

RV COLLEGE OF ENGINEERING®

(Autonomous Institution Affiliated to VTU, Belagavi) R.V. Vidyaniketan Post, Mysore Road Bengaluru – 560 059



Bachelor of Engineering (B.E) Scheme and Syllabus for VII & VIII Semesters

2016 SCHEME

INDUSTRIAL ENGINEERING AND MANAGEMENT

VISION

Leadership in Quality Technical Education, Interdisciplinary Research & Innovation, with a Focus on Sustainable and Inclusive Technology

MISSION

- 1. To deliver outcome based Quality education, emphasizing on experiential learning with the state of the art infrastructure.
- 2. To create a conducive environment for interdisciplinary research and innovation.
- 3. To develop professionals through holistic education focusing on individual growth, discipline, integrity, ethics and social sensitivity.
- 4. To nurture industry-institution collaboration leading to competency enhancement and entrepreneurship.
- 5. To focus on technologies that are sustainable and inclusive, benefiting all sections of the society.

QUALITY POLICY

Achieving Excellence in Technical Education, Research and Consulting through an Outcome Based Curriculum focusing on Continuous Improvement and Innovation by Benchmarking against the global Best Practices.

CORE VALUES

Professionalism, Commitment, Integrity, Team Work, Innovation

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Bachelor of Engineering (B.E) Scheme and Syllabus for VII & VIII Semesters

2016 SCHEME

DEPARTMENT OF INDUSTRIAL ENGINEERING AND MANAGEMENT

DEPARTMENT VISION

Imparting innovation and value based education in Industrial Engineering and Management for steering organizations to global standards with an emphasis on sustainable and inclusive development.

DEPARTMENT MISSION

- To impart scientific knowledge, engineering and managerial skills for driving organizations to global excellence.
- To promote a culture of training, consultancy, research and entrepreneurship interventions among the students.
- To institute collaborative academic and research exchange programs with national and globally renowned academia, industries and other organizations.
- To establish and nurture centers of excellence in the niche areas of Industrial and Systems Engineering.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

- PEO1. Conceive, design, implement and operate integrated systems, focus on appropriate measures of performance at strategic, tactical and operational levels.
- PEO2. Develop competency to adapt to changing roles for achieving organizational excellence.
- PEO3. Design and develop sustainable technologies and solutions for betterment of society.
- PEO4. Pursue entrepreneurial venture with a focus on creativity and innovation for developing newer products, processes and systems.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO	Description				
PSO1	Design, develop, implement and improve integrated systems that include people,				
	materials, information, equipment and energy.				
PSO2	Apply statistical and simulation tools, optimization and meta heuristics techniques for				
	analysis of various systems leading to better decision making.				
PSO3	Demonstrate the engineering relationships between the management tasks of planning,				
	organization, leadership, control, and the human element in various sectors of economy.				

Lead Society: Institute of Industrial Engineers (IIE)

ABBREVIATIONS

Sl. No.	Abbreviation	Meaning				
1.	VTU	Visvesvaraya Technological University				
2.	BS	Basic Sciences				
3.	CIE	Continuous Internal Evaluation				
4.	SEE	Semester End Examination				
5.	PE	Professional Elective				
6.	GE	Global Elective				
7.	HSS	Humanities and Social Sciences				
8.	CV	Civil Engineering				
9.	ME	Mechanical Engineering				
10.	EE	Electrical & Electronics Engineering				
11.	EC	Electronics & Communication Engineering				
12.	IM	Industrial Engineering & Management				
13.	EI	Electronics & Instrumentation Engineering				
14.	СН	Chemical Engineering				
15.	CS	Computer Science & Engineering				
16.	TE	Telecommunication Engineering				
17.	IS	Information Science & Engineering				
18.	BT	Biotechnology				
19.	AS	Aerospace Engineering				
20.	РҮ	Physics				
21.	CY	Chemistry				
22.	MA	Mathematics				

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VII Semester							
Sl. No.	Course Code	Course Title	Page No.				
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2.	16IM72	Financial Accounting and Costing	3				
3.	16IM73	Product Design and Development	5				
4.	16IM74	Foundations of Business Analytics	8				
	GROUP F: PROFESSIONAL ELECTIVES						
5.	16IM7F1	Industry 4.0 – A Growth in Manufacturing	10				
6.	16IM7F2	Retail Supply Chain Management	12				
7.	16IM7F3	Big Data Analytics	14				
8.	16IM7F4	Technology Management	16				
9.	16IM7F5	Supply Chain Technologies	18				
		GROUP G: PROFESSIONAL ELECTIVES					
10.	16IM7G1	Additive Manufacturing Methods	20				
11.	16IM7G2	Lean Manufacturing Systems	22				
12.	16IM7G3	Engineering Optimization	24				
13.	16IM7G4	Energy Management	26				
14.	16IM7G5	Predictive Analytics	28				

GROUP H: GLOBAL ELECTIVES								
Sl. No.	Course Code	Host Dept	Course Title	Page No.				
1.	16G7H01	BT	Nanotechnology	30				
2.	16G7H02	СН	Industrial Safety and Risk Management	32				
3.	16G7H03	CV	Intelligent Transport System	34				
4.	16G7H04	CS	Intelligent Systems	36				
5.	16G7H05	EC	Image Processing and Machine Learning	38				
6.	16G7H06	EE	Design of Renewable Energy Systems	40				
7.	16G7H07	IM	Systems Engineering	42				
8.	16G7H08	EI	MEMS and Applications	44				
9.	16G7H9	IS	Introduction to Internet of Things	46				
10.	16G7H10	ME	Industry 4.0 – Smart Manufacturing for The Future	48				
11.	16G7H11	TC	Space Technology and Applications	50				
12.	16G7H12	MA	Advanced linear Algebra	52				
13.	16G7H13	PY	Thin Film Nanotechnology	54				
14.	16G7H14	CY	Engineering Materials for Advanced Technology	56				
15.	16G7H15	HSS	Applied Psychology for Engineers	58				
16.	16G7H16	HSS	Foundational Course on Entrepreneurship	60				
17.	16G7H17	AS	Unmanned Aerial Vehicles	62				

VIII Semester							
Sl. No.	Sl. No. Course Code Course Title						
1.	16IM81	Major Project	64				
2.	16IM82	Technical Seminar	67				
3.	16HS83	Innovation and Social Skills	68				

RV COLLEGE OF ENGINEERING[®] (Autonomous Institution Affiliated to VTU, Belagavi) INDUSTRIAL ENGINEERING AND MANAGEMENT

SEVENTH SEMESTER CREDIT SCHEME									
SI.	Course	Comme Title	D - C	CREDIT ALLOCATION				Total	
No.	Code	Course 1 the	B02	Lecture	Tutorial	Practical	SS	Credits	
1.	16IM71	Principles of Soft Computing	IM	3	0	0	0	3	
2.	16IM72	Financial Accounting and Costing	IM	3	0	0	1	4	
3.	16IM73	Product Design and Development	IM	3	0	1	0	4	
4.	16IM74	Foundations of Business Analytics	IM	3	1	0	0	4	
5.	16IM7FX	Elective F (PE)	IM	4	0	0	0	4	
6.	16IM7GX	Elective G(PE)	IM	4	0	0	0	4	
7.	16G7HXX	Elective H(GE)*	Respective BoS	3	0	0	0	3	
	Total number of Credits			23	01	01	01	26	
	Numb	er of Hours / Wee	k	23	02	2.5	04		

*Students should take other department Open Elective courses;

EIGTH SEMESTER CREDIT SCHEME									
Sl. No.	Course Code	Course Title	BoS -	CI	N	Total			
				Lecture	Tutorial	Practical	SS	Credits	
1.	16IM81	Major Project	IM	0	0	16	0	16	
2.	16IM82	Technical Seminar	IM	0	0	2	0	2	
3.	16HS83	Innovation and Social Skills	HSS	0	0	2	0	2	
Total number of Credits				00	00	20	00	20	
Total Number of Hours / Week				00	00	50	00		

**Non contact hours

VII Semester						
	GROUP F: PROFESSIONAL ELECTIVES					
Sl. No.	. No. Course Code Course Title					
1.	16IM7F1	Industry 4.0 – A Growth in Manufacturing				
2.	16IM7F2	Retail Supply Chain Management				
3.	16IM7F3	Big Data Analytics				
4.	16IM7F4	Technology Management				
5.	16IM7F5	Supply Chain Technologies				
		VII Semester				
		GROUP G: PROFESSIONAL ELECTIVES				
Sl. No.	Course Code	Course Title				
1.	16IM7G1	Additive Manufacturing Methods				
2.	16IM7G2	Lean Manufacturing Systems				
3.	16IM7G3	Engineering Optimization				
4.	16IM7G4	Energy Management				
5.	16IM7G5	Predictive Analytics				

GLOBAL ELECTIVES						
Sl. No.	Host Dept	Course Code	Course Title			
1.	BT	16G7H01	Nanotechnology			
2.	СН	16G7H02	Industrial Safety and Risk Management			
3.	CV	16G7H03	Intelligent Transport System			
4.	CS	16G7H04	Intelligent Systems			
5.	EC	16G7H05	Image Processing and Machine Learning			
6.	EE	16G7H06	Design of Renewable Energy Systems			
7.	IM	16G7H07	Systems Engineering			
8.	EI	16G7H08	MEMS and Applications			
9.	IS	16G7H09	Introduction to Internet of Things			
10.	ME	16G7H10	Industry 4.0 – Smart Manufacturing for The Future			
11.	TC	16G7H11	Space Technology and Applications			
12.	MA	16G7H12	Advanced linear Algebra			
13.	PY	16G7H13	Thin Film Nanotechnology			
14.	CY	16G7H14	Engineering Materials for Advanced Technology			
15.	HSS	16G7H15	Applied Psychology for Engineers			
16.	HSS	16G7H16	Foundational Course on Entrepreneurship			
17.	AS	16G7H17	Unmanned Aerial Vehicles			

Semester: VII PRINCIPLES OF SOFT COMPLITING								
	(Theory)							
Course Code:	:	16IM71		CIE	:	100 Marks		
Credits: L:T:P:S:	:	3:0:0:0		SEE	:	100 Marks		
Hours:	:	33L		SEE Duration	ion : 02Hrs			
Course Learning Objectiv	es: Tl	he students	will be able	to		•		
1 To gain insight into the	princi	ples and cor	nponents of s	oft computing.				
2 To learn the unified and computing techniques.	exact	mathematic	cal basis as we	ell as the general J	princij	ples of various	soft	
To gain knowledge on f	undan	nentals of no	on-traditional	technologies and	appro	aches to solving	g	
3 hard real-world problem	ns, nan	nely of fund	lamentals of a	rtificial neural ne	twork	s, fuzzy sets and	d	
fuzzy logic and genetic	algori	thms.						
		UN	IT-I			06	Hrs	
Introduction Intelligent	svete	ms Know	ledge based	systems Knowl	edge	representation	n and	
processing Soft computing	no nr	oblems	leage based	systems, renown	cuge	representation	i unu	
processing, son company	<u>ng, pr</u>	UNI	T-II			07	Hrs	
Fundamentals of Fuzzy	Log	ic Systems	: Introduction	on background	fuzz	v sets fuzzy]	logic	
operations generalized	fizzy	v operation	ns implicat	ion definitions	filz	ziness and f		
resolution, fuzzy relation	s. con	nposition a	nd interferen	ice.	, 142	Ziness and I	ally	
Fuzzy logic control: In	ntrodu	iction. bac	kground, ba	sics of fuzzy of	contro	l. defuzzifica	tion.	
fuzzification, fuzzy contr	ol arc	hitectures.	properties of	f fuzzy control. 1	robus	tness and stabi	ility.	
		UNI	Ť-III	,		07	Hrs	
Fundamentals of Artif	ïcial	Neural N	etworks: Ir	troduction, lear	rning	& acquisitio	n of	
knowledge, features of	artific	cial neural	networks ((ANN), fundam	entals	s of connection	onist	
modeling.								
Major classes of Neura	al Ne	tworks: Ir	ntroduction,	the multilayer	perce	ptron, radial 1	basis	
function network, Kohor	en's s	self organiz	zing networl	k, the Hopfield	netwo	ork., industrial	l and	
commercial applications	of AN	JN.	C	· •				
		UNI	T-IV			07	Hrs	
Evolutionary computing	ng: Ii	ntroduction	n, overview	of evolutiona	ry co	omputing, ge	netic	
algorithms (GA) and op	timiza	ation, the s	schema theo	rem, GA opera	tors,	integration of	GA	
with neural networks, in	tegrat	ion of GA	with fuzzy	logic, known is	sues	in GA, Popula	ation	
based incremental learning, evolutionary strategies, ES applications.								
UNIT-V 06 Hrs								
Tools of soft computing in real world applications: Soft computing tools for solving a								
class of facilities layout planning problem, mobile position estimation using an RBF network								
in CDMA cellular systems, learning-based resource optimization in ATM networks.								
Course Outcomes: After c	omple	eting the co	urse, the stu	dents will be able	e to			
CO1: Apply the principles and components of soft computing in solving problems.								

CO2:	Develop intelligent systems through case studies, simulation examples and experimental
	results
CO3:	Develop program systems using approaches of these theories for solving various real-world
	problems.

CO4: Evaluate and compare solutions by various soft computing approaches for a given problem.

Refe	Reference Books								
1.	. Soft Computing and Intelligent Systems Design – Theory Tools and Applications, Fakhreddine								
	O Karray &	c Clarence De Sil	va, 2009,	PEARSON	V Education,	ISBN: 978-8	81-317-232	4-1.	
	It is first	t level course intr	oduced an	d the units	are from the	e following c	hapters:	_	
		Unit NoIIIIIIIVV							
		Chapter No	1	2,3	4,5	8	10		
2.	Principles of	of Soft Computin	ıg, S.N. Si	vanandam	and S.N. De	eepa, 1 st Edit	tion, 2007,	Wiley India	
	(P) Ltd., IS	BN: 10:81-265-1	075-7.						
3.	Fuzzy and Soft Computing; A Computational Approach to Learning and Machine Intelligence,								
	J S R Jang, C-T Sun, E Mizatani, Neurp, 1997, Prentice Hall, ISBN: 10:0132610663.								
4.	Soft Compu	uting and its App	lications,	K A Thev	& RR Aliev	, 2001, Wor	ld Scientific	c Publishing	
	Co., Inc. Ri	ver Edge, NJ, US	SA, ISBN:	98102 47	001.				

CIE is executed by way of quizzes (Q), tests (T) and Assignment/Presentation/Project (A). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for Assignment/Presentation/Project 10. Total CIE is 30(Q) + 60(T) + 10(A) = 100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											1
CO2		2	2		1			1				
CO3			2						1			
CO4		2		1	1							

	Semester: VII										
	FINANCIAL ACCOUNTING AND COSTING										
	(Theory)										
Course Code:16IM72CIE:100 Marks							100 Marks				
Cr	edits: L:T:P:S	:	: 3:0:0:1		SEE	:	100 Marks				
Ho	Hours		33	SEE Duration		:	3Hrs				
Co	urse Learning Ob	ject	ives: The stu	dents will be a	ble to						
1	To introduce the	e ba	sic tools and	techniques re	quired in financial	lacc	ounting				
2	To provide an over view of nature of costing and cost accounting.										
3	To give an unde	ersta	nding on act	tivity based co	sting.						

UNIT-I	07 Hrs							
Financial Accounting: Generally Accepted Accounting Practices (GAAP), difference	e between							
financial and cost accounting, Book keeping: double-entry accounting, journal & ledger pos	ting.							
UNIT-II	07 Hrs							
Financial Statements: Trial balance, preparation of Trading and Profit & Loss accoun	t, Balance							
sheet. (problems with simple adjustments)								
UNIT-III	07Hrs							
Costing: Objectives of costing, Elements of costing, preparation of cost sheet.								
Job Costing: Introduction, Batch Costing,								
Process Costing: introduction to Process Costing, Cost accumulation in process costing.								
UNIT-IV	06 Hrs							
Standard Costing: Components of standard cost, Material cost variance, labour cost	variance,							
overhead cost variance.								
UNIT-V	06 Hrs							
Budgeting: sales budget, production budget, cash budget, flexible budget, master budget, budgeting.	zero based							

Overview on activity based costing, lean accounting and accounting packages.

Self Study:
Case study, Design and Emerging Technologies to be discussed pertaining to the course.
1 Credit: 4 Hrs / Week

Course	e Outcomes: After completing the course, the students will be able to
CO1.	Define the needs of the various users of accounting data and demonstrate the ability to
	communicate such data effectively, as well as the ability to provide knowledgeable
	recommendations.
CO2.	Apply appropriate judgment derived from knowledge of accounting theory, to financial
	analysis and decision making.
CO3.	Demonstrate an understanding of different accounting methods to evaluate business
	performance.
CO4.	Define and illustrate various cost terms and concepts and evaluate their relevancy for
	different decision-making purposes.

Refe	erence Books
1.	Cost Accounting, Khan M Y, 7th Reprint Edition, 2007, Tata McGraw-Hill, ISBN - 0070402248
2.	Financial Accounting, P.C. Tulsian, 4th Edition, 2009, Person Education, ISBN -
	9788177582284.
3.	Handbook of Human Factors and Ergonomics, Gavriel. Salvendy, 3rd Edition, 2006, Wiley,
	Hoboken, New Jersey, USA, ISBN: 0471116904.
4.	Introduction to Human Factors Engineering, Christopher D. Wickens, John D. Lee, Yili Liu,

Sallie Gordon-Becker, 2nd Edition, 2003, Pearson Publication, ISBN: 978-0131837362

Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and Assignment/Presentation/Project (A). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for Self Study/Presentation/Project 20. Total CIE is 30(Q) + 50(T) + 20(SS) = 100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

	CO-PO Mapping											
CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1				1						
CO2	2	1				1						
CO3	1	2	1									
CO4		2		1								

	Semester: VII										
	PRODUCT DESIGN & DEVELOPMENT										
	(Theory & Practice)										
Cou	irse Code	:	16IM73		CIE	:	100 + 50 Marks				
Cre	dits: L:T:P:S	:	3:0:1:0		SEE	:	100 + 50 Marks				
Hou	irs	:	33L		SEE Duration	:	3 + 3 Hrs				
Cou	irse Learning C)bjec	tives: The stud	ents will be able	e to						
1	To understand	the st	ructured produ-	et development p	processes						
2	2 To understand the contributions and role of multiple organizational functions for creating a new product										
3	To apply engineering products.	ineeri	ng knowledge	for the develop	oment of innovative	and	market acceptable				
4	To expose the tenets of design and development of a manufacturing process that builds the product at the scales and quality as demanded by the customer and the market										
5	To develop an mission and go	abilit als o	y to coordinate f the product de	multiple, interdi velopment organ	sciplinary tasks in oro iizations.	ler t	o achieve the				
				UNIT-I			06 Hrs				
Intr	oduction: Defi	nitior	n of product de	esign, design by	v evolution, design b	oy ii	nnovation, Essential				
fact	ors of Product	desig	n, Characteristi	cs of successfu	l product developme	nt, '	The Morphology of				
Des	ign (The seven	pha	ses), who Des	igns and develo	ops products, duration	on a	nd cost of product				
deve	elopment, the ch	allen	ges of product o	levelopment.							
Dev	elopment Proc	esses	and Organiza	tions: A generic	development proces	s, cc	oncept development:				
the	front-end proce	ess, a	dapting the ge	neric product de	evelopment process,	the	AMF development				
proc	ess, product dev	velopi	nent organizati	ons, the AMF or	ganization.						
Pro	duct Planning:	The j	product plannin	g process, identi	fy opportunities. Pro	duct	strategies, Analysis				
of a	n product, The	three	S's, Evaluate	and prioritize p	rojects, allocate reso	ource	es and plan timing,				
com	plete pre project	t plan	ning, reflect on	the results and t	he process.						
				LINIT II			06 II.ma				

Identifying Customer Needs: Gather raw data from customers; interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process. Quality Function Deployment.

Product Specifications: What are specifications, Basic design considerations and constraints, Various types of specification, when are specifications established, establishing target Specifications, setting the final specifications.

Concept Generation: The activity of concept generation, clarify the problem, search

UNIT-III

Externally, search internally, Benchmarking, explore systematically, reflect on the results and the process.

Concept Selection: Overview of methodology, concept screening, concept scoring, caveats. Concept Testing: Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, reflect on the results and the process.

Product Architecture: What is product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues.

UNIT-IV07 HrsIndustrial Design: Assessing the need for industrial design, the impact of industrial design, industrial
design process, managing the industrial design process, assessing the quality of industrial
design.
Problems faced by Industrial design Engineer.

Design for Manufacturing: Definition, Approach to design, Production Requirements, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, VCP, Overview of Design for production - Metal parts, Designing with plastics, Rubber,

07 Hrs

ceramics and wood, Impact of DFM & DFX on other factors. Concurrent engineering, reasons for adopting concurrent engineering, factors preventing the adoption of Concurrent engineering.

UNIT-V	07 Hrs									
Prototyping: Prototyping basics, principles of prototyping, technologies, planning for prototypes.										
Product Development Economics: Elements of economic analysis, base case financial mode.										
Sensitive analysis, project trade-offs, influence of qualitative factors on project	success,									
Qualitative analysis.										

Managing Projects: Understanding and representing task, baseline project planning, Accelerating projects, project execution, post-mortem project evaluation.

Pedagogy or Method of conduction of exercises:

- 1. Explain the physical principle of working of the unit.
- 2. Prepare initial sketching of the Component and create a 3d model of the product.
- 3. Chart out design constraints and considerations.
- 4. Prepare component and sub-assembly drawings.
- 5. Identify the material for the component/ sub-assembly based on the requirement. (Reverse Engg)-Tool to be used- Pugh Matrix- Concept scoring and concept screening to be documented.
- 6. Identify quality parameters, critical to quality and critical to safety parameters and conduct FMEA.
- 7. List all the standards, codes referred.
- 8. Prepare Bill of materials for the identified parts.
- 9. Chart out the manufacturing process and sequence.
- 10. Prepare quality plan for production.

Exercises:

- 1. Assembly and Disassembly of a Machine Component.
- Eg: Engine or tail stock of Lathe etc
- 2. Assembly and Disassembly of an Electromechanical Component.
- Eg: Relays, Pumps, Motors, I/O modules, Knobs and Dials etc 3. Assembly and Disassembly of an Electronic component.
- 3. Assembly and Disassembly of an Electronic component. Eg: Camera, Camcorder, VCR, PLC, Interface IC's, etc
- 4. Assembly and Disassembly of a Mechatronic component.
- Eg: Actuators, Sensors, Demo of hybrid car from "ASHWA". Study of electro-pneumatic circuit.
 5. Assembly and Disassembly of a Opto-Electronics
- Eg: Displays, LED Lighting, LED Emitters, Lighting connectors.
- 6. Plumbing- Experiential learning.
- Eg: Cistern Pump, Coupling, Elbow, Bushing, Union.
- Re-design using Rapid Prototyping machine
 Eg: Replace a worn out part with a newly developed prototype and check for form, fit and function.
- 8. Bring Your Own Device (BYOD)
- 9. Any other

Cou	rse Outcomes: After completing the course, the students will be able to							
CO1	. Explain the structured approaches to Product design and development projects.							
CO2	. Understand the challenges facing product designers and appreciate the need for adapting a							
	development mind set							
CO3	. Develop the capability to work in teams and apply the structured product design and							
	development methodologies for solving problems.							
CO4	. Analyze the need for integrated product design and process development frameworks.							
CO5	. Create product solutions and develop prototypes of concepts generated.							
Refe	rence Books							
1.	Product Design and Development, Karl.T.Ulrich, Steven D Eppinger, edition 2009, 2008, Tata							
	McGrawHill, ISBN – 0-07058513-X.							

2.	Product Design and Manufacturing, A C Chitale and R C Gupta, 4 th Edition, 2007, PHI, ISBN:
	9788120333178.
3.	New Product Development, Timjones, 1997, Butterworth Heinmann, Oxford. UCI, ISBN -
	0750624273.
4.	Product Design for Manufacture and Assembly, Geoffery Boothroyd, Peter Dewhurst and
4.	Product Design for Manufacture and Assembly, Geoffery Boothroyd, Peter Dewhurst and Winston A Knight, 3 rd Edition, 1994, Marcel Dekker Inc, ISBN 0824791762.
4. 5.	 Product Design for Manufacture and Assembly, Geoffery Boothroyd, Peter Dewhurst and Winston A Knight, 3rd Edition, 1994, Marcel Dekker Inc, ISBN 0824791762. Product Design, Kevin Otto and Kristen Wood, 1st Edition, 2001, Pearson Education-, ISBN-10:

Professional societies in Product design domain:

- 1. Industrial Designers Society of America IDSA -(http://www.idsa.org/)
- 2. Product Development and Management Association (PDMA)- (http://www.pdma.org/)
- 3. Chartered Society of Designers-(https://www.csd.org.uk/)
- 4. Association of Designers of India (ADI)- (http://www.adi.org.in/)

Continuous Internal Evaluation (CIE); Theory (100 Marks)

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Laboratory- 50 Marks

The Laboratory session is held every week as per the time table and the performance of the student is evaluated in every session. The average of marks over number of weeks is considered for 40 marks. At the end of the semester a test is conducted for 10 marks. Total marks for the laboratory is 50.

Semester End Evaluation (SEE); Theory (100 Marks)

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Laboratory- 50 Marks

Experiment Conduction with proper results is evaluated for 40 marks and Viva is for 10 marks. Total SEE for laboratory is 50 marks.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	1				3	3	3	3	
CO2	2			3	2	3					2	3
CO3	3						3		3			3
CO4		3		3	3	2			3	2		

	Semester: VII							
	FOUNDATIONS OF BUSINESS ANALYTICS							
	(Theory)							
Cou	rse Code	:	: 16IM74		CIE		100 Marks	
Credits: L:T:P:S		:	3:1:0:0		SEE		100 Marks	
Hou	Hours		36L+26T		SEE Duration		3Hrs	
Cou	rse Learning Ob	ojectiv	es: The stud	ents will be	able to			
1	Understand the	need f	for using IT to	ools and the	environment for a bu	isines	s to leverage IT	
2	Differentiate be	etween	OLTP and O	OLAP system	ns			
3	3 Specify requirements for data integration and reporting							
4	4 Extract and analyze databases, and create reports							
5	Understand the need for using IT tools and the environment for a business to leverage IT							

UNIT-I	08 Hrs
Business view of IT applications: Core business processes, Purpose of using IT, Characteria	stics of
Internet ready business applications	
Types of digital data: Structured, semi-structured and unstructured data	
UNIT-II	07 Hrs
Introduction to OLTP and OLAP: OLTP, OLAP, different architectures, models,	OLAP
operations, Leveraging ERP data using analytics	
Business Intelligence : Introduction, Definitions and Concepts, Framework, Users, B	usiness
intelligence applications	
UNIT-III	07 Hrs
Data Integration: ODS, Data warehouse, Mapping & staging, Approaches to integration, Inte	egration
Technologies, Data Quality, Data Profiling	
Multidimensional data modelling: Data modelling basics, Modelling Types and tech	nniques,
Dimension tables	
UNIT-IV	08 Hrs
KPI's and performance management: Terminology, Metrics supply chain, KPI usage in com	panies
Enterprise reporting: Reporting perspectives, Presentation and practices, Balanced score	e card,
Dashboards, Funnel analysis, Distribution Channel analysis, Performance analysis	
UNIT-V	06 Hrs
Business Intelligence trends: Business intelligence and mobility, Business intelligence and	d cloud
computing, Business intelligence for ERP systems, Social CRM and Business Intelligence	

Course Outcomes: After completing the course, the students will be able to						
CO1	Explain the need for data integration, extraction and reporting					
CO2	Extract data from varied sources and integrate					
CO3	Analyze data using data handling tools					
CO4	Create enterprise reports for the purposes of monitoring.					

Refe	erence Books
1.	Fundamentals of Business Analytics, R N Prasad, Seema Acharya, 2 nd edition, 2016, Wiley
	India Pvt Ltd, ISBN: 9788126563791, 8126563796
2.	Decision Support Systems and Intelligent Systems, Efraim Turban, Jay Aronson, 6 th Edition,
	2001, Pearson Education Asia, ISBN: 81 7808 367 1
3.	Business Analytics, James Evans, 2 nd edition, Pearson, ISBN: 9789332582095, 9332582092
4.	Introduction to Business Analytics Using Simulation, Jonathan P. Pinder, Elsevier, 2016, ISBN:
	0128104848, 9780128104842

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	CO-PO Mapping											
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2									1		
CO2		1			2							
CO3	1	3		2	2							1
CO4				1	2	1		1		1		

Semester: VII							
	In	dustry 4.0 – A G	rowth in Manuf ofessional Electiv	facturing			
Course Code:	:	16IM7F1		(,)	•	100 Marks	
Credits: L:T:P:S:	•	4:0:0:0	SEE		•	100 Marks	
Hours:	•	441	SEE SEE I	Juration	•	3Hrs	
Course Learning Obie	tiv	es: The students wi	Il be able to		•	51115	
Realize about wh	at i	s Industry 4.0 – A	Growth in Manı	ifacturing	and	its importance for	
1 today's Manufact	uring	g industry		6			
2 Learn the various	com	ponents of Industry	4.0 in Manufactur	ring			
2 Explore the futur	e tre	ends in Project Port	folio Selection fo	r the Digital	l Tra	ansformation Era in	
3 manufacturing and	d ser	vice sectors.					
4 Awareness of the	lates	st manufacturing tre	nds of Industry 4.0) in manufa	cturi	ng.	
		Unit –		T 1		10 Hrs	
Understanding Indust	try	4.0: A Conceptual	Framework for	Industry 4	ł.0,	Introduction, Main	
Eromouverly for Industry	ents	of Industry 4.0, S	tate of Art, Supp	portive lecr	inoic	gies and Proposed	
Key Rusiness Model	4.0. Con	nonents of Smar	t and Connected	l Products.	Pro	posed Framework	
Value Proposition. IoT	Valu	e Creation Lavers a	nd Technologies.	a i i ouucis.	110	posed Trainework,	
,		– Unit –	II			09 Hrs	
Lean Production Sys	tem	s for Industry 4.	0: Introduction,	Literature	Revi	ew, The Proposed	
Methodology, Automati	on E	Based Lean Producti	on Applications.			-	
Maturity and Reading	ess l	Model for Industr	y 4.0 Strategy:	Existing Ind	lustr	y 4.0 Maturity and	
Readiness Models, IN	ЛРU	LS—Industry 4.0	Readiness, Indu	ıstry 4.0/Di	gital	Operations Self-	
Assessment, The Com	necte	ed Enterprise Matu	urity Model, Cor	nparison of	Ex	isting Industry 4.0	
Maturity and Readiness	s Mo	odels, Proposed Ind	ustry 4.0 Maturit	y Model, A	n A	pplication in Retail	
Sector.						0.0.77	
	C	$\underline{\text{Unit}}$		C T 1 1		09 Hrs	
Technology Roadmap	ior Due	Industry 4.0: Prop	osed Framework	for Technol	ogy	Roadmap, Strategy	
Phase, New Product and Project Portfolio Solo	l Pro	cess Development I	nase.	Fran Drainat	Dor	tfalia Ontimization	
Model Application	cuor	i for the Digital I	ransformation	Lra: Flojeci	FOI	tiono Optimization	
Talent Development for	r In	dustry 4 0 • Skill Re	equirements in the	Digital Wor	rld ⁻	Falent Development	
Practices for Industry 4.	0.		equilementes in the	Digital Wo	ina, i		
		Unit –	IV			08 Hrs	
Data Analytics in Mar	nufa	cturing: Consumpt	ion in Manufactu	ring, Quality	y Pre	ediction, Estimation	
of Manufacturing Cost	of co	omponents, Internet	of Things and Ne	w Value Pro	opos	ition, 4 IoTs Value	
Creation Barriers: Stand	lards	, Security and Priva	cy Concerns, Priv	acy concerns	s, Sta	andardization.	
Advances in Robotics	in t	he Era of Industr	y 4.0: Recent Teo	chnological	Com	ponents of Robots,	
Advanced Sensor Tech	nolo	gies, Cloud Robotic	cs, Industrial Rob	otic Applica	ition	s, Maintenance and	
Assembly.							
Unit-V 08 Hrs							
Additive Manufacturi	ng	Fechnologies and	Applications: Ste	ereo lithogra	aphy	, Fused Deposition	
Modeling, Selective Laser Sintering, Laminated Object Manufacturing, Application Areas of Additive							
Manufacturing, Laser	Manufacturing, Laser Engineered Net Shaping, Advantages of Additive Manufacturing,						
Disadvantages of Addit	ve N	Aanufacturing.					
					~		
Course Outcomes: Aft	er co	lamontal concentration	se, the students w	tod to manual	0	mina	
CO2 Analyze Lagrand		namental concepts of	Industry 4.0 relat	Moturitar		ning andinasa Madal far	
CO2. Analyze Lean Production Systems for Industry 4.0 and Maturity and Readiness Model for Industry 4.0							

Evaluate the different components of Industry 4.0 Manufacturing systems.

CO3.

CO4. Elucidate different aspects of Data Analytics, Advances in Robotics in the Era of Additive Manufacturing Technologies and Applications used in Industry 4.0

Refe	erence Books
1.	Industry 4.0: Managing The Digital Transformation, Ustundag, Alp, Cevikcan, Emre, ISBN
	978-3-319-57870-5, http://www.springer.com/978-3-319-57869-9
2.	Industry 4.0: The Industrial Internet of Things, Alasdair GILCHRIST, ISBN 978-1-4842-2047-
	4, http://www.springer.com/978-3-319-57869-9
3.	The Concept Industry 4.0-An Empirical Analysis of Technologies and Applications in
	Production Logistics, Bartodziej, Christoph Jan, 2017, Springer Gabler, ISBN 978-3-658-16502-
	4
4.	Industry 4.0: Entrepreneurship and Structural Change in the New Digital Landscape, Devezas,
	Tessaleno, Leitão, João, Sarygulov, Askar (Eds.), 2017, Springer, ISBN 978-3-319-49604-7

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CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3					2						3
CO2				1		2						
CO3					3	2			1		3	
CO4						1					2	

	Semester: VII						
	RETAIL SUPPLY CHAIN MANAGEMENT						
			(Group F:]	Profess	sional Elective)		
Course Code:16IM7F2CIE:100 Marks				100 Marks			
Credits: L:T:P:S			4:0:0:0		SEE		100 Marks
Hou	rs	:	44L		SEE Duration		3Hrs
Cou	rse Learning Objec	tives	s: The students	will be	able to		
1	1 To explain the concepts and drivers of the retail supply chain.						
2	2 To identify the market need and market value to customers in retail supply chains.						
3	3 To apply tools and techniques for improving the retail supply chain processes.						
4	To evaluate and select among alternate retail formats for various applications.						

UNIT-I	09 Hrs		
An Overview of Strategic Retail Management : Supply Chain: An Introduction to Retailing,	Reasons		
for studying Retailing, Special characteristics of retailing, Importance of developing and applying a			
retail strategy, The Retail concept, Case Studies			
Building and Sustaining Relationships in Retailing Building and Sustaining Relation	ships in		
Retailing, Value and Value chain, Retailer relationships, Differences in relationship building	between		
Goods and service retailers, Technology and relationships in retailing, Ethical performa	nce and		
relationships in retailing			
UNIT-II	09 Hrs		
Strategic Planning in Retailing, Situation Analysis, Ownership and management alte	rnatives,		
Goods/service category, Personal abilities, Financial resources, Time demands, Objective	s, Sales,		
Profit, Satisfaction of publics, Image, Selection of objectives Identification of c	onsumer		
characteristics and need, Overall strategy, controllable variables, Integrating overall strategy	specific		
activities, control, feedback, Case Studies			
Situation Analysis: Retail Institutions by Ownership, Independent, Chain, Franchising,	Leased		
Department, Vertical Marketing System, Consumer Cooperative, Horizontal Marketing	System,		
Retail Institutions by Store-Based Strategy Mix, Considerations in planning a retail strategy	mix, the		
wheel of retailing, scrambled merchandising, retail life cycle, mergers, cost containme	nt, rural		
retailing in India, Web, Nonstore-Based, and Other Forms of Nontraditional Retailing, Web I	Nonstore		
based, and other forms of non traditional retailing, Direct marketing, Domain of direct marketing, Domain of direct marketing, Domain of direct marketing, Direct marketing, Domain of direct marketing, Direct ma	arketing,		
customer data base, key issues, steps in a direct marketing strategy, Vending Macines, E	lectronic		
retailing, emergence of world wide web, role of web, scope of web retailing, factors to o	consider,		
examples Case Studies	00 TT		
	08 Hrs		
Targeting Customers and Gathering Information: Identifying and Understanding Con	nsumers,		
Consumer Demographics and lifestyles, Consumer needs and desires, Shopping attitu	des and		
behavior, Retailer actions, Environmental factors, Information Gathering and Processing in R	etailing,		
information flows, Avoiding retail strategies based on inadequate information, Retail info	ormation		
system, Market research Case Studies	o' 1		
Choosing a Store Location: Irading-Area Analysis, Use of geographic information systems,	Size and		
snape, Characteristics of Trading areas, Population, Economic base characteristics, n	ature of		
Competition, Site location Managing a Datail Dusingers Datail Opportunization and Human Description Management Sett			
Managing a Retail Business: Retail Organization and Human Resource Management, Sett	ling up a		
retail organization, specifying tasks to be performed, dividing tasks among channel mem	bers and		
customers, grouping tasks into jobs, classifying jobs, developing an organization chart	00 II.ma		
UNIT-IV Marahan dising Managamant and mising Davalaning Marahan disa nlang. Manahan dising nki	U9 Hrs		
Pusing Organization formate and processes level of formality Degree of control	lization		
Dusing Organization formats and processes, level of formativy, Degree of central	a Dlana		
Category Management Softwares	g rians,		
Unplementing Marchandise Dlang: Gathering Information Selection and interaction Ex	aluation		
implementing merchandise rians: Gamering information, Selection and interaction, EV	aiuailon,		

Negotiation, Conclusion, Receipt and Stocking, Reordering, Re-evaluation, Logistics, Performance Goals, Supply Chain Management, Ordering Processing and Fulfillment, Transportation and Warehousing, Customer Transactions and customer service, Inventory management, Retailer tasks, Inventory levels, Security, Reverse logistics, Inventory analysis

UNII-V	09Hrs
Pricing in Retailing: External factors affecting a retail price strategy, consumer and retail	pricing,
government and retail pricing, Manufacturers, wholesalers, competition and retail pricing, De	veloping
a retail price strategy, Retail Objectives and pricing, Broad price policy, Price	strategy,
Implementation, Price adjustments, Case Studies	
Dutting it all tagether Integrating and Controlling the Datail Strategy Diaming proceed	umag and

Putting it all together: Integrating and Controlling the Retail Strategy, Planning procedures and Opportunity Analysis, Defining Productivity in a manner consistent with the strategy, Performance measures, Scenario Analysis, **Case Studies**

Course Outcomes: After completing the course, the students will be able to

- **CO1.** Explain the building blocks of a typical retail supply chain.
- **CO2.** Understand the functionalities of retail supply chain processes.
- **CO3.** Analyze various types and formats of retail supply chains.

Reference Books

1.	Retail Management: A Strategic Approach, Barry Berman, Joel R. Evans and Mini Mathur, 11th
	Edn, 2011, Pearson Education, ISBN - 9788131733769,
2.	Supply Chain Management for Retailing, Rajesh Ray, 2009, Tata McGraw Hill, ISBN : 978-0-
	07-014504-7
3.	Retail Supply Chain Management, James B Ayers, Mary Ann Odegaard, 1st Edition, 2007,
	Auerbach publications, ISBN:978-0-8493-9052-4

4. Retail Supply Chain Management, quantitative models and empirical studies, NarendraAgarwal, Stephen A.Smith, 2009, Springer publications, ISBN:978-0-387-78902-6

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CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1		1	1			2			2		
CO2		2	1		1	2	2				3	1
CO3		1	3	1			2				2	2
CO4	1		1	1			2			2		

		S	emester:	VII				
		BIG D	ATA ANA	LYTICS				
	(Group F : Professional Elective)							
Course Code	Durse Code : 161MI/F3 CIE : 100 Marks							
Credits: L:T:P:S	:	4: 0: 0: 0		SEE	:	100 Marks		
Hours	:	44L		SEE Duration	:	3Hrs		
Course Learning C	<u>bje</u>	ctives: The students	s will be a	ole to				
1 Define big dat	ta fo	r business intelligent						
2 Analyze busin	iess	case studies for big c	lata analyt	ICS				
3 Explain mana	ging radi	s of Big data without	L SQL	related tools				
4 Develop map-	ieu	tee analytics using h	ladoop and	Telated tools				
			NIT-I			10 Hrs		
UNDERSTANDIN	GF	BIG DATA: What	is big dat	a why big data. Da	ata	Storage and Analysis		
Comparison with	Othe	er Systems, Rationa	al Databa	se Management System	sten	n , Grid Computing,		
Volunteer Computir	ng, c	convergence of key t	rends – un	structured data – indi	ustr	y examples of big data		
– web analytics –	big	data and marketing	– fraud a	nd big data – risk a	ind	big data – credit risk		
management - big	data	and algorithmic tra	ding – big	data and healthcare	- 1	oig data in medicine -		
advertising and big	data	– big data technolog	gies – intro	duction to Hadoop -	- op	en source technologies		
– cloud and big data	- n	nobile business intelli	igence					
NOCOL DATA M	4 B T					10 Hrs		
NOSQL DATA M.	ANA	AGEMENT: Introdu	iction to N	oSQL - aggregate d	ata	models – aggregates –		
key-value and docu	mer	it data models – rela	ationships	- graph databases -	- SC	nema less databases –		
combining – compo	– u sina	man-reduce calculati	- shading	— version – map i	leut	ice – partitioning and		
comoning – compo	sing	Inap-reduce careurati	IT-III			08 Hrs		
BASICS OF HAD	000	P: Data format –	analyzing	data with Hadoop	- 5	scaling out – Hadoop		
streaming - Hadoo	o pi	pes – design of Had	oop distril	outed file system (H	DFS	S) - HDFS concepts -		
Java interface – data	flo	w – Hadoop I/O – da	ta integrity	v – compression – ser	iali	zation		
		UN	IT-IV			08 Hrs		
MAPREDUCE AP	PL	CATIONS: MapRe	duce work	flows – unit tests wi	th N	ARUnit – test data and		
local tests – anatomy	y of	MapReduce job run	– classic N	Iap-reduce – YARN	— jo	ob scheduling – shuffle		
and sort – task exect	ition	n – MapReduce types	<u>s – input fo</u>	ormats – output forma	ats	00 H		
	ED		<u>NTT-V</u>	1. 1		08 Hrs		
HADOOP RELAI	ED	IOOLS: Hbase – o	lata model	and implementation	$S - 1_{ac}$	Hbase clients – Hbase		
Hadoon integration	Dig	andra – Cassandra C	nadel His	- Cassanura examp	iles	- Cassandra chenis -		
definition – HiveOI	dat	a manipulation – Hiv	veOL quer	es				
	aut		eqL quer					
Course Outcomes:	Aft	er completing the co	ourse, the	students will be able	e to			
CO1. Describe big	g dat	ta and use cases from	n selected	business domains and	d ey	xplain NoSQL big data		
managemen	t					_ ` `		
CO2. Install, conf	igur	e, and run Hadoop ar	nd HDFS					
CO3. Perform mag	p rec	duce analytics using	Hadoop					
CO4. Analyze big	data	a using Hadoop relate	ed tools su	ch as HBase, Cassan	dra,	Pig, and Hive		

Reference Books

1.	Hadoop: The Definitive Guide, Tom White, 3rd Edition, 2012, O'Reilley, ISBN-13: 978-
	1449311520
2.	Hadoop Operations, Eric Sammer, 2 nd Edition, 2015, O'Reilley, ISBN-13: 978-1491923832
3.	Big data analytics with R and Hadoop, Vignesh Prajapati, 2013, Packt Publishing Limited,
	ISBN-13: 978-1782163282
4.	HBase: The Definitive Guide, Lars George, 2nd Edition, 2017, O'Reilley, ISBN-13: 978-

	1491905852
5.	Programming Pig: Dataflow Scripting with Hadoop, Alan Gates and Daniel Dai, 2 nd Edition,
	2016, Shroff Publishers & Distributors Pvt. Ltd., ISBN-13: 978-9352134885

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					CO-I	PO Maj	pping					
CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						1				2		
CO2	1				3							1
CO3	1	2		2	3							1

			S	emester	: VII			
			TECHNOL	OGY M	ANAGEMENT			
	(Group F : Professional Elective)							
Cour	se Code	:	116IM7F4		CIE	:	100 Marks	
Cred	lits:L:T:P:S	:	4: 0: 0:0		SEE	:	100 Marks	
Hou	rs	:	44L		SEE Duration	:	3Hrs	
Cour	rse Learning O	bje	ectives: The student	s will be a	able to			
1	Explain the co commodity.	nce	epts and meaning of t	echnolog	y with an emphasis	on	Fechnology as a	
2	Identify the ch	alle	enges in adoption of	new techi	ology.			
	~		U	NIT-I			09 Hrs	
The	Concept of T	ech	hnology: Introductio	n, The n	ature of knowledg	e, A	Aspects of classification,	
Conc	ept and Meani	ng	of technology, the c	character	of a specific techn	olog	gy, Scope of technology,	
Leve	is of technology	/, ιε	echnology portiollos,		gy as an environme	nı.	00 11.40	
The	Natura of Too	hno	Ul alagiaal Changas Int	NII-II	Maaning of tash		giaal ahanga Concent of	
inver	tion Nature of	unio fi	innovation Emerger	nounction	w technologies I	ife	cycle of a technology	
Moti	vation for tech	,, 1 100	ogical change Nature	e of techn	ological progress	Vatu	ire of mature technology,	
Natu	re of diffusion.	Tec	chnological converge	nce.	ological progress, i	iutu	ine of matare teenhology,	
11000		100	UN	NT-III			08 Hrs	
The	Economics of	Те	echnology: Introduct	ion. Mea	ning of technologi	cal	economics. Examples of	
techr	ological econo	mi	cs, Scope of techno	ological e	conomics, Enginee	ring	g economics, Production	
econ	omics, Concept	of	f economy of scale,	Concept	of optimum size,	tech	nology as a commodity,	
techr	ology at the ma	cro	o-economic level.	_	_			
			UN	NIT-IV			08 Hrs	
Corp	orate Techno	log	gy Strategy: Introdu	iction, T	he business missio	on,	Where is the business?	
Conc	ept of busines	S S	strategy, Capability	for strat	egic planning, Co	por	ate technology strategy,	
Com	petitive techno	olog	gy, Focus of strate	egy, tech	nological alliance	s, l	Realization of strategy,	
techr	ology crisis.		TI				10.11	
	<u> </u>				<u>, 1 (° C</u>		10 Hrs	
 Technology an Instrument of Competition: Introduction, Securing competitive advantage, Technological competition analysis, Technological leadership, Adoption of new technology, marketing a new technology product, Retention of competitive advantages. Concurrent Engineering –Introduction, Basic principles, components of CE models, Benefits, co- operative concurrent teams, Types of CE organisations. 								
Сол	se Outcomes:	Aft	ter completing the c	ourse. th	e students will be a	ble	to	
CO1	. Explain the	nat	ure of technological	change ar	d its life cycle.		• •	
CO2	. Apply skills	ne	cessary to analyze ch	allenges	n adoption of new 1	ech	nology.	
CO3	Evaluate the	im	portance of Econom	ics in tech	nology assessment	and	related strategies in	
	various indu	stri	ies.		morogy assessment	and	Totatou Stratogios III	
CO4	. Select relev	ant	t technologies and pla	an for exe	cution.			

Reference Books

1.	The Management Of Technology – Perceptions & Opportunities, Paul Lowe, 1995, Chapman &
	Hall, London.
2.	Strategic Management of Technology, Frederick Betz, 1993, McGraw-Hill Inc.
3.	Management of Technology & Innovation: Competing Through Technological Excellence,
	1995, Rastogi, P. N, Sage Publications.
4.	Concurrent Engineering – Shortening Lead Times, Raising Quality & Lowering Costs, Hartely
	R John, 1998, Productivity Press, Portland, Oregon ISBN - 1563271893.

CIE is executed by way of quizzes (Q), tests (T) and Assignment/Presentation/Project (A). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for Assignment/Presentation/Project 10. **Total CIE is 30(Q) + 60(T) + 10(A) = 100 Marks**.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

					CO-]	PO Ma	pping					
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			2	1	3	1	1			1	1	
CO2		3			1				2	1		1
CO3		2						2	1	1	3	2
CO4		1		1			1	1	3	1	2	

				Semester: VII				
			SUPPLY	CHAIN TECHNOL	OGIES			
			(Grouj	5 F : Professional Elec	tive)			
Cou	rse Code	:	16IM7F5		CIE	:	100 Marks	
Crea	lits:L:T:P:S	:	4:0:0:0		SEE	:	100 Marks	
Hou	rs	:	45L		SEE Duration	:	3Hrs	
Cou	rse Learning Ol	ojec	tives: The stud	ents will be able to				
1	Describe syste	ms	available to gi	ve support to Supply	chain Information	Sy	stems support,	
	demonstrating	key	tasks with Anal	Supply Chain Tash	rl.		antribution in	
2	institutionalizir	ng Ir	dustry best pra	ctices.	lologies, and the	ſ	contribution in	
3	Explore the ful	l arr	ay of technolog	y tools to assist in the r	nanagement of ever	y b	ousiness activity	
	from Manufact	urin	g to transaction	control, to internet base	ed trade and comme	erce	•	
							00 11	
Laar	Summler Chain		1 Tashralarra	UNII-I	Uarry Dia an One		U9 Hrs	
Evte	nded and Offer	and G	lobal Supply (A Perfect Combination	I, HOW BIG an Opp	ori	unity is it, The	
Infor	mation Technol		(IT) Ricks and	Rewards Linking Con	, information sys	nen n th	e Value Chain	
Com	netitive Strategy	Bu	siness Processe	s and IT Structure Alio	mpetitive Strategy a	5 11	le value Cham,	
Softy	ware and Hard	ware	e Sourcing Pr	ocess and Application	ns of Supply Cha	ain	and Logistics	
Man	agement Techn	olog	y, The Procu	rement Process, Iden	tify and Review	Re	quirements,	
Softv	ware and Hard	lwai	e Selection,	Implementation Partne	er/VAR Selection,	Ν	Jake or Buy,	
SCM	System Costs	and	Options, "Bes	t-in-Class" Versus Sin	gle Integrated Solu	ıtio	n, Consultants,	
Proje	ect Management,	, Su	pply Chain Sof	tware Market, Supply	Chain Planning (So	CP)	, Supply Chain	
Exec	ution (SCE), Oth	ner S	Supply Chain To	echnologies, Emerging	Supply Chain Tech	nole	ogy Trends	
				UNIT-II			09 Hrs	
PLA	N: Supply Cha	in N	Network Optim	ization, Strategic Plani	ning Level, Tactica	ıl F	Planning Level,	
Oper	ational Planning	g, L	Demand Foreca	sting Systems, A Lea	n Approach to Fo	rec	asting, Typical	
Fore	casting Process	, ⊦ 11	orecasting le	chnology Options and	d Requirements,	Lea	an Forecasting	
Tech	nology Lase S		les, Sales and $/A$ garagete Play	i Operations Planning	g (S&OP), OP/Ag	ggre	egate Planning	
SOL	BCF • Material	Re	nuirements Pla	nning (MRP) Procure	ment and Purchasi	nσ	Defined The	
Purc	hasing Process	Tvr	es of Business	Purchasing Material	Requirements Plar	ng	rg Technology	
Lean	MRP and Te	echr	ology Case S	Studies. Procurement	(and e-Procurement	nt)	Systems. The	
Proc	urement Proces	s.	Automation o	f Procurement Docu	ments and Proce	sse	s Procurement	
Tech	nology	,						
				UNIT-III			09 Hrs	
MA	KE: Enterprise I	Reso	ource Planning	(ERP) Systems, Manu	facturing Executio	n S	ystems (MES),	
The	Role of MES in '	Tod	ay's Competitiv	e Environment, Manufa	acturing Execution	Sys	stems and Lean,	
MES	, Lean, and Vis	sual	Management S	Systems, Lean Supply	Chain and Manufa	ictu	ring Execution	
Syste	ems Case Studie	s_A	dvanced Planni	ng and Scheduling (Al	PS) Systems, Adva	nce	d Planning and	
Sche	duling Systems	Tee	chnology, Adva	anced Planning and So	cheduling Systems	Te	chnology Case	
Stud	ies	<i>,</i> .	D : (חר		
DEL	IVER: Distribu	Jt101	n Requirement	s Planning (DRP), L	DRP Software, DI	ΥΥ Τ	Case Studies,	
Tran Cose	Studies Order	gem	ent Systems (1	MS), Transportation M	anagement System	10	WMS) Order	
Man	agement System	-1'u s (O	MS) Customer	Relationshin Managen	nagement (CRM) System	- (16]	[ean and Order	
Fulfi	llment . Order Fi	ulfil	lment Case Stu	lies	ient (CICIT) System	13, 1		
1 4111		****		UNIT-IV			09 Hrs	
RET	URN: Reverse	Log	istics Systems	Lean Reverse Logistic	cs. Elements Kev 1	0.7	Lean Reverse	
Logi	stics Proces	E S,	Lean a	nd Reverse L	ogistics Techn	olo	gy Cases	
ENA	BLE: Measurer	nen	ts, Metrics, and	Analytics, Measurem	ent and Analysis I	Pro	cess, What and	
Whe	Where to Measure, Using the SCOR Model to Measure and Control, Supply Chain Analytics, Supply							

Chain Decision Support and Analytics Technology, Lean and Supply Chain Analytics Technology Case Studies

UNIT-V	09 Hrs
FUTURE TRENDS: Collaborative Supply Chain Systems, The 80/20 Rule, Collaboration fo	r a Lean
Supply Chain, Integrated and Collaborative Technology for a Leaner Supply Chain, Le	ean and
Collaboration Technology Case Studies, Emerging Technologies and Their Potential Impact	s on the
Lean Supply Chain, General Supply Chain Trends, Supply Chain Software and Cont	nectivity
Technology Trends, Supply Chain Software Best Practices	
Supply Chain Hardware Technology Trends, Hardware Technologies for a Competitive Adva	intage in

the Next Decade, Future Supply Chain Technology Spending, Looking Ahead

Course	e Outcomes: After completing the course, the students will be able to
CO1.	Explain in detail how Supply chain processes are combined with technologies to provides
	complete end to end solutions in line with Industry best practices
CO2.	Understand and assess the fusion of best practices with development in technologies to solve
	problems for Industry on a mass scale.
CO3.	Analyze the future course of development of Supply Chain Technologies in line with the
	latest solutions to business problems and assess their impact.

Reference Books

1.	Lean and Technology: Working Hand in Hand to Enable and Energize Your Global Supply
	Chain Paul A. Myerson, Published Oct 27, 2016 by Pearson FT Press. Part of the FT Press
	Operations Management series.
2.	Introduction to Supply Chain Management Technologies, David Frederick Ross, 2 nd Edition
	CRC Press Taylor & Francis Croup Boca Raton London New York.
3.	Supply Chain Information Technology, David Olson, 2012, Business Expert Express
4.	The Global Supply Chain: How Technology and Circular Thinking Transform Our Future,
	Wolfgang Lehmacher 2017 Springer ISBN 9783319511146

Continuous Internal Evaluation (CIE); Theory (100 Marks)

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CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2				2					2		
CO2			1						1		1	
CO3	2	2	1	2		1		1				2
T 4 14		A TT!	1 0									

Semester: VII											
		AI	DITIVE MA	ANUFACTUR	ING METHODS						
			(Group	G: Professiona	l Elective)		1				
Cours	e Code	:	16IM7G1		CIE	:	100 Marks				
Credit	s :L:T:P:S	:	4:0:0:0		SEE	:	100 Marks				
Hours		:	44L		SEE Duration	:	3Hrs				
Cours	Course Learning Objectives:										
1 I	1 Explain different prototyping techniques and solutions.										
2 0	Contrast and enume	erate	e advantages :	from different p	rototyping solutions						
				TT •4 T			00.11				
T., 4.,			Dura ta ta ang 7	Unit-I	NL - 1 f 41 -		U9 Hrs				
develo	uction: Definition		vstems class	ification of RP	ype, Need for the	com	of P P				
uevelo	pinent, mistory or i		ystems, class		systems, ribeess en	am	01 K1 . 09 Hrs				
Liquid	Based Ranid	Pro	totyping Sv	stem: Stereo	ithography System	s -	Principle, process				
specifi	cation & materials.	adv	vantages and	disadvantages.			· · · · · · · · · · · · · · · · · · ·				
Rapid	Freeze Prototy	, pin	g: Principle	, process spe	cification & mate	rial	s, advantages and				
disadva	antages.	•									
			I	J NIT-III			09 Hrs				
Solid 1	Based Rapid Pro	toty	ping System	n: Fused Depos	sition Modeling (FI	DM)	: Principle, Process				
specifi	cation & materials,	, adv	vantages and	disadvantages.							
Lamin	ated Object Man	ufa	cturing (LO	M): Principle, 1	LOM specification	& m	naterials, advantages				
and dis	sadvantages.	1.7			• •	• ~					
3D Sy	stem's Multi-Jet	NIO	delling Syste	em (MJM): Pri	nciple, process spe	C111C	ation & advantages				
and dis	sadvantages.		T	INIT IV			10 Hrs				
Powde	er Based Ranid P	roto	tvning Syste	m. Selective La	ser Sintering (SLS)	· Pr	inciple of operation				
process	s parameters, advai	ntag	es and disadv	antages.	iser bintering (bLb)	• 1 1	incipie of operation,				
Laser	Engineering Net S	Shaj	oing (LENS)	: Principle of or	peration, process par	ame	ters, advantages and				
disadva	antages.	,		1 1			<i>, C</i>				
3-D Pr	rinter: Principle of	ope	ration, proces	ss parameters, a	dvantages and disad	vant	tages.				
				UNIT-V			08 Hrs				
Rapid	Prototyping Data	ı Fo	rmats & Ap	plications: Dat	a Formats, STL For	mat,	, STL file problems,				
conseq	uences of building	val	id and invalio	tessellated mo	dels, STL file repair	: Ap	oplications: Material				
Relatio	onship, finishing p		sses, Design,	Manufacturing	and Tooling, auton	notiv	ve Industry, Jeweler				
Industr	ry, Coin Industry, I	abl	eware Industr	ry, Arts and arch	ntecture.						
Cours	Qutaamas: Afta	r 001	mplating the	agurea tha stu	dants will be able t	0					
	Explain the basic	n cu	inciples and	methodology o	f various additive n	u nanı	ifacturing processes				
	that are used for t	the t	production of	mechanical par	ts and products	and	macturing processes				
CO2:	Compare and cor	ntra	st the advant	ages and limitation	tions of different ad	lditi	ve manufacturing				
	processes										
CO3:	Solve the proble	ms	on processin	ng time and ec	onomics of process	ing	of material with				
	respect to an addi	itive	manufacturi	ng process.	ł	C					

CO4: Apply the design concept of various additive manufacturing processes when a specific product has to be manufactured.

Ref	erence Books
1	Rapid Prototyping Principles and Applications, C.K.Chua,K.F.Leong C.S Lim, 3 rd Edition, 2010,
	Cambridge University Press India Pvt. Ltd., ISBN:13:978-81-7596-778-6
2	Rapid Manufacturing, Pham D.T & Dinjoy S.S, 2001, Verlog London.
3	Wohler's Report 2000, Terry Wohler's, 2000, Wohler's Association.
4	Additive Manufacturing Technologies - 3D Printing, Rapid Prototyping & Direct Digital

Manufacturing, Ian Gibson, David Rosen, Brent Stucker, 2nd Edition 2014, Springer, ISBN: 978-1-4939-2112-6

Continuous Internal Evaluation (CIE); Theory (100 Marks)

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	CO-PO Mapping											
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1											
CO2	2								2			
CO3		2		2								
CO4		1			1	1		1			1	

High-3 : Medium-2 : Low-1

			Semester: V	I		
		LEAN M	ANUFACTURI	NG SYSTEMS		
Course Code	:	(Grou 16IM7G2	up G: Protession	CIE	:	100 Marks
Credits: L:T:P:S	:	4:0:0:0		SEE	:	100 Marks
Hours	:	44L		SEE Duration	:	3Hrs
Course Learning	Dbj	ectives: The st	udents will be ab	le to		
1 Explain the p	ract	ices of lean ma	nufacturing in To	yota production syst	tem	
2 Implement le	an i	n different proj	ects.			
1		1				
			UNIT-I			09 Hrs
Lean Manufacturi	ng a	and the Toyo	ta Production S	ystem: Definition	of I	ean, Ohno's thought
about the Toyota Pre	oduo	ction System, 7	The TPS and Lean	Manufacturing De	efine	d, The Two Pillars of
the TPS, Several Re	evol	utionary Conc	epts in the TPS,	The TPS Is Not a	Cor	nplete Manufacturing
System, Where Lear	Wi	ll Not Work	or Not Work Qui	te so Well.		
			UNIT – II			09 Hrs
Calculations, Make- Lean Manufacturii Control	:o-S 1g: '	tock versus Ma The Philosophy	y and Objectives,	the Foundation of	Qua	lity Control, Quantity
	• •	1.0.	$\frac{\text{UNII} - \text{III}}{\text{OL} - 1\text{T}}$		T .	
Time Reductions, Te How to Do Lean- Change, Some Cultu How to Do Lean- Strategies Implement	chn —C ral I the	iques to Reduc ultural Chang Aspects of a Le Four Strategi	the point lead Times ge Fundamental ean Implementation les on the Production	s: Three Fundame n Lean: Overview of on Line	ental	Issues of Cultural Lean Implementation
Strategies, implement	101112	<u>S Leun Strategi</u>	UNIT – IV			09 Hrs
How to Implemen	t L	ean—The Pre	escription for th	e Lean Project: A	An (Overview on How to
Implement Lean an System wide Evalu Current Condition, Implement the Kaize Planning and Goal Deployment, Leader Sustaining the Gair	d ste ation Red n A s: F ship s: I	eps: Assess the n of the Prese esign to Redu ctivities, Evalu Hoshin–Kanri H o in Goal Devel mportance of S	e Three Fundame ent State, Perforn ice Wastes, Evalu- iate the Newly Fo UNIT – V Planning, importa copment and Deple Sustaining the Gai	ental Issues to Cult an Educational E nate and Determine rmed Present State, nce of Goals and C byment. ns, existence of Proc	ural value the <u>Stre</u> Goal	Change, Complete a lation, Document the e Goals for the Line, <u>sss the System.</u> 08 Hrs Deployment, Policy gain and loss.
_						
Course Outcomes	Af	ter completing	the course, the stu	idents will be able to	0	
CO1 Explain the	prin	ciples of Lean	and Toyota Manu	facturing systems.		
CO2 Appreciate t	he u	tility and capa	bility of Lean thir	king.		
CO3 Apply the t	ools its	in lean manu	facturing to analy	vse a manufacturing	g sy	stem and plan for its

CO4 Develop the skills to implement lean manufacturing in industry and manage the change process to achieve continuous improvement of efficiency and productivity.

Reference Books

1. How to Implement Lean Manufacturing, Lonnie Wilson, The McGraw-Hill Companies, ISBN: 978-0-07-162508-1.

2.	REENGINEERING THE CORPORATION, A Manifesto for Business Revolution, Michael
	Hammer & James Champy, Harper Business Essentials
3.	The Toyota Way, Jeffrey K. Liker, The McGraw-Hill Companies, ISBN-10:0-07-058747-7.
4.	Just In Time Manufacturing, M.G. Korgaonker, 2006, Macmillan India Ltd., ISBN: 0333 926633.

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CO - PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	1	3	2									
CO3	2	2	2	1								
CO4		2	2						1	1		1

High-3 : Medium-2 : Low-1

	Semester: VII									
ENGINEERING OPTIMIZATION										
			(Group	G: Professiona	l Elective)		1			
Cou	rse Code	:	16IM7G3		CIE	:	100 Marks			
Hrs	Week: L:T:P:S	:	4:0:0:0		SEE	:	100 Marks			
Cre	dits	:	44L		SEE Duration	:	3Hrs			
Cou	rse Learning Ob	jec	tives: The studer	nts will be able	to					
1	1 Develop the skills in the application of advanced constructs of operations research models for complex decision making situations.									
2	Implement the making	ad	vanced methodol	ogy and tools	of operations resea	arch	to assist decision-			
3	Analyze, reason non-specialists.	an	d interpret inform	nation in a man	ner that can be com	nun	icated effectively to			
							1			
_				UNIT-I			09 Hrs			
Intr	oduction: Engin	leer	ring Application	s of Optimiz	ation, Statement	and	Classification of			
Opt1	mization Problem	S - Т	anian Duality in	T :	uning December 14	D				
or P.	ear Programming	s re	is Karmarkar's I	Linear Program	Quadratic Program	on P	rinciple, Sensitivity			
	ost optimality Alla	irys	<u>IS, Kalillaikai SI</u>	NIT – II	Quadratic 110grafili	IIIIIE	; 09 Hrs			
Non	linear Program	mi	ng - Unconst	rained Ontin	nization Techniqu	es:	Classification of			
Unc	onstrained Minim	iza	tion Methods. Go	eneral Approach	n. Rate of Converge	ence.	. Scaling of Design			
Vari	ables, Direct Sear	ch	Methods - Rand	om Search Met	hods, Grid Search N	Meth	od, Indirect Search			
(Des	scent) Methods - C	brad	dient of a Functio	n, Steepest Des	cent (Cauchy) Metho	od, N	Newton's Method			
	·		U	NIT – III	·		09 Hrs			
Non	linear Programm	ning	g - Constrained (Optimization T	echniques: Characte	erist	ics of a Constrained			
Prob	olem, DIRECT N	ΛE	THODS - Rand	om Search Me	ethods, Sequential	Li	near Programming,			
Sequ	ential Quadratic I	Pro	gramming							
			U	NIT – IV	<u>at 1, 1, 1</u>	1.	08 Hrs			
Moc	lern Methods of	f C	Optimization: Ge	enetic Algorith	ms, Simulated Ann	ealıı	ng, Particle Swarm			
Opti	mization, Ant Col	ony	Optimization, U	pumization of I	Fuzzy Systems		10 Urs			
Drad	tical Aspects of	On	timization: Redu	$\frac{1}{1} = \mathbf{v}$	f an Optimization P	rabl	m Fast Reanalysis			
Tech	niques Sensitivi	Οµ tv	of Optimum Sc	dution to Prob	lem Parameters M	Inlti	level Optimization			
Mul	tiobiective Optim	izat	tion - Utility Fu	nction Method	Inverted Utility Fu	incti	on Method Global			
Crite	Criterion Method Bounded Objective Function Method Goal Programming Method Goal									
Attainment Method										
Course Outcomes: After completing the course, the students will be able to										
1	Identify areas of	ap	plications for line	ear & non linea	r programming, and	the	practical aspects of			
	optimization with	<u>1 us</u>	sage of tools.				- •			
2	Apply various of	pe	rations research	techniques to	solve problems rela	ted	to optimization of			
	processes.									

- 3 Analyze the results of optimization techniques usage for multi variable and multi objective optimization problems.
- 4 Incorporate practical aspects of optimization in the analyses of systems.

Refe	erence Books
1.	Engineering Optimization Theory and Practice, Singiresu S. Rao, 4th Edition, 2009, John Wiley
	& Sons, Inc., ISBN: 978-0-470-18352-6
2.	Operation Research An Introduction, Taha H A, 8th Edition, 2009, PHI, ISBN: 0130488089.
3.	Principles of Operations Research - Theory and Practice, Philips, Ravindran and Solberg - John
	2 nd Edition, 2000, Wiley & Sons (Asia) Pte Ltd, ISBN 13: 978-81-265-1256-0

4. Introduction to Operation Research, Hillier, Liberman, Nag, Basu, 9th Edition, 2012,Tata McGraw Hill ISBN 13: 978-0-07-133346-7

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CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		1			1					1		
CO2	2											1
CO3		2		2						1		1
CO4	1		1		1							

	Semester: VII									
	ENERGY MANAGEMENT									
	(Group G: Professional Elective)									
Cou	Course Code16IM7G4CIE: 100 Marks									
Crea	lits: L:T:P:S	4:0:0:0	SEE	:	100 Marks					
Hou	rs:	44L	SEE Duration	:	3 Hrs					
Cou	rse Learning O	bjectives: The stud	lents will be able to							
1	To identify op	portunities for energ	y reduction in production and usag	ge o	f goods and services					
2	To describe the	e effects of usage of	energy inefficient goods and servi	ces	on our environment					
2	To analyze the	cost and performan	ce comparatively for different proc	cess	ses and systems in order					
3	³ to design and build better products and services									
4	To produce go	ods and provide service	vices within acceptable levels of en	nvir	onmental degradation.					

UNIT-I	09 Hrs						
Introduction: Energy sources, energy demand and supply, Energy crisis, future scenarios	; Energy						
system efficiency; energy conservation aspects; Instrumentation and measurements.							
Principles of Energy Management and Energy Audit: General principles, planning and program;							
Introduction to energy audit; General methodology; Site surveys; Energy systems survey	, energy						
audit; Instrumentation; Analysis of data and results.							
UNIT-II	09 Hrs						
Heating and Cooling Management: General principles of energy managements in HVAC	systems;						
Human comforts and health requirements; HVAC systems; Chillers, fans, pumps, cooling	towers,						
Energy management opportunities; Modeling of heating and cooling loads in buildings.	, ,						
Electrical Load and Lighting Management: General principles; Illumination and human	comfort;						
Lighting systems; Equipments; Energy management opportunities; Electrical systems; Electrical load							
analysis; Peak load controls.							
UNIT-III	09 Hrs						
Process Energy Management: Principles; Process heat, Combustion, Automatic fuel control	s; Steam						
generation and distribution, Hot water and pumping, Furnaces and ovens; Process el	ectricity;						
Compressed air; Manufacturing process; Energy storage for process industries; Process control	ol.						
UNIT-IV	08 Hrs						
Integrated Building systems: General principles; Environment conformation; Passive	e design						
considerations; Building envelope design consideration, Integration of building system,	Energy						
storage-cold storage techniques, Economic analysis. Green buildings.	0.						
UNIT-V	09 Hrs						
Economic Aspects of Energy Management: General considerations; Economic analysis	methods;						
Life-cycle costing. Break even analysis, benefit cost analysis, payback period analysis, present worth							
analysis, equivalent annual cost analysis; Management of energy with environment aspects.							
Course Outcomes: After completing the course, the students will be able to	i						

Course Outcomes. After completing the course, the students will be able to									
CO1.	Identify and report opportunities for energy efficient practices in the construction of building								
	sand HVAC systems								
CO2.	Describe the different sources of energy and their current usage, along with their effects on								
	the environment								
CO3.	Analyze the utilization of energy to maximize profits (minimize costs) and enhance								
	competitive positions.								
CO4.	Perform economic analysis on the proposals to help in the choice of a cost effective and								
	energy efficient product or service								
CO5.	Construct strategies for adjusting and optimizing usage of energy, through systems and								
	procedures so as to reduce energy requirements per unit of output.								

Reference Books							
1.	Energy Management Principles: Applications, Benefits, Savings, Craig B. Smith and Kelly E.						
	Parmenter, 2 nd Edition, 2016, Elsevier Inc, ISBN: 978-0-12-802506-2						
2.	Energy Management, W R Murphy and G Mckay; B.S. Publications.						
3.	Renewable Energy and Energy Management, S C Patra, B C Kurse and R Kataki; International						
	Book Co.						
4.	Rural Energy Management, S Kaushik and T Verma Deep; Deep Publications.						

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Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping													
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1			1					2		2		1	
CO2	1		1					1		1			
CO3	1	2			2								
CO4		2			2	2							
CO5	1	2			2			2				2	

RV College of Engineering \mathbb{R} – Bengaluru - 59
			Semester: VII			
		PRED	ICTIVE ANAL	YTICS		
~ ~ .		(Group (G: Professional	Elective)	1	
Course Code	:	16IM7G5		CIE	:	100 Marks
Credits: L:T:P:S	:	4:0:0:0		SEE	:	100 Marks
Hours	:	44L		SEE Duration	:	3Hrs
Course Learning	Obj	ectives: The studen	ts will be able t	0		
1 Understand v	vario	us multivariate tech	nniques for analy	vsis of real life processe	S	
2 Use techniqu	es s	uch as regression, fa	ctor analysis, cl	ustering to describe and	in	fer about
processes thr	oug	h analysis of data	1 .	<u>~ 1, · · , 1 · · </u>		
3 Compare pro	cess	ses by analyzing the	m by using speci	fic multivariate technic	ue	S.
		T				00 11.40
Aspects of Multi	von	ata Analysia In	INII-I traduction Apr	liantions Data argani	70	tion Descriptive
Statistics Data Dis	varı nlav	are Analysis – III s and Pictorial Repr	resentations Dist	ance	Za	uoli, Descriptive
Matrix algebra a	nd]	Random vectors -	Basics of Mat	ix and Vector Algebr	а. А	Positive Definite
Matrices. A Squar	e-R	oot Matrix. Randoi	m Vectors and	Matrices. Mean Vector	ors	and Covariance
Matrices.	• • •					
		U	NIT-II			09 Hrs
Multiple Regress	ion	Multivariate Mult	tiple Regression	n. The Concept of	Lir	near Regression.
Comparing the Tw	o Fo	ormulations of the H	Regression Mode	el. Multiple Regression	M	lodels with Time
Dependent Errors.						
Principal compon	ent	analysis: Populatic	on Principal Con	nponents. Summarizing	g S	Sample Variation
by Principal Comp	oner	its. Graphing the Pri	ncipal Compone	ents.		0.0 11
F 4 4 1 ¹	1	U.		· · · · · · · · · · · · · · · · · · ·		09 Hrs
Factor Analysis al	10 I	Model Methoda	f Estimation Es	ce Matrices.	100	rag Darge activas
and a Strategy for 1	Facto	r Analysis Structur	al Equation Mo	lele Rotation. Factor s	sco	res. reispectives
	acu		NIT-IV	de15.		08 Hrs
Classifications with	шu ЪТ	Wo Multivariate N	Jormal Populati	Classification for	1 V ific	vo Populations.
Fisher's Discriming	nt F	unction	onnar i opulati	ons. Evaluating Class.		auon runctions.
UNII-V U9 Hrs Clustering distance methods and ordination. Similarity Macauras Hierarchiest Clustering						
Methods Nonhiers	rchi	cal Clustering Meth	unation. Sinn ods Multidime	nsional Scaling Corres	no	ndence Analysis
Biplots for Viewi	iom ig S	Sample Units and V	Variables Procu	stes Analysis: A Met	100 100	for Comparing
Configurations.	18 ~			5005 milary 515, mil 1000		a for comparing
6						
Course Outcomes	: Af	ter completing the	course, the stud	lents will be able to		
CO1: Explain the	e ap	plicability of variou	s multivariate t	echniques to analyse d	iffe	erent sample data
sets		· ·		× •		
CO2: Apply mu	tiva	riate techniques to	draw inferences	about various process	es	by analysing the
data from t	he p	rocesses.		_		_
CO3: Analyse an	d in	terpret data so as to	describe the pro	cess and to aid in decisi	on	making.

CO4: Evaluate processes by analysing their data using multivariate techniques to help in predicting performance measures.

Refe	erence Books
1.	Applied Multivariate Statistical Analysis, Johnson & Wichern, 6th Edition, 2008, Pearson
	Education, ISBN-13: 9780131877153
2.	An Introduction to Multivariate Statistical Analysis, T.W. Anderson, 3 rd Edition, 2003, Wiley,
	ISBN: 978-0-471-36091-9
3.	Applied Predictive Analytics: Principles and Techniques for The Professional Data Analyst,
	Dean Abbott, 2014, John Wiley and Sons, ISBN: 978-1-118-72796-6
4.	Fundamentals of Machine Learning for Predictive Data Analytics, John D. Kelleher, Brian Mac
	Namee and Aoife D'Arcy, 2015, MIT Press, ISBN: 97802620 29445

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Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

					CO-l	PO Ma	pping					
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1					1				1		
CO2	2	3			2							1
CO3		3	1	2	2							
CO4	2	3	1	2	2			1		1		1

Low-1 Medium-2 High-3

				Semester: VII			
			NAN	OTECHNOLOGY	、 、		
C		r	(Grou	p H: Global Electiv	e)		100 M
Coul	rse Code	:	16G/HUI 2.0.0		CIE	:	100 Marks
Toto		:	3:0:0		SEE SEE Duration	:	100 Marks
	i rivurs rse Learning () hi	JUL Actives. The student	s will be able to	SEE DUITATION	•	5.00 Hours
1	To have the h	asic	knowledge of nano	materials and the pro	0Cess		
2	Describe meth	nod	s of nanoscale manu	facturing and charact	terization can be enal	bled	
3	3 To learn about Nano sensors and their applications in mechanical electrical electronic						
Ū	Magnetic, Ch	emi	cal field.	uppheutons			<i>ai, eieenome,</i>
4	To understand	1 th	e concept for a nano	scale product based of	on sensing, transduci	ng.	and actuating
	mechanism.			I		-0,	
5	To have awar	ene	ss about the nanosca	le products used in n	nultidisciplinary field	ls.	
				*	* *		
			I	U nit-I			06 Hrs
Intro	oduction to N	ano	materials: History	of Nanotechnology,	, structures and proj	pert	ies of carbon
based	d: Fullerenes (I	Buc	ky Ball, Nanotubes), metal based: Nan	o Shells, Quantum E	ots	, Dendrimers,
Dian	nond like carbo	on(I	DLC) Nanocarriers,	bionanomaterails: p	rotein & DNA base	d n	anostructures,
Hybr	ids: hybrid b	lolc	ogical/inorganic, Na	anosatety Issues: To	oxicology health ef	tec	ts caused by
nano	particles.		TI				00 II.ua
Cha	raatarization a	f N	U. Janostruoturos: Sn	nii — n ootrosoony: UV Vis	ible spectroscopy F	011#	ior Transform
infra	red spectrosco	n r nv	(FTIR) Raman Sn	ectroscopy. V_{-ray}	nectroscopy Flect	ron	
Scan	ning electron i	py mic	roscopy (SEM) Tr	ansmission electron	microscopy. (TEM)	Sca	nning nrohe
micr	oscony: Atomi	c Fo	orce microscopy (A)	FM). Scanning tunne	l microscopy (TEM).	50	ming prove
Non	Synthesis on	а Б	abrigation: Introdu	ction & overview of	Nonofabrication: Bo	tto	m up and Top
down	o synthesis and	u r	g processes like B	all milling Sol-gel I	Process Chemical V	anc	ur denosition
(CVI	D), plsma archi	ng a	and various lithogram	ohv techniques (Hard	& Soft lithography).	upe	a deposition
(011	<i>b</i>), piona aronn		U	nit –III			09 Hrs
Nan	osensors: Over	rvie	w of nanosensors,	prospects and mark	tet. Types of Nanos	sens	ors and their
appli	cations. Elect	rom	agnetic nanosenso	rs: Electronic nose	e and electronic to	ong	ue, Magnetic
nano	nanosensors. Mechanical nanosensors: Cantilever Nanosensors, Mechanics of CNTs, Biosensors:						
Bios	ensors in mode	rn n	nedicine.				
			U	nit –IV			06 Hrs
Micr	o & Nano-Ele	ctro	omechanical systen	ns and Microfluidics	s: MEMS/NEMS: Ma	igne	etic, Chemical
and 1	and Mechanical Transducers –Sensing and Actuators. Microfludics: Laminar flow, Hagen-Peouiselle						
equa	tion, basic fluid	1 1d	eas, Special conside	erations of flow in sr	nall channels, mixing	g, n	nicrovalves &
micro	micropumps.						
A	liastions of Na		U taabmalaann Mala	<u>nit – V</u>	-1	1 -	U/Hrs
App	incations of INa	ino	cechnology: Mole	inding wheels, aslan	olecular switches, m		anical cutting
tools, machine components, DLC coated grinding wheels, solar cells, Batteries, tuel cells, Nanofilters.							
wieu		nog	y. III Diagnostics, T	lierapeuties, Drug de	invery and manosurge	<i>. . . .</i>	
Сош	rse Outcomes:	Δf	ter completing the	course, the students	will be able to		
CO1	: Remember	1111	derstand, and apply	knowledge about of r	nanomaterials and the	eir 1	ises
	· Internet	4 -	and upply	f manufacturing	d abana stari-stice		
C02	A number of the	u aj len e	oply the techniques (nanulacturing and	a characterization pro	oces	ses machanical
	• Apply the	кПС nd 1	vicuge of manose	isors, related to har	iosensors in electrol	nes	, mechanical,
1	chemical, a	uu (nonogical systems.				

CO4: Create and evaluate nano Design, Devices and Systems in various disciplines

Ref	erence Books
	B.S. Murty., P. Shankar., B.Raj, B.B. Rath, and J. Murday, Textbook of Nanosciences and
1	Nanotechnology, Springer, Co-publication with University Press (India) Pvt. Ltd. VCH, XII.1st
	Edition, 2013, ISBN- 978-3-642-28030-6.
ſ	V. K. Khanna, Nanosensors:, Physical, Chemical and Biological, CRC press, 1st
2	edition, 2013, ISBN 9781439827123 (Unit III).
2	C. C. Kock., Nanostructured materials, Nanostructured materials, William Andrew Publishing,
3	2nd edition, 2007, ISBN 0-8155-1534-0.
4	M .Wilson., K. Kannangara., G.Smith., M.Simmons., B. Raguse., Nanotechnology, , overseas
4	Press (India) Private Ltd., 1st edition, 2005, ISBN 81-88689-20-3.

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Semester End Evaluation (SEE); Theory (100 Marks)

				Semester: VII			
		П	NDUSTRIAL SAF	ETY AND RISK M	ANAGEMENT		
			(Grou	p H: Global Elective	e)		
C	Call		1(071102				100 M
Course		:	16G/H02		CIE	:	100 Marks
Credit	<u>s: L:1:P</u>	:	3:0:0		SEE	:	100 Marks
I otal I	Hours		30L		SEE Duration	:	3.00 Hours
	e Learning O	00je	ectives: The student	s will be able to			
1	Understand t	ne i	basics of risk assess	ment methodologies			
2	Select approp	$\frac{pr_{1a}}{1}$	te risk assessment to	echniques			
3	Analyze pub	lic a	and individual perce	ption of risk			
4	Relate safety	', er	gonomics and huma	in factors			
5	Carry out ris	k as	ssessment in process	industries			
r				T • / T			00 11
C		• 0•		Jnit-I			08 Hrs
Genera	al Risk Ident		ation Methods – I:	1 1	DILA LIAZOD M	C •	
Hazard		n r	nethodologies, risk	assessment methods	S-PHA, HAZOP, MO	CA,	consequence
analysi	s, hazards in	W W	orkplaces-nature an	d type of work plac	es, types of nazards	s, na	azards due to
improp	er nousekeep	ing	, nazards due to fire		ries and buildings.		07 11
Diala A	~~~~~ M	[.4]	U.				07 Hrs
RISK A	Assessment IVI	letr	1005 – 11: d voto vootbod oow		ffi at an at least and		
KISK at	ility distribut	unu ti ar	ed rate method, cen	antly equivalent coe	militian method.	nuita haal	uive analysis,
probab	a model Uert		l, coefficient of va	iriation method, Sir	nulation method, S	паск	de approach,
TIME	s model, men	LZ IV	Iuci.	nit III			07 Hrs
Rick N	Unit –III 0/ Hrs						
Emerge	ency relief S	- 11 Svet	ems Diers program	n bench scale evne	riments design of	eme	ergency relief
system	s risk manag	iyət Tem	ent plan mandators	technology option a	nalvsis rick manage	men	t alternatives
risk me	anagement to	ols	risk management	plans risk index me	thod Dowfire and e	- xnlc	sion method
Mond i	index Method	1	, fish munugement		lilou, Dowine una e	npre	sion method,
iviona i			U	nit –IV			07 Hrs
Risk A	ssurance and	d A	ssessment – IV:				0, 1115
Propert	ty insurance.	tra	nsport insurance.	ability insurance, ri	sk Assessment, low	Pro	bability high
conseq	uence events.	Fa	ult tree analysis. Ev	ent tree analysis.	,		
			<u> </u>	nit –V			07Hrs
Risk A	Analysis in (Che	emical Industries-	V: Handling and s	torage of chemicals	5. DI	ocess plants.
person	nel protection	ea	uipment's. Internati	onal environmental n	nanagement system.	1	1 ,
		1	1				
Course	e Outcomes:	Af	ter completing the	course, the students	will be able to		
CO1:	Recall risk	ass	sessment techniques	used in process indu	stry		
CO2:	Interpret th	ie v	arious risk assessme	ent tools	<i>.</i>		
CO3:	Use hazard	lid	entification tools for	safety management			
CO4:	Analyze to	ols	and safety procedur	res for protection in n	rocess industries		
			procount	r=========			

Refere	ence Books
1	Kirkcaldy K.J.D Chauhan, Functional Safety in the Process Industry : A Handbook of practical Guidance in the application of IEC61511 and ANSI/ISA-84,North corolina, Lulu
	publication,2012,ISBN:1291187235
2	Goble and William M. Safety Instrumented Systems Verification Practical probabilistic
2	calculations, Pensulvania ISA publication,2005,ISBN:155617909X
2	Laird Wilson and Doug Mc Cutcheon. Industrial safety and risk Management, The University
3	of Alberta press, Canada, 1st Edition, 2003, ISBN: 0888643942.

4	Sincero A P and Sincero G A Environmental Engineering – A Design Approach, Prentice Hall of India, New Delhi, 1996, ISBN: 0024105643
5	Pandya C G, Risks in Chemical units, Oxford and IBH publications, New Delhi,1992,ISBN: 8120406907

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Semester End Evaluation (SEE); Theory (100 Marks)

	Semester: VII						
			INTELLIGENT	TRANSPORT SYS	TEMS		
			(Group)	H: Global Elective)			
Co	urse Code	:	16G7H03		CIE	:	100 Marks
Cre	edits: L:T:P	:	3:0:0	\$	SEE	:	100 Marks
Tot	Total Hours		36L	1	SEE Duration	:	3.00 Hours
Cou	rse Learning (Obje	ctives: The students	will be able to			
1	1 Understand basic traffic flow and control for ITS						
2	2 Understand user services for application in transportation system						
3	3 Understand ITS architecture and its planning at various levels						
4	Evaluate user	serv	vices at various level	S			

 Unit – I
 8 Hrs

 Introduction: –Historical Background, Definition, Future prospectus, ITS training and educational needs.
 Fundamentals of Traffic Flow and Control. Traffic flow elements. Traffic flow models.

Fundamentals of Traffic Flow and Control- Traffic flow elements, Traffic flow models, Shock waves in Traffic streams, Traffic signalization and control principles, Ramp metering, Traffic simulation

Unit – 11	o Hrs
ITS User services-User services bundles, Travel and Traffic management, Public Trans	sportation
Operations, Electronic Payment, Commercial Vehicles Operations, Emergency Man	nagement,
Advanced Vehicle Control and safety systems, Information Management, Maintena	ance and
construction Management	

Unit –III7 HrsITS Applications and their benefits-Freeway and incident management systems-objectives,
functions, traffic Surveillance and incident detection, Ramp control, incident management, Advanced
arterial traffic control systems- historical development, Adaptive traffic control algorithms, Advanced
Public Transportation Systems-Automatic vehicle location systems, Transit Operations software and
information systems, Electronic fare payment systems, Multimodal Traveler Information systems

 Unit –IV
 7 Hrs

 ITS Architecture-Regional and Project ITS Architecture, Need of ITS architecture, concept of Operations, National ITS Architecture, Architecture development tool.

ITS Planning-Transportation planning and ITS, Planning and the National ITS Architecture, Planning for ITS, Integrating ITS into Transportation Planning, relevant case studies.

Unit –V8 HrsITS Standards-Standard development process, National ITS architecture and standards, ITS
standards application areas, National Transportation Communications for ITS Protocol, Standards
testing.

ITS Evaluation – Project selection at the planning level, Deployment Tracking, Impact Assessment, Benefits by ITS components, Evaluation Guidelines, Challenges and Opportunities.

Course	Course Outcomes: After completing the course, the students will be able to			
CO1:	Identify various applications of ITS			
CO2:	Apply ITS applications at different levels.			
CO3:	Examine ITS architecture for planning process.			
CO4:	Define the significance of ITS for various levels			

Ref	Reference Books					
1	Choudury M A and Sadek A, "Fundamentals of Intelligent Transportation Systems Planning" Artech House publishers (31 March 2003); ISBN-10: 1580531601					
2	Bob Williams, "Intelligent transportation systems standards", Artech House, London, 2008. ISBN-13: 978-1-59693-291-3.					

	Asier Perallos, Unai Hernandez-Jayo, Enrique Onieva, Ignacio Julio García Zuazola
3	"Intelligent Transport Systems: Technologies and Applications" Wiley Publishing ©2015,
	ISBN:1118894782 9781118894781
1	ITS Hand Book 2000 Recommendations for World Road Association (PIARC) by Kan Paul
4	Chen, John Miles.
5	Dominique Luzeaux ,Jean-René Ruault, Michel Chavret "Intelligent Transport Systems" 7
Э	MAR 2013 Copyright © 2010 by John Wiley & Sons, Inc DOI: 10.1002/9781118557495.ch6

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Semester End Evaluation (SEE); Theory (100 Marks)

				Semester: VII			
			INTEI	LIGENT SYSTEM	IS		
			(Grou	p H: Global Electiv	e)		
Cou	rse Code	:	16G7H04		CIE	:	100 Marks
Cree	lits: L:T:P	:	3:0:0		SEE	:	100 Marks
Tota	l Hours	:	36L		SEE Duration	:	3.00 Hours
Cou	rse Learning ()bje	ectives: The students	s will be able to			
1	Understand fu	ında	amental AI concepts	and current issues.			
2	Understand an	nd a	pply a range of AI t	echniques including	search, logic-based re	easc	oning, neural
	networks and	rea	soning with uncertai	n information.			
3	Recognize co	mpı	itational problems s	uited to an intelligent	t system solution.		
4	Identify and l	ist t	he basic issues of kr	nowledge representat	ion, blind and heurist	ic s	earch.
				U nit-I			07 Hrs
Intr	oduction: The	Fou	ndations of Artificia	al Intelligence, Histo	ry of Artificial Intell	ige	nce, The State
of th	e Art, Intellige	ent .	Agent: Introduction	, How Agents Shoul	d Act, Structure of In	ntel	ligent Agents,
Prol	olem-solving: S	Solv	ving Problems by S	Searching Search St	rategies, Avoiding H	Rep	eated States,
Avo	iding Repeated	Sta	tes				
			U	nit – II			07 Hrs
Info	rmed Search	Me	thods: Best-First	Search, Heuristic F	unctions, Memory 1	Βου	inded Search,
Itera	tive Improveme	ent	Algorithms			_	
Gan	ne Playing: Int	rod	uction: Games as So	earch Problems, Perf	fect Decisions in Tw	o-P	erson, Games
Impe	erfect Decisions	s, A	lpha-Beta Pruning, (Games That Include a	an Element of Chance	e	
			U	nit –III			07 Hrs
Kno	wledge Inferer	ice		1			
Kno	wledge represe	ntat	ion -Production ba	sed system, Frame	based system. Infere	enco	e - Backward
chan	ning, Forward	chai	ning, Rule value ap	proach, Fuzzy reasc	oning - Certainty fac	tors	, Bayes Rule,
Unc	ertainty Princip	les,	Bayesian Theory-Ba	ayesian Network-Dei	mpster - Shafer theor	y.	07.11
				$\frac{\text{nit} - IV}{1 + CI}$	A (T 1 (° T		0/ Hrs
	rning from Ob	ser	vations: A General	Model of Learning	Agents, Inductive Le	earr	ing, Learning
Deci	sion Trees, Us	ing	Information Theory	y, Learning General	Logical Description	s, \	why Learning
wor	ks: Computatio	nai	Learning Theory	ing in a Vasser D		т	
Kell	norcement Le	arn	Active Learning in	ing in a Known E	nvironment, Passive		earning in an
Unk		lem	, Active Learning in	an Unknown Enviro	onment		07 11.
Eve	mt Swatama C		U ononta Draduation	mil-v	aconing containty fo	ata	
belie	of and disbelief	Sunt N/	leta level knowledg	Introspection Ev	asoning, certainly h	tec	ture of expert
evet	ms Roles of a	, 1V.	ert systems Know	dedge Acquisition	Meta knowledge H	auri	stics Typical
evne	systems, Koles of expert systems - Knowledge Acquisition –Meta knowledge, Heuristics. Typical						
Cxpe	11 Systems - WI		$\mathbf{N}, \mathbf{D}, \mathbf{M}, \mathbf{N}, \mathbf{N}$	Dapert systems shells	•		
Con	Course Outcomes: After completing the course, the students will be able to						
	· Understand	and	l explore the basic of	oncents and challeng	es of Artificial Intelli	0.04	nce
	• Understallu	and	i explore the basic c	oncepts and chantelig		igui	100.

CO2:	Analyze and explain basic intelligent system algorithms to solve problems.

CO3: Apply Artificial Intelligence and various logic-based techniques in real world problems.CO4: Assess their applicability by comparing different Intelligent System techniques

Ref	erence Books
1	AI – A Modern Approach ,Stuart Russel, Peter Norvig , 2 nd Edition, Pearson Education, 2010, ISBN-13: 978-0137903955.
2	Artificial Intelligence (SIE) ,Kevin Night, Elaine Rich, Nair B., ,McGraw Hill, 1 st Edition, 2008, ISBN: 9780070087705
3	Introduction to AI and ES ,Dan W. Patterson, Pearson Education, 1st Edition, 2007, ISBN: 0132097680
4	Introduction to Expert Systems ,Peter Jackson, 3 rd Edition, Pearson Education, 2007, ISBN- 978-0201876864

CIE is executed by way of quizzes (Q), tests (T) and Assignment/Presentation/Project (A). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for Assignment/Presentation/Project 10. Total CIE is 30(Q) + 60(T) + 10(A) = 100 Marks.

Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

					CO-I	PO Maj	pping					
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	2	1	2	-	2	2
CO2	3	3	3	3	3	2	2	1	2	-	2	2
CO3	3	3	3	3	3	2	1	1	2	-	2	2
CO4	3	3	3	3	3	1	2	1	1	1	2	2

High-3: Medium-2 : Low-1

	Semester: VII						
		I	MAGE PROCESSI	ING AND MACHIN	NE LEARNING		
		-	(Grou	p H: Global Electiv	e)	-	
Cou	rse Code	:	16G7H05		CIE	:	100 Marks
Cree	lits: L:T:P:S	:	3:0:0:0		SEE	:	100 Marks
Tota	l Hours	:	40L		SEE Duration	:	03 Hours
Cou	rse Learning C)bje	ectives: The student	s will be able to			
1	Understand th	ne m	najor concepts and te	echniques in image p	rocessing and Mach	ine I	Learning
2	To explore, m	ani	pulate and analyze i	mage processing tech	nniques		
3	To become far	mil	iar with regression r	nethods, classificatio	n methods, clusterin	g m	ethods.
4	Demonstrate i	ima	ge processing and N	Iachine Learning kno	owledge by designin	g an	d
	implementing	alg	orithms to solve pra	ctical problems			
			l	Jnit-I			08 Hrs
Intr	oduction to image	age	processing:				
Imag	ges, Pixels, Ima	age	resolution, PPI and	d DPI, Bitmap imag	ges, Lossless and le	ossy	compression,
Imag	ge file formats	, C	olor spaces, Bezier	r curve, Ellipsoid, (Gamma correction,	Ad	vanced image
conc	epts						
			U	nit – II			08 Hrs
Basi	cs of Python &	: Sc	ikit image:				
Basi	cs of python, v	varı	ables & data types	, data structures, co	ontrol flow & cond	tion	al statements,
uplo	adıng & view	ing	an image, Image	e resolution, gamm	a correction, deter	mın	ing structural
simi	arities.			•			00 H
				nit –III			08 Hrs
Adv	anced Image p	roc	essing using Open		T T C		.1 ·
Blen	ding Two Imag	es,	Changing Contrast	and Brightness Addin	ng Text to Images Si	moo	thing Images,
Med	ian Filter ,Gau		an Filter ,Bilateral	Filter ,Changing the	e Shape of Images	,Ef	tecting Image
Inre	sholding,Calcu	ilati	ing Gradients, Perfo	orming Histogram Eq	ualization		00.11
м		T		$\frac{\text{nit} - 1V}{2}$			08 Hrs
Mac	hine Learning	le	chniques in Image	Processing	1 NT / 1 NT		
Baye	esian Classifica	tior	i, Maximum Likelih	nood Methods, Neur	al Networks; Non-p	aran	netric models;
Manifold estimation, Support Vector Machines, Logistic Regression							
Unit –V 08 Hrs							
Intr	oduction to obj	ject	Tracking, Modeli	ng & Recognition			1.0.1
Exhaustive vs. Stochastic Search, Shapes, Contours, and Appearance Models. Mean-shift tracking;							
Cont	our-based mode	els,	Adaboost approach	es: Face Detection / 1	Recognition, Trackii	ıg.	
							1
Cou	rse Outcomes:	Af	ter completing the	course, the students	will be able to		
CO1	CO1: Gain knowledge about basic concepts of Image Processing						

CO2:	Identify ma	chine lear	ning techniq	ues suitable	for a given	problem
	10011011 / 11100	villie iven	ming cooming	gaeb barraore	IOI & LIVEII	

CO3: Write programs for specific applications in image processing

CO4: Apply different techniques for various applications using machine learning techniques.

Refe	erence Books
1	Practical Machine Learning and Image Processing: For Facial Recognition, Object Detection,
1	and Pattern Recognition Using Python", by Himanshu Singh, Apress publisher.
2	Pattern Recognition and Machine Learning, by Christopher Bishop, Springer, 2008
2	Computer Vision: A modern Approach" by David Forsyth and Jean Ponce, Prentice Hall India
3	2004.
4	Machine Vision : Theory Algorithms Practicalities ,by E.R. Davies Elsevier 2005.
5	Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods Pearson Education, Ed,
3	2001.

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Semester End Evaluation (SEE); Theory (100 Marks)

	SEMESTER: VII							
			DESIGN C	DF RENEWABLE EN	ERGY SYSTEMS			
G	(GROUP H: GLOBAL ELECTIVE)							
Cours	se Code	:	16G7H06		CIE Marks	:	100	
Total	LS: L:1:P:5	:	3:0:0 701		SEE Marks	:	100 3 00 H	OURS
Cours	riours se Learning (l · Dhi	ectives:		SEE Duration	•	5.00 11	louis
1 To	provide opp	ortu	nity for stude	ents to work on multidi	sciplinary projects.			
2 To	familiarize t	he : /ste	students with	the basic concepts of v conversion	nonconventional ener	rgy s	sources a	and allied
3 To	impart skill epare them fo	to r gr	formulate, so aduate studie	olve and analyze basic	Non – conventional	ener	rgy prob	olems and
4 To	enable the st	ude	nt to design	primarily solar and win	d power systems.			
5 To	expose the s	tude	ents to variou	is applications of solar,	wind and tidal system	ıs.		
				UNIT – I				07 Hrs
An int	troduction to	en	ergy sources	S:		1	1 1	
Indus	try overview	', 11 'ran	centives for	r renewable, utility pe	erspective, Relevant	prot	olems d	iscussion,
curren	n positions of	ICI		UNIT – II				09 Hrs
PV Te	echnology:							07 m 5
photov maps, electri (differ	voltaic power Technology ical circuit, o rent methodol	, P trei pen ogio	V projects, B nds, Photov -circuit volta es), peak-pov	Building-integrated PV oltaic Power Systems age and short-circuit c ver operation, system co	system, PV cell techn : PV cell, Module a urrent, I-V and P-V omponents.	nolog nd A curv	gies, sol Array, E ves, Arra	ar energy Equivalent ay design
				UNIT – III				09 Hrs
Wind Speed speed compo	Speed and H and power r distribution (onents, turbi- tion, system-c	Ener elat par ne r lesig	rgy: ions, power ameters calcu ating , powe gn trade-offs	extracted from the win ulations), wind speed j r vs. speed and TSR, r , system control require	d, Air density, Globa prediction, Wind Pov naximum energy capt ements, environmenta	ul wi ver s ture, l asp	nd patte Systems maximu pects.	rns, wind s : system am power
				UNIT – IV				07 Hrs
Geoth Geoth Comp Energ and po	Geothermal and ocean energy: Geothermal power, geo pressured sources, Geothermal well drilling, advantages and disadvantages, Comparison of flashed steam and total flow concept Energy from ocean: OTEC power generation, OPEN and CLOSED cycle OTEC. Estimate of Energy and power in simple single basin tidal and double basin tidal system							
				UNIT – V				08 Hrs
Stand alone system: PV stand-alone, Electric vehicle, wind standalone, hybrid systems (case study), system sizing, wind farm sizing. Grid-Connected Systems: introduction, interface requirements, synchronizing with the grid, operating limit, Energy storage and load scheduling, Grid stability issues, distributed power generation.								
Senere	- Sensimilari							
Cours	Course outcomes:							
	Course outcomes: CO1 Demonstrate an understanding of the scientific principles of methodology of Non-conventional amorgy							
CO1	energy.	e an	understand	ng of the scientific prin	ciples of methodology	y of]	Non-con	ventional
CO1 CO2	energy.	e an r <u>k</u> in	g knowledge	of different Renewable	ciples of methodology e energy science-relat	y of] ed to	Non-con	ventional

CO4 Students will be able to decide the appropriate procedures to ensure that the working model has developed properly.

Reference Books

- Wind and Solar Power Systems Design, Analysis and operation, Mukund R Patel, 2nd Edition, 1. 2006, Taylor and Francis publishers, ISBN 978-0-8493-1570-1. Non-Conventional sources of energy, G.D.Rai, 4th Edition, 2009, Khanna Publishers, ISBN
- 2. 8174090738, 9788174090737,
- Solar Energy, Sukhatme, 4th Edition, 2017, McGraw Hill Education, ISBN-13: 978-3. 9352607112
- Renewable energy sources, John Twidell, Tony Weir, 3rd Edition, 2015, Routledge Publisher, 4. ISBN-13: 978-0415584388.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

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Semester End Evaluation (SEE); Theory (100 Marks)

				I Semester VI			
			S	SYSTEMS ENGINEERING			
6	(Group H: Global Elective)						
Co	urse Code	:	16G7H07		CIE Marks	:	100
Cr	edits: L:1:P:S	:	3:0:0:0		SEE Marks	:	100
	tal Hours	: 0h	33L		SEE Duration	:	03 Hours
1	Develop on or	onr	jectives:	nderstanding of the role of s	ustama anginaarir	10.1	processes and
1	systems manage	ppr	ent in produci	ng products and services.	ystems engineern	ig j	processes and
2	Document sys	sten	natic measure	ment approaches for generall	y cross disciplina	ary	development
3	Discuss capabi capabilities.	ility	assessment m	odels to evaluate and improve	orgnizational syst	em	s engineering
				Unit I			07 Hrs
Sve	stem Engineeri	nσ	and the Worl	d of Modem System: What is	s System Enginee	rin	a? Origins of
Sys vie Str sys Th Eve	stem Engineerin wpoint, Systems ucture of Con tems, System bu e System Dev polutionary Char	ng, s En n pl uild velo acto	Examples of ngineering as a ex Systems: 1 ing blocks, Th opment Proc eristics of the velopment pro	Systems Requiring Systems Profession, The power of Syst System building blocks and it e system environment, Interfac ess: Systems Engineering the development process, The systems	Engineering, Sys tems Engineering, interfaces, Hierar es and Interaction hrough the system stem engineering	tem pro chy s. em me	Life Cycle, ethod, Testing
univ	Sugnout system	uev	ciopinent, pro	Unit _ II			07 Hrs
 Systems Engineering Management: Managing systems development and risks, work breakdown structure (WBS), System Engineering Management Plan (SEMP), Risk Management, Organization of Systems Engineering, Systems Engineering Capability Maturity Assessment, Systems Engineering standards, Problem. Needs Analysis: Originating a new system, Operations analysis, Functional analysis, Feasibility analysis, Feasibility definition, Needs validation, System operational requirements, problems. Concept Exploration: Developing the system requirements, Operational requirements analysis, Performance requirements formulation, Implementation concept exploration, Performance 							
			· 1	Unit – III			07 Hrs
Concept Definition: Selecting the system concept, Performance requirements analysis, Functional analysis and formulation, Concept selection, Concept validation, System Development planning, System Functional Specifications, problems Advanced Development: Reducing program risks, Requirements analysis, Functional Analysis and Design, Prototype development, Development testing, Risk reduction, problems.							
Unit – Iv 06 Hrs Engineering Design: Implementing the System Building blocks, requirements analysis, Functional analysis and design, Component design, Design validation, Configuration Management, problems. Integration and Evaluation: Integrating, Testing and evaluating the total system, Test planning and preparation, System integration, Developmental system testing, Operational test and evaluation, problems.							
n			<u>г · · ·</u>	$\frac{\text{Unit} - \text{V}}{1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 +$	<u> </u>	T	<u> </u>
Pro dev pro Op ser	Production: Systems Engineering in the factory, Engineering for production, Transition from development to production, Production operations, Acquiring a production knowledge base, problems. Operations and support : Installing, maintenance and upgrading the system, Installation and test, Inservice support, Major system upgrades: Modernization, Operational factors in system development,						
pro	blems.						

Cours	Course Outcomes: After completing the course, the students will be able to					
CO1	Understand the Life Cycle of Systems.					
CO2	Explain the role of Stake holders and their needs in organizational systems.					
CO3	Develop and Document the knowledge base for effective systems engineering processes.					
CO4	Apply available tools, methods and technologies to support complex high technology systems.					
CO5	Create the frameworks for quality processes to ensure high reliability of systems.					

Ref	erence Books
1	Systems Engineering – Principles and Practice, Alexander Kossoakoff, William N Sweet, 2012,
1	John Wiley & Sons, Inc, ISBN: 978-81-265-2453-2
r	Systems Engineering and Analysis, Blanchard, B., and Fabrycky W, 5th Edition, 2010, Saddle
4	River, NJ, USA: Prentice Hall.
3	Handbook of Human Systems Integration, Booher, H. (ed.) 2003. Hoboken, NJ, USA: Wiley.
1	Systems Engineering: A 21 st Century Methodology, Hitchins, D., 2007. Chichester, England:
4	Wiley.
	Systems Thinking, Systems Practice, Checkland, P. 1981. 2 nd Edition, 1999, Hoboken, NJ, USA:
ה	Wiley
6	Systems Architecting, Rechtin, E. 1991, Upper Saddle River, NJ, USA: Prentice Hall.
7	Handbook of Human Systems Integration, Booher, H. (ed.) 2003. Hoboken, NJ, USA: Wiley.
0	Systems Engineering: A 21st Century Methodology, Hitchins, D., 2007. Chichester, England:
Ø	Wiley.

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Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

					CO-]	PO Maj	pping					
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2					1						
CO2			2									
CO3					2							
CO4			2									

High-3: Medium-2: Low-1

				Semester: VII			
			MEMS.	AND APPLICATIC	NS		
			(Grou	p H: Global Electiv	e)		
Cou	rse Code	:	16G7H08		CIE	:	100 Marks
Cre	dits: L:T:P	:	3:0:0:0		SEE	:	100 Marks
Tota	al Hours	:	35L		SEE Duration	:	3.00 Hours
Cou	rse Learning (Obje	ectives: The student	s will be able to			
1	Understand th	he rı	idiments of Micro fa	abrication techniques			
2	Identify and a	asso	ciate the various sen	sors and actuators to	applications.		
3	Analyze diffe	erent	t materials used for]	MEMS.			
4	Design applic	catic	ons of MEMS to disc	ciplines.			
			U	Init - I			06 Hrs
Ove	rview of MEM	IS &	Microsystems: M	EMS and Microsyste	ms, Typical MEMS	and	micro system
prod	ucts, Evolution	n o	f micro fabrication	n, Microsystems and	d microelectronics,	Mu	ltidisciplinary
natu	re of Microsys	stem	is, Design and ma	nufacture, Applicati	ons of Microsystem	S 1	n automotive,
heal	thcare, aerospa		nd other industries.	D' 1' 1 1 1	1.0		
WOI	king Princip	le (of Microsystems:	Biomedical and bi	osensors. Micro se	ensc	ors: Acoustic,
Cher	mical, Optical,	Pres	sure, Thermal.	• •			00 11
1.4.	4 4• T	т.		<u>nit – II</u>	D: 1 () (1		08 Hrs
NIC	ro actuation: (\cup sin	g thermal forces, sh	ape memory alloys,	Piezoelectric crystals	s an	
Iorco	es. MEMS Wit	tn n	hiero actuators: Mi	crogrippers, microm	otors, microvalves a	and	micropumps,
Inici	oduction to	rs, II Sool	incrontulates.	aamatmy Saaling in	Digid hady dyna	mia	a Saaling in
Flee	trostatic forces	Scal	ling in electromagn	etic forces and scalin	g in fluid mechanics	me	s, scaling in
Lice	tiostatic forces.	, sca		1010000000000000000000000000000000000	g in nulu incentances.		08 Hrs
Mat	arials for MF	MS	and Microsystems	Nubstrates and wafe	pre Active substrate	mat	terials Silicon
25 5	ubstrate materi	al	Silicon Compounds	Si-Piezoresistors	GaAs Quartz Piezo	ele	ctric Crystals
Polv	mers and nack	zaoi	ng materials Three	e level of Microsyst	em nackaging Die	lev	el nackaging
Dev	ice level nack	aoin	σ System level na	ckaging Interfaces	in microsystem pac	kao	ing Essential
pack	aging technolo	gies	: die preparation. Su	urface bonding. Wire	bonding. Sealing, 31) pa	ckaging.
1		8	U1	nit – IV			06 Hrs
Mic	rosvstem Fal	bric	ation Process: I	ntroduction to mi	crosystems, Photol	ithe	ography, Ion
Imp	antation, Diffu	isioi	n, Oxidation, CVD	PVD-Sputtering, D	eposition of Epiaxy	. Е	tching, LIGA
proc	ess: General d	lescr	iption, Materials fo	or substrates and ph	otoresists, Electropla	tin	g and SLIGA
proc	process.						
			U	nit – V			07 Hrs
Tact	ile and Flow se	ensc	ors – Piezoelectric s	ensors and actuators	- piezoelectric effec	ts -	- piezoelectric
mate	materials – Applications to Inertia, Acoustic, Tactile and Flow sensors.						
Ove	Overview, Application, Fabrication Process in Applications:						
Silic	Silicon Capacitive Accelerometer, Piezo resistive Pressure sensor, Electrostatic Comb drive, Portable						
bloo	d analyzer, Piez	zo e	lectric Inkjet Print h	ead, Micromirror arr	ay for Video projecti	on.	
Cou	rse Outcomes:	: Af	ter completing the	course, the students	will be able to		
CO	L: Understand	the	operation of micro	devices, micro syster	ns and their applicati	ons	

- **CO2:** Apply the principle of material science to sensor design.
- **CO3:** Analyze the materials used for sensor designs.

CO4: Conceptualize and design micro devices, micro systems.

Refere	ence Books
1	MEMS & Microsystems Design and Manufacture, Tai-Ran Hsu, 2 nd Edition, 2002, Tata
	McGraw Hill Education, New Delhi, ISBN-13:978-0-07-048709-3.
2	Foundations of MEMS, Chang Liu, 2012, Pearson Education Inc., ISBN-13:978-0-13-
2	249736-7.
3	Smart Material Systems and MEMS, Vijay K Varadan, K. J. Vinoy, S. Gopalakrishnan, 2006,
	Wiley-INDIA, ISBN-978-81-265-3170-7.
4	Micro and Smart Systems, G.K. Ananthasuresh, K.J. Vinoy, K.N. Bhat, V.K. Aatre, 2015,
	Wiley Publications, ISBN-:978-81-265-2715-1.

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Semester End Evaluation (SEE); Theory (100 Marks)

	Semester: VII						
			INTRODUCTIO	N TO INTERNET (OF THINGS		
			(Grou	p H: Global Elective	e)		
Cou	rse Code	:	16G7H09		CIE		100 Marks
Crec	lits: L:T:P	:	3:0:0		SEE	:	100 Marks
Total Hours		: 39L			SEE Duration	:	3.00 Hours
Cou	rse Learning (Dbj	ectives: The student	s will be able to			
1	1 Learn the fundamentals of IoT						
2	2 Understands the hardware, networks & protocols used in IoT development						
3	3 Illustrate smart applications using IoT devices and building applications						
4	4 Know more advanced concepts like cloud connectivity in IoT						
_	T 41 C						

5 Learn the fundamentals of IoT

	Unit-I	06 Hrs
Fundar	mentals Of IOT: Introduction, Physical design of IoT, Logical design of IoT, IoT	Enabling
technol	ogies, IoT Levels and Deployment Templates, , IoTvs M2M	
	Unit – II	06 Hrs
IOT De	esign Methodology: Need for IoT systems management, IoT Design Methodology	
Interne	et of Things Strategic Research and Innovation Agenda: Internet of Things Vi	sion, IoT
Strategi	ic Research and Innovation Directions, IoT Smart-X Applications, Internet of Th	nings and
Related	Future Internet Technologies.	-
	Unit –III	11 Hrs
IOT Sy	stems - Logical Design using Python: Provides an introduction to Python, installing	g Python,
Python	data types & data structures, control flow, functions, modules, packages, file inp	ut/output,
data/tin	ne operations and classes.	-
	Unit –IV	09 Hrs
IOT PI	hysical Devices & Endpoints: What is an IoT device, Raspberry Pi device, About t	he board,
Linux o	on Raspberry Pi, Raspberry Pi interfaces, Programming Raspberry Pi with Python.	
	Unit –V	07 Hrs
IOT P	hysical Servers & Cloud Offerings: Provides an introduction to the use of cloud	platforms
and fram	meworks such as Xively and AWS for developing IoT applications.	•
Course	Outcomes: After completing the course, the students will be able to	
CO1:	Understand the fundamentals of IoT.	
COL	Analyse the LoT devices programming networking requirements and protocols for h	milding

CO2: Analyse the IoT devices, programming, networking requirements and protocols for building IoT products.
 CO3: Apply the concepts to design and develop IoT applications

CO4: Creating applications of IoT using physical devices and interfacing with cloud.

Reference Books

1101	
1	Internet of Things (A Hands-on-Approach), Vijay Madisetti and ArshdeepBahga, 1 st Edition,
	VPT, 2014, ISBN-13: 978-0996025515.
	Internet of Things - From Research and Innovation to Market Deployment, OvidiuVermesan,
2	Peter Friess, River Publishers Series in Communication, River Publishers, 2014, ISBN: ISBN:
	978-87-93102-94-1 (Hard copy), 978-87-93102-95-8 (Ebook) (UnitsII 2 nd part)
2	Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, Francis
3	daCosta, , 1st Edition, Apress Publications, 2013, ISBN-13: 978-1430257400.
4	Meta products - Building the Internet of Things, WimerHazenberg, Menno Huisman, BIS
	Publishers, 2012, ISBN: 9789863692515.

CIE is executed by way of quizzes (Q), tests (T) and Assignment/Presentation/Project (A). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 60. The marks component for Assignment/Presentation/Project 10. **Total CIE is 30(Q) + 60(T) + 10(A) = 100 Marks**.

Semester End Evaluation (SEE); Theory (100 Marks)

				Semester: VII			
	INDUS'	ΓR	Y 4.0- SMART N	MANUFACTURING FOR THE FUTU	RE		
			(Grou	p H: Global Elective)			
Cou	rse Code	:	16G7H10	CIE	:	100 Marks	
Crea	lits: L:T:P	:	3:0:0	SEE	:	100 Marks	
Tota	l Hours	:	39L	SEE Duration	:	3.00 Hours	
Cou	rse Learning Ob	iect	ives: The student	s will be able to			
1	Understand the	imn	ortance and role of	of Smart Manufacturing Systems, IoT and	Πο	Г	
2	Explain importa	nce	of automation tec	chnologies, sensors, Robotics and Machin	e vi	sion	
3	Understand app	lica	tion of artificial i	ntelligence and the need for data transfor	mat	ion handling	
Ū	storing and secu	rity		interingence and the need for data function	mat	ion, nananng,	
4	Understand simi	ulat	ion_predictive and	d knowledge modeling along with analysi	s		
5	Learn networkir	10°	sustainable techno	logy and factory networks	5		
0	Learn networkin	16, 1		hogy and factory networks.			
			1	Init_I		06 Hrs	
Smo	rt Manufaaturin	<u>α ο</u>	nd Industry 1.0	Jimt-1		001115	
Maar	for Smort Mon	g a	nu muusu y 4.0	The second technologies in Smort may	aufo	aturing CAD	
Aroh	itecture surround	ling	, 2D Models (E	rep and CSG) MEMS Industry 40	Iura	teroperability	
Infor	mation transpar	anc	x Technical a	ssistance Decentralized decision making	-m	Internet of	
Thin	as(IoT) Industry	Unt Inte	y, reclinical a ernet of Things (II	oT) Future of Manufacturing industries	ng,	internet of	
1 11111	$g_{s(101)}$, muusu y	mu	Inct of Things (II	nit II		10 Hrs	
Mon	ufacturing Auto	ma	tion			071118	
Tech	malagy intensive	ma	uiuii nufaatumina and a	when alwaical avatama Automation wai	.~ D	abatian Data	
rech	mology intensive		nulacturing and c	systems, Automation using for consing state	ig K	obolics, Dala	
stora	ge, retrieval, ma	ութ ե	and line and press	entation, we change in a sensing stat	e ai	achina flaw	
Maa	esses, Material	II Jugar	and and appage	, controlling material movement and	III . Iorrat	ion Mashina	
Visi	natronics, Transc		ers and sensors,	Froximity sensors, biosensors, Acce		non Machine	
Maal	hing Vision in ind	ll, I	rositioning, ident	incation, vernication and weasuremen	$\Pi - P$	application of	
Iviac		usu	lies II.			00 II.wa	
Data	h an dlin a main a	F		IIIt –111		09 1115	
Data	thanking using	ЕШ Ма	thematical funct	iong Dogragion Nood for different	fu	ations Data	
Data	ing Discrete	-ivia	Dondom vorio	hlas Transformation languages Inte	IUI foo	in a systema	
Min	ging-Discrete	and	Kandom varia	Dete transformation languages, Inte		ing systems-	
WIICI	oprocessors, Dir		memory access	, Data transfer schemes and systems,			
Dete	Security Artific	1 III : _ 1		quency domain, industrial Network Data	C011	minumications,	
Data	Security Attille		Interingence – I	acoming	Iai	networks –	
Supe	ivised, Olisuperv	1500				06 Uma	
C:m.	Jation Modeling		U d Analysia			UU HIS	
Sim	ulation system	3 af	iu Allalysis	parformance managing and Empetional	-01-4	ionshing	
SIIII	ation - system en		es, input variables	s, performance measures, and Functional	teral	nonsmps,	
types	s of simulation. Pr	ear	cuve modering an	a simulation tools, Knowledge Modeling	-ty]	Evention of	
techi	nology options, Fi	inc	tional analysis of	control systems – Linear and Non-lin	ear,	Functional	
deco	decomposition, runctional sequencing, information / dataflow, interface						
D f	ъ		U	mu – v		U9 Hrs	
Perf	ormance Measu	res	of Smart Man	Hacturing Systems- Smart manufactur	ng-	Sensing and	
rerc	epuon, Manipulat	101 101	, woollity and A	Lutonomy, Factory Networks, Informati	un I	vioueling and	
	Testing, Performance Measurement and Optimization, Engineering System integration, Production						
Netw	vork integration,	Pı	for Section networ	k data quality, Sustainable Processes	an	a Resources,	
Integ	gration Intrastruct	ure	for Sustainable M	anutacturing			
C		<u>.</u>	a . a . a				
Cou	rse Outcomes: A	iter	completing the	course, the students will be able to			
C01	: Explain role a	nd	importance of Sm	art Manufacturing Systems, IoT and IIoT			

CO2:	Explain importance of automation technologies, sensors, robotics and machine vision
CO3:	Illustrate the application of artificial intelligence and need for data transformation, handling

CO4: Explain analytical and simulation for performance study of smart technologies and networks

Ref	erence Books
	Zongwei Luo, Smart Manufacturing Innovation and Transformation: Interconnection And
1	Intelligence, 1 st Edition, IGI Global Publications, 2014,ISBN-13: 978-1466658363 ISBN-10:
	1466658363
2	Yan Lu. KC Morris, Simon Frechette, Smart Manufacturing Standards, NIST, 1st Edition, 2016,
2	Project report.

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Semester End Evaluation (SEE); Theory (100 Marks)

			Semester: VII			
SPACE TECHNOLOGY AND APPLICATIONS (Group H: Global Elective)						
Course Code	:	16G7H11	(CIE	:	100 Marks
Credits: L:T:P :S	:	3:0:0:0	S	SEE	:	100 Marks
Hrs/Week	:	35L	S	SEE Duration	:	3.00 Hours
Course Learning Ob	jectiv	ves: The stuc	lents will be able to			
1 Define the earth e concepts.	nviro	onment and it	s behavior, launching ve	chicles for satelli	tes ar	nd its associated
2 Analyze satellites	in te	rms of techno	logy, structure and com	munications.		
3 Use satellites for s	pace	applications	remote sensing and met	rology.		
4 Apply the space te	chnc	ology, techno	ogy mission and advanc	ed space systems	to na	ation's growth.
						07 11
Fauth's anxieonmor		Atmograhara	UNII-I ionographore Magneter	anhara Van A	11.00	U/ Hrs Dediction holts
Internlanetary medium	n: A	ar wind Sola	r- Farth Weather Relation	spilere, vali A	пеп	Radiation bens,
Launch Vehicles: R	ocke	try. Propella	nts. Propulsion. Combi	istion Solid Li	duid	and Cryogenic
engines, Control and C	Guida	ince system,]	on propulsion and Nucle	ear Propulsion.	quiu	und Oryogenie
			UNIT-II			07 Hrs
Satellite Technology	Satellite Technology: Structural, Mechanical, Thermal, Power control, Telemetry, Telecomm					
and Quality and Reliab	oility	, Payloads, S	pace simulation.			
Satellite structure: Sa	atelli	te Communic	ations, Transponders, Sa	atellite antennas.		0=
			UNIT-III	. 1. 1 1 1	• .	07 Hrs
Satellite Communica	Satellite Communications: LEO, MEO and GEO orbits, Altitude and orbit controls, Multiple					
Space applications: T medicine, Satellite nav	Telep vigati	hony, V-SA7 on, GPS.	, DBS system, Satellite	Radio and TV, T	Tele-I	Education, Tele-
,	U	,	UNIT-IV			07 Hrs
Remote Sensing: Vis	sual 1	bands, Agricu	Iltural, Crop vegetation,	Forestry, water l	Resou	urces, Land use,
Land mapping, geolog	y, U	rban develop	nent resource Managem	ent, and image pr	oces	sing techniques.
Metrology: Weather	Metrology: Weather forecast (Long term and Short term), weather modelling, Cyclone					
predictions, Disaster and flood warning, rainfall predictions using satellites.						
			UNIT-V			07Hrs
Satellite payloads: 7	ſechı	nology missi	ons, deep space planet	tary missions, L	unar	missions, zero
gravity experiments, s	pace	biology and	nternational space Missi	ions.	11	<i>, ,</i> .
Advanced space syste	ems:	Remote sens	ing cameras, planetary	payloads, space s	hutti	e, space station,
inter-space communic	auon	systems.				
Course Outcomes: A	fter 4	completing t	he course, the students	will be able to		

Course	outcomes. After completing the course, the students will be able to
CO1	Explain different types of satellites, orbit and associated subsystems.
CO2	Apply the basics of launching vehicles, satellites and sub systems for space applications.
CO3	Analyze the applications of satellite in the area of communication, remote sensing, metrology etc.,
CO4	Study technology trends, satellite missions and advanced space systems.

Refe	erence Books
1	Atmosphere, weather and climate, R G Barry, Routledge publications, 2009, ISBN- 10
	:0415465702.
2	Fundamentals of Satellite Communication, K N Raja Rao, PHI, 2012, ISBN:9788120324015.
3	Satellite Communication, Timothy pratt, John Wiley, 1986 ISBN: 978-0- 471- 37007 -9,
	ISBN 10: 047137007X.
4	Remote sensing and applications, B C Panda, VIVA books Pvt. Ltd., 2009, ISBN:
	108176496308.

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Semester End Evaluation (SEE); Theory (100 Marks)

Semester: VII											
ADVANCED LINEAR ALGEBRA											
C			(Grou	p G: Global Electiv	e)	T	100 M 1				
Cour	se Code	:	16G/H12 3.0.0		CIE	:	100 Marks				
Toto	IIS: L:I:P	:	3:0:0		SEE SEE Duration	:	100 Marks				
	rse Learning (• Dhia	57L ectives: The student	s will be able to	SEE DUI ALION	•	5.00 Hours				
1	1 Adequate exposure to learn the fundamental concepts to model a system of linear equations and										
-	to obtain the solution of system of linear equations										
2	Analyze and e	exte	end the structure of	vector spaces linear	transformations Svr	nm	etric matrices				
-	quadratic form	ns r	required in application	ons of Business Scie	nce and Engineering		ente mantees,				
3	Apply the cor		t of Figenvalues to	study differential equ	uations and dynamic	als	ustems Apply				
5	the concept of	ice _r Cor	thogonality to evan	ine some of the least	-squares problems	ur 5 <u>.</u>	stems. repry				
4	Apply Lipcor	Dre	aromming to Nature	and control and Con	-squares problems.						
4	Apply Linear	FIC	gramming to Netwo	ork problems and Gar	ne meory.						
			1	Unit I			07 Hrs				
Sveta	m of linear on	1101	tions	01111-1			07 1118				
Matr	ices and system	ua n o	f linear equations (Geometry of linear e	equations Linear mo	del	s in Business				
Scier	ce and Engin	eer	ing-Input-Output m	odel in Economics	Balancing chemic	al e	equations and				
Elect	rical networks.		5 I I		, 8		1				
			U	nit – II			09 Hrs				
Vect	or spaces and	line	ear transformation	5							
Revis	sion of Vector	Spa	aces, Subspaces, Lir	near independence, B	asis, Dimension and	Ch	ange of basis.				
Appl	ications to Di	ffer	ence equations, Ma	arkov chains. Inters	ection, Sum, Produc	ct c	of spaces and				
Tens	or product of	ft	wo vector spaces.	Introduction to I	Linear transformation	ons,	Geometrical				
ınterp	pretations in 2-0	lım	ensions and 3-dime	nsions.			00 H				
0.4	I.4 E.			<u>nıt –111</u>			09 Hrs				
Orth	ogonality, Eig	en	values and Eigen v	ectors	1 / 15		·				
Ortho	gonality, Inne	r pi	roduct spaces, Appl	ications to Weighted	least-squares and Fo	ouri	er series, Fast				
Four	er transform.	zigo	en values and Eiger	n vectors, Applicatio	ons to Differential ec	luat	ions, Discrete				
dyna	mear systems.		T	nit IV			07 Hrs				
Sym	metric matrice	6 9	nd quadratic form				07 111 5				
Intro	duction to syn	nme	etric matrices. Qua	dratic forms. Test f	or Positive definiter	iess	. Constrained				
Optir	nization, Singu	lar	Value Decomposition	on. Applications to ir	nage processing.		,				
			U	nit –V	0 1 0		07 Hrs				
Line	ar programmi	ng	and game theory								
A Ge	cometrical intro	odu	ction to Linear pro	gramming, Simplex	method and its geor	netr	ical meaning,				
Network models-Max flow-min cut theorem, Payoff matrix and Matrix games.											
Cour	se Outcomes:	Af	ter completing the	course, the students	will be able to		1.				
CO1	: Identify and	111	terpret the fundamer	ntal concepts of linea	r equations, vector sp	ace	s, linear				
	transformat	lons	s, Orthogonality, Eig	gen values, symmetri	c matrices, quadratic	tor	ms, linear				
<u> </u>	programmir	ig a	ing game theory.	Lincon clashes to -1	vo lincon o metion a	: ff					
	Apply the K	110¥ 601	vieuge and skills of	ntimization problem	ve linear equations, o	uife	roblems and				
	related prob	len	auons, constrained (opunitzation problem	is, inicai programmi	ıg þ	iooicilis allu				
L	renated prob	1011	10.								

Refere	ence Books
1	David C Lay; Linear Algebra and Its Applications; Pearson Education; III Edition; 2003; ISBN: 978-81-775-8333-5.
2	Gareth Williams; Linear Algebra with Applications; 6 th edition; 2008; Narosa publications; ISBN: 978-81-7319-981-3.
3	Gilbert Strang; Linear Algebra and Its Applications; IV Edition; Cengage Learning India Edition; 2006; ISBN: 81-315-0172-8.
4	Howard Anton and Chris Rorres; Elementary Linear Algebra Applications Version; Wiley Global Education; 11th Edition; 2013; ISBN: 9781118879160.

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Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part - A and Part - B. Part - A consists of objective type questions for 20 marks covering the complete syllabus. Part - B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	1	-	-	-	-	-	-	-	2
CO2	3	2	1	-	-	-	-	-	-	-	-	2
CO3	2	3	2	2	-	-	-	-	-	-	-	1
CO4	3	3	1	2	1	-	-	-	-	-	-	3

High-3: Medium-2 : Low-1

	Semester: VII									
	THIN FILM NANOTECHNOLOGY									
(Group G: Giodal Elective)										
Cou	rse Code	:	16G7H13		CIE	:	100 Ma	rks		
Crea	lits: L:T:P	:	3:0:0		SEE	:	100 Ma	rks		
Tota	l Hours	:	39L		SEE Duration	:	3.00 Ho	urs		
Cou	rse Learning ()bj	ectives: The student	s will be able to)					
1	Understand th	ne in	nportance of vacuur	n in thin film fa	brication					
2	Acquire the k	nov	vledge of thin film p	reparation by v	arious techniques					
3	Analyze the p	rop	erties of thin films u	ising different c	haracterization met	hods				
4	Optimize the	pro	cess parameter and p	property depend	lence					
5	Apply the kno	owl	edge for developing	thin film devic	es.					
[1	Init_I				08 Hrs		
Vaci	um Technolo	σv·	Basics of Vacuum	- Principles o	f different vacuum	num	ns. Rotar	v Roots		
Diffi	ision Turbo m	gy. olec	ular and Cryogenic	numps: Measu	rement of vacuum -	Con	rent of Ca	nacitance		
Man	ometer Pirani a	and	Penning gauges - V	acuum Systems	& Applications	Con	cpt of Ca	pacitatice		
Ivian	Sincter, I fram a	ina	<u>I eming gauges - V</u>	nit – II				08 Hrs		
Met	nods of thin fil	m r	reparation					00 1115		
Phys	ical Vapor Den	osi	tion (PVD) Technia	ues:						
Evar	oration: Ther	nal	evaporation. Elect	ron beam evar	oration. Laser abl	ation	and Cat	thode arc		
depo	sition. Sputteri	ng:	DC sputtering, RF S	Sputtering, Mag	gnetron sputtering,	React	ive Sputte	ering, and		
Ion b	eam sputtering		1 0,	1 0/ 0			1	0,		
Cher	nical Vapor I	Dep	osition (CVD) Te	chniques: Cor	ventional CVD,	Plasn	na Enhan	ce CVD		
(PEC	CVD) and Atom	nic 1	ayer deposition (AL	.D).	,					
Othe	r Methods: Spi	n co	pating and Spray Pyr	rolysis.						
	•		U	nit –III				07 Hrs		
Surf	ace Modificati	on	and Growth of Thi	n Films:						
Surfa	ice preparation	1 &	<u>Engineering</u> for	Thin film gro	wth: Cleaning, Me	odific	ation, Ma	asking &		
Patte	rning, Base Co	ats	and Top Coats.							
Thin	Film growth:	S	equence of thin fil	m growth, De	fects and impuritie	es, Ef	fect of D	eposition		
Para	meters on film	gro	wth.					1		
			U	nit –IV				08 Hrs		
Prop	erties and Ch	ara	cterization of Thin	Films						
Film	thickness (Qua	ırtz	crystal thickness mo	onitor and Stylu	s Profiler);					
Film	Adhesion (Tap	be, (Cross-hatch test, and	Humidity metl	nods);					
Surfa	ice morphology	/ an	d topography (SEM	and AFM);						
Film	composition (2	X-ra	y Photoelectron Spe	ectroscopy);						
Film	structure (X-ra	ıy d	iffraction and Rama	n studies);						
Elect	rical characteri	zati	ion (Four Probe and	Semiconductor	Analyzer); and					
Opti	cal characteriza	.t101	n (Spectrophotomete	er).						
	Unit –V 08 Hrs									
Thin	Film Applica	tior	IS:	1						
	Electrodes:	Dej	position of a Metal f	iim, Ex: Alumi	num.	e.	1			
	film Free 7		nducting oxides (IC	(U) – Preparatio	on and Optimization	1 OI a	semicond	ucting		
_	$\begin{array}{c} \text{IIIm, Ex: } ZnO. \\ \hline \end{array}$									
,	C pumizatio	011 0 icc:	i a dielectric film, E	x. A12 O_3 or S131	N4.					
		The). - Film Transistors ("	гст)						
	•	1 [[]] TL :	n Film Fransistors (11,1),						
	•	1 n1) Th	n Film Sensors							
	•	1 h11	n Film Capacitors							
1	• '	I hi	• Thin film Solar Cells,							

- Thin film Solar Absorbers
- Diamond-like carbon (DLC) coating
- EMI Shielding coatings
- Hard coatings
- Coatings on Plastics/Polymers.

Course Outcomes: After completing the course, the students will be able to

CO1	Understand the importance of vacuum technology for thin film growth
CO2	Prepare various kinds of thin films using different deposition techniques
CO3	Characterize the deposited films for various properties
CO4	Fabricate thin film based devices.

Reference Books

1.	Vacuum Technology by A. Roth, Elsevier, 3 rd Edition, 1976, ISBN: 9780444880109, 9780444598745,
2.	Thin Film Phenomenon by K.L. Chopra, McGraw-Hill, 1 st Edition, 1969, ISBN: 0070107998, 978-0070107991
3.	Materials Science of Thin Films by Milton Ohring, Elsevier, 2 rd Edition, 2001, ISBN: 9780125249751
4.	Thin-Film Deposition: Principles and Practice by Donald Smith, McGraw-Hill, 1 st Edition, 1995, ISBN: 0070585024, 9780070585027

Continuous Internal Evaluation (CIE); Theory (100 Marks)

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Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			1									2
CO2				2								2
CO3					2							2
CO4			2	2	2		2		2	2		2

High-3; Medium-2; Low-1

Semester: VII											
	ENGINEERING MATERIALS FOR ADVANCED TECHNOLOGY										
			(Grouj	p H: Global Elective)							
Cour	rse Code:	•••	16G7H14	CIE	:	100 Marks					
Cred	lits: L:T:P	••	3:0:0	SEE	:	100 Marks					
Tota	l Hours	••	39L	SEE Duration	:	3.00 Hours					
Cour	rse Learning Obje	ctiv	ves: The students w	vill be able to							
1	Aapply the basic of the area of Engine	con eeri	cepts of Chemistry ng.	to develop futuristic materials for high	-tec	h applications in					
2	Impart sound knowledge in the different fields of material chemistry so as to apply it to the problems in engineering field.										
3	Develop analytica in engineering and	ul ca d ap	apabilities of stude oply knowledge gai	nts so that they can characterize, transfo ned in solving related engineering prob	orm lem	and use materials					

UNIT-I08 HrsCoating and packaging materialsSurface Coating materials:Synthesis and applications of Polymer coating materials: Teflon, Silicone films Polyvinyl chloride & its
copolymers, Poly vinyl acetate, Poly ethylene-HDPE, LDPE, Polyurethane.Properties required in a pigment and extenders.Inorganic pigments-titanium dioxide, zinc oxide, carbon black, chromate pigments, chrome green,
ultramarine blue, iron blue, cadmium red.Corrosion inhibiting pigments- zinc phosphate, zinc and barium chromate pigments, ceramic pigments,
metal flake pigments, extenders.Developments in new polymers such as dendrimers, biopoplymers & biodegradable polymers.

Packaging materials:

Food products: Cellulosic and Polymeric packaging materials and their properties – including barrier properties, strength properties, optical properties. Glass, aluminium, tin, paper, plastics, composites.

Pharmaceutical products: Injectibles and tablet packaging materials.	
UNIT-II	07 Hrs

Adhesives

Introduction-Classification of Adhesives-Natural adhesives, synthetic adhesives-drying adhesives, pressure sensitive adhesives, contact adhesives, hot adhesives. One part adhesives, multi part adhesives. Adhesive Action. Development of Adhesive strength- Physical factors influencing Adhesive Action-surface tension, surface smoothness, thickness of adhesive film, elasticity and tensile strength. Chemical Factors Influencing Adhesive action - presence of polar groups, degree of polymerization, complexity of the adhesive molecules, effect of pH. Adhesive action- specific adhesive action, mechanical adhesive action, fusion adhesion. Development of adhesive strength- adsorption theory and diffusion theory. Preparation, curing and bonding Processes by adhesives-with reference to Epoxy, phenolics, Silicone, Polyurethane, Acrylic adhesives, Poly vinyl alcohol, Polyvinyl acetate.

Optical fibre materials

Fiber Optics, Advantages of optical fiber communication over analog communication, Classification based on refractive index of the core- step index and graded index optical fibres, Classification based on core radius-single mode and multimode optical fibres, Fibre fabrication.-Methods to manufacture optical glass fibres. Double crucible method and preform methods. Manufacture of perform- Chemical Vapour Deposition (CVD), Modified vapour deposition (MCVD) Plasma activated vapour deposition (PCVD), Outside vapour deposition (OVD)-Vapour-phase axial deposition (VAD). Drawing the fibres from perform, coating and jacketing process.

UNIT-III

Ion exchange resins and membranes

Ion exchange resins-Introduction, Types, physical properties, chemical properties-capacity, swelling, kinetics, stability, ion exchange equilibrium, regeneration. Applications of ion exchange resins-softening of water, demineralization of water, advantages and disadvantages of ion exchange resins-calcium sulphate

08 Hrs

fouling, iron fouling, adsorption of organic matter, bacterial contamination. Ion exchange membranes, Types, Classification, Fabrication of ion exchange cottons- anion exchange cotton and cation exchange cotton. Application of ion exchange membranes in purification of water by electro dialysis method.

	1 <u> </u>		/ *	
	UNIT-I	V		08 Hrs
Spectroso	copic Characterization of materials:			

Electromagnetic radiation, interaction of materials with electromagnetic radiation.

UV- visible spectrophotometry :Introduction-Electronic transitions- factors influencing position and intensity of absorption bands-absorption spectra of dienes, polyene and α,β -unsaturated carbonyl compounds, Working of UV-Vis spectrophotometer, Theoretical calculation of λ_{max} by using Woodward-Fieser rules- for cyclic and α,β -unsaturated carbonyl compounds.

IR Spectroscopy: Introduction, principle, molecular vibrations, vibrational frequency, number of fundamental vibrations, factors influencing fundamental vibrations, instrumentation of IR spectrophotometer, sampling techniques and application of IR spectroscopy in characterization of functional groups.

UNIT-V

08 Hrs

NMR spectroscopy:

H¹ NMR Spectroscopy: Basic concepts- relaxation process. NMR spectrometer-FT NMR-Solvents used in NMR, internal standards-Chemical equivalence -Integrals and Integrations- chemical shift-Factors affecting chemical shifts- shielding and deshielding effects – chemical and magnetic equivalent –magnetic anisotropy-spin-spin splitting rules- Application of NMR on various compounds such as alkanes, alkenes, alkynes, alkyl halides, alcohols, ethers, amines, aldehydes, ketones, carboxylic acids, esters, amides & mono substituted aromatic compounds. Problems on prediction of structure of compounds.

Cou	rse Outcomes: After completing the course, the students will be able to						
CO	I Identify sustainable engineering materials and understand their properties.						
CO2	2 Apply the basic concepts of chemistry to develop futuristic materials for high-tech applications in						
	different areas of engineering.						
CO	3 Analyze and evaluate the specific application of materials.						
CO4	1 Design the route for synthesis of material and its characterization.						
Refe	erence Books						
1.	Materials Science, G.K.Narula, K.S.Narula & V.K.Gupta. 38th Editon, 2015, Tata McGraw-Hill						
	Publishing Company Limited ISBN: 978-0-07-451796-3.						
2.	Solar Lighting, Ramachandra Pode and Boucar Diouf, Springer e-book, 2011, ISBN: 978-1-44-						
	712133-6 (Print) 978-1-44-712134-3 (Online),						
3.	Spectroscopy of organic compounds, P.S.Kalsi, 6th Edition, 2013, New Age International(P)						
	ltd,publisher, ISBN: 978-1-22-415438-6.						
4.	Food Packaging Materials, Mahadeviah M & Gowramma RV, 6th Edition, 1996, Tata McGraw Hill						
	Publishing Company Itd ISBN:746-2-23-82 9780-0						

Continuous Internal Evaluation (CIE); Theory (100 Marks)

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Semester End Evaluation (SEE); Theory (100 Marks)

Semester: VII								
			APPLIED PSYC	CHOLOGY FOR ENGINEERS	-			
			(Grou	p H: Global Elective)				
Cou	rse Code	:	16G7H15	CIE	:	100		
Crea	lits: L:T:P	:	3:0:0	SEE	:	100		
Tota	l Hours	:	35 L	SEE Duration	:	3 Hours		
Cou	rse Learning C)bje	ectives: The students	s will be able to				
1	To appreciate	hu	man behavior and h	numan mind in the context of learner's in	nm	ediate society		
	and environm	ent.						
2	To understand	d th	e importance of life	elong learning and personal flexibility to	su	stain personal		
	and Profession	nal	development as the	nature of work evolves.				
3	To provide st	tude	ents with knowledge	e and skills for building firm foundation	ı fo	or the suitable		
	engineering p	rofe	essions.					
4	To prepare stu	idei	its to function as eff	ective Engineering Psychologists in an In	dus	trial,		
_	Governmenta	<u>1 01</u>	consulting organiza	ation.				
5	To enable stu	den	ts to use psychologic	cal knowledge, skills, and values in occup	atio	onal pursuits		
	in a variety of	set	tings that meet perso	onal goals and societal needs.				
r			T	· •/ T		7.11		
T /	1 /			$\frac{nit - I}{I}$	1	1 / Hrs		
Intro	duction to Ps	sych	ology: Definition	and goals of Psychology: Role of a Psy	/cho	ologist in the		
Soci	ety: Today's Pe	ersp	ectives (Branches C	Mathada ta atudu Human Dahayia	risu	Ic, Cognitive,		
Hum Obse	anistic, Psych	010g	gical Research and	t Methods to study Human Benavior		Experimental,		
Obse	rivation, Questi	om		nit II		7 Ums		
Into	liganca and	Ant	ituda: Concent ar	nd definition of Intelligence and Anti-	tud	A Nature of		
Intel	ligence Theori	Apu	of Intelligence – S	nearman Thurston Guilford Vernon ('har	c, Nature of		
Intel	ligence tests	Tvr	es of tests Measure	rement of Intelligence and Antitude		ncent of IO		
Mea	surement of Mi	ıltin	le Intelligence – Flu	id and Crystallized Intelligence	CO	neept of iQ,		
wied	surement of Me	inp	te inteningenee 1 te	ne und Orystamzed interingenee.				
			Ur	nit — III		7 Hrs		
Pers	onality: Conce	ept	and definition of p	ersonality, Approaches of personality- p	osyc	choanalytical,		
Soci	o- Cultural, I	nter	personal and dev	elopmental, Humanistic, Behaviorist,	Tra	it and type		
appr	oaches. Assessi	nen	t of Personality: Se	lf- report measures of Personality, Questi	onr	naires, Rating		
Scale	es and Projectiv	/e te	echniques, its Chara	cteristics, advantages & limitations, exam	ıple	s. Behavioral		
Asse	ssment. Psycho	olog	ical Stress: a. Stres	ss- Definition, Symptoms of Stress, Extr	eme	e products of		
stres	s v s Burnout, V	Woi	k Place Trauma. Ca	uses of Stress – Job related causes of stre	SS.	Sources		
of Fr	ustration, Stres	s ar	d Job Performance,	Stress Vulnerability-Stress threshold, per	ceiv	ved control.		
				$\frac{\operatorname{nt} - \operatorname{IV}}{\operatorname{D}}$		7 Hrs		
App	lication of Ps	sych	ology in Workin	g Environment: The present scenario	of	information		
techi	nology, the rol	e o	i psychologist in t	the organization, Selection and Training	3 OI	f Psychology		
Profe	Protessionals to work in the field of Information Technology. Distance learning, Psychological							
cons	consequences of recent developments in Information Technology. Type A and Type B Psychological							
Cour	Counsening - Need for Counsening, Types – Directed, Non- Directed, Participative Counseling.							
Lea	ming Definiti	07	Conditioning O	langing Conditioning Design of Classic		/ Hrs		
(Davi	lov) the mean	011,	conditioning - C	assivat Conditioning, Basics of Classic	al	Conditioning		
(Pav	10v, the proc		of extinction, Dis	litioning Schodulos of minforcoment.	III III	tive Seciel		
	mer expl). The	oa ne	L stent L soming	Informational Learning, Trial and Error M	Jgni [ath	od Insightful		
appro	ning	ng ·	- Latent Learning, (Justi vational Learning, Trial and Effor M	cui	ou, msignuul		
Lear	nıng.							

Experimental Psychology (Practicals)- Self Study 2 Hrs /Week

1.Bhatia's Battery of Performance and intelligence test

2. Multidimensional Assessment of Personality

3. David's Battery of Differential Abilities (Aptitude test)

4.Bilateral Transfer of Training Mirror drawing apparatus with Electronic Digital Reset Error Counter (Performance)

5. Student Stress Scale.

Course	Course Outcomes: After completing the course, the students will be able to									
CO1	Describe the basic theories, principles, and concepts of applied psychology as they relate to									
	behaviors and mental processes.									
CO2	Define learning and compare and contrast the factors that cognitive, behavioral, and									
	Humanistic theorists believe influence the learning process.									
CO3	Develop understanding of psychological attributes such as intelligence, aptitude, creativity,									
	resulting in their enhancement and apply effective strategies for self-management and self-									
	improvement.									
CO4	Apply the theories into their own and others' lives in order to better understand their									
	personalities and experiences.									
CO5	Understand the application of psychology in engineering and technology and develop a route									
	to accomplish goals in their work environment.									

Reference Books:

1. . Understanding Psychology Feldman R. S, IV edition, (1996) McGraw Hill India

2. Psychology Robert A. Baron, III edition (1995) Prentice Hall India.

3. Organizational Behaviour , Stephen P Robbins $\,$ Pearson Education Publications, 13th Edition, ISBN-81-317-1132-3

4. Organisational Behaviour : Human Behaviour at Work ,John W.Newstrem and Keith Davis. Tata McGraw Hill India, 10th Edition, ISBN 0-07-046504-5

5. Psychology-themes and variations, Wayne Weiten, IV edition, Brooks / Cole Publishing Co.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

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Semester End Evaluation (SEE); Theory (100 Marks)

VII Semester										
FOUNDATIONAL COURSE ON ENTREPRENEURSHIP										
(Group H: Global Elective)										
Course Code:16G7H16CIE Marks:100										
Cr	edits: L:T:P:S : 3:0:0:0	SEI	E Marks	: 100						
To	Total Hours : 36L SEE Duration : 03 Hours									
Co	urse Learning Objectives:									
1	1 To make participants self-discover their innate flow, entrepreneurial style, and identify problems									
	worth solving thereby becoming	entrepreneurs								
2	To handhold participants on lea	n methodology to craft value propos	sition and get re	eady with lean						
	canvas	1		1						
3	To create solution demo by con	ducting customer interviews and fir	iding problem-s	solution fit for						
_	building Minimum Viable Produ	ict (MVP)	1.	<u> </u>						
4	To make participants understance	cost structure, pricing, revenue type	es and important	ce of adopting						
_	shared leadership to build good t		1	1						
Э	To help participants build a stroi	ig brand and identify various sales c	nannels for their	r products and						
6	Services	asias of hyperpass recrulations and	other legal tom	na alana with						
0	understanding of Intellectual Pr	asies of business regulations and operty Pights	other legal tern	ns along-with						
	understanding of interfectual FIG	perty Rights								
		IInit_I		07 Hrs						
Se	f Discovery and Opportunity D	iscoverv		07 111 5						
Fir	ding the Flow: Effectuation: Ide	ntifying the Effectuation principles	used in activitie	es: Identifying						
Pro	blem Worth Solving: Design	Thinking: Brainstorming: Presenti	ng the Identifi	ied problems:						
Ide	ntifying the Entrepreneurial Style	· · · · · · · · · · · · · · · · · · ·		, F ,						
		Unit – II		07 Hrs						
Cu	stomer, Solution and Lean Met	hodology		!						
Cu	stomers and Markets; Segmentat	ion and Targeting; Identifying Jobs	, Pains, and Ga	ins and Early						
Ad	opters; Crafting Value Propositio	n Canvas (VPC); Presenting VPC; I	Basics of Busine	ess Model and						
Le	an Approach; Sketching the Lean	Canvas; Risks and Assumptions; Pro	esenting Lean C	anvas.						
		Unit – III		07 Hrs						
Pr	oblem-Solution Fit and Building	g MVP								
Bl	e Ocean Strategy - Plotting the	Strategy Canvas; Four Action Fra	amework: Elim	inate-Reduce-						
Ra	se-Create Grid of Blue Ocean	Strategy; Building Solution Dem	io and Conduc	ting Solution						
Interviews; Problem-Solution Fit; Building MVP; Product-Market Fit; Presenting MVP.										
		Unit – IV	Unit – IV 06 Hrs							
Financial Planning & Team Building										
ГП	lancial Planning & Team Build			T						
Co	st Structure - Estimating Costs	ng s; Revenues and Pricing: Revenu	e Streams, Re	venue Types,						
Co Ide	st Structure - Estimating Costs ntifying Secondary Revenue S	ng s; Revenues and Pricing: Revenu treams, Estimating Revenue and	e Streams, Re Price; Profitab	venue Types, vility Checks;						
Co Ide Bo	st Structure - Estimating Costs ntifying Secondary Revenue S otstrapping and Initial Financing	ng s; Revenues and Pricing: Revenu treams, Estimating Revenue and ; Practising Pitch; Shared Leadershi	e Streams, Re Price; Profitab p; Hiring and F	venue Types, bility Checks; Fitment, Team						
Co Ide Bo Ro	st Structure - Estimating Costs ntifying Secondary Revenue S otstrapping and Initial Financing le and Responsibilities.	ng s; Revenues and Pricing: Revenu treams, Estimating Revenue and ; Practising Pitch; Shared Leadershi	e Streams, Re Price; Profitab p; Hiring and F	venue Types, bility Checks; ⁷ itment, Team						
Co Ide Bo Ro	st Structure - Estimating Cost: ntifying Secondary Revenue S otstrapping and Initial Financing le and Responsibilities.	ng s; Revenues and Pricing: Revenu treams, Estimating Revenue and ; Practising Pitch; Shared Leadershi Unit – V Intellectual Property	e Streams, Re Price; Profitab p; Hiring and F	venue Types, pility Checks; Fitment, Team 09 Hrs						
Co Ide Bo Ro Ma	st Structure - Estimating Cost ntifying Secondary Revenue S otstrapping and Initial Financing le and Responsibilities.	ng s; Revenues and Pricing: Revenu treams, Estimating Revenue and ; Practising Pitch; Shared Leadershi Unit – V Intellectual Property	e Streams, Re Price; Profitab p; Hiring and F	venue Types, bility Checks; Fitment, Team 09 Hrs						
Co Ide Bo Ro Ma Po Re	st Structure - Estimating Cost ntifying Secondary Revenue S otstrapping and Initial Financing le and Responsibilities. Trketing, Sales, Regulations and sitioning and Branding; Channe gulations: How to Get Help to G	ng s; Revenues and Pricing: Revenu treams, Estimating Revenue and ; Practising Pitch; Shared Leadershi <u>Unit – V</u> Intellectual Property els; Sales Planning; Project Mana Fet Started: Patents Trademark Li	e Streams, Re Price; Profitab p; Hiring and F gement; Basics censing Contra	venue Types, bility Checks; Fitment, Team 09 Hrs of Business						
Co Ide Bo Ro Ma Po Re	st Structure - Estimating Cost ntifying Secondary Revenue S otstrapping and Initial Financing le and Responsibilities. Irketing, Sales, Regulations and sitioning and Branding; Channe gulations; How to Get Help to O ral mistakes. Types of Permits	ng s; Revenues and Pricing: Revenu treams, Estimating Revenue and ; Practising Pitch; Shared Leadershi Unit – V Intellectual Property els; Sales Planning; Project Mana Get Started; Patents, Trademark, Li Tax Registration Documents Co	e Streams, Re Price; Profitab p; Hiring and F gement; Basics censing, Contra	venue Types, pility Checks; Fitment, Team 09 Hrs of Business acts; Common ingement and						

Course Outcomes: After completing the course, the students will be able to							
CO1	showcase the ability to discern distinct entrepreneurial traits						
CO2	Know the parameters to assess opportunities and constraints for new business ideas						
CO3	Understand the systematic process to select and screen a business idea						
CO4	design strategies for successful implementation of ideas						
CO5	Create Business Model and develop Minimum Viable Product						

Reference Books

1	Running Lean: Iterate from Plan A to a Plan That Works. O'Reilly Media, Maurya, A., 2012.
2	Entrepreneurship.Roy, R., 2012. Oxford University Press
3	Intellectual Property Law in India. Gupta, T. S., 2011. Kluwer Law International
4	Flow: The Psychology of Optimal Experience. Czikszentmihalyi, M., 2008. Harper Perennial
	Modern Classics
5	Effectuation: Elements of Entrepreneurial Expertise. Sarasvathy, S. D., 2009. Edward Elgar
	Publishing Ltd.

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Semester End Evaluation (SEE); Theory (100 Marks)

Semester: VII										
UNMANNED AERIAL VEHICLES										
	(Group H: Global Elective)									
Course Code	:	16G7H17		CIE	:	100 Marks				
Credits: L:T:P:S	:	3:0:0:0		SEE	:	100 Marks				
Hours	:	36L		SEE Duration:	:	3 Hrs				

Course Learning Objectives: The students will be able to

1	Get an overview of the history of UAV systems
2	Understand the importance of aerodynamics, propulsion, structures and avionics in the design of UAV
3	Demonstrate ability to address the various mission payloads - on-board & off-board, propulsion systems integration with manned systems
4	Assess the performance and airworthiness of the designed UAV

Unit-I	06 Hrs
Introduction to Flight Vehicles:	
History of Flight Vehicles and UAVs, Classifications, Woking principles of flight vehicle.	
Introduction to Unmanned Aircraft Systems	
Types of UAVs, configurations and their advantages disadvantages, System Con	nposition,
Applications of UAVs, Characteristics of Aircraft	
Unit – II	07 Hrs
Design of UAV Systems: Governing aspects:	
a. Aerodynamics, b. Propulsion, C. structure, d. Controls	
Aerodynamics:	
Introduction basic Aerodynamics, lift, drag, Aerofoils, wing area optimization.	
Propulsion:	
Introduction to propulsion system in UAV, Propulsion system for fixed wing UAV ar	id VTOL
(Vertical take-off and landing) UAV, Advanced propulsion systems, fuel cells, generate	ors based
systems.	
Unit -III	07Hrs
Structures of UAV:	
Mechanic loading, basics of types of load calculation and structural engineering, Material	used for
UAV (general introduction), FRP and methods of usage in UAV, Testing of FRP specimens	for UAV,
selection criteria for structure, Types of structural elements used in UAV their signific	ance and
characteristics, Methods of manufacturing UAV structure.	
Unit -IV	07 Hrs
Controls, Avionics, Hardware, Communication, Payloads:	
Basics of control system and Systems for control system in UAV, PID control, s	imulation
introduction to Hardware in loop system (HILS), Avionics: Autopilot (AP) - architectur	e of AP,
sensors, actuators, power supply, integration, installation, configuration, and testing.	
Hardware, Communication	
Electronics Hardware in UAV, Communication methods, communication antenna a	and their
significance.	
Payloads:	
Payload types and their applications	
Unit -V	09 Hrs
Design of UAV Systems:	
Fixed wing UAV and Rotary wing UAV (VTOL)	
Task specific, activity based exercise	

Course Outcomes: At the end of this course the student will be able to :								
CO1	Appraise the evolution of UAVs and understand the current potential benefits of UAVs							
CO2	Apply the principles of Aerospace Engineering in design and development of UAVs							
CO3	Determine and evaluate the performance of UAV designed for various Missions and applications							
CO4	Assess the performance and airworthiness of the designed UAV							

Reference Books

1	Unmanned Aircraft Systems UAV design, development and deployment, Reg Austin, 1 st Edition, 2010, Wiley, ISBN 9780470058190.
2	Flight Stability and Automatic Control, Robert C. Nelson, 2 nd Edition, October 1, 1997, McGraw-
	Hill, Inc, ISBN 978-0070402731.
3	Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy, Kimon P.
3	Valavanis, 1 st Edition,2007, Springer ISBN 9781402061141
4	Introduction to UAV Systems, Paul G Fahlstrom, Thomas J Gleason, 4th Edition, 2012, Wiley, ISBN:
	978-1-119-97866-4
5	Design of Unmanned Air Vehicle Systems, Dr. Armand J. Chaput, 3rd Edition, 2001, Lockheed
	Martin Aeronautics Company, ISBN: 978-1-60086-843-6

Continuous Internal Evaluation (CIE); Theory (100 Marks)

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Semester End Evaluation (SEE); Theory (100 Marks)

SEE for 100 marks is executed by means of an examination. The Question paper for the course contains two parts, Part – A and Part – B. Part – A consists of objective type questions for 20 marks covering the complete syllabus. Part – B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom's taxonomy level.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	1	3	2	2				1
CO2	2	3	3	3	1	1	1	1				2
CO3	1		3	3								2
CO4	3	3	3	3		2	1	2				2

High-3 : Medium-2 : Low-1
Semester: VIII								
MAJOR PROJECT								
	(Common to all Programs)							
Course Code	:	16IM81		CIE	:	100 Marks		
Credits: L: T: P: S	:	0:0:16:0	1	SEE	:	100 Marks		
Hrs/week	:	32	1	SEE Duration	:	3 Hrs		

Course Learning Objectives: The students will be able to

1	Acquire the ability to make links across different areas of knowledge and to generate, develop
	and evaluate ideas and information so as to apply these skills to the project task.
2	Acquire the skills to communicate effectively and to present ideas clearly and coherently to a
	specific audience in both written and oral forms.
3	Acquire collaborative skills through working in a team to achieve common goals.
4	Self-learn, reflect on their learning and take appropriate action to improve it.
5	Prepare schedules and budgets and keep track of the progress and expenditure.

Major Project Guidelines:

- 1. The project topic, title and synopsis have to be finalized and submitted to their respective internal guide(s) before the beginning of the 8th semester.
- 2. The detailed Synopsis *(approved by the department Project Review Committee)* has to be submitted during the 1st week after the commencement of 8th semester.

Batch Formation:

- Students are free to choose their project partners from within the program or any other program;
- Each student in the team must contribute towards the successful completion of the project. The project may be carried out In-house / Industry / R & D Institution;
- > The project work is to be carried out by a team of two to four students, in exceptional cases where a student is placed in a company and offered an internship through the competitive process or student is selected for internship at national or international level through competitive process, the student can work independently.
- > The students are allowed to do either a project for full 5 days in the industry or full 5 days in the college.
- In case the project work is carried out outside Bengaluru, such students must be available during Project Evaluation process scheduled by the respective departments and they must also interact with their guide regularly through Email / Webinar / Skype etc.

Project Topic Selection:

The topics of the project work must be in the *field of respective program areas or in line with CoE's (Centre of Excellence) identified by the college* or List of project areas as given by industry/Faculty. The projects as far as possible should have societal relevance with focus on sustainability.

Project Evaluation:

- Continuous monitoring of project work will be carried out and cumulative evaluation will be done.
- The students are required to meet their internal guides once in a week to report their progress in project work.
- Weekly Activity Report (WAR) has to be maintained in the form of a diary by the project batch and the same has to be discussed with the Internal Guide regularly.
- In case of *Industry project*, during the course of project work, the internal guides will have continuous interaction with external guides and will visit the industry at least twice during the project period.
- For CIE assessment the project groups must give a final seminar with the draft copy of the project report.

- The presentation by each group will be for 20-30 minutes and every member of the team needs to justify the contributions to the project.
- > The project team is required to submit Hard copies of the detailed Project Report in the prescribed format to the department.
- ➢ For CIE 50% weightage should be given to the project guide and 50% weightage to the project evaluation committee.
- Before the final evaluations the project group is required to produce a No dues certificate from Industry, Central Library and Department.

Cours	se Outcomes of Major Project:
1	Apply knowledge of mathematics, science and engineering to solve respective engineering
	domain problems.
2	Design, develop, present and document innovative/multidisciplinary modules for a complete
	engineering system.
3	Use modern engineering tools, software and equipment to solve problem and engage in life-
	long learning to follow technological developments.
4	Function effectively as an individual, or leader in diverse teams, with the understanding of
	professional ethics and responsibilities.

CIE Assessment:

The following are the weightings given for the various stages of the project.

1.	Selection of the topic and formulation of objectives	10%
2.	Design and Development of Project methodology	25%
3.	Execution of Project	25%
4.	Presentation, Demonstration and Results Discussion	30%
5.	Report Writing & Publication	10%
SEE A The	ssessment: e following are the weightages given during Viva Examination.	
The	e following are the weightages given during Viva Examination.	100/
1.	Written presentation of synopsis	10%
2.	Presentation/Demonstration of the project	30%
3.	Methodology and Experimental Results & Discussion	30%
4.	Report	10%
5.	Viva Voce	20%

Calendar of Events for the Project Work:

Week	Event			
Beginning of 7 th Semester	Formation of group and approval by the department committee.			
7 th Semester	Problem selection and literature survey			
Last two weeks of 7 th Semester	Finalization of project and guide allotment			
II Week of 8 th Semester	Synopsis submission and preliminary seminar			
III Week	First visit of the internal guides to industry (In case of project being			
	carried out in industry)			
III to VI Week	Design and development of project methodology			
VII to IX Week	Implementation of the project			
X Week	Submission of draft copy of the project report			
XI and XII Week	Second visit by guide to industry for demonstration. Final seminar			
	assessment Finalization of CIE			

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Scheme of Evaluation for CI	Scheme of Evaluation for SEE			
Particulars	%Marks	Particulars	%Marks	
Project Evaluation I	10%	Project Synopsis (Initial Write up)	10%	
Project Evaluation II	25%	Project Demo / Presentation	30%	
Project Evaluation III	25%	Methodology and Results Discussion	30%	
Project Evaluation Phase-IV (Submission of Draft Project Report for Verification)	30%	Project Work Report	10%	
Project Evaluation Phase-V (Project Final Internal Evaluation)	10%	Viva-voce	20%	
Total	100	Total	100	

Evaluation Scheme for CIE and SEE

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	3	2	1	1	2	3	3	1	1
CO2			3	1	1			1		3		2
CO3			1	1	3				1			3
CO4						1	1	3	3			

High-3 : Medium-2 : Low-1

	Semester: VIII								
	TECHNICAL SEMINAR								
(Common to all Programs)									
Cou	Course Code : 16IM82 CIE : 100 Marks								
Credits: L: T: P: S		:	0:0:2:0		SEE	:	100 Marks		
Hrs/week		:	4		SEE Duration	:	3Hrs		
Cou	rse Learning O	bje	ctives: The stud	ents will be al	ble to				
1	Recognize rece	nt c	levelopments in a	specific progra	am and in multidisc	iplin	ary fields.		
2	Summarize the	rec	ent technologies	and inculcate	the skills for literat	ure s	survey.		
3	3 Demonstrate good presentation skills.								
4	4 Plan and improve the Technical Report writing skills.								
5	Support Group	dis	cussion and Tear	n work.					

General Guidelines for the Seminar

- 1. The seminar has to be presented by individual student.
- 2. The topic of the seminar should be from current thrust area along with consultation with the guide.
- 3. The topic can be based on standard papers (like IEEE/ACM/CSI etc.) in the thrust area for the selected topic.
- 4. Presenting/publishing this paper in conference/ Journal will be given weightage in CIE.
- 5. The student needs to submit both hard & soft copy of the seminar report.
- 6. As Outcome of Technical Seminar, each student has to prepare a technical paper out of seminar topic.

General Guidelines for the Internship

- 1. Students have to start the Industrial Training / Internship for a minimum duration of two weeks during 6th & 7th semester break.
- 2. Students have to complete the Internship reporting and presentation within the first two weeks of the 7th Semester. A report has to be submitted at the end of Internship.
- 3. Credits will be awarded in 8th Semester.

Course Outcomes of Technical Seminar:

1	Communicate effectively on complex engineering problems and demonstrate contextual knowledge							
	to assess societal and environmental contexts.							
2	Identify, formulate, review research literature, analyze and Design solutions for complex							
	engineering problems using appropriate techniques with effective documentation.							
3	Analyze, interpret and synthesize the information to provide valid conclusions with innovative							
	ideas and ethical principles.							
4	Apply the knowledge of engineering specialization to suggest solutions to complex engineering							
	problems and recognize the need for technological changes.							

Evaluation of CIE Marks:

1.	Relevance of the topic / work	10%
2.	Literature Survey / Background	10%
3.	Presentation	40%
4.	Report	20%
5.	Paper Publication	20%

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2		1	2		1	1	3	2		1
CO2					3				1	3	1	
CO3			2		2				2		1	1
CO4								2				3

Low-1 Medium-2 High-3

Semester: VIII									
	INNOVATION & SOCIAL SKILLS								
				(Common to all Programs)					
Co	Course Code : 16HS83 CIE : 100 Marks								
Credits: L: T: P: S		:	0:0:2:0	SEE	:	100 Marks			
Hrs/week		:	2	SEE Duration	:	3Hrs			
Co	ourse Learning O	bjec	tives: The s	tudents will be able to					
1	To provide a pla	tfor	m for the st	udents to exhibit their organiza	tional	capabilities, team building,			
	ethical values an	d ex	tra mural ab	ilities.					
2	To encourage to	carr	yout innova	tive ideas and projects.					
3	3 Take part in societal and community building activities.								
4	Make self-learning	ng, e	thics and lif	elong learning a motto.					

Guidelines

- 1. The HSS will be evaluated individually based on the broad parameters which include the progress made by student during 3rd& 4th year in innovative projects, Seminar, Paper Presentation, Field activity & other Co-curricular activities.
- 2. Students shall submit a report and documents as a proof his/her achievements.

Course Outcomes of Innovation & Social Skills:							
1	Apply the knowledge and skills for solving societal issues						
2	Plan to work in team in various areas with inclusive effort and sustainability						
3	Organize various events and use managerial and budgeting abilities						
4	Demonstrate leadership qualities and ethics						

CO-PO Mapping													
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	1			1		2	1	1				1	
CO2					3	2	2	1	3				
CO3							1	1	3	3	3	2	
CO4								3	3	2		1	

Low-1 Medium-2 High-3



Curriculum Design Process

Academic Planning and Implementation



Process for Course Outcome Attainment



Program Outcome Attainment Process



Guidelines for Fixing Targets

• The target may be fixed based on last 3 years' average attainment

PROGRAM OUTCOMES (PO)

- **PO1:** Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **PO2: Problem analysis**: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **PO3:** Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO4:** Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO5:** Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **PO6:** The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO7:** Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO8:** Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **PO9:** Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **PO10:** Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO11: Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **PO12:** Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.