

SEMESTER S4

ADVANCED DATA STRUCTURES

(Common to CS/CD/CM/CA/AM/CB/CN/CC/CU/CI/CG)

Course Code	PECST495	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCCST303	Course type	Theory

Course Objectives:

1. To equip students with comprehensive knowledge of advanced data structures utilized in cutting-edge areas of computer science, including database management, cyber security, information retrieval, and networked systems.
2. To prepare students to address challenges in emerging fields of computer science by applying advanced data structures to practical, real-world problems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Foundational Data Structures- Overview of Arrays and Linked Lists, implementation of pointers and objects, Representing rooted trees, Hashing - Hash Tables, Hash functions, Cuckoo Hashing; Bloom Filters - Count-Min Sketch, Applications to Networks - Click Stream Processing using Bloom Filters, Applications to Data Science - Heavy Hitters and count-min structures.	9
2	Advanced Tree Data Structures - Balanced Trees - AVL Trees (review), Red-Black Trees, Suffix Trees and Arrays, Segment Trees, Heaps and Related Structures – Binomial heap, Fibonacci Heaps, Merkle Trees, Applications to information Retrieval and WWW - AutoComplete using Tries.	9

3	Specialized Data Structures - Spatial Data Structures – Quadtree, K-D Trees (k-dimensional tree); R-trees; Temporal Data Structures- Persistence, Retroactivity; Search and Optimization Trees – Skip List, Tango Trees; Applications to Data Science - Approximate nearest neighbor search, Applications to information Retrieval and WWW, Posting List intersection.	9
4	Data Structure applications - Distributed and Parallel Data Structures - Distributed Hash Tables (DHTs); Consistent Hashing; Distributed BST; Data Compression and Transformations - Burrows-Wheeler Transform; Histogram; Wavelet Trees; Cryptographic Applications – Hashing.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

<i>Attendance</i>	<i>Internal Ex</i>	<i>Evaluate</i>	<i>Analyse</i>	<i>Total</i>
5	15	10	10	40

Criteria for Evaluation (Evaluate and Analyze): 20 marks

Implement various real world problems using multiple suitable data structures and compare the performance.

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> ● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks (8x3 =24 marks) 	<ul style="list-style-type: none"> ● 2 questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 subdivisions. ● Each question carries 9 marks. (4x9 = 36 marks) 	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Implement and use arrays, linked lists, rooted trees and hashing techniques in various programming scenarios.	K3
CO2	Design and implement advanced tree data structures for information retrieval.	K3
CO3	Use spatial and temporal data structures in data science problems.	K3
CO4	Analyze data structures in special scenarios such as distributed, parallel and data compression areas.	K5

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

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

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Advanced Data Structures: Theory and Applications	Suman Saha, Shailendra Shukla	CRC Press	1/e, 2019
2	Advanced Data Structures	Peter Brass	Cambridge University Press	1/e, 2008
3	Introduction to Algorithms	Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein	MIT Press	4/e, 2022
4	Fundamentals of Computer Algorithms	Ellis Horowitz, SatrajSahani and Rajasekharam	University Press	2/e, 2009
5	Advanced Data Structures	Reema Thareja, S. Rama Sree	Oxford University Press	1/e, 2018
6	Data Structures and Algorithm Analysis in C++,	Mark Allen Weiss	Pearson	2/e, 2004.
7	Design and Analysis of Algorithms	M T Goodrich, Roberto Tamassia	Wiley	1/e, 2021

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://web.stanford.edu/class/cs166/

SEMESTER S3/S4

ECONOMICS FOR ENGINEERS

Course Code	UCHUT346	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To provide students with an understanding of fundamental economic principles essential for effective decision-making in engineering contexts.
2. To enable students to apply economic analysis to production decisions, cost management, and market strategies in engineering practice.
3. To equip students with the ability to evaluate macroeconomic scenarios, financial methods, and investment decisions relevant to engineering projects.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic economic problems – Production Possibility Curve – Utility – Law of diminishing marginal utility –Demand: Factors determining demand – Law of Demand – Demand curve- Price elasticity of demand- measurement of price elasticity and its applications – Supply: factors determining supply - Law of supply – Supply curve- Equilibrium price determination- Changes in demand and supply and its effects on equilibrium price and quantity Production: Production function - Law of variable proportion –Returns to scale- Cobb-Douglas Production Function	6
2	Cost: Cost concepts – Private cost and social cost – Sunk cost – Opportunity cost -Explicit and implicit cost –Short run cost curves –Long run average cost curve -Revenue concepts – Break-even point Market: Perfect Competition – Monopoly - Monopolistic Competition (features and equilibrium of a firm) - Oligopoly – Features – Kinked demand model	6

3	National income: Concepts (GDP, GNP and NNP)– Final goods and Intermediate goods - Methods of Estimation –output method – expenditure method-- Difficulties in the measurement of national income. Inflation: Causes and Effects – Measures to Control Inflation - Monetary and Fiscal policies – Repo and reverse repo rate	6
4	Value Analysis and value Engineering: Cost Value, Exchange Value, Use Value, Esteem Value - Aims, Advantages and Application areas of Value Engineering - Value Engineering Procedure Capital Budgeting: Time value of money - Net Present Value Method - Benefit Cost Ratio – Internal Rate of Return – Payback – Accounting Rate of Return.	6

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/Case Study/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
10	15	12.5	12.5	50

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none"> • Minimum 1 and Maximum 2 Questions from each module. • Total of 6 Questions, each carrying 3 marks (6x3 =18 marks) 	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. (4x8 = 32 marks)	50

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the fundamentals of various economic issues using laws and learn the concepts of demand, supply, elasticity and production function.	K2
CO2	Develop decision making capability by applying concepts relating to costs and revenue, and acquire knowledge regarding the functioning of firms in different market situations.	K3
CO3	Outline the macroeconomic principles of monetary and fiscal systems and national income.	K2
CO4	Make use of the possibilities of value analysis and engineering, and take investment decisions through capital budgeting techniques.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

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

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Managerial Economics	Geetika, Piyali Ghosh and Chodhury	Tata McGraw Hill,	2015
2	Engineering Economy	H. G. Thuesen, W. J. Fabrycky	PHI	1966
3	Engineering Economics	R. Paneerselvam	PHI	2012
4	Financial Management	I M Pandey	Vikas Publishing House	2015

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Economy	Leland Blank P.E, Anthony Tarquin P. E.	Mc Graw Hill	7 TH Edition
2	Indian Financial System	Khan M. Y.	Tata McGraw Hill	2011
3	Engineering Economics and analysis	Donald G. Newman, Jerome P. Lavelle	Engg. Press, Texas	2002
4	Contemporary Engineering Economics	Chan S. Park	Prentice Hall of India Ltd	2001
5	Financial Management: Theory and Practice	Prasanna Chandra	Mc Graw Hill	2007

MODEL QUESTION PAPER

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH AND YEAR

Course Code: UCHUT346

Course Name: Economics for Engineers

Max. Marks: 50

Duration: 2 hours 30 minutes

PART A

Answer all questions. Each question carries 3 marks

CO Marks

1		What are the central problems of an economy?	CO1	(3)
2		Point out any three applications of price elasticity of demand.	CO1	(3)
3		What is the social cost of production?	CO2	(3)
4		What is repo rate?	CO3	(3)
5		What is esteem value?	CO4	(3)
6		Write a short note on time value of money.	CO4	(3)

PART B

Answer any one full question from each module. Each question carries 8 marks

Module 1

9	a)	Suppose a country is producing at a point inside the production possibility curve. Draw a PPC and examine this situation.	CO1	(5)
	b)	State the law of demand. Point out any two exceptions of this law.	CO1	(3)
10	a)	A consumer purchases 10 units of a commodity when its price is Rs.100. Later when its price falls to Rs.90, he purchases 8 units only. Estimate price elasticity. What type of a commodity is this?	CO1	(5)
	b)	State the law of variable proportion.	CO1	(3)

Module 2				
11	a)	What is oligopoly? Why price is rigid under oligopoly?	CO2	(5)
	b)	The cost function of a firm is given as $TC=1000+10Q-6Q^2+Q^3$. Calculate fixed cost, variable cost and marginal cost when output is 10 units.	CO2	(3)
12	a)	Suppose a firm is earning super normal profit under monopolistic market condition. Explain this situation by drawing a diagram.	CO2	(5)
	b)	Suppose a firm sells its product at a price of Rs.10 per unit and its average variable cost is Rs.6. If the firm spend Ra.10000 as rent and pay Rs. 6000 as interest every month, estimate its break-even level of output.	CO2	(3)
Module 3				
13	a)	What is inflation? How does inflation affect investment and production.	CO3	(5)
	b)	How will you obtain NNP _{fc} from GDP _{mp} .	CO3	(3)
14	a)	From the data given below (In Rs. Crores) estimate GDP _{mp} and national income. Private final consumption expenditure = 1000, Government expenditure = 500, Invest expenditure = 700, Net exports = 300, Depreciation = 200, NFIA=(-200) and Net indirect tax = 100	CO3	(5)
	b)	What is bank rate? Examine the bank rate policy of the government during inflation.	CO3	(3)
Module 4				
15	a)	Examine the procedures of value engineering.	CO4	(5)
	b)	Examine the application areas of value engineering	CO4	(3)

16	a)	1. Suppose the initial investment of a project is Rs. 3000 (Crores) and the cost of capital or the opportunity cost of capital is 10 percent. Calculate NPV of the project based on the cash flows given below. Year 1 2 3 4 5 Cash flow 1000 900 800 700 600 (In Crores)	CO4	(5)
	b)	Point out any three merits of NPV method.	CO4	(3)

SEMESTER S3/S4

ENGINEERING ETHICS AND SUSTAINABLE DEVELOPMENT

Course Code	UCHUT347	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Equip with the knowledge and skills to make ethical decisions and implement gender-sensitive practices in their professional lives.
2. Develop a holistic and comprehensive interdisciplinary approach to understanding engineering ethics principles from a perspective of environment protection and sustainable development.
3. Develop the ability to find strategies for implementing sustainable engineering solutions.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fundamentals of ethics - Personal vs. professional ethics, Civic Virtue, Respect for others, Profession and Professionalism , Ingenuity, diligence and responsibility, Integrity in design, development, and research domains, Plagiarism, a balanced outlook on law - challenges - case studies, Technology and digital revolution -Data, information, and knowledge, Cybertrust and cybersecurity, Data collection & management, High technologies: connecting people and places -accessibility and social impacts, Managing conflict , Collective bargaining, Confidentiality , Role of confidentiality in moral integrity, Codes of Ethics . Basic concepts in Gender Studies - sex, gender, sexuality, gender	6

	<p>spectrum: beyond the binary, gender identity, gender expression, gender stereotypes, Gender disparity and discrimination in education, employment and everyday life, History of women in Science & Technology, Gendered technologies & innovations, Ethical values and practices in connection with gender - equity, diversity & gender justice, Gender policy and women/transgender empowerment initiatives.</p>	
2	<p>Introduction to Environmental Ethics: Definition, importance and historical development of environmental ethics, key philosophical theories (anthropocentrism, biocentrism, ecocentrism). Sustainable Engineering Principles: Definition and scope, triple bottom line (economic, social and environmental sustainability), life cycle analysis and sustainability metrics. Ecosystems and Biodiversity: Basics of ecosystems and their functions, Importance of biodiversity and its conservation, Human impact on ecosystems and biodiversity loss, An overview of various ecosystems in Kerala/India, and its significance. Landscape and Urban Ecology: Principles of landscape ecology, Urbanization and its environmental impact, Sustainable urban planning and green infrastructure.</p>	6
3	<p>Hydrology and Water Management: Basics of hydrology and water cycle, Water scarcity and pollution issues, Sustainable water management practices, Environmental flow, disruptions and disasters. Zero Waste Concepts and Practices: Definition of zero waste and its principles, Strategies for waste reduction, reuse, reduce and recycling, Case studies of successful zero waste initiatives. Circular Economy and Degrowth: Introduction to the circular economy model, Differences between linear and circular economies, degrowth principles, Strategies for implementing circular economy practices and degrowth principles in engineering. Mobility and Sustainable Transportation: Impacts of transportation on the environment and climate, Basic tenets of a Sustainable Transportation design, Sustainable urban mobility solutions, Integrated mobility systems, E-Mobility, Existing and upcoming models of sustainable mobility solutions.</p>	6
4	<p>Renewable Energy and Sustainable Technologies: Overview of renewable energy sources (solar, wind, hydro, biomass), Sustainable technologies in</p>	6

	<p>energy production and consumption, Challenges and opportunities in renewable energy adoption. Climate Change and Engineering Solutions: Basics of climate change science, Impact of climate change on natural and human systems, Kerala/India and the Climate crisis, Engineering solutions to mitigate, adapt and build resilience to climate change. Environmental Policies and Regulations: Overview of key environmental policies and regulations (national and international), Role of engineers in policy implementation and compliance, Ethical considerations in environmental policy-making. Case Studies and Future Directions: Analysis of real-world case studies, Emerging trends and future directions in environmental ethics and sustainability, Discussion on the role of engineers in promoting a sustainable future.</p>	
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**Course Assessment Method
(CIE: 50 marks , ESE: 50)**

Continuous Internal Evaluation Marks (CIE):

Continuous internal evaluation will be based on individual and group activities undertaken throughout the course and the portfolio created documenting their work and learning. The portfolio will include reflections, project reports, case studies, and all other relevant materials.

- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. These groups can be the same ones they have formed in the previous semester.
- Activities are to be distributed between 2 class hours and 3 Self-study hours.
- The portfolio and reflective journal should be carried forward and displayed during the 7th Semester Seminar course as a part of the experience sharing regarding the skills developed through various courses.

Sl. No.	Item	Particulars	Group/Individual (G/I)	Marks
1	Reflective Journal	Weekly entries reflecting on what was learned, personal insights, and how it can be applied to local contexts.	I	5
2	Micro project (Detailed documentation of the project, including methodologies, findings, and reflections)	1 a) Perform an Engineering Ethics Case Study analysis and prepare a report 1 b) Conduct a literature survey on 'Code of Ethics for Engineers' and prepare a sample code of ethics	G	8
		2. Listen to a TED talk on a Gender-related topic, do a literature survey on that topic and make a report citing the relevant papers with a specific analysis of the Kerala context	G	5
		3. Undertake a project study based on the concepts of sustainable development* - Module II, Module III & Module IV	G	12
3	Activities	2. One activity* each from Module II, Module III & Module IV	G	15
4	Final Presentation	A comprehensive presentation summarising the key takeaways from the course, personal reflections, and proposed future actions based on the learnings.	G	5
Total Marks				50

*Can be taken from the given sample activities/projects

Evaluation Criteria:

- **Depth of Analysis:** Quality and depth of reflections and analysis in project reports and case studies.
- **Application of Concepts:** Ability to apply course concepts to real-world problems and local contexts.
- **Creativity:** Innovative approaches and creative solutions proposed in projects and reflections.
- **Presentation Skills:** Clarity, coherence, and professionalism in the final presentation.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop the ability to apply the principles of engineering ethics in their professional life.	K3
CO2	Develop the ability to exercise gender-sensitive practices in their professional lives	K4
CO3	Develop the ability to explore contemporary environmental issues and sustainable practices.	K5
CO4	Develop the ability to analyse the role of engineers in promoting sustainability and climate resilience.	K4
CO5	Develop interest and skills in addressing pertinent environmental and climate-related challenges through a sustainable engineering approach.	K3

Note: *K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						3	2	3	3	2		2
CO2		1				3	2	3	3	2		2
CO3						3	3	2	3	2		2
CO4		1				3	3	2	3	2		2
CO5						3	3	2	3	2		2

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Ethics in Engineering Practice and Research	Caroline Whitbeck	Cambridge University Press & Assessment	2nd edition & August 2011
2	Virtue Ethics and Professional Roles	Justin Oakley	Cambridge University Press & Assessment	November 2006
3	Sustainability Science	Bert J. M. de Vries	Cambridge University Press & Assessment	2nd edition & December 2023
4	Sustainable Engineering Principles and Practice	Bhavik R. Bakshi,	Cambridge University Press & Assessment	2019
5	Engineering Ethics	M Govindarajan, S Natarajan and V S Senthil Kumar	PHI Learning Private Ltd, New Delhi	2012
6	Professional ethics and human values	RS Naagarazan	New age international (P) limited New Delhi	2006.
7	Ethics in Engineering	Mike W Martin and Roland Schinzinger,	Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi	4" edition, 2014

Suggested Activities/Projects:

Module-II

- Write a reflection on a local environmental issue (e.g., plastic waste in Kerala backwaters or oceans) from different ethical perspectives (anthropocentric, biocentric, ecocentric).
- Write a life cycle analysis report of a common product used in Kerala (e.g., a coconut, bamboo or rubber-based product) and present findings on its sustainability.
- Create a sustainability report for a local business, assessing its environmental, social, and economic impacts
- Presentation on biodiversity in a nearby area (e.g., a local park, a wetland, mangroves, college campus etc) and propose conservation strategies to protect it.
- Develop a conservation plan for an endangered species found in Kerala.
- Analyze the green spaces in a local urban area and propose a plan to enhance urban ecology using native plants and sustainable design.
- Create a model of a sustainable urban landscape for a chosen locality in Kerala.

Module-III

- Study a local water body (e.g., a river or lake) for signs of pollution or natural flow disruption and suggest sustainable management and restoration practices.
- Analyse the effectiveness of water management in the college campus and propose improvements - calculate the water footprint, how to reduce the footprint, how to increase supply through rainwater harvesting, and how to decrease the supply-demand ratio
- Implement a zero waste initiative on the college campus for one week and document the challenges and outcomes.
- Develop a waste audit report for the campus. Suggest a plan for a zero-waste approach.
- Create a circular economy model for a common product used in Kerala (e.g., coconut oil, cloth etc).
- Design a product or service based on circular economy and degrowth principles and present a business plan.
- Develop a plan to improve pedestrian and cycling infrastructure in a chosen locality in Kerala

Module-IV

- Evaluate the potential for installing solar panels on the college campus including cost-benefit analysis and feasibility study.
- Analyse the energy consumption patterns of the college campus and propose sustainable alternatives to reduce consumption - What gadgets are being used? How can we reduce demand using energy-saving gadgets?
- Analyse a local infrastructure project for its climate resilience and suggest improvements.
- Analyse a specific environmental regulation in India (e.g., Coastal Regulation Zone) and its impact on local communities and ecosystems.
- Research and present a case study of a successful sustainable engineering project in Kerala/India (e.g., sustainable building design, water management project, infrastructure project).
- Research and present a case study of an unsustainable engineering project in Kerala/India highlighting design and implementation faults and possible corrections/alternatives (e.g., a housing complex with water logging, a water management project causing frequent floods, infrastructure project that affects surrounding landscapes or ecosystems).