloys - brass, bronze, copp	er – nickel. Aluminum and its a	lloys, hardening treatment. Al
• • •	titanium and its alloys, cermets,	
materials, nano particles and na	ano structures	
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
Physical Characteristics of Mat		
	tors, electron theory, band theory	
	erials, and application. Soft and	hard magnets. Conductivity of
materials, zone refining, crysta	l growth techniques	
Unit–V:	No. of Lectures: 08 Hours	Marks: 12
Non-Metallic Materials :		
Ceramic materials - oxides, sil	icates. Refractories, abrasives, c	ement and concrete materials.
Polymers – classification, react	tion, types, mechanisms, deformation	ation of polymers, mechanical,
thermal, electrical and chemic	cal behavior. Rubber, silicones,	, fluorocarbons, composites -
FRP, particulates, and laminate	es	_
Text Books:		
	ence and Engineering: A first cou	urse", V Edition, Prentice Hall
of India, 2004.		
,	of Materials Science and Enginee	e (
in metallurgy and materials e	ngineering), VI Edition, Prentice	Hall, 6th Edition, 1989.
Reference Books:		
	nce", Cambridge Univ. Press, Ne	w York, 2006.
	gineering Materials", John Wiley	
	Smeering materials, John Wile	y, 110W 101R, 1707.

			Open Electiv	e Course -	– IV			
				atistics				
			COURSE					
Course Title:	Biostatistic	CS			Short Title:	BST	Cour Code	
Course of	description:			•				•
emphasis probabili sampling inference	s on Biotech ity distribution distribution es concerning	nnology a ons; prob ns; infere g proportio	f both elementa applications. The pability densition ences concerning ons; analysis of	ne course es; curve ng means variance; i	covera fitting; ; infer factoria	ege exp correl ences o l experi	lores the ation and concerning mentation.	probability regression variances
Lecture	Но	ours/weel	X No. of w	veeks	Total h	ours	Seme credit	
		3	1	4		42		3
 Studen Norma Studen and als Studen samplii Studen Studen	l distribution ts will under o learn vario ts will learn ng. ts will earn to ts will earn for ts will learn for cessful comp e able to use lata will follo e able to calcu e sampling for e able to use esis.	are discu stand what us tests, for how to test a hy Experime pletion of Probabili ow which ulate the r or perform se t-test, domizatio	nean and varian ning any real ex F-test and chi n to avoid conf	allow the f bi-variat and small given dat on a samp 2^2 , 2^3 desig	m to ap te data a sample ta and de. gns. <u>all be ab</u> y. Also obabilit which is est etc.	ply to e and cor also un <u>le to:</u> will be y distrik s otherw for Go	able to known wise very exponents of	problems. tween then meaning o now a given ow a given spensive fit to tes
			COURSE	CONTEN	T			
Biostatis	stics			Semeste			V	III
Teachin	g Scheme:			Examina	ation so	cheme		
Lectures	-							
	5:	3 hour	S/WEEK	End sem	nester e	xam (E	CSE):	60 marks
	5:	3 hour	S/WEEK	End sem			CSE):	marks
		3 hour	s/week	Duration Internal	n of ES	E:		marks 03 hours 40
	S: Unit–I:	3 hour	S/week	Duration Internal (ISE):	n of ES I Sessio	E:		marks 03 hours 40 marks

Probability Distributions. Random variables, The mean and variance of a Probability distribution, The Binomial and Poisson distributions, The Poisson's approximation to the Binomial Distribution. Continuous random variable, and Normal Distribution, Normal approximation to the Binomial Distribution.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12
Curve Fitting, Correlation and	Regression.	
· · ·	Curvilinear regression (quadra egression coefficient, line of reg	1 / / / / /
Unit-III:	No. of Lectures: 09 Hours	Marks: 12
hypothesis, alternative hypothe Confidence interval, confidence	population, sample, statistic, esis, critical region, level of sign ce limit, Sampling, types of s gle mean, two means. Hypothes portions	nificance), Interval estimation, ampling, type-I error, type-II
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
populations when sample obset of two populations,)Chi-squar homogeneity of samples	te-test for an assumed mean ar rvations are independent, 2.F-tea re test for independence of att	st for comparison of variances tributes, Goodness of fit and
Unit–V:	No. of Lectures: 08 Hours	Marks: 12
square designs, Simple fac	signs, Completely randomized, torial experiments of 22,23, ivations not required);Analysis	24,Confounding in factorial
Text Books:		
1. N.P. Bali and Manish Goyal,	A Text Book of Engineering Ma	athematics
2. Gupta S. C. Fundamentals of	Statistics. Himalaya Publishing	House, NewDelhi
3. Khan, Biostatistics. Tata Mc	Graw Hill Publishers	
Reference Books:		
 Richard A. Johnson, Miller Edition). Law L. Devere Probability on 	, ,	C X
 Jay L. Devore, Probability an Norman T .J .Bailey, Statistic Press (1995). 	–	
4. Daniel W.W.(9th Edn. 200 Sciences	9).Biostatistics: A Foundation	for Analysis in the Health

				Open	n Electiv	e Course	e – IV				
					Cyber	Security					
				C	OURSE	OUTLIN	NE				
Course	Cyber S	Secur	ity				Short	CS	Cou	rse	
Title:							Title:		Cod	e:	
Course d	lescription	o n:									
Cyber Se	ecurity co	ourse	focuses	on cy	ber thre	ats and c	yber see	curity tl	hat provid	es tl	he much
needed a	wareness	in th	e times o	of grow	ving cyb	ercrime e	pisodes.				
Lecture		Hou	ırs/week	K	No. of v		Total l		Sem		r credits
			3		1	4		42		3	3
Prerequi	isite cour	rse(s)	:								
Course o	bjective	s:									
1. To ur	nderstand	Cybe	ercrime	and Cy	ber offer	nses.					
2. To ur	nderstand	Cybe	ercrime	through	h portabl	e devices					
		•		-	-	Cybercrim					
	nderstand										
	nderstand		0		•						
			•								
Course o	outcomes	5:									
After suc	cessful c	omple	etion of	this co	urse the	student w	vill be at	ole to:			
1. Deter	mine the	act o	f Cyber	offense	es.						
						e devices	•				
	mine the	•		-	-						
4. Deter				•							
	ribe Com	-		-							
		r									
				CC	DURSE	CONTE	NT				
Cyber Se	ecurity					Semeste	er:		١	/III	
Teaching	g Scheme	e:				Examin	ation so	cheme:			
Lectures	:		3 hours	s/week		End Ser	mester]	Exam (ESE):	6	0
									,		narks
						Duratio	on of ES	E:			3 hours
									am (ISE):		0
						menna		nui LA			narks
	Unit–I	•		No. (of Lectu	res: 09 H	ours		Marks:		
Introduc			ercrime					Definitio	on and Or		s of the
									als?, Class		
Cybercrit	-	e une	· mioim	iution i	Security	, , , , , , , , , , , , , , , , , , ,	e eyeer	CIIIIII		met	
Cyberen	liies										
Cyber of	fenses• I	How	Crimina	als Plai	n Them	Introduc	tion He	w Crim	ninals Plan	the	Attacks
									Botnets: T		
Cybercrit	-	-	-	-	-		<i>y</i> utiti	11103, L	50110to. 1		
Cyberen	ine, Atta	LA VC		Juu CO	mputing	•					
	Unit–I	r.	[No	fIcet				Monlea	12	
Cuborer			and W			res: 08 H		Drollifa	Marks:		hilo and
-									ration of		
w ireless	Devices,	1 ren	us m M(oomty,	Credit (Jaru Frau	us m M	oone an	d Wireles	s U0	mpung

Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices,

Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile device related security issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12					
Tools and Methods Used in							
Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses							
and Backdoors, Steganography	y, DoS and DDoS Attacks, SQ	L Injection, Buffer Overflow,					
Attacks on Wireless Networks							
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12					

Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft)

Understanding Computer Forensics: Introduction, Historical Background of Cyberforensics, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics Analysis of E-Mail

No. of Lectures: 09 Hours	Marks: 12
Forensics Life Cycle, Chain	of Custody Concept, Network
omputer Forensics Investigation	on, Computer Forensics and
he OSI 7 Layer Model to Com	puter Forensics, Forensics and
Security/Privacy Threats, Chall	lenges in Computer Forensics,
Forensics Auditing, Antiforensi	cs
	Forensics Life Cycle, Chain omputer Forensics Investigation he OSI 7 Layer Model to Com Security/Privacy Threats, Chall

Text Book:

Nina Godbole and Sunil Belapure, "Cyber Security", Wiley India Publication, 2014

Reference Books:

1. Nina Godbole, Information Systems Security, Wiley India Publication

2. V.K. Pachghare, Cryptography and Information security, PHI, Second edition

			AB COURSE OUT	conomics			
Course Title:	Process		Economics Lab	Short Title:	PTE Lab	Cour Code	
	descriptio	n:		The.	Lau	Coue	•
This cou	urse educ	ates and trains	the students abou ers useful for them				
Laborat	ory	Hours/week	No. of weeks	Total ł	iours	Seme credi	
	F	2	14		28		1
End Sen	nester Ex	am (ESE) Patter	n: Pract	ical (PR)			
1. To und	objectives derstand g			ing in che	mical proc	acc dasi	1
 Acquin manuf To dra To ide 	opment. re basic un facturing of tw process ontify majo basic con	nderstanding of d of commercially in s flow sheet of ch or engineering pro	nsiderations involv esign parameters, l mportant chemical emical products oblems involved du c analysis for proce	knowledge products.	e of desigr ufacturing	n procedu	ares for
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 Acquin manuf To dra To dra To ide Learn profita Course of Upon sud State t Under Draw Identif Perfor process. 	opment. re basic un facturing of tw process entify majo basic condi- bility. Dutcomes the basic of stand imp the process fy and the m econom	nderstanding of d of commercially in s flow sheet of ch or engineering pro- cepts of economic mpletion of lab (concepts of process ortance of unit pro- ss flow sheet for t reby solve major nic analysis for pr	esign parameters, I mportant chemical emical products oblems involved du c analysis for proce Course, student wi ss design developm cocesses and symbole he manufacturing of engineering proble cocess to calculate B COURSE CON cs Lab Semes	knowledge products. uring man ess, involv ll be able the nent and go ols of unit of specific ems encou equipment VTENT	e of design ufacturing ring equipt to: eneral design operations chemical ntered dur t cost, and	ign const s. products ing man profitab	ideration
 Acquir manuf To dra To dra To ide Learn profita Course of Upon sud State t Under Draw Identif Perfor process Process	opment. re basic un facturing of a process entify majo basic condi- bility. Dutcomes ccessful co- he basic c stand imp the process fy and the m econom Technolo g Scheme	nderstanding of d of commercially in s flow sheet of ch or engineering pro- cepts of economic cepts of economic concepts of process ortance of unit pr treby solve major nic analysis for pr LA ogy and Economic	esign parameters, I mportant chemical emical products oblems involved du c analysis for proce Course, student wi ss design developm ocesses and symbol he manufacturing of engineering proble cocess to calculate B COURSE CON cs Lab Semes Exam	knowledge products. uring man ess, involv <u>II be able t</u> nent and go ols of unit of specific ems encou equipment	e of design ufacturing ring equipt to: eneral design operations chemical ntered dur t cost, and	ign const s. products ing man profitab	ideration s. ufacturin ility for
 Acquir manuf To dra To dra To ide Learn profita Course of Upon such State t Under Drawn Identif Perfor process. Process	opment. re basic un facturing of a process entify majo basic condi- bility. Dutcomes ccessful co- he basic c stand imp the process fy and the m econom Technolo g Scheme	nderstanding of d of commercially in s flow sheet of ch or engineering pro- cepts of economic cepts of economic concepts of process ortance of unit pro- ss flow sheet for t reby solve major nic analysis for pro- LA gy and Economi	esign parameters, l mportant chemical emical products oblems involved du c analysis for proce Course, student wi ss design developm ocesses and symbol he manufacturing of engineering proble cocess to calculate B COURSE CON cs Lab Semes Exam ek End s	knowledge products. uring man ess, involv Il be able the nent and ge ols of unit of specific ems encou equipment VTENT ster: ination so	e of design ufacturing ring equipt to: eneral des operations chemical ntered dur t cost, and cheme t cost, and cheme t cost	ign const s. products ing man profitab	ideration s. ufacturin ility for

- 2. Drawing of process flowsheets for the manufacturing of chemical products with major engineering problems involved (any four).
- 3. Location of a chemical plant.
- 4. Indian Chemical industry.
- 5. Cost Estimation.

- 6. Interest and Investment costs.
- 7. Depreciation.
- 8. Profitability and Replacement.

Text Book:

Designed Standard College Laboratory Manual and Instruction Manuals of the Laboratory Equipment Suppliers.

Reference Books:

- 1. Shreve's Chemical Process Industries, George T. Austin, McGraw-Hill International Editions Series, 1984.
- 2. M. Gopala Rao, Marshall Sittig, Dryden's Outlines of Chemical Technology, , East West Press, 1997.

Guide lines for ICA:

Internal Continuous Assessment shall be based on continuous evaluation of Student performance throughout semester and practical / assignments submitted by the student in the form of journal

Guidelines for ESE:

End Semester Examinationshall be based on practical / oral evaluation of student performance and practical / assignments submitted by the student in the form of journal.

			ign and Simulation B COURSE OUT			
Course	Design a	and Simulation LA		Short	D&S	Course
Title:	Designe		uo	Title:	Lab	Code:
	descriptio	n:		11000	1100	0000
This cour illustrates	se describe the applic	es how to use appro	rinciples associated	with proc		uipments/processes. ent design. The inte
Laborat	ory	Hours/week	No. of weeks	Total I	iours	Semester credits
	-	2	14		28	1
End Sen	nester Ex	am (ESE) Patteri	n: Oral (OR)		
	isite cour	· · · ·		- /		
		s transfer-I and II	, Applied Chemist	try I & II,	Applied p	ohysics I and II,
		tics I and II, Eleme				
* *	objectives				<u>U</u>	-
То асси	ustom CAE	O of the Shell and tu	be heat exchanger.			
		the Single Effect Ev				
		the rotary dryer.				
To lear	n CAD of a	absorber.				
. To acc	ustom sim	ulation of ammon	ia production sys	tem, cat	alyst tem	perature by Newto
Raphso	on method	l, Reactor Design e	etc			
Course	outcomes	•				
Upon su	ccessful co	ompletion of lab C	Course, student wil	l be able	to:	
. Demor	strate the	ability of using C	hemical Engineeri	ng conce	pts in desi	gning and providir
compu C/C++		solutions to vario	ous unit operation	s and un	it process	es with the help of
. Displa		ning the task wit	h multidisciplinar	ry teams	by ident	ifying, formulatin
design						
design . Unders	0	fessional and ethi	ical responsibilition	es forma	lly and in	nformallv show th
. Unders	stand prof		-		•	nformally show th
Unders capacit	stand prof ty of desig	gning to meet econ	omical and societa	al require	ments.	·
Unders capacit	stand prof ty of design stand about	gning to meet econ ut computer aided	omical and societa d design along w	al require	ments.	nformally show th ntal issues and wi
. Unders capacit . Unders provid	stand prof ty of design stand about the solutions	gning to meet econ ut computer aided s for green and cle	omical and societa design along wan technologies.	al require	ments.	·
 Unders capacit Unders provid 	stand prof ty of design stand about the solutions	gning to meet econ ut computer aideo s for green and cle putational skills us	omical and societa design along w an technologies. ing simulation.	al require ith the e	ments.	·
 Unders capacit Unders provide Exhibi 	stand prof ty of designstand about the solutions the comp	gning to meet econ ut computer aided s for green and cle putational skills us LAI	omical and societa d design along w an technologies. ing simulation. B COURSE CON	al require ith the e TENT	ments.	ntal issues and wi
 Unders capacit Unders provide Exhibi 	stand prof by of design stand about t solutions t the comp and Simul	gning to meet econ ut computer aided s for green and cle putational skills us LAI lation Lab	omical and societa d design along w an technologies. ing simulation. B COURSE CON Semes	al require ith the e TENT ter:	ments.	·
 Unders capacit Unders provide Exhibi 	stand prof ty of designstand about the solutions the comp	gning to meet econ ut computer aided s for green and cle putational skills us LAI lation Lab	omical and societa d design along w an technologies. ing simulation. B COURSE CON Semes	al require ith the e TENT	ments.	ntal issues and wi
 Unders capacit Unders provide Exhibi Design a	stand prof by of design stand about t solutions t the comp and Simul	gning to meet econ ut computer aided s for green and cle putational skills us LAI lation Lab	omical and societa d design along w an technologies. ing simulation. B COURSE CON Semes Exami	al require ith the e TENT ter: ination se	ments.	ntal issues and wi
 B. Underscapacific capacific capa	stand prof ty of design stand about the comp and Simul g Scheme	gning to meet econ ut computer aided s for green and cle putational skills us LAI lation Lab e: 2 hours/wee	omical and societa d design along w an technologies. ing simulation. B COURSE CON Semes Exami k End so	al require ith the e TENT ter: ination se emester e	ments. nvironmen cheme xam (ES)	IV E): 25 marks
 Unders capacit Unders provide Exhibi Design a	stand prof ty of design stand about the comp and Simul g Scheme	gning to meet econ ut computer aided s for green and cle putational skills us LAI lation Lab	omical and societs d design along w an technologies. ing simulation. B COURSE CON Semes Examt k End so k Intern	al require ith the e TENT ter: ination se	ments. nvironmen cheme exam (ES) nuous	IV E): 25

List of Experiments/Assignments:

- 1. Computer aided design of shell & tube heat exchanger.
- 2. Computer aided design of single effect evaporator.
- 3. Computer aided design of rotary dryer.
- 4. Simulation of ammonia production system.
- 5. Simulation of catalyst temperature by Newton Raphson method.
- 6. Simulation of Reactor Design.
- 7. Development of the model equations for a double pipe heat exchanger.
- 8. Computer Aided Design of absorber.
- 9. Computer Aided Design of tall vessels.
- 10. Computer Aided Design of Design of thick-walled high pressure vessel.
- 11. Computer Aided Design: of Vertical supports for chemical process plant.
- 12. Computer Aided Design of Design of vessel under internal pressure.

Text Book:

Designed Standard College Laboratory Manual and Instruction Manuals of the Laboratory Equipment Suppliers.

Reference Book:

R.W.Gaikwad, Dr. Dhirendra, Process Modelling and Simulation, Central Techno Publication, Nagpur. First Edition.

Guide lines for ICA:

Internal Continuous Assessment shall be based on continuous evaluation of Student performance throughout semester and practical / assignments submitted by the student in the form of journal

Guidelines for ESE:

End Semester Examination shall be based on practical / oral evaluation of Student performance and practical / assignments submitted by the student in the form of journal.

	Pro	oject						
	LAB COUR	SE OI		NF				
Course Title:	Project	<u>5E U</u>		Shor t Title:	PRO		ourse ode:	
Course description:				1100				
Project represents the culmi	nation of study to	wards	the Ba	achelor	of Eng	gineering	degree.	The
project offers the opportuni						U	1 0	
The emphasis is necessarily	on facilitating stu	ident l	earnin	g in tec	hnical,	project n	nanagen	nent
and presentation spheres.								
Laboratory	Hours/week	No. o week	-	Total	hours	Seme credi		
	6	1	4	8	34		3	
End Semester Exam (ESE)) Pattern:		0	ral (OR)			
Prerequisite course(s):								
Course objectives:		· ·	1	<u> </u>				
1. To understand the basic								
2. To understand the value								
3. To apply the theoretical	concepts to solve	probl	ems w	1th team	work	and multi	disciplii	nary
approach.								_
4. To demonstrate professi		-		effective	e comr	nunicatio	n skills	and
relate engineering issues					_			
5. To develop ability of					ferent	sources a	and wri	ting
comprehensively and ex	haustive report on	an all	otted t	opic.				
9								
Course outcomes: Upon successful completion	of lab Course stu	idant i	vill bo	abla to:				
- 1						nia		
 Demonstrate a sound tec Undertake problem iden 	0			•	ject to	pic.		
 Design engineering solu 					vetem	s annroac	h	
4. Conduct an engineering		100101	ins util	inzing a	system	s approac	11.	
 Demonstrate the knowle 		tudes	ofanı	ofession	nal enc	ineer		
5. Demonstrate the knowle	age, skins and att	luues	orapi	01055101		,incer.		
	LAB COURS	SE CO	DNTE	NT				
Project			Seme	ster:		۲	VII	
Teaching Scheme:			Exam	nination	schen	ne:		
		F	End s	semeste	r exan	n (ESE):	50	
						× ,	marl	KS
Practical:	6		Inter	nal Con	tinuoi	15	50	
	hours/w	veek		sment (marl	KS
	10415/11				, •			-~
In continuation with Project	(Stage – I) at Ser	nester	– VII	by the	end of	Semester	· _ VIII	the
	(Suge 1) at Del		· 11,	, ey uie		Semester	· · · · · · · · · · · · · · · · · · ·	une

student should complete implementation of ideas as formulated in Project (Stage - I). By the end of Semester - VIII the students shall complete the project. Assessment for the project shall also include presentation by the students.

Each student group should submit partial project report in the form of thermal bound at the end of Semester -V

Each student group is required to maintain separate log book for documenting various activities of the project.

Suggestive outline for the project report is as follows.

Abstract

Chapter 1. Introduction

Chapter 2. Literature Survey

Chapter 3. Methodology

Chapter 4. Results & Discussion

Chapter 5. Conclusion

Bibliography

Index

Appendix

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Project in Semester – VIII shall be as per the guidelines given in Table – B.

				Tal	ole – B				
			Assessm	nent by G	uide		Assessm	nent by	
						Departr	nental		
						Comm	nittee		
Sr	Nam	Attenda	Problem	Literat	Methodo	Rep	Depth of	Presenta	Tot
	e of	nce /	Identifica	ure	logy /	ort	Understan	tion	al
Ν	the	Participa	tion /	Surve	Design		ding		
0.	Stud	tion	Project	У					
	ent		Objectiv						
			es						
	Marks	5	5	5	5	5	10	15	50

Guidelines for ESE:

In End Semester Examination (ESE), the student may be asked for presentation / demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.