



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject code: 3150004

Subject Name: Contributor Personality Development Program

Semester V

Type of course: Work-Personality Development

Rationale: The Contributor Program aims to accomplish the following outcomes in the lives of students–

- Improve the employability of students by giving them the right work ethic and thinking that employers are looking for.
- Build their confidence with which they can go into any job and contribute meaningfully.
- Improve their ability to engage better in the workplace and to be able to handle the challenges that come up there.
- Build their career-worthiness and help them develop into future-ready contributors with ability to navigate a career in a volatile, changing world.
- Widen their choices of career and success, so that they are able to open up more opportunities for themselves and take up unconventional career pathways.
- Enable them to recognize how they, as technical professionals, can participate and make a positive contribution to their communities and to their state.

Towards this goal, the Contributor Program has been designed to awaken and strengthen students from within, in terms of building positive self-esteem, increasing their confidence level and I-can attitude, improving their aspirations, giving them new methods of thinking, building their cognitive capacities, exposing them to the skills and practices associated with being contributors in the workplace (not mere employees).

The Program content is also designed to expose students to real-world workplace scenarios and sensitize them to some of the challenges faced in society around them, especially in the local communities around them and in their own state of Gujarat.

The Contributor Program syllabus has been evolved and fine-tuned over several years, (a) to address the changing need and contemporary challenges being faced by industry and what employers of today are looking for in the people they hire and (b) by working extensively with universities and students building an appreciation of their challenges and concerns. At the core, the program is guided by the higher ideas and principles of practical Vedanta in work.

Teaching and Examination Scheme per semester:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	0	2	70	30	30	20	150

Note:

- Weekly 2 hours of Classroom facilitated sessions are planned which include Solutioning and Self-discovery sessions.



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- In addition, there will be individual/ team projects as part of Practicals. Students can do this on their own, with faculty as guide.

Note:

It is the responsibility of the institute heads that marks for PA of theory & ESE and PA of practical for each student are entered online into the GTU Portal at the end of each semester within the dates specified by GTU.

Content:

Sr. No.	Content	Total Hrs
1	The Contributor Work Ideal <i>In this topic, students explore what is their “ideal” of work - is the ideal to be a “worker” or to be a “contributor”? For example, an employee who has the ideal of a “worker” goes to work to pass time, earn a living, get benefits; in contrast to an employee with the ideal of a “contributor” who wants to make a difference, get things done well, create value for the company. This enables students to transform their expectation of themselves in work</i>	1.5 hrs Classroom engagement (including self-discovery/ solutioning sessions)
2	Identity & Self-esteem <i>In this topic, students engage with the question “who am I?” or on what basis do they define themselves. Is their identity defined by what others think of them (extrinsic self-esteem) or by what they think of themselves (intrinsic self-esteem)? Further, they discover positive identities that lead to intrinsic self-esteem, such as an I-can identity based on one’s capacity and inner strength. This enables them to build confidence and self-esteem.</i>	Same as above
3	Become a Creator of one’s destiny <i>In a “victim stance”, we see the career environment as full of difficulties and hurdles. We feel powerless or blame our circumstances for not having many opportunities. This makes us fearful of uncertainty and makes us settle for jobs where we remain mediocre. In this topic, students discover the “creator of destiny stance” to challenges and situations. This stance frees them to try out new things, open up new possibilities, take on responsibility, see the opportunity hidden in their environment.</i>	Same as above
4	Achieving Sustainable Success <i>In this topic, students discover how to achieve sustainable or lasting success, by building one’s “engine of success”, making them successful. Where their focus shifts to building one’s “engine of success” rather than being on chasing the “fruits of success”. This is important,</i>	Same as above



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	<i>because over a lifetime of work, all people go through ups and downs – where the fruits are not in their control. People who are focused on the fruits of success, fall prey to disappointment, loss in motivation, quitting too early, trying to find shortcuts – when fruits don't come. Whereas people focused on building their engine of success continue to contribute steadily, irrespective of whether fruits come or not. And with a strong engine of success, fruits come to them in time.</i>	
5	Career Development Models <i>In this topic, students explore a range of diverse “career development models” and the possibilities for contribution each opens up to them (e.g. start-up career model, change-maker career model, etc.). This opens their mind to different and even unconventional career models possible, beyond the usual (such as “stable large company career model” where one gets an engineering degree, then MBA, then get a job in a large company). This frees them from a herd mentality when making career choices.</i>	Same as above
6	Expanding contribution in every role <i>In this topic, students explore the many roles they can play in their life & discover the power they have to expand the contribution possible in any role. (E.g. role of student, role of manager, role of a project site engineer). So, the potential of a role is in the individual's hands. This opens their mind to an alternative way of career growth.</i>	Same as above

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (for B.Pharma)					
R Level	U Level	A Level	N Level	E Level	C Level
-	15	20	-	25	20

Distribution of Theory Marks (for B.E., Diploma, MCA)					
R Level	U Level	A Level	N Level	E Level	C Level
-	15	15	-	20	20

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference resources:

A. Basic reference for both students and teachers

- Contributor Personality Program textbook cum workbook developed by Illumine



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2. Web-based ActivGuide™ for self-exploration of rich media resources to vividly understand many of the ideas, watch role models, learn from industry people, get reference readings – that help them enrich the understanding they gained in the class published by Illumine Foundation

B. Advanced reference for teachers

1. On Contributors, Srinivas V.; Illumine Ideas, 2011
2. Enlightened Citizenship and Democracy; Swami Ranganathananda, Bharatiya Vidya Bhavan, 1989
3. Eternal Values for a Changing Society – Vol I-IV, Swami Ranganathananda; Bharatiya Vidya Bhavan
4. Karma Yoga, Swami Vivekananda; Advaita Ashrama
5. Vivekananda: His Call to the Nation, Swami Vivekananda; Advaita Ashrama
6. Six Pillars of Self Esteem, Nathaniel Branden; Bantam, 1995
7. Mindset: The New Psychology of Success, Carol S. Dweck; Random House Publishing Group, 2007
8. Lasting Contribution: How to Think, Plan, and Act to Accomplish Meaningful Work, Tad Waddington; Agate Publishing, 2007
9. Why not?: how to use everyday ingenuity to solve problems big and small, Barry Nalebuff, Ian Ayres; Harvard Business School Press, 2003
10. The value mindset: returning to the first principles of capitalist enterprise (Ch 8 & 9); Erik Stern, Mike Hutchinson; John Wiley and Sons, 2004
11. The Power of Full Engagement: Managing Energy, Not Time, is the Key to High Performance and Personal Renewal, Jim Loehr, Tony Schwartz; Simon and Schuster, 2003
12. Creating Shared Value, Michael E. Porter and Mark R. Kramer; Harvard Business Review; Jan/Feb2011, Vol. 89 Issue 1/2
13. The Speed of Trust: The One Thing That Changes Everything, Stephen M. R. Covey, Rebecca R. Merrill, Stephen R. Covey; Free Press, 2008
14. The Courage to Meet the Demands of Reality, Henry Cloud; HarperCollins, 2009
15. Responsibility at work: how leading professionals act (or don't act) responsibly, Howard Gardner; John Wiley & Sons, 2007

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
Outcome of theory sessions		
CO-1	Students will be able to recognize & appreciate two alternative ideals of work – ideal of a “worker” and ideal of a “contributor”. And why organizations of today expect people they employ to be contributors and not just workers.	10-12%
CO-2	Students will be able to recognize & appreciate alternative ways in which they could define themselves or “who am I” (their identity) – and which are positive identities that will lead to building intrinsic self-esteem and confidence in oneself; in contrast to identities that will lead to extrinsic self-esteem that makes them	10-12%



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	more dependent on their environment.	
CO-3	Students will be able to recognize & appreciate a “victim” stance as distinct from a “creator of destiny” stance in the way people approach challenges and situations; and how the latter frees individuals to take on challenges and open up opportunities.	10-12%
CO-4	Students will be able to differentiate between two alternative approaches to success - ‘building one’s engine of success’ and ‘chasing the fruits of success’; they also appreciate the payoffs/ consequences of both and which is more likely to lead to sustainable or lasting success in the long run.	10-12%
CO-5	Students will be able to recognize & appreciate different career models and their value; to help them make more informed career-related choices.	10-12%
CO-6	Students will be able to recognize & appreciate how one can expand the contribution possible in any role, thereby opening up an alternative way of career growth to them.	10-12%
Outcome of practical sessions		
CO-7	Students learn to re-interpret their life and college experiences to showcase their contribution affinities which are relevant for employers.	15%
CO-8	Students learn to apply contributor thinking to real-world or career relevant challenges.	15%



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Bachelor of Engineering

Subject Code: 3150005

Semester – V

Subject Name: INTEGRATED PERSONALITY DEVELOPMENT COURSE

Type of Course –

Value-based holistic personality development course for university students.

Rationale -

This course aims to help a person understand and know his / her purpose in life, get a positive thought pattern, gain confidence, improve behaviour, learn better communication and develop a healthy physique with morality and ethics in its core.

Today youth lack the guidance to face insecurity about their health and career, premature relationships and family breakdown, addictions and substance abuse, negative impact of internet and social media etc. This course includes such topics that will cover all aspects and provide solution to the current challenges through creative and interactive activities.

This course will allow students to enjoy, understand and practice invaluable lessons preparing them for a successful future.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
2	0	0	2	70	30	30	20	150

Content:

Lecture No.	Content	Hours
IPDC-1 (Semester-1)		
1	Remaking Yourself - Restructuring Yourself	2
2	Remaking Yourself - Power of Habit	2
3	Learning from Legends - Tendulkar & Tata	2
4	Mass Management - Project Management	2
5	From House to Home - Affectionate Relationships	2
6	Facing Failures - Factors Affecting Failures	2
7	Facing Failures - Failures are not Always Bad	2



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8	Remaking Yourself - Being Addiction-Free	2
9	Soft Skills - Teamwork & Harmony	2
10	Remaking Yourself - Handling the Devil - Social Media	2
11	From House to Home - Forgive & Forget	2
12	From House to Home - Listening & Understanding	2
13	Financial Wisdom - Basics of Financial Planning	2
14	Soft Skills - Networking - Decision Making - Leadership	2
15	Review Lecture - Student Voice-1	2

BASIC STUDY MATERIAL / MAIN COURSE WORK-BOOK -

1. IPDC Workbook-I
2. IPDC Workbook-II

IPDC REFERENCES –

- *These are the reference material for each lectures of IPDC.*

Module No.	Module/ Course Topics	Lectures	References
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1	Facing Failures	Factors Affecting Failures Failures are not Always Bad Insignificance of Failures Power of Faith Practicing Faith	<ol style="list-style-type: none">1. Thomas Edison's factory burns down, New York Times Archives, Page 1, 10/12/19142. Lincoln Financial Foundation, Abraham Lincoln's "Failures": Critiques, Forgotten Books, 20173. J.K. Rowling Harvard Commencement Speech Harvard University Commencement, 20084. Born Again on the Mountain: A Story of Losing Everything and Finding It Back, Arunima Sinha, Penguin, 20145. Failing Forward: Turning Mistakes Into Stepping Stones for Success, John C. Maxwell, Thomas Nelson, 20076. Steve Jobs: The Exclusive Biography Paperback, Walter Isaacson, Abacus, 2015
2	Learning from Legends	Tendulkar & Tata Leading Without Leading	<ol style="list-style-type: none">1. Chase Your Dreams: My Autobiography, Sachin Tendulkar, Hachette India, 20172. Playing It My Way: My Autobiography, Sachin Tendulkar, Hodder & Stoughton, 20143. The Wit and Wisdom of Ratan Tata, Ratan Tata, Hay House, 20184. The Tata Group: From Torchbearers to Trailblazers, Shashank Shah, Penguin Portfolio, 20185. The Leader Who Had No Title, Robin Sharma, Jaico Publishing House, 20106. In the Joy of Others: A Life Sketch of Pramukh Swami Maharaj, Mohanlal Patel and BAPS Sadhus, Swaminarayan Aksharpath, 2013
3	Mass Management	Project Management	<ol style="list-style-type: none">1. Project Management Absolute Beginner's Guide, Gregory Horine, Que Publishing, 20172. The Fast Forward MBA in Project Management, Eric Verzuh, Wiley, 20113. Guide to Project Management: Getting it right and achieving lasting benefit, Paul Roberts, Wiley, 2013



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4	My India My Pride	Glorious Past - Part 1 Glorious Past - Part 2 Present Scenario An Ideal Citizen - 1 An Ideal Citizen - 2 An Ideal Citizen - 3	<ol style="list-style-type: none">1. Hidden Horizons, Dr. David Frawley and Dr. Navaratna S. Rajaram, 20062. Rishis, Mystics and Heroes of India, Sadhu Mukundcharandas, Swaminarayan Aksharpath, 20113. Physics in Ancient India, Narayan Dongre, Shankar Nene, National Book Trust, 20164. The Rise of Civilization in India and Pakistan, Raymond Allchin, Bridget Allchin, Cambridge University Press, 19825. The Āryabhaṭīya of Āryabhaṭa: An Ancient Indian Work on Mathematics and Astronomy (1930), Walter Eugene Clark, University of Chicago Press, reprint, Kessinger Publishing, 2006
5	Remaking Yourself	Restructuring Yourself Power of Habit Being Addiction-Free Begin with the End in Mind Handling the Devil – Social Media	<ol style="list-style-type: none">1. Power of Habit, Charles Duhigg, Random House Trade Paperbacks, 20142. Change Your Habit, Change Your Life, Tom Corley, North Loop Books, 20163. The Seven Habits of Highly Effective People, Stephen Covey, Simon & Schuster, 20134. Seven Habits of Highly Effective Teens, Sean Covey, Simon & Schuster, 20125. Atomic Habits, James Clear, Random House, 20186. How a handful of tech companies control billions of minds every day, Tristan Harris, TED Talk, 2017
6	Financial Wisdom	Basics of Financial Planning Financial Planning Process	<ol style="list-style-type: none">1. Rich Dad Poor Dad, Robert Kiyosaki, Plata Publishing, 20172. The Warren Buffett Way, Robert Hagstrom, Wiley, 20133. The Intelligent Investor, Benjamin Graham, Harper Business, 20064. Yogic Wealth: The Wealth That Gives Bliss, Gaurav Mashruwala, TV18 Broadcast Ltd, 2016
7	From House to Home	Affectionate Relationships Forgive & Forget Listening & Understanding Bonding the Family	<ol style="list-style-type: none">1. “What Makes a Good Life? Lessons from the Longest Study on Happiness”, R. Waldinger, Ted Talks, 20152. Long Walk To Freedom, Nelson Mandela, Back Bay Books, 19953. Outliers, Malcolm Gladwell, Back Bay Books, 2011



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8	Soft Skills	Teamwork & Harmony Networking - Decision Making - Leadership	<ol style="list-style-type: none">1. The 17 Indisputable Laws of Teamwork, John Maxwell, HarperCollins, 20132. Team of Teams: New Rules of Engagement for a Complex World, Stanley McChrystal, Portfolio, 20153. Predictably Irrational, Revised and Expanded Edition: The Hidden Forces That Shape Our Decisions, Harper Perennial, Dan Ariely, 2010
9	Review	Student Voice – 1 Student Voice – 2 Words of Wim	

Course Outcomes:

- To provide students with a holistic education – focused on increasing their intelligence quotient, physical quotient, emotional quotient and spiritual quotient.
- To provide students with hard and soft skills, making them more marketable when entering the workforce.
- To educate students on their social responsibilities as citizens of India and have a greater sense of social responsibility.
- To provide students with a value-based education which will enable them to be successful in their family, professional, and social relationships by improving their moral and ethical values.
- To teach self-analysis and self-improvement exercises to enhance the potential of the participants.
- To have a broader sense of self-confidence and a defined identity.



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Civil and Infrastructure Engineering

Subject Code: 3154006

Semester – V

Subject Name: Health and Safety Management

Type of course: Humanities and Social Science

Prerequisite: NIL

Rationale: Rapid growth in infrastructure and more and more investments for industrial establishments there is a need for every employee to have the basic understanding of Health and Safety Management including the occupational health and safety issues involved in a business environment.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Hrs
1	Overview of Health & Safety Management System	3
2	International Health and Safety Policies/Standards: OSHA, ISO 45001	8
3	Hazard & Risk assessments: Key hazard identification techniques such as HIS, HAZID, HAZOP and FMECA, LOPA etc.	8
4	Occupational Health & Safety Hazards: Introduction, Socio-economic aspects of occupational health and safety, Workplace Health and Safety, Major occupational health & safety hazards, Control Measures, PPE, Occupational Hygiene, First Aid, Health Screening Measures, Occupational health and safety legislations in India.	10
5	Industrial Safety & Management: Classification of Industrial hazards: Fire hazards & Control measures, Electrical hazards & control measure, Industry specific safety hazards: Construction & Chemical Industries, Case studies	8
6	Emergency Planning, Incident reporting and investigation, Safety Management & Communication	5
	Total	42



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Subject Code: 3154006

Course Outcomes: After successful completion of the course the students shall be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Understand the process involved in health and safety management systems for an organization including concepts and techniques of identifying	30 %
CO-2	Know the important provisions of Health and Safety Policies and regulations commonly practiced at Workplaces	30 %
CO-3	Identify occupational and industrial health & safety hazards. Also, comprehend their incident reporting.	40 %

Learning Outcome:

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
40	40	20	00	00	00

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Holt A & Andrews H. (1998), The Principles of Safety and Health at Work, IOSH Services Ltd
2. Hughes P and Ferrett E (2009), Introduction to Health & Safety at Work, NEBOSH
3. Stranks J. (2000), The Handbook of Health and Safety Practice, Financial Times Management
4. Charles D. Reese (2003), Occupational Health and Safety Management: A Practical Approach by CRC.
5. Handbook on Construction Safety Practices-2001 (SP 70 from BIS)

Websites for all relevant Regulations, case studies, and other information:

1. www.hse.gov.uk/
2. www.osha.gov/



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Civil and Infrastructure Engineering

Subject Code: 3154007

Semester – V

Subject Name: Geotechnical Engineering

Type of course: Core Subject

Prerequisite: Mechanics of Solids and Fluid mechanics

Rationale:

Geotechnical Engineering is a fundamental subject consisting of determination of various soil parameters theoretically and experimentally based on laws of mechanics and hydraulics. It also deals with the application of strength parameters and stress states in slope stability analysis and earth retaining structures.

The objective of this course is to provide the basic understanding of geotechnical engineering to students. Some of the important topics that students will learn during the course are: grain size distribution; identification and classification of soils for engineering purposes; physical and engineering properties of soils; fundamental behaviour of soils subjected to various forces; groundwater and seepage through soils; compaction; consolidation; shear strength.

Students will get acquainted with several geotechnical problems and documentation of geotechnical observations. Upon successful completion of the course, students should be able to apply the fundamentals of soil mechanics and principles of geotechnical engineering in the analysis, design, and construction of civil engineering projects.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Hours
1	Properties of soil Origin of soil and soil formation, three-phase soil system, particle size and shape, weight volume relationships, index properties of soil, I.S. classification of soil, unified classification of soils, plasticity chart.	10
2	Permeability and Seepage Determination of coefficient of permeability, laboratory method: constant head method, falling head method, permeability of stratified soils, seepage analysis, characteristics of flow nets, graphical method to plot flow nets.	6



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3	Stress distribution and Compaction Boussinesq's and Westergaard's theory and its applications for different loads, Newmark's chart, its preparation and uses. Theory of compaction, laboratory (Proctor test) determination of optimum moisture content and maximum dry density, compaction in the field	6
4	Consolidation of soil Theory of consolidation, initial primary consolidation, spring analogy for primary consolidation test results. Terzaghi's theory of consolidation, consolidation settlement: one-dimensional consolidation.	6
5	Shear strength of soil Mohr's circle, Mohr-coulomb theory, types of shear test: direct shear test, merits and demerits of the direct shear test, tri-axial compression tests, and behavior of soil under different drainage conditions, unconfined compression test, vane shear test.	8
6	Earth pressure theories and Applications Different earth pressures, Rankine's and Coulomb's earth pressure theories, different factors of safety, types of slope failure, various methods to determine slope stability, Introduction of bearing capacity theories.	12

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	30	30	10	10	00

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

Course Outcomes:

At the end of the course students will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Understand various index and engineering properties of soil, its determination through various methodology	30
CO-2	Analyse compaction intensity, shear strength, consolidation, earth pressure, stress distribution	30
CO-3	Perform experiments of a variety of soils to judge the soil parameters	30



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	and its behaviour under various loading conditions	
CO-4	Estimate slope stability for civil engineering applications like railways, highway and earth dams	10

List of Experiments:

- Determination of field Moisture Content and density
- Determination of Specific Gravity
- Grain Size Analysis
- Determination of Consistency Limits
- Density/Relative Density Index
- Permeability Test
- Proctor Test
- Vane Shear Test
- Direct Shear Test
- Unconfined Compression Test
- Consolidation Test

Major Equipment:

- Casagrande's apparatus
- Consolidometer
- Direct shear test
- Direct shear test
- Permeameter
- Proctor mould
- Sieve set and sieve shaker
- Unconfined compression strength apparatus

Open-Ended Problems: Each group of students has to undertake one open-ended problem using sub-soil profile of their local city. Few examples of the same are given below: 1. Development of spreadsheets/computer programmes for the determination of shear parameters using the Mohr's circle. 2. Powerpoint presentation on any one of the above topic supported with one field application/case study.

List of Open Source Software/learning website:

<https://nptel.ac.in/courses/105/103/105103097/>

<https://nptel.ac.in/courses/105105168/>

<https://nptel.ac.in/courses/105101084/>

<https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-361-advanced-soil-mechanics-fall-2004/lecture-notes/>



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Bachelor of Civil and Infrastructure Engineering

Subject Code: 3154008

Semester – V

Subject Name: Highway and Traffic Engineering

Type of course: Professional Core Course

Prerequisite: Nil

Rationale: For the overall development of any country, road transportation plays an important role. Efficient road network is necessary for safe, economic and timely conveyance of passengers and freight. The study of this subject enables to impart knowledge to the civil engineering students about highway planning; it's geometric and structural design, methods of construction, quality control, traffic parameters, traffic control, accident causes and remedies, maintenance and economy.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Introduction Scope of transportation engineering, Historical development of transport in India – 20 year Road Plans, National Transportation Policy Recommendations, IRC, CRRI, Vision 2021, NHDP, and PMGSY. Classification of rural and urban roads, Road patterns, Planning and alignment surveys. Characteristics of different modes of transport and their integrations and interactions.	4
2	Geometric design Cross sectional elements – Carriageway, Right of Way, Camber, Building and Control line, Surface and subsurface drainage, Sight distance Elements - SSD, OSD, ISD, HSD, Design of horizontal alignment - curves, super-elevation, Extra widening, Design of Vertical Alignment: Gradients, summit and valley curves- Design based on comfort criteria and sight distance criteria	8
3	Highway materials Subgrade soil, aggregates, binder materials, bituminous materials, bituminous paving mixes: WBM, DBM, BC, SDBC, Marshall Method of Mix Design cement and cement concrete - their engineering and physical properties, basic tests. IRC and MORTH requirements.	4



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4	Pavement Analysis, Design and Maintenance Pavement design factors, Design of flexible (GI, IRC and CBR method) and rigid pavements (fatigue concept), Construction of earthen, Gravel, WBM, Bituminous, Cement concrete, RCC and Pre-stressed concrete roads, Soil stabilized roads. IRC and MORTH procedural requirements. Pavement failures, Maintenance, Surface and sub-surface drainage, Hill roads - alignment, construction, drainage and maintenance. Road side development - arboriculture, street lighting. Highway administration, economics and finance, road safety audit. IRC and MORTH requirements.	11
5	Traffic Engineering and ITS Traffic engineering: basic elements, road users - vehicles - traffic flow characteristics, speed-volume studies, travel-time studies, origin and destination studies, Traffic Stream Models: Greenshield's model, Greenberg's logarithmic model, Underwood's exponential model, parking studies, Accident studies: collision and condition diagrams, preventive measures, Concept of Capacity and Level of Service, Traffic control: markings, signs, signals, intersections, rotaries, Design of Signalized Intersections, need of coordination of signals, pedestrian actuated signals. IRC requirements. Indo-HCM analysis. Intelligent Transport System (ITS): Components of ITS, Working principles, Applications of ITS, Adaptive traffic signals.	15
		42

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	30	20	15	15	00

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:



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1. L.R. Kadiyali, "Highway Engineering", Khanna Publishers, New Delhi.
2. L.R. Kadiyali, "Traffic Engineering and Transport Planning," Khanna Publishers, New Delhi.
3. Dr. S.K. Khanna and Dr. C.E. G. Justo, "Highway Engineering", Nem Chand & Bros., Roorkee.
4. S.K. Sharma, "Principles, Practice and Design of Highway Engineering", S. Chand & Co., New Delhi.
5. IRC - 37 "Guidelines for Design of flexible Pavements", IRC, New Delhi, 2001.
6. IRC - 67 "Code of Practice for Road Signs", IRC, New Delhi - 2001.
7. IRC: 58, 2002: "Guidelines for the Design of Plain Jointed Rigid Pavements for Highways", IRC, N. Delhi, December, 2002.
8. Dr. Hariharan K. V. (Author), Container & Multimodal Transport Management, Shroff Publishers
9. Slim Hammadi, Mekki Ksouri, Multimodal Transport Systems, Wiley-ISTE

Course Outcomes:

After learning the course the students should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Know about highway planning, its classification and geometric design	25
CO-2	Perform laboratory tests on highway materials like aggregates and bituminous materials	15
CO-3	Accomplish the preliminary design of flexible and rigid pavement and know about pavement failures, its maintenance, importance of drainage, hill roads and their challenges	25
CO-4	Carry out survey of classified traffic volume count and spot speed study on highway and know about importance and working of different traffic control devices.	35

List of Experiments:

- Introduction to Highway Engineering Laboratory Equipment.
- California Bearing Ratio (CBR) Test.
- Aggregate crushing Test
- Aggregate Impact Test.
- Flakiness Index and Elongation Index Test for Aggregate.
- Los Angeles Abrasion Test / Deval Abrasion Test
- Marshall Stability test on Bitumen mix.
- Specific gravity and Water Absorption test for Aggregate.
- Penetration test for Bitumen.
- Softening point test for Bitumen.
- Ductility test for Bitumen.
- Flash and Fire Point test for Bitumen.



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- Specific gravity test for Bitumen
- Viscosity Test for Bitumen.
- Classified traffic volume count on mid-block of link
- Spot-speed survey
- Classified traffic volume count on intersection

Major Equipment:

- CBR testing machine
- Los-Angeles abrasion testing machine
- Aggregate Impact testing machine
- Marshall stability testing machine
- Bituminous material's ductility testing machine
- Standard penetrometer for bituminous materials

List of Open Source Software/learning website:

www.nptel.iitm.ac.in/courses/

GTUQuestionPapers.com



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Civil and Infrastructure Engineering

Subject Code: 3154009

Semester – V

Subject Name: Green Chemistry and Environmental Technology

Type of course: Professional Elective Course

Prerequisite: Study of Environmental Science and Environmental Sustainability.

Rationale: Civil and Infrastructure engineers have a major role in planning, designing, building, and ensuring a sustainable prospect by providing the connection between science and society. It needs a holistic approach to understand multiple dimensions with ecologist, economists, and sociologists as well as latest sustainable technologies to meet the needs of sustainable future.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	<p>Principles and Concepts of Green Chemistry - Green chemistry –Definition –Principles of Green Chemistry, Importance and limitations, Atom Economy</p> <p>Waste Management and Green Chemistry Waste: sources of waste production, problems and prevention, Management of construction wastes. Waste minimization technique, Waste treatment and recycling,</p> <p>Water and sanitation: Water: Waste water, toxicity, Treatment Processes –Sedimentation -Coagulation and Flocculation -Activated Sludge -Sand Filters -Membrane Separation, advanced oxidation process, adsorption. Sewage treatment process.</p>	12
2	<p>Application of Green Chemistry in Agriculture and Energy</p> <p>Agriculture: Agro production processing, organic farming systems – sustainable organic manure, bio-fertilizer. Post-harvest technologies. Energy: Various green technologies available for energy production, Energy from biomass and solid waste, Biofuels, hydrogen production technology, biofuels from Jatropa</p>	7



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3	Environmental Technologies for Sustainable Cities and Communities- Role of green chemistry in sustainable building- material, Health and safety. Indoor Air quality, The Energy Conservation Building Code (ECBC), Concepts of Green Hotels and Hospitals, Green Technologies for Transport, Green Roads, Industries, 'Green' Infrastructure for Municipal Services and Ecological Sanitation. Utility of Solar energy in buildings- concepts of Solar Passive Cooling and Heating of Buildings. Water Utilization in Buildings.	10
4	Combat Climate Change Air Pollution Control Methods, Steps taken to control Carbon emissions universally, The general approach in planning for the future, Developing mitigative measures for global reduction of Carbon, India's National Action Plan on Climate Change (NAPCC) till date, National Mission for a Green India.	7
5	Circular Economy Concept, Principles, significance and few applications of circular economy, Difference between Cradle to Cradle and Cradle to Grave approach, Concept of sustainable designing in circular economy. Concepts of different R's in designing.	6

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	40	30	00	00	00

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. V. Kumar, "An Introduction to Green Chemistry" Vishal publishing Co. Reprint Edition 2010
2. Green Technologies, Soli J. Arceivala, Mc Graw Hill Education
3. .Green Technologies and Environmental Sustainability edited by Ritu Singh, Sanjeev Kumar 2.
4. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.



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5. K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao. Alternative Building Materials and Technologies. New Age International, 2007.
6. Green Chemistry for Sustainable future in “Fundamentals of Environmental Chemistry ” Stanley F. Manahan (Ed). Lewis Publishers.
7. N. Adger , K. Brown , D. Conway. (Vol. 22). 2012. Global Environmental Change: Understanding the Human Dimensions. The National Academic Press.

Course Outcomes:

At the end of the course students will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Understand the environmental status and evolution	20
CO-2	Apply the knowledge of various analytical green methods	30
CO-3	Develop holistic approach towards different segments of infrastructure with the lens of green chemistry and technology	30
CO-4	Understand the Current approaches of designing and economical approach towards better future	20

List of Experiments:

- Introduction to Equipment in Environmental Engineering Laboratory
- Introduction to Standards, Sampling, Collection and Preservation of samples
- Determination of pH and conductivity for water and wastewater
- Determination of Solids (suspended, dissolved and settleable)
- Determination of Acidity and Alkalinity
- Determination of hardness and residual chlorine
- Determination of fluoride and nitrate
- Ambient air quality measurement using High Volume sampler
- Coliform count

Field Study and Report thereof

- Students are required to visit any green community/industry or other site and prepare a study report thereof. The field study will be evaluated on the basis of report and presentation
- Report on Carbon footprint, Carbon Emissions from a Selected Industry in India

Major Equipment:

- pH meter
- TDS meter



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Bachelor of Civil and Infrastructure Engineering Subject Code: 3154009

- High volume sampler
- Exhaust gas analyser
- Ion selective meter for Fluoride and Chloride estimation
- Autoclave

List of Open Source Software/learning website:

MoEFCC

www.nptel.ac.in,

www.ocw.mit.edu

<https://www.rsc.org>,

<https://www.weforum.org>,

<http://cpcbenvvis.nic.in/greentechnology.html#>

GTUQuestionPapers.com



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Civil and Infrastructure Engineering

Subject Code: 3154010

Semester – V

Subject Name: ADVANCED STRUCTURAL ANALYSIS

Type of course: Professional Elective Course

Prerequisite: Engineering Mathematics, Mechanics of Solids, Fundamental Structural Analysis

Rationale:

The primary objective is to equip the students with fundamental concepts of advanced topics of structural analysis, especially Matrix Methods (force and stiffness) and the Moment Distribution Methods. With this course, a student will be able to:

1. Understand the method of analyzing structural frames using moment distribution methods.
2. Understand the effects of moving loads on indeterminate members and structures.
3. Carry out structural analysis of members and frames based on the matrix methods.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
3	0	2	4	70	30	30	20	150

Sr. No.	Content	Total Hrs
1	Review of concepts of Fundamental Structural Analysis: <ul style="list-style-type: none">• Loading Conditions: Loads and their Effects, Force-Displacement Relationships• Geometrical Conditions: Kinematic Indeterminacy, Rigidity, Stability, Compatibility• Boundary Conditions: Joints, Static Indeterminacy, Equilibrium• Principle of Virtual Work: displacement-based and force-based energy principles; deriving stiffness and flexibility coefficients.• method of consistent deformations; theorem of least work• slope-deflection method; moment distribution method	6
2	Qualitative and Quantitative Influence Lines: Introduction, Influence Lines for Beams, Qualitative Influence Lines, Influence Lines for a series of concentrated loads and UDL, Absolute maximum shear force and bending moment using influence lines	6
3	Moment Distribution Method: Analysis of continuous beams & frames including non-sway and sway conditions, use of symmetry of structure up to two storied / two bay frames.	6



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4	Matrix Analysis of Structures with Axial Members: Introduction: Axial stiffness and flexibility; stiffness matrices for an axial element (two dof), plane truss element (four dof) and space truss element (six dof); One-dimensional axial structures: Analysis by conventional stiffness method (two dof per element) and by flexibility method; Plane trusses: Analysis by conventional stiffness method (four dof per element) and by flexibility method;	8
5	Matrix Analysis of Beams: Conventional stiffness method for beams: Beam element stiffness (four dof); analysis of continuous beam using stiffness matrix for different end conditions; Reduced stiffness method for beams (two dof); Flexibility method for fixed and continuous beams: Force transformation matrix; element flexibility matrix; analysis of single span and continuous beam using flexibility matrix for different end conditions;	16

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	30	20	30	10	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Junarkar S. B. & Shah H. J.; Mechanics of Structures Vol-II; Charotar publishing house, Anand
2. Wang C. K.; Intermediate Structural Analysis; Tata McGraw Hill book Company, New Delhi
3. Gere & Weaver; Matrix Analysis of framed structures, CBS Publications
4. Ryder G.H.; Strength of Materials; Mcmillan
5. Gere & Timoshenko; Mechanics of Materials; CBS Publishers & Distributors, Delhi
6. Hibbler R C; Structural Analysis; Pearson Education
7. Aslam Kassimali, Structural Analysis, Cengage Learning
8. Devdas Menon, Structural Analysis, Alpha Science International Limited

Course Outcomes:

At the end of the program students will be able to



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Sr. No.	CO statement	Marks % weightage
CO-1	Determine different types of structures and suitable method of analysis for specific structure	15
CO-2	Construct the Influence Lines of Beams, Girders and Trusses	15
CO-3	Conduct Sway analysis of Indeterminate frames using Moment Distribution Method	15
CO-4	Analyse Axial and Flexural Members using Matrix Methods	55

Term Work:

The students will have to solve at least five examples and related theory from each topic as an assignment/tutorial. Practical examinations shall consist of oral based on term-work and above course

Tutorials:

Develop software model (using any structural analysis tool) and compare the answer of different outputs with manual method output. Develop small spreadsheets (using MS Excel) based programs for methods of analysis.

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above specifications

Open Source Software/learning website: www.nptel.ac.in



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Civil and Infrastructure Engineering
Subject Code: 3154011

Semester – V
Subject Name: Building and Town Planning

Type of course: Professional Elective Course

Prerequisite: Preliminary knowledge of Building drawing.

Rationale:

After food and clothing, the residential building is the most essential requirement for human being. Its planning, designing and construction are important stages to be considered for safe, economic and elegant structures. Besides the buildings other than residential are also having almost similar considerations. The job of planning, designing and construction is done effectively by Civil Engineers and Architects, by following the guiding standard principles of planning and architecture. It is also necessary to provide healthy, comfortable and pleasant living environment to society by better town planning. Keeping in view these points, this subject is framed to provide knowledge of principles of planning and architecture, building bye-laws and town planning. Moreover, building drawing skill of students may also be enhanced with this subject. State-of-the-art rules and regulations of multi storeyed buildings and public buildings, concept of earth quake resistant buildings, smart cities are also included in this subject.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Building Planning: <ul style="list-style-type: none">• Study of general principles of Planning and Architecture.• Typical Building Byelaws as per National Building Code and General Development Control Regulation.• Planning of residential buildings, Public buildings and Multi- storied structure.	11
2	Preparation of Drawings: <ul style="list-style-type: none">• Perspective views, one point and two point problems, drawings.• Planning of Earthquake resistant buildings considering symmetry, simplicity, continuity, staircase, water tank etc.• Preparing Working Drawings of Residential and Public Buildings. Various types, Scale selection, Material description, Utilities like water supply, drainage lines, rain water harvesting arrangements, gas supply lines, electric and internet installations, air	10



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Bachelor of Civil and Infrastructure Engineering

Subject Code: 3154011

	conditioning, solar panels.	
3	Town & Infrastructure Planning: <ul style="list-style-type: none">• Origin and Growth of towns, Satellite Town, Ribbon development• Definitions of town planning and urban design, levels of planning and steps for preparation of a town plan, survey techniques in planning and urban design, concepts, functions, components and preparation of a development plan.• Elements of City Planning, Circulation, Zoning and land use, Housing, Landscape pattern, Master plan, Town Center, Civic centers, Shopping Center, Town Planning Schemes, CBD.	11
4	Urban area planning: <ul style="list-style-type: none">• Urban Design principles and criteria, Urban Scale and Spaces. Design for the Pedestrians. Waterfront Development. Principles of Urban Conservation. Principles of Streetscape Design. Urban design regulations and control, the comprehensive role of urban design in town planning process.• Slum: definition, Slum improvements.• Introduction to Smart City, its Characteristics as per present scenario.	10

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	30	15	5	20

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

- Building drawing by M.G.Shah, C.M. Kale and S.Y.Patki, Tata Mcgraw Hill, New Delhi
- Building planning, designing and scheduling by Gurcharan Singh, Standard Book House. New Delhi
- Planning and designing building by Y.S. Sane, Allies Book Stall.
- Town Planning by G.K.Hiraskar, Dhanpatrai & Sons Delhi.
- National Building Code-2005 , New Delhi.
- Town Planning by S.C. Rangwala, Charotar Publishing House, Anand.
- General Development Control Regulations published by AUDA and GICEA
- Peter Hall and M.Tewdwr-Jones, Urban and regional planning, Routledge, Fifth Edition, 2010



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- Peter Hall, Urban and regional planning, Routledge, 4th Edition, 2002
- K. V. Sundaram, Urban and regional planning in India, Vikas Pub. House, Fifth Edition, 1977

Course Outcomes: After completion of this subject, students will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Understand principles of building planning and architecture	10
CO-2	Plan different types of residential and public buildings considering building bye-laws	20
CO-3	Derive the plan, elevation, sectional elevation, perspective view of different types of residential and public buildings for given conditions	40
CO-4	Understand concepts, principles, necessity and components of town planning and smart city	30

Term Work:

(A) Four A1 Size Drawing sheet:

- (1) Residential Planning: Two storied Building: Plans, elevation, section, lay-out plan, key plan, site plan, area table, schedule of opening. Scale - 1:100.
- (2) Public Building: Ground Floor plan, typical floor plan, elevation, section, lay-out plan, key plan, site plan, area table, schedule of opening.
- (3) Working Drawing: sheet should accommodate min. six types with sectional details. (Furniture plan, Drainage lay out, Toilet Detail, Wood work detail, Kitchen detail, Electrical plan etc.)
- (4) Perspective Drawing: Two point perspective of sheet -1 planning.

(B) Assignments:

- (1) Assignment -1: Principles of Planning & Architecture
- (2) Assignment -2: Building Bye laws
- (3) Assignment -3: Town Planning

Major Equipment: Nil



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Bachelor of Civil and Infrastructure Engineering
Subject Code: 3154012

Semester – V
Subject Name: Infrastructure Utilities

Type of course: Open Elective Course

Prerequisite: Nil

Rationale: Utilities for Civil Infrastructure is providing conceptual understanding and applications of variety of utilities required for infrastructure projects. With the help of this knowledge students may be able:

1. To impart basic understanding and knowledge on various utility requirements of civil infrastructure.
2. To provide the knowledge on the various utility systems and practices used in civil infrastructure including MEP and IT systems
3. To aware of the methodology involved in costing the utility requirements

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	2	3	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	<p>Electrical Utilities:</p> <p>Electrical System: General overview of electricity demand & supply. Different types of electrical wiring system. AC & DC power supply, power modulator, and open loop and closed loop system, UPS and emergency lighting.</p> <p>Power requirement calculation for typical civil infrastructure: residential building, industrial building, commercial and social infrastructures.</p> <p>Power Distribution Systems for Township: Township power distribution system, substations, underground power distribution, overhead power distribution and electrical maintenance.</p> <p>Power Distribution Systems for Industrial Plant: Internal power distribution system, protection system and safety.</p> <p>Cost Estimate for Electrical System: Elements of Cost Estimation, cost estimate for typical residential building and township.</p> <p>Renewable Energy System for civil infrastructure: Introduction, Classification, Suitability of energy system.</p>	10
2	<p>Mechanical</p> <p>Fire Fighting Systems: Installation requirements, components of Firefighting systems. Basics of Types of systems like Fire extinguishers, Fire hose reels, Fire hydrant systems & Automatic sprinkler systems. Cost Estimation of all firefighting system.</p>	12



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	<p>HVAC (Heating, Ventilation and Air Conditioning): Basics of HVAC, Types of HVAC, Various types of conditioning systems for buildings</p> <p>Ventilation system in building: Mechanical ventilation system in building. Types of Ducts, Duct Profiling.</p> <p>Building Lifts: Various types of lifts, Escalation system. Case study of mall escalator aspects like space design, capacity, material assembly, safety aspects and cost estimation. Safety precautionary Standards for lift and escalator standard.(To be covered in lab)</p>	
3	<p>Water and Waste Water System</p> <p>Water Distribution system: Design of Water Supply, Evaluation of water demand, water supply pressure, scope of water authority for permission for multi-story building, system for boosting water pressure. Pipe and fitting materials, pipe supports and hangers. Plumbing fixtures, appliances and equipment. Fixing and jointing pipes and accessories.</p> <p>Drainage System: Considerations, Classification, Vacuum drainage system, Traps.</p> <p>Sanitary system: Methods of sewage collection, , Sewer section, Sewer joint, Manhole, Flushing tank, catch basin, laying of sewer, appurtenances and its locations, Sanitary fittings, Hydraulic testing of sewer pipe, Robotics application in sewer cleaning.</p>	20

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	30	15	15	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. N. Jenkins, J.B. Ekanayake, G. Strbac, Distributed Generation, IET, Renewable Energy Series, 2010
2. Gilbert M. Masters, Renewable and Efficient Electric Power Systems, Wiley, 2004.
3. J. J. Grainger and W.D. Stevenson Jr., Power System Analysis, Tata McGraw-Hill, (1994)
4. D. P. Kothari and I.J. Nagrath, Modern Power System Analysis, Tata McGraw-Hill, Third Edition, (2003)



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Bachelor of Engineering Subject Code:

5. A. J. Wood and B.F. Wollenberg, Power Generation Operation and Control, Wiley India Edition, Second Edition, (2003)
6. M. A. Pai, Computer Techniques in Power System Analysis, Tata McGraw-Hill, Second Edition, (2006)
7. Frank Harris, Modern construction and ground engineering equipment and methods, Longman Scientific & Technical, 1994.
8. R.J.Dossat, Principles of Refrigeration, Pearson Education (Singapore) Pte. Ltd. , 2008.
9. A. Ameen, Refrigeration and Air Conditioning, Prentice Hall of India Private Limited, New Delhi. 2006
10. Punmia B.C., Jain Ashok kumar, Jain Arun K., “WaterSupply Engineering”, Laxmi Publications(P) Ltd.,1995

Course Outcomes:

After learning the course the students should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Understand various utility requirements (primarily MEP) in civil infrastructure	40
CO-2	Propose suitable utility systems required for infrastructure projects	30
CO-3	Estimate quantity requirements for various items of utility systems	30

List of Open Source Software/learning website:

www.nptel.iitm.ac.in/courses/



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Civil and Infrastructure Engineering

Subject Code: 3154013

Semester – V

Subject Name: Optimisation of Engineering Systems

Type of course: Open Elective

Prerequisite: Mathematics-1 and 2, Numerical and Statistical Methods

Rationale:

The objective of this Open Elective is to enable the students with tools for optimization of systems and processes, for obtaining the best result under given circumstances. At each step in an engineering process (design, construction and/or maintenance) engineers are required to make critical decisions. These decisions must be aimed at either maximizing the benefits or to minimize the efforts. This course imparts understanding of optimization methods for solving different optimization problems. In this course, after discussing about the optimization problem formulation, Linear Programming, Non Linear Programming, Dynamic Programming techniques will be explained in detail along with their applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
1	Introduction and Basic Concepts: Historical Development; Engineering applications of Optimization; Art of Modeling Objective function; Constraints and Constraint surface; Formulation of design problems as mathematical Programming problems Classification of optimization problems Optimization techniques – classical and advanced techniques	8
2	Optimization using Calculus: Stationary points; Functions of single and two variables; Global Optimum Convexity and concavity of functions of one and two variables Optimization of function of one variable and multiple variables; Gradient vectors; Examples Optimization of function of multiple variables subject to equality constraints; Lagrangian function Optimization of function of multiple variables subject to Equality constraints; Hessian	10



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Subject Code: 3154013

	matrix formulation; Eigen values Kuhn-Tucker Conditions; Examples	
3	Linear Programming and its Applications: Standard form of linear programming (LP) problem; Canonical form of LP problem; Assumptions in LP Models; Elementary operations Graphical method for two variable optimization problem; Examples Motivation of simplex method, Simplex algorithm and construction of simplex tableau; Simplex criterion; Minimization versus maximization problems Revised simplex method; Duality in LP; Primal-dual relations; Dual Simplex method; Sensitivity or post optimality analysis Other algorithms for solving LP problems – Karmarkar’s projective scaling method Use of software for solving linear optimization problems using graphical and simplex methods Examples for transportation, assignment, water resources, structural and other optimization problems	12
4	Dynamic Programming and its Applications: Sequential optimization; Representation of multistage decision process; Types of multistage decision problems; Concept of sub optimization and the principle of optimality Recursive equations – Forward and backward recursions; Computational procedure in dynamic programming (DP) Discrete versus continuous dynamic programming; Multiple state variables; curse of dimensionality in DP Problem formulation and application in Design of continuous beam and Optimal geometric layout of a truss Water allocation as a sequential process Capacity expansion and Reservoir operation	12

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	30	30	10	10	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom’s Taxonomy)

Reference Books:

1. S.S. Rao, "Engineering Optimization: Theory and Practice", New Age International (P) Ltd., New Delhi, 2000.



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2. G. Hadley, "Linear programming", Narosa Publishing House, New Delhi, 1990.
3. H.A. Taha, "Operations Research: An Introduction", 5th Edition, Macmillan, New York, 1992.
4. K. Deb, "Optimization for Engineering Design- Algorithms and Examples", Prentice-Hall of India Pvt. Ltd., New Delhi, 1995.
5. K. Srinivasa Raju and D. Nagesh Kumar, "Multicriterion Analysis in Engineering and Management", PHI Learning Pvt. Ltd., New Delhi, India, ISBN 978-81-203-3976-7, pp.288, 2010.

Course Outcomes:

Upon successful completion of the course, the students will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Understand the need and philosophy of optimization of systems and create optimization problems for existing and proposed systems	10
CO-2	Understand the various methods for optimization of an engineering system	20
CO-3	Analyse a system for optimum performance using Linear Programming	30
CO-4	Apply optimisation techniques to determine the most efficient system properties	40

Term Work:

The students will have to solve at least five examples and related theory from each topic as an assignment/tutorial. Practical examinations shall consist of oral based on term-work and above course.

Open Source Software/learning website: www.nptel.ac.in

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be presented and put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide.