



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject code: 3160002

Contributor Personality Development Program

SEMESTER VI

Type of course: Work-Personality Development

For Year: Pre-final year for all Diploma, Degree & Masters programmes over 2 semesters. For e.g. for Bachelors of Pharmacy and Engineering, the course will be conducted in Semesters V & VI.

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 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

COURSE CONTENT :

Sr. No.	Content	Total Hrs
1	Finding Solutions The market environment in which organizations are operating, is becoming increasingly dynamic and uncertain. So, employers are increasingly seeking out people who can innovate and figure out solutions in the face of any challenge (unlike in the past when it was the	1.5 hrs Classroom engagement (including self-discovery/ solutioning sessions)



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	<p>people who were most efficient and productive, who were valued by organizations). At the heart of innovation lies this way of thinking of “finding solutions” rather than “seeing problems or roadblocks”.</p> <p>Students learn how to build this way of thinking, in this topic.</p>	
2	<p>Creating Value</p> <p>Companies are also looking for employees who do not just work hard, or work efficiently or productively - but those who will make a valuable difference to the fortunes of the company. This difference may come from innovation, but it may also come from focusing on the right things and identifying what really matters – both to the company and to the customers. In this topic, students learn how to build this capability.</p>	Same as above
3	<p>Engaging deeply</p> <p>The environment we live in is becoming increasingly complex because more and more things are getting interconnected, new fields are emerging, technologies are rapidly changing, capabilities and knowledge one is trained in will become fast obsolete. In such a scenario, the student’s ability to quickly understand and master what is going on, dive deep, get involved in any area, rapidly learn new capabilities that a job demands, is important. Engaging deeply is a core way of thinking that can help them in this. In this topic, students learn how to engage deeply.</p>	Same as above
4	<p>Enlightened self-interest & collaboration at work</p> <p>The changing nature of work in organizations and in the global environment is increasingly demanding that people work more collaboratively towards shared goals and more sustainable goals. A key to working successfully when multiple stakeholders are involved is “thinking in enlightened self-interest”. In this topic, students learn how to develop this way of thinking (going beyond “narrow self-interest”).</p>	Same as above
5	<p>Human-centered thinking & Empathy</p> <p>In this topic, students explore a human-centric approach to work – where the ability to recognize and respond to other people (whether they are users or customers or team members) as a human being with human needs and difficulties, is essential. This is at the heart of user-centric design of products and solutions, at the heart of genuine customer-centricity in services, and of any successful interaction with other people.</p>	Same as above
6	<p>Trust Conduct</p> <p>The biggest currency in a sustainable career is “trust” i.e. being trusted by team members, bosses, and customers. When we are trusted, people listen to us, they are willing to give us the chance to grow, give us the space to make mistakes, and work seamlessly with each other without always having to “prove ourselves”. In this topic, students learn how to demonstrate conduct that builds the trust of people.</p>	Same as above
Showcase Lab Sessions		3 hrs
Project work		Beyond classroom



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Distribution of Theory Marks

R Level	U Level	A Level	N Level	E Level	C Level
-	15	15	-	20	20

Reference resources:

A. Basic reference for both students and teachers

1. Contributor Personality Program textbook cum workbook developed by Illumine
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



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Course Outcomes:

Sr. No.	CO statement	Marks % weightage
Outcome of theory sessions		
CO-1	Students will be able to recognize & appreciate the thinking required to find solutions in the face of any challenge.	10-12%
CO-2	Students will be able to recognize & appreciate different types of value that can be created and the different ways to create value for others.	10-12%
CO-3	Students will be able to recognize & appreciate how to engage deeply, and its need, value, payoffs and consequences in different contexts.	10-12%
CO-4	Students will be able to differentiate between 'enlightened self-interest' and 'narrow self-interest' & appreciate the payoffs/ consequences of both when working with multiple stakeholders.	10-12%
CO-5	Students will be able to recognize & appreciate the human side of situations or interactions or projects that will help them develop a more human-centric approach/ response to work.	10-12%
CO-6	Students will be able to recognize & appreciate conduct which builds trust of people in contrast to conduct which breaks trust of people - in teams / organization & the value of trust conduct in various situations.	10-12%
Outcome of practical sessions		
CO-7	Students complete their 'Contributor Showcase Profile' on the Showcase Platform. This includes (a) completing Illumine's Contributor Mindset Assessment (b) building evidence to demonstrate their functional orientations as contributors.	15%
CO-8	Students learn to apply contributor thinking to think-through and address real-world challenges.	15%



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INTEGRATED PERSONALITY DEVELOPMENT COURSE

SEMESTER VI

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's 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 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

COURSE CONTENT :

Lecture No.	Content	Hours
1	Facing Failures - Insignificance of Failures	2
2	Facing Failures - Power of Faith	2
3	Facing Failures - Practicing Faith	2
4	From House to Home - Bonding the Family	2
5	Learning from Legends - Leading without Leading (Pramukh Swami Maharaj)	2
6	Review Lecture – Words of Wisdom	2
7	My India My Pride - Glorious Past - Part 1	2
8	My India My Pride - Glorious Past - Part 2	2



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9	My India My Pride - Present Scenario	2
10	Remaking Yourself - Begin with the End in Mind	2
11	My India My Pride - An Ideal Citizen - 1 (Accountability - Responsibility - Honesty - Integrity)	2
12	My India My Pride - An Ideal Citizen - 2 (Loyalty - Sincerity - Punctuality)	2
13	My India My Pride - An Ideal Citizen - 3 (Ethical & Moral Values/Practices)	2
14	Financial Wisdom - Financial Planning Process	2
15	Review Lecture - Student Voice-2	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
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



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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, 2017 2. Playing It My Way: My Autobiography, Sachin Tendulkar, Hodder & Stoughton, 2014 3. The Wit and Wisdom of Ratan Tata, Ratan Tata, Hay House, 2018 4. The Tata Group: From Torchbearers to Trailblazers, Shashank Shah, Penguin Portfolio, 2018 5. The Leader Who Had No Title, Robin Sharma, Jaico Publishing House, 2010 6. 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, 2017 2. The Fast Forward MBA in Project Management, Eric Verzuh, Wiley, 2011 3. Guide to Project Management: Getting it right and achieving lasting benefit, Paul Roberts, Wiley, 2013
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, 2006 2. Rishis, Mystics and Heroes of India, Sadhu Mukundcharandas, Swaminarayan Aksharpath, 2011 3. Physics in Ancient India, Narayan Dongre, Shankar Nene, National Book Trust, 2016 4. <u>The Rise of Civilization in India and Pakistan</u>, Raymond Allchin, Bridget Allchin, <u>Cambridge University Press</u>, 1982 5. 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, 2014 2. Change Your Habit, Change Your Life, Tom Corley, North Loop Books, 2016 3. The Seven Habits of Highly Effective People, Stephen Covey, Simon & Schuster, 2013 4. Seven Habits of Highly Effective Teens, Sean Covey, Simon & Schuster, 2012 5. Atomic Habits, James Clear, Random House, 2018 6. How a handful of tech companies control billions of minds every day, Tristan Harris, TED Talk, 2017



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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
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

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Subject Code: 3160608

Semester VI

Subject Name: Urban Transportation Planning

Type of course: Professional Elective courses-II

Prerequisite: Nil

Rationale:

In Urban area there are opportunities for education and employment with social, economic and cultural development. Industries, medical facilities, tourism, business models attract population from surrounding. Increase in population expanding boundaries of urban areas. Rapid urbanization leads to planning demand of households and land use activities. Vehicle ownership i.e. number of private vehicles increasing at faster pace which demands for traffic management. Sprawl in urban area necessitates efficient road/railway network and reliable mass transportation systems to cater the increased need of the passengers and goods trips within urban as well as suburban area. Safe, economic, timely and comfortable urban mass transportation systems reduce private vehicle trips, which ultimately reduce traffic congestion, accidents and environmental pollution. Study of this subject imparts knowledge of urbanization process, urban transportation system planning, land use planning, and travel demand modeling procedure, different urban mass transportation systems and urban goods movement.

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	Urbanization, urban class groups, transportation problems and identification, impacts of transportation on urban development, urban transport system planning process. Introduction to Preparation of comprehensive plan and transportation system management planning. Urban forms and structures: point, linear, radial, poly-nuclear	5
2	Urban mass transportation systems: urban transit problems, travel demand, types of transit systems, public, private, para-transit transport, mass and rapid transit systems, BRTS and Metro rails, capacity, merits and comparison of systems, coordination, types of coordination.	6
3	Survey and data collection for urban landuse and transportation planning models, Study area definition; division into traffic analysis zones; network identification and coding; types of trips, socio economic and trip characteristics of urban area; home interview survey/ Household Information Survey; roadside interview survey; goods transportation information survey, mass transit survey, Intermediate public transport/IPT surveys; methods of sampling and expansion factors; accuracy checks, screen line checks, consistency checks.	9



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4	Travel demand modeling: Four stage modeling: Factors affecting trip generation, methods of trip generation -zonal regression and cross category /classification analysis, Trip distribution-growth factor methods, gravity model, Desire line diagram. Trip Assignment models, Factors affecting mode choice and route choice. Captive rider and choice rider.	15
5	Mass transit systems: Introduction to routing and scheduling, parameters to measure performance of transit system. Corridor identification and corridor screen line analysis. As per developments suitability of transit system.	6
6	Introduction to goods movement study for urban area. Problems and issues of urban goods movement. Factors affecting goods movement, components of urban goods traffic.	1

Course Outcomes: At the end of the course, Student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Explain basics of urban, town, transportation planning and existing system.	20
CO-2	Collect the data and analyze for travel demand forecasting for horizon year by four stage modeling.	25
CO-3	Classified types and Suggest mass transportation system in urban area with performance measurement.	25
CO-4	Development of trip generation and trip distribution models for study area.	20
CO-5	Describe goods/freight movement in urban area and identify the factors affecting.	10

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10%	20%	20%	25%	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. Kadiyali L.R., Traffic Engineering and Transport Planning, Khanna Publishers
2. Khisty, C J., Transportation Engineering – An Introduction, Prentice-Hall, NJ
3. S.C. Saxena, Traffic Planning and Design, Dhanpat Rai Pub., New Delhi.
4. Partho Chakraborty and Animesh Das, Principles of Transportation Engineering, PHI
5. C. S. Papacostas, Fundamentals of Transportation System Analysis, PHI.



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6. Pradip Kumar Sarkar, Vinay Maitri, G.J.Joshi, Transportation Planning :Principles, Practices and Policies, PHI

List of Experiments: Assignments based on syllabus including numerical, survey and analysis and visit report.

Major Equipment: N.A.

List of Open Source Software:

- TransCAD/Cube/VISUM
- Q-GIS

Field Visit:

1. A visit to Public Transportation System and office of operator for urban area.
2. A visit to authority office-Town planning section, urban planning section, urban development section.
3. A visit to depot, terminal, bus stops.



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Bachelor of Engineering

Subject Code: 3160610

Semester – VI

Subject Name: WATER RESOURCES ENGINEERING AND HYDROLOGY

Type of course: Professional Core Course of Civil Engineering

Prerequisite: Knowledge of hydrological cycle and its component, ground water hydrology, Basic ideas about floods, drought, hydropower plants and reservoir

Rationale:

1. To develop basic understanding about precipitation, infiltration, evapotranspiration, hydrograph, capacity of reservoir
2. To enable the students for estimation of runoff, infiltration, evaporation, floods and reservoir capacity
3. To create understanding about features of various types of dam

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	MODULE - I Hydrological Parameters: Hydrological cycle, Water balance concept, Climate and availability of water, types and forms of precipitation, Variability in rainfall, Measurement & Data analysis of precipitation, Evaporation and its measurement, Transpiration and its measurement, Measurement of Evapotranspiration, Potential and actual evapotranspiration, Penman Monteith method. Infiltration indices, Factors affecting infiltration, Horton's equation and Green Ampt method.	12
2	MODULE – II Runoff: Drainage basin and watershed characteristics, Types of runoff, Surface, subsurface flow, base flow. Hydrographic Analysis: Mass curve, Hyetograph, Hydrograph with types, assumptions, rationale and limitations of unit hydrograph, Derivation of unit hydrograph and its conversions, S- hydrograph and its uses, Snyder's Hydrograph, Flow duration curve and its uses.	15



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3	MODULE – III Groundwater Hydrology: Occurrence, Darcy’s law, Well hydraulics, Well losses, Yield, Pumping and recuperation test. Dams and Reservoirs: Types, Investigations, Site selection, Zones and levels of storage in reservoir, Safe and Design yield, Reservoir capacity, Reservoir sedimentation and control, Bed load, suspended load. Types of dams, Selection of type and site of dam, Information about major dams and reservoirs of India.	15
4	MODULE – IV Floods: Indian rivers and floods, Causes of floods, Alleviation and flood management, Levees and floodwalls, Floodways, Channel improvement works, Flood damage analysis. Flood Terminology and Hydrological Analysis: Design flood, Standard Project flood, Probable maximum flood, Flood estimation, Frequency analysis, Flood routing through reservoirs and open channels, Muskingham Routing. Hydel Power: Micro, Small, High generation plants, Low, Medium and High head plants, Power house components and Hydel schemes.	10
5	MODULE – V Drought Management and Water Harvesting: Definition of drought, Causes and types of drought, measures for water conservation and augmentation, drought contingency planning and execuion. Water harvesting: rainwater collection, small dams, runoff enhancement, runoff collection, ponds, tanks, rooftop model of rainwater harvesting. Water Resources Planning and Management: Requirement of Water Resources schemes, Principles and objectives of Water resources planning. Levels in planning, Functional requirements of water resources projects, steps in water resources planning, Environmental aspects in water resources planning.	8

Suggested Specification table with Marks (Theory): (For BE only)

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

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. K. Subramanya, Engineering Hydrology, Tata McGraw Hill Pub. Co. New Delhi.



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2. C.S.P. Ojha, R. Berndtsson and P. Bhunya, Engineering Hydrology, Oxford University Press, New Delhi.
3. R.A. Wurbs and W.P. James, Water Resources Engineering, Prentice Hall of India, New Delhi.
4. R.K. Sharma and T.K. Sharma, Hydrology and Water Resources Engineering, Dhanpat Rai Publications, New Delhi.
5. H. M. Raghunath, Hydrology: Design, Principles and Analysis, New Age International Publishers.
6. R.K. Linsley, J.B. Franzini, D.L. Freyberg and G. Tchobanoglous, Water Resources Engineering, McGraw Hill Singapore.
7. V.P. Singh, Elementary Hydrology, Prentice Hall, Englewood Cliffs, New Jersey.
8. Ven Te Chow, D.R. Maidment and L.W Mays, Applied Hydrology, McGraw Hill International Edition, New York

Course Outcomes: At the end of the course, Student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Computation of mean precipitation from a catchment , infiltration rate and Infiltration Capacity	15
CO-2	Able to calculate runoff from a catchment and Compute peak flood flow	20
CO-3	Able to compute reservoir capacity using mass curve and dependable flow using flow duration curve for the requirement of irrigation, power generation etc.	15
CO-4	Develop basic idea about reservoir sedimentation, its control and Computing the capacity of well	20
CO-5	Estimation of design flood for the design of hydraulic structure and Measures of water conservation to battle drought	15
CO-6	Understanding the concepts of Water resources planning and its environmental aspects.	15

List of Experiments:

1. To determine rate of infiltration and infiltration capacity using double ring infiltrometer.
2. Measurement of rainfall



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3. Estimation of flood using unit hydrograph
4. Computation of rate of infiltration using infiltrometer
5. Computation of live and dead storage capacity of reservoir
6. Flood routing of reservoir and channel
7. Calculation of dependable flow.
8. Determination of capacity of well.
9. Calculation of power of a hydro-power plant

Major Equipment:

Double ring infiltrometer, rainfall simulator, rain gauges, models of various dams

List of Open Source Software/learning website:

1. <http://www.nptel.iitm.ac.in/courses/Hydrology>

GTUQuestionPapers.com



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Bachelor of Engineering

Subject Code: 3160611

**SUBJECT NAME: ENVIRONMENTAL ENGINEERING
SEMESTER-VI**

Type of course: Professional Core course

Prerequisite: Mandatory course of Environmental Science

Rationale:

1. Drinking water is one of the basic needs of the human being; this subject helps the civil engineer in planning of a water supply scheme that can provide potable water to the community.
2. To maintain the general hygiene in the habitation, proper handling and disposal of sewage and solid waste is important. This subject helps the civil engineer in dealing with the issues related to collection, treatment and disposal of sewage and solid waste.
3. To understand effect of noise and air pollution and its control measures

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

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Water Supply scheme/System Components and layout of water supply scheme, Sources of water, Types of water demand, Estimation of quantity of water required, Collection and conveyance of water, Quality characteristic of drinking water, Drinking water standard, Water borne diseases Water, Treatment processes: aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes, Water Distribution system: components, type of layouts, determination of capacity of elevated reservoirs, The Water (prevention and control of pollution) Act-1974	12	30
2	Sewage : Characteristics, Treatment and Disposal Physical, chemical and biological characteristics of sewage, Methods of sewage disposal, Indian standards for disposal of sewage, Self purification capacity of river, Sewage farming, Unit operations and unit processes in sewage treatment, Layout of sewage treatment plant, Preliminary, Primary treatment of sewage, Aerobic and anaerobic biological treatment: attached growth and suspended growth processes, Low cost sanitation: septic tank and soak pit.	11	25
3.	Collection of sewage Type of sewerage systems: combined and separate, Quantity of Sewage, Sewage flow variations. Conveyance of sewage: Sewers, shapes design parameters, laying and testing of sewer, Sewer appurtenances.	5	10



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4	House Drainage Principles of house drainage, Pipes and traps, Classification of traps: nahni trap, gully trap, interception trap, grease trap, Sanitary fitting, System of plumbing, House drainage plan for building.	2	10
5	Solid Waste Management Quantity, composition and characteristics of solid wastes, Classification of solid wastes. Hazardous solid wastes, Biomedical solid wastes, Typical generation rate for solid wastes, Factors affecting the generation rate. Estimation of quantity of solid waste, Onsite handling, storage and processing, Collection services, Types of collection systems, Transfer stations, Solid waste processing techniques, Disposal of solid waste.	5	10
6	Air and noise pollution Classification and sources of air pollutants. Air quality standards, Effects of air pollution on human, plant and material, Basic Air pollution control methods, Salient features of the Air (Prevention and control of pollution) Act – 1981 Noise pollution: definition, measurement, standards, sources, effect and control measure.	4	10
7	Environment Impact Assessment(EIA) Environment Protection Act, Need of EIA, Steps for EIA, Role of EIA is sustainable develop met	3	5

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10%	25%	30%	15%	10%	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. H.S. Peavy, D.R. Rowe and G. Tchobanoglous, Environmental Engineering, McGraw Hill International Edition
2. M. L. Davis, Water and waste water Engineering, Mc Graw Hill education (India).
3. Metcalf and Eddy, Wastewater Engineering: Treatment, disposal Reuse, Tata-McGraw Hill education (India).
4. Integrated Solid Waste Management, Tchobanoglous, Theissen & Vigil, McGraw Hill Publication
5. S.K. Garg, Environmental engineering Vol. I & II, Khanna Publication
6. Manual on Water Supply and Treatment, Ministry of Urban Development, New Delhi
7. Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and
8. Environmental Engineering Organization, Ministry of Urban Development.



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3160611

Course Outcome:

Sr. No.	CO statement	Marks % weightage
CO-1	Determine the quantity and quality of water required for public water supply	20%
CO-2	Interpret the effect of wastewater characteristics on human health and environment	15%
CO-3	Design different units of water and sewage treatment plant	40%
CO-4	Classify solid waste and interpret the components of solid waste management system	10%
CO-5	Analyze the effects of air and noise pollution on human and environment and develop its remedial measures.	15%

List of Experiments:

1. Physical Characterization of water: Turbidity, Conductivity, pH
2. Analysis of solids content of water: Dissolved, Settleable, suspended, total, volatile, inorganic etc.
3. Determination of Alkalinity and acidity
4. Determination of Hardness: total hardness, calcium and magnesium hardness
5. Determination of Chlorides
6. Determination of Optimum coagulant dose: Jar Test
7. Chemical Oxygen Demand (COD)
8. Dissolved Oxygen (D.O) and Biochemical Oxygen Demand (BOD)
9. Determination of residual chlorine in water
10. Bacteriological quality measurement: MPN,
11. Ambient Air quality monitoring (SPM, SO_x, NO_x)
12. Ambient noise measurement

Assignments:

1. Design of various units of a conventional water treatment plant
2. Design of Trickling filter and Activated sludge unit.

Major Equipment:

1. BOD incubator
2. COD digester
3. Hot air oven
4. Muffle furnace
5. Electronic Balance (Accuracy: 1mg)
6. Jar Test Apparatus
7. pH, Turbidity, TDS and Conductivity meter
8. Sound level meter
9. High volume sampler
10. 3/5 Gas Analyzer
11. Microbial Incubator

List of Open Source Software/learning website:

1. <http://nptel.ac.in/courses>



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2. <http://moef.gov.in>
3. <http://jalshakti-ddws.gov.in>
4. <http://cpcb.nic.in>
5. EPANET

GTUQuestionPapers.com



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3160612

Design of Reinforced Concrete structures

SEMESTER-VI

Type of course: Professional Elective Core

Prerequisite: Structural Analysis, Design of structure

Rationale: Majority of civil engineering structures are made up of Reinforced Cement Concrete. Knowledge of designing and detailing of reinforced concrete structures is very important for civil engineers in order to make structures safe, serviceable and durable during its life span. Limit State design philosophy is prevailing in our country for designing RC structures. Proper designing and detailing of reinforcement will ensure the correct behavior of structures and also leads to smooth construction of RC structures. This course will provide detailed knowledge of design and reinforcement detailing as per Indian standards.

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

Note: IS:456(2000), IS-1893-1(2016), IS-13920(2016), IS-3370(Part 1 TO 4), SP-16, SP-34, IS-875 are permitted in the examination.

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Unit-1: Building Layout and Design Loads as per I.S., distribution & flow of loads, lateral load due to wind and seismic as per latest IS standards, load combinations, guide lines for preparation of structural layout for building. Analysis, design & detailing of G+3 RC framed building for residential /commercial purpose including ductile detailing.	12	30
2	Unit-2: Design of Retaining wall Types, behavior and application of retaining wall, stability criteria, design & detailing of cantilever & counter-fort type retaining wall for various ground conditions.	08	20
3	Unit-3: Design of Water Tank Classification of water tank and method of analysis, permissible stresses, codal provisions, Design of circular and rectangular under-ground water tanks using IS code method, Design of elevated water tank with Intze type of container, frame and shaft type of staging and foundation considering effect of earthquake and wind forces. Design of Foundations: Design of isolated footing under axial load and uni-axial bending, combined footing.	09	20



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4	Unit-4: Design of Flat Slab Direct design method – Distribution of moments in column strips and middle strip-moment and shear transfer from slabs to columns – Shear in Flat slabs-Check for one way and two way shears, Limitations of Direct design method, Introduction to Equivalent frame method.	06	15
5	Unit-5: Earthquake Resistant Design of building Earthquake resistant design philosophy, capacity design concept, four virtues of Earthquake Resistant design: strength, stiffness, ductility and configuration, Irregularities in structures, Lateral load distribution – Torsionally coupled & uncoupled system, Seismic coefficient Method, Ductile detailing as per IS:13920.	07	15

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
05	10	30	30	20	5

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. P. C. Vargheese, Limit State Design of Concrete structure,
2. Shah & Karve; Limit State Theory & Design of Reinforced Concrete; Structure Pub., Pune
3. Dr. H.J. Shah; Reinforced concrete Vol-I; Charotar Pub. Anand
4. Punmia B.C "Advanced RCC Design" Laxmi Publications Pvt. Ltd". 2006.
5. Varghese P. C., Advanced Reinforced Concrete, Varghese, Prentice Hall of India.
6. Sinha S. N., Reinforced Concrete Design, Tata Mc-Graw Hill, Delhi.
7. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers.
8. S. Unnikrishna Pillai and Devdas Menon, Reinforced Concrete Design, Tata McGraw Hill.
9. IS: 456 - Code of practice for plain and reinforced concrete
10. IS: 875 (Part I to V) - Code of practice for structural safety of Buildings Loading standards
11. IS: 1893 - Criteria for earthquake resistant design of structures
12. IS: 13920 -Code of Practice for ductile detailing of RC structure subjected to seismic force
13. IS: 3370 (P-1 to 4)
14. SP:16, SP:34.

Course Outcome:

Sr. No.	CO statement	Marks % weightage
CO-1	Apply the principles, procedures and current Indian code requirements to the analysis and design of RC structures	15



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CO-2	Prepare layout, determined loads, analyse, design and detail various structural elements for RC framed structure up to G+3.	25
CO-3	Design & detail RC structures like Retaining Wall, Water Tank and Flat slab.	25
CO-4	Apply the concept of earthquake resistant design in the building.	15
CO-5	Prepare design report covering design basis, structural calculations, structural drawings	20

Term Work :

Term work shall consist of satisfactory completion and submission of following list of Practicals/Tutorials.

List of Practicals /Tutorials:

1. Full Design of following structures with detailing in A2 size drawing sheet covering all required details in structural drawing.
(1) design of G+3 building (design manually & check with software)
(2) Retaining wall/water tank
2. Software applications of Multi-storied building subjected to wind and earthquake forces
3. Preparation of EXCLE Worksheets for the design of various structural components of building and/or other structures of the syllabus.
4. Prepare at least one drawing in any CAD software (like AutoCAD) for design of structures conducted in the syllabus.

Practical examinations shall consist of oral based on the term-work and above course.

Major Equipment/Software:

1. Any professional software of Structural analysis such as STAAD-pro, SAP, ETABS

List of Open Source Software/learning website:

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



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3160613
6th Semester
Rock Mechanics & Tunneling

Type of course: Elective

Prerequisite: Geotechnical Engineering, Mechanics of Solids and Fluid Mechanics

Rationale: The course on *Rock Mechanics & Tunneling* provides the students basic knowledge on rock exploration, classification, mechanical properties of rock, rock testing, tunnel classification, its purposes, constructions supported with rock bolting, rock anchoring, rock stability and its engineering applications acquainted with latest field practices and codal provisions. This will help them to identify rock type, classify rock mass, rock parameters based on testing, in-situ stress determination for rock strength, tunnel selection, tunnel design and its construction implications for underground structures and mining applications for various types of infrastructural projects/need.

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

Content:

Sr. No.	Content	Total Hrs
1	Module I: Rock formation, exploration and classification: Basic terminology, Its genesis, Rock and Rock mass classification, Geological petro graphic, Index properties of rocks, Physical and Mechanical properties, Defects in rock mass, Elastic constants of rock; Insitu stresses in rock, Modes of failures of rocks, Objective of rock exploration, methods of rock exploration; by direct penetration, by geophysical processing, in-situ and laboratory tests. Examples	10
2	Module II: Rock strength and failure Rock strength, Types of failure, Theories of failure (Coulomb-Navier, Mohr, Griffith), Hoek and Brown Strength criteria for rocks with discontinuity sets, Absolute stress by bore hole deformation method, Flat jack method, Propagation velocity method, Bearing capacity of foundations on rocks – case studies; Examples Testing of rocks: Laboratory and field test, assessment of in-situ strength	06
3	Module III: Rock Bearing Capacity and Rock Stability Rock Foundation: Shallow and Deep investigation for foundation design and construction aspect, Slope Stability analysis, Mode of failures in rock. Design of slopes, Excavation in rock and stabilization concepts, Bearing capacity of foundations on rocks – case studies, Examples	06
3	Module IV: Tunnels Tunnels – Basic terminology and application, Site investigations, methods of excavation	06



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Subject Code: 3160613

	of tunnels, supports and stabilization, Construction control and maintenance, tunnel ventilation, control of ground water and gas.	
4	Module V: Design of Tunnels and Construction General Principles; Tunneling in solid rocks; Full face tunneling without supports and with supports, Single stage mining methods and multi-stage classical methods of tunnel construction, shield tunneling Analysis and Design of horse-shoe shaped tunnels, Design of circular shape tunnels.	10
5	Module VI: Engineering Applications Reinforcement of fractured and jointed rocks - Shotcreting, Bolting, Anchoring, Installation methods - Case studies. Rock bolting, Reinforcement of laminated rock	04

Reference Books:

1. K.Szechy "Art of Tunnelling" Published by – "Atademiaikiado , Budapest 1973"
2. Obert & Duall- "Rock Mechanics & Design of Structures in Rock"
3. Jager & Cook " Fundamentals of Rock Mechanics"
4. Verma B.P."Rock Mechanics Engineers", Khanna Publishers. New Delhi 1985
5. Hudson, A. and Harrison, P., Engineering Rock mechanics – An introduction to the principles, Pergamon publications, 1997.
6. Wittke, W., Rock Mechanics. Theory and Applications with case Histories, Springer-Verlag, Berlin, 1990.
7. T. Ramamurthy, Editor, Engineering in Rocks for Slopes Foundations and Tunnels, PHI Learning Pvt. Ltd., 2007

Course Outcomes: Students will be able to

Sr. No.	CO statement Students will be able to:	Marks % weightage
CO-1	Classify Rock system with complete testing program and calculate bearing capacity of Rocks.	25
CO-2	Check stability of Rock under different stress conditions	20
CO-3	Design for rock reinforcement by means of rock bolting, rock is grouting and rock freezing.	20
CO-4	Select and Design tunnels under different circumstances	25
CO-5	Define a role of geotechnical engineer as rock specialist/mining engineer/ tunnel specialist for proper execution of any infrastructure project.	10

List of Experiments/Tutorials

Identification of rock

Point load index – Brazilian test

Direct shear test for Rock



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Uniaxial compressive strength test for Rock

Rock Triaxial Shear Test

Slake durability test

Design based Problems (DP)/Open Ended Problem:

Apart from above tutorials/experiments a group of students has to undertake one open ended problem/design problem. Few examples of the same are given below:

1. Development of spread sheets/computer programs for the determination of various index and engineering properties of rock.
2. Determination of rock parameters based on stress-strain relationships and various rock failure criteria.
3. Design of tunnels as per shape and multiple openings or simulation of stresses using either photo-elastic models or using software like PLAXIS, ANSYS

List of Open Source Software/learning website:

1. NPTEL lecture series
2. MIT open source material



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3160614

Contracts Management

SEMESTER-VI

Type of Course: **Department Elective**

Prerequisite: **NIL**

Course Objectives:

1. To make students understand various contracts, their suitability and the procurement process involved in construction projects.
2. To make student capable of understanding and reviewing various provisions included in the contract for effective management of the projects
3. To make the student understand various contract management processes involved in construction projects

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	1	0	4	70	30	0	0	100

Course Contents

Sr.No.	Topics	Hrs.	% Weightage
1	Introduction to Contract: Definition and legal issues in contract, Essential requirement of a contract as per Indian Contract Act 1872, Characteristics of a good contract, Legal enforceability of contract, Breach & termination of contracts, Major stake holders in construction contracts, Overview of Activities in Contract Management.	4	10
2	Construction Contracts: Type of construction contracts: Lump sum contracts, Fixed price contracts, Percentage rate contracts, Cost plus contracts, Target contracts, Design-Build contracts, Turn-key contracts, BOT contracts. Parties to a Contract, Contract Formation, Common contract clauses: Notice to proceed, rights and duties of various parties, Contract Duration and Price.	8	20
3	Tendering: Process of tendering: Tender notice, EOI, RFQ & RFP, Bid security, Prequalification process, Bidding Models and bidding strategy, Tender submission and evaluation, Tender rejection, Security deposits/performance guarantee & Defect liability, Contract agreement & contract documents Performance Parameters: Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination.	13	34
4	Conditions of Contracts: General conditions & special conditions, Contract conditions for payments, Time delay, Scope changes, Extra claims, Termination of contracts, subcontracting.	7	18
5	Contract Administration: Elements of contract management, Major stake holders in construction contracts, Contract administration; Duties and responsibilities of parties, Stake holder agreements, Contract risk management,	7	18



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Management reporting, Dispute resolution mechanisms: Negotiation, Mediation.			
	Total	39	100

Reference Book(s)

1. Keith Collier, "Construction Contracts" Reston Publishing Company, Inc, Reston, Virginia.
2. Patil, B.S., "Building and Engineering Contracts" Mrs. S.B. Patil, Pune.
3. John Murdoch & Will Hughes, "Construction Contracts - Law and Management" Spon Press, Taylor & Francis Group.
4. Gajera, G.T., "Law relating to Building and Engineering Contracts in India" Butterworths.
5. Govt of India, Central Public Works Department, "CPWD Works Manual 2003."
6. Govt of India, Central Public Works Department, "CPWD 7/8: General Conditions of Contracts."
7. V. K. Raina, Raina's Construction and Contract Management Vol.1 (Second Edition), SPD Publishers, 2009

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

Sr. No.	CO statement	Marks % weightage
CO-1	Decide suitable contracts for a given project scenario and stakeholders of contract	20 %
CO-2	Judge best form of contract for a specific project and design performance parameters	30 %
CO-3	Summarize tender processing and assess various contractual provisions in a tender documents and develop bidding strategy	20 %
CO-4	Formulate contract management processes involved in construction projects	30%

List of Tutorials

1. Collection of Evaluation of tender notices/ EOI, RFQ & RFP
2. Tender notice preparation
3. Exercise on pre-qualification of contractors
4. Case Study & evaluation of tender documents for:
 - Tendering process
 - Security and performance bonds
 - Risk assessments of contractual provisions
 - Arbitration/dispute resolution

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level



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20	35	25	10	10	00
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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.

List of Open Source Software/learning website: www.nptel.iitm.ac.in/courses/

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GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3160615

Subject Name: TRAFFIC ENGINEERING AND MANAGEMENT

Semester VI

Type of course: Professional Elective Course-III

Rationale:

1. To set a compact foundation in the field of traffic engineering, its management in order to achieve the safety to the road users.
2. To enable the students to apply the basic principles of traffic engineering in the design of traffic facilities based on traffic flow theory.
3. To equip the students for traffic system management in the urban area.
4. To enable the students for estimating capacity and level of service for the rural and urban area.

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

Content:

Sr. No.	Content	Total Hrs
1	Introduction: Traffic engineering administration and functions, Organization of the traffic engineering department, Road user and vehicular characteristics.	2
2	Basic traffic flow parameter and Traffic Surveys: Definition – Flow, Volume, Speed, Space headway, Time headway, Density. Relationship between Flow, Speed and Density, Traffic Surveys: Speed, Journey time and Delay surveys, Classified volume count survey, Vehicle occupancy survey, Origin – Destination survey, Parking Survey , Use of photographic techniques in traffic survey.	8
3	Lighthill and Witham's Theory: General, Assumption, Theory, Approach to signalized intersection, Bottleneck, Car following theory, Queuing theory concept	5
4	Traffic Forecasting: Need for traffic forecasting, Types of traffic, Forecasts based on past trends and extrapolation, period for forecasting.	4
5	Parking studies: Traffic and parking problems, Ill effects of parking, Zoning and parking space requirement standards, Design standards for on street parking, Off street parking facilities, Peripheral parking system.	2



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6	Design of Intersection: Design of at grade & grade separated intersection – rotary intersection – capacity of rotary intersection – Traffic signals, Advantages and disadvantages, Types of signals, Methods of setting signal timings, Warrants for signals, Coordinated control of signals, Necessity of signal coordination, Types of coordinated signal system.	10
7	Traffic Accidents – Causes and prevention: Accident situation in India, Collection of accident data, Statistical methods for analysis of accident data, Road and it's effect on accidents, Skidding, Speed in relation of safety, Traffic management measures and their influence on accident prevention, Condition and collision diagram and its utility, Legislation, Enforcement, Education and Propaganda.	4
8	Traffic system management: Introduction, Travel demand management, Traffic management measures, Restrictions to turning movements – one way streets – tidal flow operations-Traffic segregation –Traffic calming- Exclusive bus lanes, conflict point diagram for various types of streets, Introduction to ITS in traffic management.	2
9	Highway Capacity: Importance of 'Capacity' in Highway transportation studies, Capacity of uninterrupted flow conditions as per Indo-HCM, PCU in reference to Indo-HCM in urban and rural area, Determination of theoretical capacity, Level of service, Factors affecting capacity and level of service.	5

Course Outcomes: At the end of the course, Student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Determine the traffic flow parameters for traffic management	20
CO-2	Predict the future traffic demand for the urban and rural area	20
CO-3	Plan the parking plots as per the traffic availability in the urban area	10
CO-4	Design the various types of intersection in the urban area.	20
CO-5	Propose the different types of traffic system management technique.	15
CO-6	Evaluate the capacity and level of service on the streets of rural and urban area.	15

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10%	20%	20%	20%	10%	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.



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Bachelor of Engineering Subject Code: 3160615

Reference Books:

1. Dr. Kadiyali L. R., Traffic Engineering and Transport Planning, Khanna Publishers
2. Dr. Sharma S. K., Principles, Practice and Design of Highway Engineering (Including Airports), S. Chand & Company Ltd.
3. Chakraborty Partho, Das Animesh, Principles of Transportation Engineering, PHI
4. Khanna S.K., Justo C.E.G., Highway Engineering, Nem Chand & Bros., Roorkee.
5. Bindra S.P., A course in Highway Engineering, Dhanpat Rai Publications
6. Kadiyali L. R. and Lal, N. B., Principles & Practice of Highway Engineering, Khanna Publishers, Delhi.
7. Chakraborty Partha, Das Animesh, Principles of Transportation Engineering
8. Indo-Highway Capacity Manual, 2018
9. Martin Whol, Brian V Martin , Traffic system Analysis for Engineers and Planners, McGraw Hill, NY, 1967
10. IRC-SP -12 2015 Parking facilities in Urban Roads
11. IRC SP - 41 Guidelines for the Design of At-Grade Intersection
12. IRC 35 - 2015 Code of Practice for Road Markings – Second Revision
13. IRC 67 - 2001 Road Signs
14. IRC 108 - 2015 Guidelines for traffic forecast on Highways
15. IRC 119 - 2015 Guidelines for traffic safety Barriers
16. IRC 65 - 1976 Traffic Rotaries
17. IRC 93 - 1985 Design & Installation of Road Traffic Signals

List of Experiments:

1. Determination of various speeds to be used for geometric design, traffic regulation at the urban/rural road
2. Determination of signal timings at the intersection of the urban area

List of Traffic Survey:

1. Spot speed survey
2. Moving car method of survey for journey time
3. Delay studies survey
4. Classified volume count survey
5. Vehicle occupancy survey
6. Origin – Destination survey
7. Parking survey

List of Open Source learning website:

1. <http://www.nptel.iitm.ac.in/courses/>



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GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3160616

Semester – VI

Subject Name: Foundation Engineering

Type of course: Program Elective

Prerequisite: Knowledge of Geotechnical Engineering, Soil Mechanics and Fluid Mechanics

Rationale: Loads of all civil engineering structures must be transmitted to the soil or rock through a foundation system that is safe and economical. The course on *Foundation Engineering* provides the necessary technical knowledge to select, analyze and design various types of foundation systems under different loads with full understanding on soil investigation, its requirements, interpretation of data and its application. Various types of foundations and their analytical solution help students to design suitable foundation with respect to soil and site condition and type of structure.

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	Foundation Classification and Soil exploration/investigation: Types of foundation, Factors affecting the selection of type of foundations, steps in choosing types of foundation based on soil condition, Objectives and planning of exploration program, methods of exploration-depth of boring, Soil samples and samplers- Methods of sampling, field penetration tests: SPT, SCPT, DCPT. Introduction to geophysical methods, Bore log and report writing and Data interpretation.	8
2	Shallow Foundation: Introduction, significant depth, design criteria, modes of shear failures. Detail study of bearing capacity theories (Prandtl, Meyerhoff, Terzaghi, Skempton, Vesic etc), bearing capacity determination using IS Code (IS 6403), Presumptive bearing capacity. Settlements: components of settlement & its estimation (IS 8009), permissible settlement, Proportioning of footing for equal settlement, Allowable bearing pressure. Bearing capacity from in-situ tests (SPT, SCPT, PLT, DCPT), Factors affecting bearing capacity. Bearing capacity of raft/mat foundation as per codal provisions, Contact pressure under rigid and flexible footings. Floating foundation. Types of pavements & its design.	10
3	Pile Classifications & Load Transfer Principle of Pile foundation : Introduction, load transfer mechanism, types of piles and their function, factors influencing selection of pile, their method of installation and their load carrying characteristics for cohesive and granular soils, piles subjected to vertical loads- pile load carrying capacity	10



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	from static formula, dynamic formulae (ENR and Hiley), penetration test data & Pile load test (IS 2911). Pile group: Carrying capacity, Group Efficiency and settlement. Negative skin friction.	
4	Foundations on problematic soil & Introduction to Geosynthetics : Significant characteristics of expansive soil, footing on such soils, Problems and preventive measures. Under-reamed pile foundation-its concept, design & field installation. Introduction to geosynthetics-types and uses.	6
5	Retaining walls and Diaphragm walls : Types (types of flexible and rigid earth retention systems: counter fort, gravity, diaphragm walls, sheet pile walls etc.), Analysis of retaining and diaphragm walls	8

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
05	15	25	15	05	05

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. Foundation Engineering, Peck hanson & Thronburg(1974). John Wiley & Sons,.
2. Analysis and design of Substructures- Swami Saran (2009), Oxford & IBH
3. Foundation Engineering Naryana S Naik(2012), Dhanphat Rai publishers, New Delhi
4. Winterkorn, H.F. and Fang, Y.F., Foundation Engineering Handbook, Van Nostrand Reinhold, 1994.
5. Hemsley, J.A, Elastic Analysis of Raft Foundations, Thomas Telford, 1998.
6. Swami Saran, Gopal Ranjan, "Analysis & Design of Foundaions & Retaining Structures", Sarita Prakashan.
7. Poulos, H.G., Davis, E.H., Pile foundation analysis and design, John Wiley and Sons, New York, 1980.
8. Grigorian, Pile Foundation for Buildings and Structures in collapsible Soil, Oxford & IBH Publishing Co, Pvt. Ltd., New Delhi, 1999.
9. Bowles, J.E., "Foundation Analysis and Design, 5th Edition, McGraw Hill, New York, 1995.

Course Outcomes:

Sr. No.	CO statement Students will be able to	Marks % weightage
CO-1	Select appropriate soil investigation/testing technique/method and get true sub soil parameters used for selection of type of foundation as per codal guidelines.	20



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CO-2	Select and design appropriate (Shallow/ Deep) foundation system for different structures, that satisfy the allowable bearing capacity and settlement requirements based on soil properties,	30
CO-3	Design vertical piles and pile groups for various types of loading, soil conditions and settlement requirements.	25
CO-4	Design and analyze retaining walls, sheet piles and diaphragm walls under static loads	15
CO-5	Explain engineering behavior of expansive soils and selection of suitable foundation type for such soils, suggest suitable type of geosynthetics for various foundation issues and its proper implications.	10

List of Experiments/ Tutorials:

- Bearing capacity computations using Box Shear Test, Triaxial Test, UCS, Vane Shear test, SPT, PLT, CPT, DCPT, Pile load test, Geophysical tests and other in-situ tests
- Settlement computations using Consolidation test, Settlement calculations for layered soil and Soft Marine clay
- Swell pressure and swell index test for expansive soils
- CBR test

Major Equipment: SPT, PLT, SCPT, DCPT, Triaxial machine with pore pressure measurements

List of Open Source Software/learning website:

<http://nptel.ac.in/>

<http://ocw.mit.edu/courses/civil-and-environmental-engineering/>



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Bachelor of Engineering

Subject Code: 3160617

Construction Equipment and Automation

Semester VI

Type of course: Professional Elective course

Prerequisite: Building construction Technology,

Rationale: In the last decade, technology is updated very fast. In construction sector also various equipments and automation have made the construction work with speed, accuracy and quality. This subject covers various equipments and automation used in the construction industries and help the students to know the current & latest trends of construction.

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	1	0	4	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
1	Introduction: Unique features of construction equipment, Need of construction Equipment, past history. Construction Equipment: Capacity, Feasibility, owning and operating cost and Productivity of Different Equipment: Excavators, Pavers, Plastering machines; Pre-stressing jacks and grouting equipment; Cranes and Hoists, Concrete Batching Plants, etc..	08
2	Automation in Construction Industry: Need and Benefit of automation: Automation in Canal lining, Automation in Construction of Highway, Automation in concrete technology.	14
3	Drones: Photogrammetry, Project Monitoring- real time data, aerial mapping, land survey, quantity survey, quality survey, structural health monitoring survey, under water survey.	08
4	Robotics in Construction: Introduction, Benefits of robots in construction industry with respect to time, cost, quality, safety. Use of robots for construction activities like Brick laying, Demolition, Material Handling, Structural steel cutting, Rebar tying/bending, Form work mould making, 3D printing- print complex, layered, parts and objects of homes, buildings, bridges and roads 3D Scanner for surveying and project management	10
5	Introduction to Advanced Technologies: Virtual Reality, Augmented Reality, Building Information Modeling (BIM).	05



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Subject Code: 3160617

Suggested Specification table with Marks (Theory):

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

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) Construction Planning, Methods and Equipment, R.L Peurifoy, McGraw Hill, 2011
- 2) Construction Project management, Theory & Practice, Kumar Neeraj Jha., Pearson Education India.
- 3) BIM and Construction Management: Proven Tools, Methods, and Workflows By Brad Hardin, Dave McCool, John Wiley & Sons
- 4) Construction equipment and its planning and application Mahesh Varma Metropolitan Book Co
- 5) Robotics and Automation in Construction, Open access peer-reviewed edited volume
- 6) Automation in Construction Management: Automated management of Construction Materials Using RFID Technology, Javad Majrouhi Sardroud, Scholars' Press
- 7) Enhancing BIM Methodology with VR Technology, Open access peer

Course Outcome:

After learning the course the students should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Derive feasibility of specific equipment in different project conditions	25
CO-2	Selection of Automation techniques in construction industry	25
CO-3	Select suitable Drone technology for surveying and project management	20
CO-4	Analyze benefits of robotics versus conventional construction equipment	20
CO-5	Classify application of Virtual Reality, Augmented Reality, BIM in construction industry	10

List of Tutorials:

Tutorials based on:

1. Construction Equipment
 - Capacity, Feasibility, owning and operating cost and Productivity of pavers
 - Capacity, Feasibility, owning and operating cost and Productivity of cranes



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- Capacity, Feasibility, owning and operating cost and Productivity of Excavators
 - Capacity, Feasibility, owning and operating cost and Productivity of Concrete Batching Plants
2. Automation in Construction
 3. Robotics in construction
 4. Drones application in construction
 5. Application of Virtual Reality and Augmented Reality in construction

Student should do Power Point presentation and assignment based on above topics.

Site Visit :

1. A site visit of heavy construction project should be arranged to show the working of construction equipment's like dragline, bull dozers, clamshell, belt conveyors, scrappers, compactors, etc.

Major Equipment: Computer with all supported software.

List of Open Source Software/learning website:

softwares:

1. Revit for BIM modeling

learning website

<https://www.youtube.com/watch?v=wOsZk13UIO0>

https://www.youtube.com/watch?v=T_CMr2KFSd4

<https://www.youtube.com/watch?v=8lY4qaVvR8c>



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Semester-VI

Subject Code: 3160618
Semester VI

Subject Name: OPEN CHANNEL FLOW

Type of course: Professional Elective Course-III

Prerequisite: Basic knowledge of hydraulics

Rationale:

1. To comprehend types of open channel and their behaviors.
2. To identify types of channels and its requirement.
3. To enable the students to apply the basic principles of flow to design different types of channels.

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	Basic Flow Concepts: Types of channels, classification of flows, basic equations, velocity distribution, velocity coefficients, pressure distribution.	3
2	Energy and momentum principles: Specific energy, critical flow, section factor for critical flow computation, first hydraulic exponent, computation of critical flow, specific force, specific force, channel transitions.	5
3	Uniform flow in rigid boundary channels: Shear stress distribution, velocity distribution in turbulent flow, Chezy's equation, Manning's equation, conveyance of a channel, section factor for uniform flow computation, second hydraulic exponent, computation of uniform flow.	8
4	Uniform flow in mobile boundary channels: Incipient motion condition, shield's analysis, regimes of flow, prediction of regimes, flow resistance.	6
5	Design of channels: Rigid boundary channels, non-scouring channels, alluvial channels.	6
6	Gradually varied flow: Differential equation of GVF, classification and analysis of flow profiles, computation of GVF.	5
7	Hydraulic jump: Types of jump, general equation for jump in prismatic channels, jump in horizontal and slopping rectangular channels, location of hydraulic jump	4
8	Rapidly varied flow: Flow over sharp crested weir, spillways, flow under sluice gate.	4



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Semester-VI

Subject Code: 3160618

9	Unsteady flow: Waves, celerity of small gravity wave, St. Venant's equation, surges in open channels.	3
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Course Outcomes: At the end of the course, Student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Explain types of flow in open channel, velocity and pressure distribution	10
CO-2	Explain specific energy, compute uniform flow, critical flow, section factor and conveyance of channel and its transitions.	15
CO-3	Analyze and design of artificial channels with rigid and mobile boundary	20
CO-4	Classify various flow profiles and compute gradually varied flow profiles in various types of slopes in channel	20
CO-5	Comprehend hydraulic jump, its types and compute initial and sequent depth in case of various channels	20
CO-6	Analyze rapidly varied and unsteady flow in various hydraulic structures and its applications	15

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10%	10%	20%	20%	20%	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:

1. V.T Chow, Open Channel Hydraulics, Mc Graw Hill, 2009.
2. K. Subramanya, Flow in Open Channels, Tata Mc. Graw Hill, 2009 and later ed.
3. K.G. Rangaraju, Flow through Open Channels, Tata Mc. Graw Hill, 1993.
4. M.H Chaudhury, Open Channel Flow, Prentice Hall of India, 2008 and later ed..
5. Rajesh Srivastava, Flow through open channels, Oxford higher education
6. NPTEL Web Resources on Open Channel Flow/Hydraulics

List of Experiments:

1. Establishing uniform flow in an open channel



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2. Determining velocity distribution in open channel
3. Computing carrying capacity/conveyance of an open channel
4. Determination Mannig's/Chezy's constant
5. Hydraulic jump below spillway/ sluice gate
6. Various flow profiles in mild sloped channel

List of Open Source learning website:

1. <http://www.nptel.iitm.ac.in/courses/>

Field Visit :

1. A visit Narmada canal project.
2. A visit to alluvial channel of Gujarat.

GTUQuestionPapers.com



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3160619

Semester – VI

Subject Name: Soft Computing Techniques

Type of course: Open Elective

Prerequisite: A strong mathematical background, Programming skill in C, C++, Proficiency with algorithm

Rationale:

1. To apply the soft computing techniques for solving the problem of civil engineering.
2. To learn fuzzy logic and applications in civil engineering
3. To solve single-objective optimization and its applications using GAs.
4. To understand the Artificial neural network and its 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)	
2	0	2	3	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Introduction to Soft Computing: Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing, Some applications of Soft computing techniques	4
2	Fuzzy logic: Introduction to Fuzzy logic, Fuzzy sets and membership functions, Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications and inferences, Defuzzification techniques, Some applications of Fuzzy logic.	10
3	Genetic Algorithms: Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques, Basic GA framework and different GA architectures, GA operators: Encoding, Crossover, Selection, Mutation, etc. Solving single-objective optimization problems using GAs.	10
4	Artificial Neural Networks: Biological neurons and its working, Simulation of biological neurons to problem solving, Different ANNs architectures, Training techniques for ANNs, Applications of ANNs to solve some real-life problems.	10



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Bachelor of Engineering

Subject Code: 3160619

5	Hybrid Systems: Fuzzy Neural systems, Genetic Fuzzy systems, Genetic Neural system	8
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Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10%	40%	30%	5%	5%	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:

- Fuzzy Logic: A Practical approach, F. Martin, Mc neill, and Ellen Thro, AP Professional, 2000.
- Fuzzy Logic with Engineering Applications (3rd Edn.), Timothy J. Ross, Willey, 2010.
- Foundations of Neural Networks, Fuzzy Systems, and Knowledge Engineering, Nikola K. Kasabov, MIT Press, 1998.
- Fuzzy Logic for Embedded Systems Applications, Ahmed M. Ibrahim, Elsevier Press, 2004.
- An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 2000.
- Genetic Algorithms in Search, Optimization and Machine Learning, David E. Goldberg, Pearson Education, 2002.
- Practical Genetic Algorithms, Randy L. Haupt and sue Ellen Haupt, John Willey & Sons, 2002.
- Neural Networks, Fuzzy Logis and Genetic Algorithms: Synthesis, and Applications, S. Rajasekaran, and G. A. Vijayalakshmi Pai, Prentice Hall of India, 2007.
- Soft Computing, D. K. Pratihari, Narosa, 2008.
- Neuro-Fuzzy and soft Computing, J.-S. R. Jang, C.-T. Sun, and E. Mizutani, PHI Learning, 2009.
- Neural Networks and Learning Machines, (3rd Edn.), Simon Haykin, PHI Learning, 2011.
- Timothy J. Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill
- Simon Haykin, Neural Networks, Prentice Hall
- J.M. Zurada, Introduction to artificial neural systems., Jaico Publishers
- H.J. Zimmermann, Fuzzy set theory and its applications., III Edition, Kluwer Academic Publishers, London.
- Suran Goonatilake, Sukhdev Khebbal (Eds), Intelligent hybrid systems., John Wiley & Sons, New York, 1995
- Goldberg, D. E, Genetic algorithm in search, optimization and machine learning, Addison-Wesley, Reading Mass.
- Kalyanmoy Deb, Optimization for Engineering Design – Algorithms and examples, PHI, New Delhi, ISBN-81-203-0943-x.



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Subject Code: 3160619

Course Outcomes: Students should able to

Sr. No.	CO statement	Weightage
CO-1	Comprehend soft computing techniques and its applications.	15%
CO-2	Understand the artificial neural networks and its applications.	30%
CO-3	Analyze the single-objective optimization problems using GAs.	15%
CO-4	Develop the fuzzy logic sets and membership function and defuzzification techniques.	30%
CO-5	Design the hybrid system for solving the real-life problem of civil engineering	10%

List of Exercise:

1. Problems based on GA and its applications in civil engineering.
2. Problems based on Fuzzy logic and its applications in civil engineering
3. Problems based on ANN and its applications in civil engineering
4. Problems based on hybrid systems and its application in civil engineering.

List of Open Source Software/learning website:

1. Student can refer Open source Code and material available for example
2. <http://www.iitk.ac.in/kangal/codes.shtml>
3. <http://lancet.mit.edu/ga/dist/galibdoc.pdf>
4. https://books.google.co.in/books?hl=en&lr=&id=W5SAhUqBVYoc&oi=fnd&pg=PR11&d=SOft+computing+course+&ots=et_2Nvjy_4&sig=jDXLrGleD3zc4QUxvcEvC5FrFY#v=onepage&q=SOft%20computing%20course&f=false



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3160620

SUBJECT NAME: INSTRUMENTATION AND SENSORS
SEMESTER- VI

Type of course: Program Elective

Prerequisite: Basic Electrical Engineering

Rationale: The objective of this Course is to understand instrumentation, sensor theory and technology, data acquisition, digital signal processing, damage detection algorithm, life time analysis and decision making. This course introduces theoretical and practical principles of design of sensor systems. The topics include: transducer characteristics for acoustic, current, temperature, pressure, electric, magnetic, gravity, salinity, concentration of contaminants, velocity, heatflow, and optical devices, limitations on these devices imposed by building/structure/pavement environments, signal conditioning and recording, noise sensitivity and sampling limitations and standards. Lectures will cover the principles of state-of-the-art systems being used in physical infrastructure/bridges/buildings/pavements, etc.

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	2	3	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Module 1: Fundamentals of Measurement, Sensing and Instrumentation: Definition of measurement and instrumentation, physical variables, common types of sensors; Describe the function of these sensors; Use appropriate terminology to discuss sensor applications and qualitatively interpret signals from a known sensor type, types of instrumentation, Sensor Specifics, Permanent installations, Temporary installations.	10	25%
2	Module 2: Sensor Installation and Operations : Predict the response of sensors to various inputs, Construct a conceptual instrumentation and monitoring program, Describe the order and methodology for sensor installation, Differentiate between types of sensors and their modes of operation and measurement ,Approach to Planning and Monitoring Programs, Define target, Sensor selection, Sensor siting, Sensor Installation & Configuration, Sensor design, Measurement uncertainty.	15	30%
3	Module 3: Data Analysis and Interpretation : Fundamental statistical concepts, Data reduction and interpretation, Piezometer, Inclinator, Strain gauge, etc. Time domain signal processing, Discrete signals, Signals and noise and a few examples of statistical information to calculate Average value (mean), standard deviation, median, mode, range.	10	25%



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4	Module 4: Frequency Domain Signal Processing and Analysis : Explain the need for frequency domain analysis and its principles, Draw conclusions about physical processes based on analysis of sensor data, Combine signals in a meaningful way to gain deeper insight into physical phenomena, Basic concepts in frequency domain signal processing and analysis, Fourier Transform, FFT (Fast Fourier Transform), Example problems: Noise reduction with filters, Leakage, Frequency resolution. Case Study.	10	20%
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Suggested Specification table with Marks (Theory):

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

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. Alan S Morris (2001), Measurement and Instrumentation Principles, 3rd/e, Butterworth Hienemann
2. David A. Bell (2007), Electronic Instrumentation and Measurements 2nd/e, Oxford Press
3. S. Tumanski (2006), Principle of Electrical Measurement, Taylor & Francis
4. Ilya Gertsbakh (2010), Measurement Theory for Engineers, Springer

Course Outcomes: After learning the course the students should be able to:

Sr. No.	Course Outcome	Weightage
CO-1	Specify the requirements in the calibration of sensors and instruments	25%
CO-2	Suggest proper sensor technologies for specific applications	35%
CO-3	Design and set up measurement systems and do the studies	20%
CO-4	Analyze the errors during measurements	20%



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List of Experiments:

1. Instrumentation of typical civil engineering members/structures/structural elements
2. Use of different sensors, strain gauges, inclinometers and their performance characteristics
3. Errors during the measurement process
4. Calibration of measuring sensors and instruments
5. Measurement of noise
6. Analog Signal processing
7. Digital Signal Processing
8. Demonstration & use of sensor technologies

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GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3160621

SUBJECT NAME: EARTHQUAKE ENGINEERING
SEMESTER-VI

Type of course: Professional Elective Course

Prerequisite: Mechanics of Solids, Structural Analysis I, Design of Structure

Rationale: This subject is conceptual applications of principles of dynamics and earthquake resistant design & detailing of RC structures. Some special topics like Earthquake resistant masonry structures, liquefaction, structural controls and seismic strengthening are included aiming students know that these are challenges in this subject. This subject is useful to understand the behaviour of the structure subjected to earthquake forces and earthquake resistant design of the structure.

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	% Weightage
1	Earthquake Basics: Interior of Earth, plate tectonics, faults, consequences of earthquake, Basic parameters of earthquake, seismic waves, magnitude & intensity, scales, Seismic zones of India, damages caused during past earthquakes (worldwide).	4	10
2	Fundamentals of Earthquake Vibrations of buildings Static load v/s Dynamic load, simplified single degree of freedom system, mathematical modelling of buildings, natural frequency, resonance v/s increased response, responses of buildings to different types of vibrations like free and forced, damped and un-damped vibration, response of building to earthquake ground motion, Response to multi degree (maximum three) of freedom systems up to mode shapes.	11	25
3	Design Philosophy: Philosophy of earthquake resistant design, earthquake proof v/s earthquake resistant design, four virtues of earthquake resistant structures (strength, stiffness, ductility and configuration), seismic structural configuration, Introduction to IS: 1893 (Part I) 2016, IS: 875 (Part V). Seismic load: Seismic Coefficient Method – base shear and its distribution along height. Introduction to Response spectrum, IS code provisions.	11	25
4	Lateral Loads on Buildings: Lateral Load Distribution (SDOF): Rigid diaphragm effect, centres of mass and stiffness, torsionally coupled and uncoupled system. Lateral Load Analysis: Analysis of frames using approximate methods like portal & cantilever methods	6	15
5	Ductile Detailing: Concepts of Ductile Design & Detailing of various structural components as per IS:	5	13



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	13920 - 2016 provisions.		
6	Special topics: Introduction to Earthquake Resistant Features of un-reinforced & reinforced masonry Structure, Confined Masonry, Soil liquefaction, Structural controls, Seismic strengthening.	5	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	20	20	5	5

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. Manish Shrikhande & Pankaj Agrawal; Earthquake resistant design of structures, PHI Publication, New Delhi
2. S.K.Duggal; Earthquake resistance design of structures; Oxford University Press, New Delhi.
3. A.K.Chopra; Dynamics of structures , Pearson, New Delhi
4. Clough & Penzin; Dynamics of structures
5. Park & Pauly; Behaviour of RC structure
6. John M.Biggs; Introduction to Structural Dynamics
7. C V R Murthy - Earthquake Tips, NICEE
8. IITK-GSDMA EQ26 – V -3.0 Design Example of a Six Storey Building
9. S S Rao; Mechanical Vibration; Pearson, New Delhi.
10. **IS Codes:**
 - a) Criteria for earthquake resistant design General provision & Building - IS: 1893 (Part I)- 2016
 - b) Code of Practice for Ductile Detailing of RC Structures - IS: 13920 (2016).
 - c) Code of Practice for earthquake resistant design & Construction of buildings – IS 4326 (2013).
 - d) Improving Earthquake Resistance of Earthen Buildings - IS 13827(1993) (R 2006)
 - e) Guide lines for Improving Earthquake Resistance low strength masonry buildings - IS 13828 (1993) (R2008)

Course Outcome:

After learning the course the students should be able to:

Sr.	CO statement	Marks % weightage
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No.		
CO-1	Identify the causes of damages in structures during earthquake events	10
CO-2	Determine the response of SDOF & MDOF structural system subjected to vibration including earthquake	25
CO-3	Apply the concept of Earthquake Resistant Design & concept of lateral load distribution on buildings in design of RC structures	25
CO-4	Determine the lateral forces generated in the structure due to earthquake.	15
CO-5	Apply the concept of ductile detailing in RC structures & the concepts ERD to Masonry structures with knowledge of advanced technology	25

Term Work :

Term work shall consist of satisfactory completion and submission of following list of Practicals/Tutorials.

List of Experiments:

Following experiments should be carried out in laboratory.

1. Spring Mass model
2. Mode shapes of multi-storey building
3. Response of structure with & without Shear wall and bracing system
4. Response of building with re-entrant corner
5. Behaviour of structure under pounding
6. (a) Liquefaction potential of clayey & sandy soil (b) Response of structure with isolated, raft & pile foundation under liquefaction

Practical examinations shall consist of oral based on the term-work and above course.

Major Equipment:

1. Shake table to simulate earthquake
2. Models required to perform above experiments

List of Open Source Software/learning website:

1. www.nicee.org
2. www.eeri.org
3. www.gsdma.org
4. www.ndma.gov.in
5. www.nptel.iitm.ac.in/courses
6. www.nisee.berkeley.edu/elibrary/getpkg?id=NONLIN