LIST OF OPEN ELECTIVE-II
Courses Offered at T.Y.B.Tech (Semester-VI) under NEP 2020

Sr. No.	Open Elective – II	Course Code	Credits	Minimum Intake	Maximum Intake	Offered by
1	Intellectual Property	UILOE0621	03	30	150	Mechanical Engineering
2	Engineering Econometrics	UILOE0622	03	30	150	Electronics and Telecommunication Engineering
3	Entrepreneurship Development	UILOE0623	03	30	150	Mechanical Engineering
4	Positive Psychology	UILOE0624	03	30	150	Basic Science and Humanities
5	Landscape Design	UILOE0625	03	30	150	Institute Level
6	Micro Economics	UILOE0626	03	30	150	Institute Level
7	Waste Management	UILOE0627	03	30	150	Civil and Environmental Engineering
8	Social Entrepreneurship	UILOE0628	03	30	150	Biotechnology Engineering
9	Industrial Health & Safety	UILOE0629	03	30	150	Civil and Environmental Engineering
10	Appropriate Technology	UILOE0630	03	30	150	Civil Engineering
11	Six Sigma	UILOE0631	03	30	150	Mechanical Engineering

Title of the Course:	INTELLECTUAL PROPERTY	L	T	P	Credit
Course Code	UILOE0621	3	-	-	3

Course Pre-Requisite: Creative mindset and interest in innovation, entrepreneurship, and technology management.

Course Description:
This course familiarizes engineering students with the fundamentals of **Intellectual Property Rights (IPR)** — including patents, copyrights, trademarks, industrial designs, and emerging IP issues in technology and digital domains. Students learn how innovation can be protected, commercialized, and ethically managed in a competitive environment.

Course Learning Objectives:
1. To introduce the fundamental aspects and need for protection of intellectual property.
2. To understand the procedures for registration of various IP rights.
3. To develop awareness about IP management, licensing, and commercialization.
4. To promote innovation, creativity, and understanding of current IPR trends in technology.

Course Outcomes:

CO	After the completion of the course	Bloom's Cognitive	
		Level	Descriptor
CO1	Explain the fundamental concepts, need, and types of Intellectual Property Rights.	II	Understanding
CO2	Apply procedures for registration and protection of patents, copyrights, and trademarks.	III	Applying
CO3	Analyze case studies of IPR violations and their legal, ethical, and technological implications.	IV	Analyze
CO4	Evaluate strategies for IP management, licensing, and commercialization in technology sectors.	V	Evaluating

Assessments :
Teacher Assessment:
- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

- ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three modules)
- ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: - Introduction To Intellectual Property : Concept and meaning of IPR, Need for IPR, Kinds of Intellectual Property rights Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design. IPR in India : Genesis and development Need and Importance of IP in Technology and Business	**6 Hrs.**

Unit 2: - Patents Meaning of Patent, Patents - Elements of Patentability: Novelty , Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and licence , Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties - Patent office and Appellate Board. Case Studies on Patents in Engineering	**6 Hrs.**
Unit 3: - Copyrights And Trademarks **Copyrights :** Definition, Types of copy right, Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright - Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights **Trademarks :** Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board	**10 Hrs.**
Unit 4: - Trade Secrets and Industrial Designs **Trade Secrets:** Definition, importance, and examples in engineering industries; methods of protection through contracts and confidentiality agreements; significance in R&D and innovation. **Industrial Designs:** Meaning and concept of novelty and originality; criteria for registration; rights of design holders; remedies for infringement under the *Designs Act 2000*. Case Studies on Trade Secrets and Design Rights	**06 Hrs.**
Unit 5: - Other Forms of IPs **Geographical Indications (GI):** Meaning and significance; difference between GI and trademarks; Indian examples (*Kolhapuri Chappal, Darjeeling Tea*); procedure for registration and protection under the *Geographical Indications of Goods (Registration and Protection) Act, 1999*. **Plant Variety Protection:** Concept and objectives; benefit sharing and farmers' rights; registration procedure under the *Protection of Plant Varieties and Farmers' Rights (PPV&FR) Act, 2001*; examples from Indian agriculture. **Layout Design Protection:** Meaning and scope; protection of semiconductor integrated circuit layouts; procedure for registration under the *Semiconductor Integrated Circuits Layout-Design Act, 2000*; relevance to electronics and chip design industries.	**08 Hrs.**
Unit 6: IP Management and Commercialization **IP Management in R&D:** Importance of managing intellectual assets in research and innovation; role of IPR cells and institutional IP policies. **Licensing and Commercialization:** Concepts, types of licenses, technology transfer models, and revenue generation through IP assets. **IP in the Digital Age:** Software patents, data protection, AI-generated works, and cyber law implications. **International IP Treaties and Organizations:** Overview of WIPO, TRIPS, and their role in global IP protection. **Future Trends in IP:** Emerging areas such as digital innovation, open-source licensing, and sustainability-driven IP practices.	**07 Hrs.**

Textbooks:

1. P. Narayanan, "Intellectual Property Law," Eastern Law House.
2. N. S. Gopalakrishnan & T.G. Agitha, "Principles of Intellectual Property," Eastern Book Company

Reference Books:

1. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
2. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.
3. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis
4. N.R. Subbaram.S. Viswanathan, "Hand book Indian Patent Law and, Practice" Printers and publishers Pvt, Ltd, 2008.
5. Dr. S.R.Myneni, "Law of Intellectual Property", 9th Ed, Asia law House,2019
6. Indian Patent Law : Legal and Business Implications" by Ajit Parulekar, Sarita D'Souza Macmillan India publication, 2006
7. "Agriculture and Intellectual Property Rights", edited by: Santaniello, V., Evenson, R.E., Zilberman, D. and Carlson, G.A. University Press publication, 2003
8. David Bainbridge: Intellectual Property (2002), Pearson Education Ltd, New Delhi
9. . Pearson & Miller : Commercial Exploitation of Intellectual Property (2004), University Law Publishing Co. Pvt. Ltd, Delhi.
10. Prabhuddha Ganguli: Intellectual Property Rights–Unleashing Knowledge Economy, 2001, Tata-Mcgraw Hill, New Delhi.
11. Ganguli Prabuddha Gearing up for Patents…..The Indian Scenario", Universities Press (1998)
12. Inventing the Future: An introduction to Patents for small and medium sized Enterprises; WIPO publication No. 917.
13. Looking Good: An Introduction to Industrial Designs for Small and Medium sized Enterprises; WIPO publication No.498. URL
14. Creative Expression: An Introduction to Copyright and Related Rights for Small and Medium-sized Enterprises; WIPO publication No. 918
15. Making a Mark: An Introduction to Trademarks for Small and Medium-sized Enterprises; WIPO publication No. 900

Title of the Course:	**ENGINEERING ECONOMETRICS**	**L**	**T**	**P**	**Credit**
Course Code:	**UILOE0622**	**3**	**-**	**-**	**3**

Course Pre-Requisite: Industrial Management

Course Description: It is open elective course in electronics and telecommunication field with diverse applications in area of entrepreneurship. These courses focus on all aspects about Engineering Economics.

Course Learning Objectives:

1. Train the student to cost estimation of component.
2. To Provide Knowledge about value Engineering.
3. To know about cash flow.
4. To solve problem on depreciation.

Course Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Taxonomy	
		Level	Descriptor
CO1	To explain basic of Economics for Engineering	II	Explain
CO2	To Know value Engineering for Engineering Economics	I	Know
CO3	To provide Knowledge of cash flow	I	Knowing
CO4	To analyze the problem of Replacement, maintenance and depreciation	III	Analyse

Assessments :

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	**Marks**
ISE1	10
MSE	30
ISE2	10
ESE	50

- ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three modules)
- ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Introduction to Economics: Introduction to economics, flow in an Economy, law of supply and demand, scope of engineering economics, element of costs, marginal costs, marginal revenue, sunk cost, opportunity cost, elementary economic analysis.	**9 Hrs.**
Unit 2: Value Engineering: Make or buy decision, value engineering functions and aims, value engineering procedure, Interest formulae and their applications, single payment compound amount factor, equal payment series sinking fund and worth factor with examples	**9 Hrs.**
Unit 3: Cash Flow : Methods of comparison of alternatives, present worth method (Revenue dominated cash flow diagram), future worth method (Revenue dominated cash flow diagram, cash dominated cash flow diagram), Annual equivalent method, Rate of return method – Examples all methods.	**9 Hrs.**
Unit 4: Replacement and maintenance Analysis: Introduction, Types of Maintenance, Types of replacement problem, Determination of economic life of an asset, Replacement of an asset with a new asset, Capital Recovery with return and concept of challenger and defender.	**9 Hrs.**

Unit 5: Depreciation: Introduction, Straight line method of depreciation, Declining balance method of depreciation, Sum of the year digits method of depreciation, Sinking fund method of depreciation, Service output method of depreciation.	**9 Hrs.**
Textbooks: 1. Panneer Selvam R. "Engineering Economics", Prentice Hall of India Ltd, 2001. 2. Smith, G.W. "Engineering Economics", Lowa State Press 1973.	
Reference Books: 1. Park C.S., "Contemporary Engineering Economics", Prentice Hall of India Ltd, 2002. 2. Newman, D.G. and Lavelle, J.P., Engineering Economics" and Analysis", Engineering Press,2002.	

Title of the Course:	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	Credit
Course Code:	UILOE0623	3	-	-	3

Course Pre-Requisite:
Genuine interest in development of entrepreneurial mind set. Planning competency and global awareness competency

Course Description:
Familiarize students with fundamentals of entrepreneurship, study government support organizations for entrepreneurs, study the process of starting the industry besides studying the ecosystem available for new entrepreneurs

Course Learning Objectives:

1. To develop conceptual understanding of the topic among the students and comprehend the environment of making of an entrepreneur
2. To develop the ability of analyzing and understanding business situations in which entrepreneursactandtomastertheknowledgenecessarytoplanentrepreneurialactivities

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive Level	Bloom's Cognitive Descriptor
CO1	Relate the concept of Entrepreneurship and describe the role of Entrepreneurship with in society	I	Remember
CO2	Discuss Market research, Survey, Project report, business finance	II	Understand
CO3	Describe marketing, sales, operations and accounting activities.	II	Understand
CO4	Use/Demonstrate/Interpret/Apply entrepreneur in puts for starting and establishing business	III	Apply

Assessments :
Teacher Assessment:

- Two components of In Semester Evaluation (ISE), one Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

- ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three units)
- ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three units) covered after MSE.

Course Contents:

Unit 1: Entrepreneurship Entrepreneur: Meaning of entrepreneurship, Types of Entrepreneurships, Traits of entrepreneurship, Factors promoting entrepreneurship, Barriers to entrepreneurship, the entrepreneurial culture, Stages in entrepreneurial process, Women entrepreneurship and economic development, SHG.	**06 Hrs.**
Unit 2: Project Identification, Selection Meaning, classification of projects-Factors involved in project identification, selection-significance, contents, formulation of a project report-specimen of a project report-planning	**06 Hrs.**

commission's guidelines for formulating a project-Basics of capital budgeting- Payback period, Net present value, Internal Rate of Return.	
Unit 3: Business Finance: Need for Financial Planning, Sources of finance, Capital Structure, Term-loan, Sources of Short- Term Finance, Capitalization, Venture capital, Export Finance, Institutional Finance to Entrepreneurs, Institution Support to Entrepreneurs, Business lifecycle, Break even.	**06 Hrs.**
Unit 4: Marketing, Sales Marketing - Basics, Marketing Strategy and Brand Positioning, Plans and Execution Techniques, Marketing Analytics, Online Marketing Sales -Understanding Sales, Pitching Techniques, Sales strategies, Inside Sales v/s Outside Sales, Request for Proposal (RFP)	**06 Hrs.**
Unit 5: Ownership Structures & Evaluation of EDP's Ownership structures-sole trader, partnership (Partnership deed) types of partnership-Joint stock companies- Difference between private and a public company-Advantage and disadvantages of the ownership structures- Distinction between MDP and EDP.	**06 Hrs.**
Unit 6: Costing and Accounting Direct and Indirect costs, financial appraisal, financial projection, Income tax, Profit and loss account, Balance sheet, , Goods and Service tax, letter of credit, over draft , Excise Tax and Export process.	**06 Hrs.**

Recommended Textbooks:

1. Roy, R. (Rajeev). Entrepreneurship. Oxford University Press, Latest Edition.
2. Gordon, E., & Natarajan, K. (2008). Entrepreneurship Development. Himalaya Publishing House, Mumbai.
3. Coulter, M. (2005). Entrepreneurship in Action (2nd ed.). Prentice Hall of India (PHI), New Delhi.
4. Ramachandran, K. (2003). Entrepreneurial Development. Tata McGraw-Hill Publishing Company, New Delhi.
5. Saini, J. S. (2006). Entrepreneurial Development Programmes and Practices. Deep & Deep Publications (P) Ltd., New Delhi.
6. Charantimath, P. M. (2013). Entrepreneurship Development and Small Business Enterprises. Pearson Education, New Delhi.
7. Entrepreneurship Development Institute of India (EDI). Developing New Entrepreneurs. EDI of India, Ahmedabad.
8. Government of India. Handbook of New Entrepreneurs. Ministry of MSME, New Delhi.
9. Desai, V. (2006). Management of Small Scale Industries. Himalaya Publishing House, Mumbai.
10. Gordon, B. (2000). Entrepreneurship: Playing to Win. Taraporewala & Co. Ltd., Mumbai.
11. McClelland, D. C., & Winter, D. G. (1969). Motivating Economic Achievement. Free Press, New York.
12. Maharashtra Industrial Development Corporation (MIDC). Industrial Maharashtra: Facts, Figures and Opportunities. MIDC, Mumbai.
13. Banga, T. R. (2008). Project Planning and Entrepreneurship Development. Tata McGraw-Hill Publishing Company, New Delhi.
14. Desai, V. (2005). Dynamics of Entrepreneurial Development and Management. Himalaya Publishing House, Mumbai.
15. Desai, V. (2004). Small Scale Industries and Entrepreneurship. Himalaya Publishing House, Mumbai.
16. Peterson, H. C., & Lewis, W. C. (2002). Managerial Economics (4th ed.). Pearson Education / PHI, New Delhi.
17. Ahuja, H. L. (2010). Managerial Economics. S. Chand & Company Ltd., New Delhi.
18. Trivedi, M. L. (2004). Managerial Economics. Tata McGraw-Hill Publishing Company, New Delhi.
19. Ramachandran, K., & Kakani, R. K. (2009). How to Analyze Financial Statements. Tata McGraw-Hill Publishing Company, New Delhi.
20. Palat, R. (2004). How to Read Annual Reports and Balance Sheets. Jaico Publishing House, Mumbai.

21. Dash, A. P. (2009). Financial Wisdom: Finance for Non-Finance Executives. Biztantra Publishing, New Delhi. ISBN: 978-81-7722-378-1.
22. Martin, M. J. C. (1994). Managing Innovation and Entrepreneurship in Technology-Based Firms. John Wiley & Sons, New York.
23. Ettlie, J. E. (2000). Managing Technological Innovation. John Wiley & Sons, New York.
24. Christensen, C. M., & Raynor, M. E. (2003). The Innovator's Solution: Creating and Sustaining Successful Growth. Harvard Business School Press, Boston.
25. Kidder, D. (2012). The Startup Playbook: Secrets of the Fastest-Growing Startups from Their Founding Entrepreneurs. Chronicle Books, San Francisco. Catmull, E. (2014). Creativity, Inc.: Overcoming the Unseen Forces That Stand in the Way of True Inspiration. Random House, New York.
26. Bhargava, S. (Ed.). (2003). Transformational Leadership: Value-Based Management for Indian Organizations. Response Books / Sage Publications, New Delhi.
27. Cardullo, M. W. P. E. (1999). Technological Entrepreneurism: Enterprise Formation, Financing, and Growth. Research Studies Press Ltd., England.
28. Hisrich, R. D., & Peters, M. P. (2001). Entrepreneurship: Starting, Developing, and Managing a New Enterprise (5th ed.). McGraw-Hill, New York

References Books:

1. Jain, P. C. (Latest ed.). *Handbook for New Entrepreneurs*. Oxford University Press, New Delhi.
2. Khanka, S. S. (Latest ed.). *Entrepreneurial Development*. S. Chand & Company Ltd., New Delhi.
3. Zimmerer, T. W., & Scarborough, N. M. (2005). *Essentials of Entrepreneurship and Small Business Management* (4th ed.). Prentice Hall of India (PHI), New Delhi.
4. Hattangadi, V. (2007). *Entrepreneurship*. Himalaya Publishing House, Mumbai.
5. Desai, V. (2006). *Small Scale Industries and Entrepreneurship*. Himalaya Publishing House, Mumbai.
6. Badhai, B. (2004). *Entrepreneurship for Engineers*. Dhanpat Rai & Company (P) Ltd., New Delhi.
7. Gupta, C. B., & Srinivasan, N. P. (2007). *Entrepreneurial Development*. S. Chand & Sons, New Delhi.
8. Drucker, P. F. (2006). *Innovation and Entrepreneurship*. Harper Business, New York.
9. McClelland, D. C., & Winter, D. G. (1969). *Motivating Economic Achievement*. Free Press, New York.
10. Harvard Business School Press. (2001). *Harvard Business Review on Innovation*. Harvard Business School Press, Boston.
11. Harvard Business School Press. (1999). *Harvard Business Review on Entrepreneurship*. Harvard Business School Press, Boston.
12. Rogers, E. M. (2003). *Diffusion of Innovations* (5th ed.). Simon & Schuster, New York.
13. Kanungo, R. N. (Ed.). (1998). *Entrepreneurship and Innovation: Models for Development* (Vol. 2). Sage Publications, New Delhi.
14. Verma, J. C., & Singh, G. (2002). *Small Business and Industry: A Handbook for Entrepreneurs*. Response Books / Sage Publications, New Delhi.
15. Brealey, R. A., & Myers, S. C. (2004). *Principles of Corporate Finance* (7th ed.). McGraw-Hill, New York.
16. Chandra, P. (2004). *Financial Management: Theory and Practice* (6th ed.). Tata McGraw-Hill Publishing Company, New Delhi.
17. Pandey, I. M., & Bhat, R. (2004). *Cases in Financial Management*. Tata McGraw-Hill Publishing Company, New Delhi.

Title of the Course:	POSITIVE PSYCHOLOGY	L	T	P	Credit
Course Code:	UILOE0624	3	-	-	3

Course Pre-Requisite:
Basic academic skills like essay writing, reading and critical thinking. Basic understanding of psychology like behavior, emotions, motivation. Willingness in discussing personal experiences, elementary statistics for understanding empirical studies.

Course Description:
This course introduces students to the scientific study of positive human functioning, with a focus on strengths, well-being, resilience, and optimal performance. Positive Psychology examines factors that enable individuals and communities to thrive. Students will explore core concepts such as happiness, positive emotions, character strengths, motivation, meaning and purpose, resilience, mindfulness, optimism, gratitude, and flourishing. The course enables learners to apply evidence-based interventions to enhance personal well-being, workplace effectiveness, educational outcomes, and community health.

Course Learning Objectives:
1. Understand foundational concepts
2. Analyze theories of well-being
3. Identify and assess human strengths
4. Apply evidence-based interventions
5. Promote resilience and emotional well-being
6. Demonstrate ethical and cultural sensitivity
7. Integrate theory into real-world contexts

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Explain foundations of Positive Psychology.		
CO2	Differentiate hedonic & eudemonic well-being.		
CO3	Analyze resilience, trauma & cultural influences.		
CO4	Evaluate optimism, virtues & spirituality.		
CO5	Interpret close relationships and well-being.		
CO6	Apply concepts through self-reflection.		

Assessments :
Teacher Assessment:
- Two components of In Semester Evaluation (ISE), one Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

- ISE 1 and ISE 2 are based on assignment / declared test / quiz / seminar / Group Discussions etc.

- MSE: Assessment is based on 50% of course content (Normally first three modules) .
- ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit: 1 Foundations of Positive Psychology	
1.1 - Traditional Psychology & Medical Model 1.2 - Introduction to Positive Psychology 1.3 - Happiness: Hedonic & Eudemonic Traditions 1.4 - Self-Realization & Well-Being	**8 Hrs.**
Unit: 2 Resilience, Trauma & Human Strength	
2.1 Resilience in Cultural Context 2.2 Trauma & Post-Traumatic Growth	**8 Hrs.**
Unit: 3 Money, Culture & Well-Being	
3.1 Money & Happiness 3.2 Culture & Well-Being	**7 Hrs.**
Unit: 4 Optimism, Virtues & Character Strengths	
4.1 Optimism 4.2 Human Virtues & Wisdom 4.3 Spirituality, Religion & Transcendence 4.4 Religious Coping	**8 Hrs.**
Unit: 5 Relationships, Love & Marriage	
5.1 Close Relationship Dynamics 5.2 Friendship & Romantic Love 5.3 Marriage & Divorce: Cultural Perspectives	**7 Hrs.**
Unit: 6 Conflict, Communication & Relationship Well-Being	
6.1 Conflict Management 6.2 Building Happy Relationships	**7 Hrs.**

Recommended Textbooks:

1. Baumgardner Steve, Crothers Marie, Misra Girishwar, Saini Damini (2025): *Positive Psychology*; Pearson India Education Services Pvt. Ltd.; Indian Edition - First Impression **(ISBN: 978-93-615-9099-3)**
2. WORKBOOK: Smith Bruce W. (2020): Move from Surviving To Thriving; Kindle Direct Publishing, Seattle, WA, USA; First Edition (ISBN: 9798571856447)

References Books:

1. Seligman, Martin E. P. (2002): *Authentic Happiness: Using the new positive psychology to realize your potential for* lasting fulfillment; THE FREE PRESS - A Division of Simon & Schuster, Inc., New York, USA, First Edition (ISBN-13: 978-0-7432-4788-7; ISBN-10: 0-7432-4788-4)
2. Compton William C. (2018): Positive Psychology: The science of happiness and flourishing; SAGE Publications, UK; Third Edition (ISBN 9781544322926)
3. Lopez S, Pedrotti J, Snyder C: Positive Psychology - The Scientific and Practical Explorations of Human Strengths, Sage Publication, UK; Third Edition

Title of the Course:	**LANDSCAPE DESIGN**	**L**	**T**	**P**	**Credit**
Course Code:	**UILOE0625**	**3**	**-**	**-**	**3**

Course Pre-Requisite: Basic knowledge of engineering graphics, environmental science, basic civil, and introductory CAD skills.

Course Description: An introductory course on integrating natural and built environments through landscape planning, design principles, planting, hardscape elements, and hands-on site-based training for engineering applications.

Course Learning Objectives:

1. Understand fundamental principles of landscape design, ecology, and site planning.
2. Develop skills in site analysis, inventory mapping, and design concept development.
3. Apply softscape and hardscape design techniques to create sustainable landscape solutions.

Course Outcomes:

CO	**After the completion of the course the student should be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Ability to analyze and interpret site conditions including climate, soil, topography, and vegetation.	L4	Analyze
CO2	Develop functional and sustainable landscape design solutions for various engineering project contexts.	L6	Create
CO3	Prepare professional landscape drawings and models	L3	Apply
CO4	Demonstrate hands-on proficiency through fieldwork, plant identification, material detailing, and a complete landscape design project.	L5	Evaluate

Assessments :

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), one Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	**Marks**
ISE 1	10
MSE	30
ISE 2	10
ESE	50

- ISE 1 and ISE 2 are based on assignment / declared test / quiz / seminar / Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three modules) .
- ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit: 1:Introduction to Landscape Design **6Hrs.**

- Definition, scope, and significance of landscape design in engineering.
- Relationship between built environment, infrastructure, and landscape.
- Landscape as a system: Natural, cultural, visual, and functional components.
- Landscape aesthetics: Form, color, texture, scale, balance.
- Short sketching exercise: site elements and space character.

Unit: 2: Landscape Ecology & Site Planning Principles	
• Ecology basics: climate, soil, hydrology, biodiversity. • Site planning concepts: landform, drainage, circulation, microclimate. • Slope and contour understanding; cut-fill concepts. • Sustainable landscape strategies: rainwater harvesting, bioswales, low-impact development (LID).	**6Hrs.**
Unit: 3:Softscape Design	
• Plant typologies: trees, shrubs, groundcovers, turf, water plants. • Plant selection criteria: climate, soil, maintenance, function. • Planting design concepts: grouping, layering, buffer planting, avenue planting. • Plant palettes for Indian landscapes (native vs. exotic). • Create a planting plan for a small area using symbols and annotations.	**8 Hrs.**
Unit: 4: :Hardscape & Landscape Structures	
• Paths, plazas, decks, pergolas, gazebos, seating, water features. • Paving materials: stone, brick, concrete, gravel. • Outdoor lighting basics. • Landscape services: irrigation, drainage, electrical. • Detail drawing exercise of a pathway, seating element, or pergola.	**6 Hrs.**
Unit: 5:Landscape Design Process & Graphics	
• Stages: site analysis , concept development , master plan ,detailed design ,BOQ. • Landscape drawings: plans, sections, elevations, perspectives. • Software exposure: AutoCAD, SketchUp, Photoshop/Illustrator, GIS basics, Lumion for rendering. • Visual communication: color coding, textures, line weights.	**8 Hrs.**
Unit: 6: Applied Landscape Engineering	
• Landscape for infrastructure: roads, bridges, industries, housing, campuses. • Stormwater and waterbody edge design. • Green roofs, vertical gardens, urban agriculture. • Maintenance planning and cost estimation. • Field visit to a built landscape project	**6 Hrs.**

Recommended Textbooks:

1. Landscape Design: A Practical Approach by Leroy Hannebaum — A very clear practical guide to the landscape design process.
2. Landscape Design in Color: History, Theory, and Practice 1750 to Today by Mira Engler — A design-theory rich work focusing on colour, history & visual aspects of landscapes.
3. Site Planning and Design Handbook by Thomas H. Russ — Useful for the engineering and site-planning component of the course.
4. Landscape Architecture: A Manual of Environmental Planning and Design by John Ormsbee Simonds & Barry Starke — A classic text covering broad aspects of landscape architecture & planning.
5. Time-Saver Standards for Landscape Architecture by Charles W. Harris & Nicholas T. Dines — A handy reference for materials, details, standards and technical data.

References Books:

1. Landscape Architecture in India: A Reader (Editors: Mohammad Shaheer, Geeta Wahi Dua, Adit Pal) — a region-specific compilation covering natural processes, planting, historical & cultural context of landscapes in India.
2. Landscape Architecture: An Introduction (Robert Holden & Jamie Liversedge) — provides broad overview of history, theory and practice of landscape architecture.
3. Landscape Architecture: A Manual of Environmental Planning and Design (John

Ormsbee Simonds & Barry Starke) — a comprehensive manual of planning, design, and environmental considerations in landscape architecture.
4. Time-Saver Standards for Landscape Architecture (Charles W. Harris & Nicholas T. Dines) — a handy technical reference covering materials, construction details, dimensions and standards.
5. Landscape Architecture (Ian Thompson) — part of the Very Short Introductions series; a concise overview of the field's origins, evolution, and current issues.
6. Digital Drawing for Landscape Architecture: Contemporary Techniques and Tools for Digital Representation in Site Design — focuses on digital tools, representation techniques and visual communication in landscape design.
7. Form and Fabric in Landscape Architecture: A Visual Introduction — explores the visual language, patterns, and fabric of landscapes; useful for design and graphics.

Title of the Course:	MICRO ECONOMICS	L	T	P	Credit
Course Code:	UILOE0626	3	-	-	3

Course Pre-Requisite:
Basic mathematical skills (algebra, graphs, and simple functions), Fundamental analytical and logical reasoning abilities developed through prior engineering courses, Basic understanding of real-world industrial or technological contexts.

Course Description:
All Engineering Branches (Open Elective)

Course Learning Objectives:

1. To introduce the fundamental principles of microeconomics and their relevance to engineering and managerial decision-making.
2. To enable students to understand market mechanisms, consumer and producer behaviour, and cost structures.
3. To relate economic theories with practical engineering and industrial contexts for cost optimization and resource allocation.

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive Level	Bloom's Cognitive Descriptor
CO1	Explain the core concepts and principles of microeconomics.	L1, L2	
CO2	Analyze consumer and producer behavior using demand, supply, and cost theories.	L3	
CO3	Evaluate market structures and their impact on pricing and output decisions.	L3	
CO4	Apply microeconomic tools to solve engineering and managerial problems.	L4	

Assessments :

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), one Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

- ISE 1 and ISE 2 are based on assignment / declared test / quiz / seminar / Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three modules) .
- ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit: 1 Introduction to Microeconomics

Nature and scope of economics; micro and macroeconomics; basic concepts like scarcity, choice, opportunity cost, central problems of an economy, relevance of microeconomics in engineering and technological applications.	**Hrs. 06**

Unit: 2 Demand and Consumer Behavior	
Law of demand, determinants of demand; elasticity of demand (price, income, cross); consumer equilibrium utility and indifference curve approaches, budget line and consumer choice, consumer surplus and its applications in product design and market analysis.	**Hrs. 09**
Unit: 3 Production and Cost Analysis	
Production function short-run and long-run; law of variable proportions, returns to scale, isoquants and least-cost combination; cost analysis types of costs, cost curves, economies and diseconomies of scale.	**Hrs. 09**
Unit: 4 Market Structures and Pricing	
Market classification; price and output determination under perfect competition, monopoly, monopolistic competition, and oligopoly; price discrimination; role of technology and innovation in market structures.	**Hrs. 09**
Unit: 5 Factor Pricing and Distribution	
Marginal productivity theory; rent, wages, interest, and profit – meaning and determination; wage and productivity relationship; distribution in industrial and engineering sectors.	**Hrs. 06**
Unit: 6 Welfare Economics and Engineering Applications	
Concept of social welfare and efficiency; market failures and externalities; government intervention and regulation; cost-benefit analysis for engineering and infrastructure projects; sustainable economic decision-making.	**Hrs. 06**
Recommended Textbooks: 1. Ahuja, H.L. – Modern Microeconomics: Theory and Applications, S. Chand. 2. Pindyck, R.S. & Rubinfeld, D.L. – Microeconomics, Pearson Education. 3. Varian, H.R. – Intermediate Microeconomics: A Modern Approach, W.W. Norton.	
References Books: 1. Koutsoyiannis, A. – Modern Microeconomics. 2. Dwivedi, D.N. – Microeconomic Theory and Applications, Pearson. 3. Samuelson, P.A. & Nordhaus, W.D. – Economics.	

Title of the Course:	WASTE MANAGEMENT	L	T	P	Credit
Course Code:	UILOE0627	3	-	-	3

Course Pre-Requisite:
Students shall have knowledge of:
- Basic Sciences
- Engineering Sciences

Course Description:
Understanding the importance of waste management is the need of current scenario. After studying the course students will know problems related to waste management and will be able to grasp an overview of municipal solid waste, industrial waste and hazardous waste management. Students will be able to explain planning and engineering principles needed to address the growing and increasing problems of refuse. Students will understand different treatment technologies for waste to energy and disposal options. Students will be able to describe various legislations in waste management.

Course Learning Objectives:
1. Understand the importance of waste management for sustainable development.
2. Know consequences of various types of pollutions, and effects of it on human health, socio economic problems, climate and marine environment.
3. Know utilization of waste effectively by applying waste to energy concept.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Cognitive Descriptor
CO1	Discuss various sources, types, classification of solid waste, importance of waste management, waste suitable for energy production etc.	Cognitive (Understanding) L2
CO2	Explain waste generation, storage, collection, separation, transportation and processing of waste.	Cognitive (Understanding) L2
CO3	Describe characteristics of solid waste and different treatment methods to recover energy from waste, densification of solids.	Cognitive (Understanding) L2
CO4	Grasp various legislations in waste management and integrated waste management system.	Cognitive (Remembering) L1

Assessments :

Teacher Assessment:
- Two components of In Semester Evaluation (ISE), one Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

- ISE 1 and ISE 2 are based on assignment / declared test / quiz / seminar / Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three modules) .
- ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
Unit 1: Introduction: Definition of waste and importance of waste management, classification and types of solid waste, Important quality parameters of wastes, Waste suitable for energy production.	**07 Hrs.**
Unit 2: Elements of waste management system: Waste generation, storage, collection, segregation and processing, transfer and transport, disposal methods of waste.	**07 Hrs.**
Unit 3: Characterization of waste: Characterization of solid wastes-Physical, Chemical, Proximate analysis, Leaching properties, Energy content, Heating value.	**08 Hrs.**
Unit 4: Waste to Energy Technologies: Need for energy production from wastes, Routes of energy production from waste, Energy production from Organic Waste- Composting, Vermi composting, Anaerobic digestion and biogas production from organic waste, anaerobic digester and types.	**07 Hrs.**
Unit 5: Energy production from Plastic- Plastic waste generation and need for proper management of plastic, classification of plastic, various types of plastics and suitability for energy production, common steps for converting waste plastic to fuels. **Densification of solids-** Fundamentals of densification, types of briquetting, Briquetting process and their comparison, Briquette characteristics, application of briquettes.	**08 Hrs.**
Unit 6: Integrated Solid Waste Management (ISWM) Integrated solid waste management, Principles of waste hierarchy**,** waste prevention and reduction, reuse, recycling. Swachh Bharat Abhiyan • **Legislation in Waste Management:** Solid Waste Management Rules 2016, Hazardous and Other Wastes (Management and Transboundary movement) Rules, 2016,Plastic Waste Management Rules 2016, Extended Producer's Responsibility	**08 Hrs.**

Textbooks:

1. Tchobanoglous, G. and Kreith, F., HANDBOOK OF SOLID WASTE MANAGEMENT, McGraw Hill, 2002, 2nd Edition
2. Tchobanoglous, G., Theisen and Vigil, Integrated Solid Waste Management: Engineering Principles and Management Issues, McGraw Hill, 1993.
3. Ni –Bin Chang., Sustainable solid waste management: A Systems Engineering Approach Somerset: Wiley 1st ed, 2015

References:

1. Municipal Solid Waste management Manual, 2016 by CPHEEO.
2. Christensen, H. T., Solid Waste Technology & Management, Wiley, 2010, Volume 1 & 2
3. Nicholasp P. Cheremisinoff., Handbook of Solid Waste Management and Waste Minimization Technologies, Butterworth Heinemann An imprint of Elsevier Science.

Title of the Course:	SOCIAL ENTREPRENEURSHIP	L	T	P	Credit

Course Code:	**UILOE0628**	**3**	**-**	**-**	**3**

Course Pre-Requisite: Basic understanding of management principles, innovation, and sustainability concepts.

Course Description: This course introduces the concept of social entrepreneurship, emphasizing innovation and sustainability for societal impact. It focuses on identifying social issues, developing sustainable business models, and evaluating ethical and financial implications of social ventures. Students will gain practical exposure to problem-solving through real-world case studies and community projects.

Course Learning Objectives:

1. To introduce the fundamental concepts and principles of social entrepreneurship.
2. To develop students' ability to design innovative and sustainable social business models.
3. To cultivate ethical values, entrepreneurial mindset, and responsibility towards society.

Course Outcomes:

CO	**After the completion of the course the student will be able to**	**Bloom's Taxonomy**	
		level	Descriptor
CO1	Analyze the concept, characteristics, and relevance of social entrepreneurship for sustainable development.	IV	Analyze
CO2	Design innovative and sustainable business models to address social and environmental problems.	VI	Create
CO3	Evaluate ethical, social, and financial aspects of social enterprise projects to ensure sustainable impact.	V	Evaluate

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), one Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	**Marks**
ISE 1	10
MSE	30
ISE 2	10
ESE	50

- ISE 1 and ISE 2 are based on assignment / declared test / quiz / seminar / Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three modules) .
- ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit: I Introduction to Social Entrepreneurship • Meaning and evolution of social entrepreneurship • Difference between social entrepreneurship and commercial entrepreneurship • Importance of social entrepreneurship in national development • Role of engineers in social innovation • Global and Indian social entrepreneurship landscape	**8 Hrs.**
Unit: II Social Innovation and Opportunity Identification • Identifying social and environmental challenges • Design thinking and human-centered design for problem solving • Idea generation, screening, and feasibility analysis • Case discussions: local social issues and entrepreneurial responses	**7 Hrs**

Unit: III Business Models and Financing of Social Enterprises • Components of social business model canvas • Hybrid models: balancing social and financial objectives • Triple bottom line (People, Planet, Profit) • Resource mobilization: crowd funding, CSR, impact investors, grants, incubators • Revenue sustainability and scaling strategies	**8 Hrs**
Unit: IV Financing of Social Enterprises • Resource mobilization methods ✓ Crowd funding ✓ CSR funding ✓ Social/Impact investors ✓ Grants & philanthropic capital ✓ Incubators and accelerators • Financial planning for sustainability • Cost structure & revenue streams in social enterprises	**7 Hrs**
Unit V: Impact Assessment and & Project Planning • **Measuring Social Impact:** Concept and importance of measuring social impact. ✓ Basic tools and approaches: o **SROI (Social Return on Investment)** – assessing value created in social and economic terms. o **Logical Framework (Log Frame)** – linking goals, activities, and measurable outcomes. o **Impact indicators** – examples: employment generated, energy saved, waste reduced, number of beneficiaries. • **Project Planning and Proposal Development:** ✓ Steps in preparing a small social entrepreneurship project proposal: o Identifying a social problem. o Setting objectives and expected outcomes. o Planning activities, timelines, and resources. o Defining impact indicators and evaluation method. ✓ Group exercise: draft a one-page concept note for a local community problem (e.g., waste segregation, rural water filtration, women's self-help groups).	**8 Hrs**
Unit VI: Case Studies • SELCO **India (Karnataka):** Solar energy solutions for low-income households • **Aravind Eye Care (Tamil Nadu):** Cross-subsidy model for affordable healthcare • **Mann Deshi Foundation (Maharashtra):** Rural women empowerment through microfinance & skills • **Barefoot College (Rajasthan):** Training rural women as solar engineers • **Tata Trusts (Pan India):** Social innovation in health, water & livelihoods • Havells–Luminous Solar in Rural Maharashtra	**7 Hrs**

Textbooks and references:

Textbooks:

1. Bornstein, D. (2007). How to Change the World: Social Entrepreneurs and the Power of New Ideas Oxford University Press, New York. ISBN: 978-0195334760
2. Dees, J. Gregory, Emerson, J., & Economy, P. (2002). Enterprising Nonprofits: A Toolkit for Social Entrepreneurs Wiley, San Francisco. ISBN: 978-0471397350
3. Nicholls, A. (Ed.) (2006). Social Entrepreneurship: New Models of Sustainable Social Change Oxford University Press, New York. ISBN: 978-0199283880
4. Drayton, B. (2011). Everyone a Changemaker: Social Entrepreneurship and the Power of Innovation Ashoka Foundation.

5. Mair, J., Robinson, J., & Hockerts, K. (Eds.) (2006). Social Entrepreneurship Palgrave Macmillan, London. ISBN: 978-1403996647

Reference books :

1. Austin, J., Stevenson, H., & Wei-Skillern, J. (2006). Social and Commercial Entrepreneurship: Same, Different, or Both? Entrepreneurship Theory and Practice, 30(1), 1–22.
2. Handbook on Social Entrepreneurship (2020) NITI Aayog, Government of India. Available on niti.gov.in.
3. Prajapati, A. & Waghmare, A. (2021). Social Entrepreneurship in India: Concepts, Cases, and Practices Sage Publications India. ISBN: 9789354790565
4. Tata Trusts & TISS Case Compendium (2022). Indian Social Innovations Report Tata Institute of Social Sciences, Mumbai.

Title of the Course:	INDUSTRIAL HEALTH AND SAFETY	L	T	P	Credit
Course Code:	UILOE0629	3	-	-	3

Course Pre-Requisite:

- Fundamentals of Engineering and Manufacturing Processes
- Basic Physics and Chemistry
- Workplace Safety Awareness

Course Description:

This course introduces students to key concepts in industrial health and safety, emphasizing the identification, evaluation, and control of workplace hazards. It covers occupational health, risk assessment, accident prevention, and legal frameworks to ensure a safe working environment in various industries.

Course Learning Objectives:

1. To understand the fundamentals of industrial health and safety.
2. To identify potential hazards and risks in the workplace.
3. To study various accident prevention and safety management techniques.
4. To evaluate occupational health issues and their control measures.
5. To familiarize students with safety laws, regulations, and industry standards.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Cognitive Descriptor
CO.1	Explain the importance of industrial health and safety in the workplace.	Cognitive (Understanding) L2
CO.2	Identify and analyse workplace hazards and risks.	Cognitive (Analyzing) L4
CO.3	Apply accident prevention techniques and risk mitigation strategies.	Cognitive (Apply) L3
CO.4	Examine occupational health concerns and suggest appropriate control measures and interpret industrial safety laws, regulations, and compliance requirements.	Cognitive (Analysing) L4

Assessments :

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), one Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

- ISE 1 and ISE 2 are based on assignment / declared test / quiz / seminar / Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three modules) .
- ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
Unit 1: Introduction to Industrial Health and Safety Definition and importance of industrial health and safety, Types of workplace hazards: Physical, chemical, biological, ergonomic, and psychosocial, Occupational health and safety management systems (OHSMS), Case studies of major industrial accidents	**08 Hrs.**
Unit 2: Hazard Identification and Risk Assessment Techniques for hazard identification and risk analysis, Safety audits and inspections, Job safety analysis (JSA) and failure mode effect analysis (FMEA), Hierarchy of hazard control measures	**07 Hrs.**
Unit 3: Accident Prevention and Safety Management Causes and effects of industrial accidents, Safety training and behaviour-based safety programs, Fire and explosion prevention strategies, Emergency preparedness and response plans, 5S concept of safety and Behaviour based safety.	**08 Hrs.**
Unit 4: Occupational Health and Industrial Hygiene Workplace health hazards: Noise, dust, radiation, and chemical exposure, Ergonomics and workplace design for health and safety, Personal protective equipment (PPE) and its selection, Industrial hygiene monitoring and control strategies	**07 Hrs.**
Unit 5: Safety Standards, Regulations, and Legal Framework National and international safety laws (Factories Act, OSHA, ISO 45001), Environmental regulations related to workplace safety, Safety standards for different industries (construction, manufacturing, healthcare), Ethical responsibilities and safety culture in organizations	**08 Hrs.**
Unit 6: Emerging Trends in Industrial Safety Role of artificial intelligence (AI) and IoT in workplace safety, Digital safety tools: Wearable technology, sensors, and real-time monitoring, Sustainable safety practices and green workplaces, Future challenges and innovations in industrial health and safety	**08 Hrs.**
Textbooks: 1. Industrial Safety and Health Management – C. Ray Asfahl 2. Fundamentals of Occupational Safety and Health – Mark A. Friend, James P. Kohn	
References: 1. Occupational Health and Safety Management: A Practical Approach – Charles D. Reese 2. Introduction to Health and Safety at Work – Phil Hughes, Ed Ferrett 3. Accident Prevention Manual for Business & Industry – National Safety Council	

Title of the Course:	APPROPRIATE TECHNOLOGY	L	T	P	Credit
Course Code:	UILOE0630	3	-	-	3

Course Pre-Requisite:
Basic engineering concepts, Operation Management, sustainable development

Course Description:
This course introduces students to the principles, concepts, and applications of Appropriate Technology in engineering. It explores sustainable and contextually appropriate solutions for addressing the needs of underserved communities, emphasizing resource efficiency, environmental impact, and social inclusivity.

Course Learning Objectives:

1. Understand the principles and philosophies of Appropriate Technology.
2. Explore the role of engineering in sustainable development and social equity.
3. Develop critical thinking and problem-solving skills to design context-specific engineering solutions.
4. Analyze the environmental, social, and economic implications of implementing Appropriate Technology.
5. Familiarize with case studies and real-world examples of successful Appropriate Technology projects.

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand the Concept of Appropriate Technology, comprehensive understanding of the concept, principles, and philosophies of Appropriate Technology.	2	Understand
CO2	Critically reflect on the ethical, cultural, and social implications of technology interventions.	2	Understand
CO3	Able to critically analyze and evaluate various technological solutions within the context of Appropriate Technology, considering their environmental, social, and economic implications through case studies.	3	Analyze
CO4	Design context-specific engineering solutions that align with the principles of Appropriate Technology by studying case studies.	6	Design

Assessments:
Teacher Assessment:

- Two components of In Semester Evaluation (ISE), one Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

- ISE 1 and ISE 2 are based on Report Writing, Presentation, Site Visit Report, etc.

• MSE: Assessment is based on 50% of course content (Normally first three modules) • ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.	
Course Contents:	
Unit: 1 Development and Society	
Knowledge and action, Scientific method, Ethical problems, Societal goals, Changes in societal forms, Development, World-National-Sate level statistics on inequality, unemployment, migration and pollution	**7 Hrs.**
Unit: 2 Introduction to Appropriate Technology	
Definitions of technology, Systemic views of Technology-Society relationships Definition, principles, and philosophies of Appropriate Technology Historical and cultural context of Appropriate Technology Comparison with conventional technology and its limitations	**7 Hrs.**
Unit: 3 Needs Assessment and Stakeholder Engagement	
Understanding the needs and aspirations of target communities Participatory approaches and community engagement Identifying stakeholders and building collaborative partnerships	**8 Hrs.**
Unit: 4 Design Principles for Appropriate Technology	
Design thinking and human-centered design approaches Materials selection and utilization of local resources Design for affordability, maintainability, and scalability	**8 Hrs.**
Unit: 5 : Alternative frameworks for conscious linking Choice of Technology	
Intermediate/ Appropriate Technology, Scanning spectrum of technology alternatives, Analytical hierarchy process (AHP) for ranking alternatives, case studies on AHP	**7 Hrs.**
Unit: 6 : Influence of development perspectives on rankings Case Studies	
Illustration of Technology Innovation-chain through conception-generation-transfer-use stages in the form of case studies in several sectors such as domestic, agricultural, energy, transport etc.	**8 Hrs.**
Recommended Textbooks: 1. "Appropriate Technology: Tools, Choices, and Implications" by K.V. Nagarajan 2. "Appropriate Technology for Water Supply and Sanitation: A Handbook for Water Utilities, Engineers, and Development Practitioners" by Sean Furey 3. "The Barefoot Architect: A Handbook for Green Building" by Johan van Lengen 4. "Appropriate Technology: Technology with a Human Face" by Michael Hobbs 5. "Appropriate Technology: Science and Tools" by David Shearman and Joseph Wayne Smith	
References Books: 1. "Small is Beautiful: Economics as if People Mattered" by E.F. Schumacher 2. "Appropriate Technology: Problems and Promises" by Chris Wood 3. "The Human-Powered Home: Choosing Muscles Over Motors" by Tamara Dean 4. "Appropriate Technology in Rural Development: A Manual for Workers" by David Clements 5. "Appropriate Technology and Social Values: A Critical Appraisal" edited by Simon Bell and Stephen Morse	

Title of the Course:	**SIX SIGMA**	**L**	**T**	**P**	**Credit**
Course Code:	**UILOE0631**	**3**	**-**	**-**	**3**

Course Pre-Requisite:

Course Description: Six-Sigma will focus on detailed strategic and operational issues of process improvement and variation reduction. Six-sigma is a measure of quality that strives for near perfection. It is a disciplined, data-driven approach for eliminating defects (driving towards six standard deviations between the mean and the nearest specification limit) in any process-from manufacturing to transactional and from product to service.

Course Objectives:

1) Identify project selection and evaluation criteria.
2) Plan and execute six sigma projects
3) Form and effectively lead a six-sigma project team.
4) Apply DMAIC (Define, Measure, Analyze, Improve, and Control) and various six sigma tools in process and quality improvement.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	**Bloom's Cognitive level**	**Descriptor**
CO1	Explain advantages and challenges of the Six Sigma methodology.	Cognitive (Understanding) L2	
CO2	Identify proper tools to address and to lead on production issues in their organisations.	Cognitive (Applying) L3	
CO3	Describe the methodologies of various tools of six sigma methodology.	Cognitive (Analyzing) L4	
CO4	Analyse problem solving skills that can be immediately applied in real world projects.	Cognitive (Analyzing) L4	

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), one Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

- ISE 1 and ISE 2 are based on assignment / declared test / quiz / seminar / Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three modules)
- ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: QUALITY, DEFINE Quality Management: Basics and Key Concepts, Fundamentals of Total Quality Management, Cost of quality, Quality concepts and definition, History of continuous improvement, Voice of customer, Quality Function Deployment (QFD), Management and Planning Tools, Six Sigma Project Identification, Selection and Definition, Project Charter and Monitoring, Process characteristics and analysis, Process Mapping: SIPOC	7 **Hrs.**

Unit 2: MEASURE Data Collection and Summarization, Process capability concepts & analysis, Measures and Indices, Non-normal process capability analysis	6 **Hrs.**
Unit 3: ANALYZE Hypothesis testing: Fundamentals, Hypothesis Testing Correlation and Regression Analysis, Regression Analysis: Model Validation, ANOVA (eg One-Way ANOVA), Failure Mode Effect Analysis (FMEA)	8 **Hrs.**
Unit 4: **IMPROVE** Introduction to Design of Experiment, Randomized Block Design, Factorial Design, Fractional Factorial Design, Taguchi Method, Illustrative Application	**8 Hrs.**
Unit 5: **CONTROL** Acceptance Sampling: Key Concepts, Seven QC Tools, Statistical Process Control: Key Concepts, Control Charts for Variables, Operating Characteristic (OC) Curve for Variable Control charts, Control Charts for Attributes, Minitab Application	8 **Hrs**
Unit 6: **SIX SIGMA IMPLEMENTATION CHALLENGES** Six Sigma Project Identification, Selection and Definition, Process Mapping: SIPOC, Design for Six Sigma (DFSS), Case study	7 **Hrs.**

Textbooks:

1. Roderick A. Munro and Govindarajan Ramu and Daniel J. Zrymiak, The certified six sigma Green Belt Handbook, ASQ Quality Press and Infotech Standards India Pvt. Ltd.
2. T. M. Kubiak and Donald W. Benbow, The Certified Six Sigma Black Belt Handbook, Pearson Publication.
3. Forrest W. Breyfogle III, Implementing Six Sigma, John Wiley & Sons, INC.
4. Evans, J R and W M Lindsay, An Introduction to Six Sigma and Process Improvement, CENGAGE Learning.
5. Howard S. Gitlow and David M. Levine, Six Sigma for Green Belts and Champions, Pearson Education, Inc.
6. Montgomery, D C. Design and Analysis of Experiments, Wiley.
7. Mitra, Amitava. Fundamentals of Quality Control and Improvement, Wiley India Pvt Ltd.
8. Montgomery, D C. Statistical Quality Control: A modern introduction, Wiley.

Reference Books:

1. Joseph M. Juran and A. Blanton Godfrey, Juran's Quality Handbook- The Complete Guide to Performance Excellence
2. Dr. Genichi Taguchi, Dr. Subir Chowdhury , Taguchi's Quality Engineering Handbook, Wiley Online