15EC401M	Multidisciplinary Design	L	T	P	C
		2	2	0	3
Co-requisite:	Nil				
Prerequisite:	Nil				
Data Book / Codes/Standards	Nil				
Course Category	**P** **Professional Core**	**Application**			
Course designed by	Department of Electronics and Communication Engineering				
Approval	30th Academic Council Meeting 24th March 2016				

Purpose	Students of any specialization at an undergraduate level learn courses related to various sub-domains (Multi-disciplinary) of their specialization individually. They are not exposed to understanding how the various multi-disciplinary fields interact and integrate in real life situations. It is very common that an expert in a particular domain models and designs systems or products oblivious of the impact of other subsystems. This lack of multi-disciplinary thinking is very blatantly visible when the students take up their major project during their final year. This course aims to develop appropriate skills on systemic thinking on how to identify and formulate a problem, decompose the problem into smaller elements, conceptualize the design, evaluate the conceptual design by using scientific, engineering and managerial tools, select, analyze and interpret the data, consideration of safety, socio-politico-cultural, risks and hazards, disposal, regional and national laws, costing and financial model and undertake documentation and finally presentation.

Instructional Objectives		**Student Outcomes**		
At the end of the course, learner will be able to		**H**	**M**	**L**
1.	To subdivide a complex system into smaller disciplinary models, manage their interfaces and reintegrate them into an overall system model	a	c	e,f,i
2.	To rationalize a system architecture or product design problem by selecting appropriate design variables, parameters and constraints	a	c	e,f,i
3.	To design for value and quantitatively assess the expected lifecycle cost of a new system or product	a	c	e,f,i
4.	To take on the challenges of teamwork, prepare a presentation in a professional manner, and document all aspects of design work.	a	c	e,f,i

H: High Correlation M: Medium Correlation L: Low Correlation

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
1.	Introduction: Facilitating Multidisciplinary Projects	4	C, D, I, O	1-4	
2.	Identifying and formulating a problem	4	C, D, I, O	1-4	
3.	System Modelling	4	C, D, I, O	1-4	
4.	Thinking perspectives: Decomposition–Composition Thinking Hierarchical Thinking, Organizational Thinking, Life-Cycle Thinking, Safety Thinking, Risk Thinking, Socio-politico-cultural thinking, Environment thinking	6	C, D, I, O	1-4	
5.	Decomposing a system – Identifying the major sub-systems	4	C, D, I, O	1-4	

Session	Description of Topic	Contact hours	C-D-I-O	IOs	Reference
6.	Mathematical Modeling and Governing equations for each sub systems	4	C, D, I, O	1-4	
7.	Objectives, Constraints and Design Variables	4	C, D, I, O	1-4	
8.	Conceptual Design	6	C, D, I, O	1-4	
9.	Collaborative Design – Disciplinary teams satisfy the local constraints while trying to match the global constraints set by the project coordinator.	6	C, D, I, O	1-4	
10.	Tools for modeling, designing, analysis, data interpretation, decision making etc	6	C, D, I, O	1-4	
11.	Design Analysis, evaluation and selection	4	C, D, I, O	1-4	
12.	Costing and Financial model	4	C, D, I, O	1-4	
13.	Documentation, reviewing and presentation	4	C, D, I, O	1-4	
	Total contact hours	**60**			

Learning Resources	
1.	G. Maarten Bonnema, Karel T. Veenvliet, Jan F. Broenink, “Systems Design and Engineering: Facilitating Multidisciplinary Development Projects”, December 15, 2015, CRC Press, ISBN 9781498751261.
2.	Ina Wagner , Tone Bratteteig , Dagny Stuedahl, “Exploring Digital Design-Multi-Disciplinary Design Practices”, Springer-Verlag London, 2010, ISSN:1431-1496.
	Domain-1: Human Machine Interface
3.	Roberto Cipolla and Alex Pentland, “Computer Vision For Human-Machine Interaction”, Cambridge University Press, 1998
4.	Dix, Alan, et. al. “Human-Computer Interaction”, 3rd Edition. Prentice Hall, 2003
	Domain-2: Robotics for Electronics Automation
5.	Dominik Sankowski, Jacek Nowakowski, “Computer Vision in Robotics and Industrial Applications”, Series in Computer Vision: Volume 3, World Scientific, August 2014.
6.	Karl Mathia, “’Robotics for Electronics Manufacturing”, Cambridge University Press, 2010.
7.	Marco Ceccarelli, “Robots and Robotics: Design and Application”, University of Cassino, Italy, March, 2012.
	Domain-3: BioMedical Applications
8.	Rangaraj M. Rangayyan, “Biomedical signal analysis A case-study approach” Wiley, IEEE Press, 2013
9.	Joseph J. Carr, John No. Brown, “Introduction to Biodmedical Equipment Technology” 4th Edition, Pearson Education Seventh Impression, 2011
	Domain-4: Digital Image Processing
10.	R. Gonzalez and R. Woods, “Digital Image Processing”, 2nd ed.", Prentice-Hall, 2002, www.imageprocessingbook.com.
11.	K. Rao and P. Yip, “The Transform and Data Compression Handbook”, CRC Press, 2001, http://www.engnetbase.com/ejournals/books/book_summary/summary.asp?id=431
12.	J. Shapiro, “Embedded image coding using zerotreesofwavelet coefficients” IEEE Trans. on Signal Processing, vol. 41, pp. 3445–3462, 1993.

Learning Resources	
	Domain-5: Space Mission Analysis and Design: Astrionics
13.	James R. Wertz, *"Space Mission Engineering: The New SMAD"*, Space Technology Library(Vol. 28), 3rd Edition
14.	Mukund R. Patel, *"Spacecraft Power Systems"*, CRC Press, November 29, 2004.
15.	Howard Curtis, *"Orbital Mechanics for Engineering Students (Aerospace Engineering)"*, Butterworth-Heinemann Ltd, 3rd Revised edition.
16.	Marcel J. Sidi, *"Spacecraft Dynamics and Control: A Practical Engineering Approach"*, Cambridge University Press, Revised ed. edition.
17.	Charles Brown, *"Elements of Spacecraft Design"*, AIAA, 1st edition.
18.	Jens Eickhoff, *"Onboard Computers, Onboard Software and Satellite Operations"*, Springer Aerospace Technology, 2012.
	Domain-6: Networking
19.	Wireless Communication Standards: A Study of IEEE 802.11, 802.15, 802.16 By Todor Cooklev,Published By Standards Information Network IEEE Press,2004
20.	Network Analysis, Architecture, and Design THIRD EDITION James D. McCabe, Elsevier 2007
21.	Cisco Collaboration System 11.*x*Solution Reference Network Designs (SRND), January 19, 2016

Course nature				**Predominantly Practice complimented by theory**		
Assessment Method (Weightage 100%)						
In-semester	**Assessment tool**	Review 1	Review 2	Review 3	Review 4	**Total**
	Weightage	**10%**	**25%**	**25%**	**40%**	**100%**
End semester examination Weightage :						**0%**

Pedagogy

Theme or major/broad domains will be announced by the department every semester. Multi-disciplinary designs will be made by the students in groups (group size may be decided by the course coordinator), with the topic of interest falling within the theme or major/broad domains as announced by the department, applying any combinations of the disciplines in engineering. 3D modelling and / or simulation must be used to validate the design.

In a combination of lecture and hands-on experiences, students must be exposed to understand and analyse engineering designs (or products) and systems, their realization process and project management. Analysis of the design criteria for safety, ergonomics, environment, life cycle cost and sociological impact is to be covered. Periodic oral and written status reports are required. The course culminates in a comprehensive written report and oral presentation. If required guest lecturers from industry experts from the sub-domains may be arranged to provide an outside perspective and show how the system design is being handled by the industry. The Conceive Design Implement Operate (CDIO) principles must be taught to the students.

A full-scale fabrication is not within the purview /scope of this course. Of course this design, if scalable and approved by the department, can be extended as the major project work. This course is 100% internal continuous assessment.