

**PROGRAMME REQUIREMENT
DEPARTMENT OF CIVIL ENGINEERING
M.TECH. (ENVIRONMENTAL ENGINEERING)**

OVERALL CREDIT STRUCTURE

Postgraduate core (PC)		Postgraduate Elective (PE)	
Category	Credit	Category	Credit
DC	74	DE	30
Total	74	Total	30
Grand Total PC + PE 104			

Course Code	Course	Structure	Credits
Departmental Core, DC			
MAL 4xx	Statistics and O. R. Techniques *	3-0-0	6
CEL 501	Environmental Chemistry & Microbiology	3-0-0	6
CEL 502	Municipal and Industrial Water Treatment *	3-0-0	6
CEP 501	Environmental Monitoring Laboratory-I.	0-0-2	2
CEL 503	Municipal Wastewater Treatment	3-0-0	6
CEL 504	Water Supply and Wastewater Collection Systems	3-0-0	6
CEL 405	Industrial Wastewater Treatment, Recycle & Reuse	3-0-0	6
CEL 505	Municipal Solid Waste Management	3-0-0	6
CEL 506	Air Pollution Control	3-0-0	6
CED 501	Project Phase I	-	6
CED 502	Project Phase II	-	18
			74
Departmental Elective, DE			
CEL 507	Environmental Engineering System Design *	0-0-0	2
CEL 508	Environmental Geotechnics	3-0-0	6
CEL 509	Bioremediation : Principles & Applications *	3-0-0	6
CEL 510	Environmental Management	3-0-0	6
CEL 511	Environmental Engineering Systems Optimization	3-0-0	6
CEL 417	Hazardous Waste Management *	3-0-0	6
CEL 512	Environmental Biotechnology	3-0-0	6
CEL 513	Environmental Systems Modelling	3-0-0	6
CE – 5xx	Seminar *	0-0-0	2
CEP-502	Environmental Monitoring Laboratory-II *	0-0-2	2
CEL 412	Spatial analysis for Resources Management *	3-0-0	6
CEL 418	Energy Conversion & Environment *	3-0-0	6
CEL 432	Environmental Impact Assessment	3-0-0	6
CEL 3xx	Energy Efficient Buildings	3-0-0	6

* Subject to Senate Approval

Department : Civil Engineering

Course No.	MAL4xx	Open Course (Y/N)	HM Course (Y/N)	Discontinued (Y/N)
Course Title	Statistics & O.R. Techniques			
Course Coordinator	Dr. G. P. Singh			
Slot in which offered. If not offered write N	Odd		Even	
	A			
Structure	Lecture	Tutorial	Practical	Credits
	3	0	0	6
Prerequisite Course Codes As per proposed				
Prerequisite Credits				
Equivalent Course Codes. As per proposed Courses & Old courses				
Overlap Course Codes As per proposed Course numbers				
Text Book (max. 2)	Title	Probability and Statistics		
	Author	M.R. Spiegel		
	Publisher	McGraw Hill		
	Title	Operation Research		
	Author	H.A. Taha		
Reference Books	Publisher	Prentice Hall of India Pvt. Ltd.		
	Title	Introduction to Optimisation : Operations Research		
	Author	J.C. Pant		
	Publisher	Jain Brothers, New Delhi		
	Edition			
	Title	Probability and Statistics for Engineers		
Content	Author	Miller and Freund		
	<p>Statistics Sampling Theory : Population Parameter, Sample Statistics, Sampling distributions, Sample mean, Sampling distribution of means, the sample variance, the sampling distribution of variance. Estimation Theory: Point estimate and interval estimates, reliability, confidence interval estimates of population parameters, confidence intervals for means, proportions and variance. Tests of Hypothesis and Significance: Statistical decisions, tests of hypotheses and significance, Type I and Type II errors, level of significance, one tailed and two tailed tests. Tests involving small samples and large samples, fitting theoretical distributions to sample frequency distribution, The chi-square test for goodness of fit.</p> <p>O. R. Techniques Linear Programming: Formulation of linear programming problem, Graphical solution- simplex method (including Big M method and two phase method), dual problem- duality theory, dual simplex method, revised simplex method. Transportation problem: existence of solution-degeneracy- MODI method; Assignment problem- traveling salesman problem Nonlinear programming problem (NLPP): Constrained NLPP, Lagrange's multipliers method – convex NLPP, Kuhn-Tucker conditions.</p>			
Course No.				

Head of the Department of Civil Engg

Course No.	CEL 501	Open Course (Y/N)	HM Course (Y/N)	Discontinued (Y/N)	
Course Title	Environmental Chemistry & Microbiology				
Course Coordinator	Dr. (Mrs.) M. V. Latkar				
Slot in which offered. If not offered write N	Odd		Even		
	G		-		
Structure	Lecture	Tutorial	Practical	Credits	
	3	0	0	6	
Prerequisite Course Codes As per proposed Course Numbers	-				
Prerequisite credits					
Equivalent Course Codes. As per proposed courses and old courses	CEL498				
Overlap course codes As per proposed Course Numbers					
Text Book (Max. 2)	Title	Chemistry for Environmental Engineers			
	Author	C. N. Sawyer and P. L. McCarty			
	Publisher	McGraw Hill			
	Edition	Latest			
	Title	Microbiology			
	Author	Pelezar Reid & Chan			
	Publisher	Tata McGraw Hill			
	Edition	Latest			
Reference Books	Title	General Microbiology Vol. I &II			
	Author	Powar & Daginawala			
	Publisher	Himalaya Publishing House			
	Edition	Latest			
	Title				
	Author				
	Publisher				
	Edition				
	Title				
	Author				
	Publisher				
	Edition				
	Title				
	Author				
Publisher					
Edition					

	Title	
	Author	
	Publisher	
	Edition	
	Title	
	Author	
	Publisher	
	Edition	
Content	<p>Basic concepts of oxidation and reduction reactions, Gas laws and their application in Environmental Engineering, Osmosis, Dialysis, Principles of solvent extraction, Amphoteric hydroxides.</p> <p>Concept of pH, and its application in Environmental Engineering, Definitions and basic concepts of acids, bases and buffers, colloid chemistry, Basic concepts of carbohydrates, proteins, lipids and enzymes, Definition and concept of Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD) and Total Organic Carbon (TOC).</p> <p>Chemistry of water treatment processes like coagulation, disinfection, water softening and demineralization.</p> <p>Definitions of Ecology and ecosystem, structure and components of ecosystem, concepts of trophic levels, food chain and food web, types of ecosystem, productivity, sulphur cycle, nitrogen cycle.</p> <p>Introduction to Microbiology, Haeckel's classification, Morphology and structure of bacteria, nutritional requirement and nutritional classification of bacteria, Growth of bacteria, Indicator bacteria, Multiple Tube Dilution (MTD) and Membrane Filter (MF) techniques, Definition and characteristics of viruses.</p>	
Course No.	CEL 501	

Head of The Department of Civil Engineering

Department : Civil Engineering

Course No.	CEL 502	Open Course (Y/N)	HM Course (Y/N)	Discontinued (Y/N)
Course Title	MUNICIPAL AND INDUSTRIAL WATER TREATMENT			
Course Coordinator	Dr. A. R. Tembhurkar			
Slot in which offered. If not offered write N	Odd		Even	
	F		-	
Structure	Lecture	Tutorial	Practical	Credits
	3	0	0	6
Prerequisite Course Codes As per proposed Course Numbers	-			
Prerequisite credits				
Equivalent Course Codes. As per proposed courses and old courses	-			
Overlap course codes As per proposed Course Numbers Text Book (Max. 2)				
	Title	Water and Waste water Engineering Vol I and II		
	Author	Fair Geyer & Okun		
	Publisher	John Wiley & Sons		
	Edition	1 st		
	Title	Physiochemical process for water quality control		
	Author	W.J.Weber		
	Publisher	John Wiley & Sons		
	Edition	2 nd		
	Reference Books	Title	Water treatment plant design	
Author		ASCE, AWWA		
Publisher				
Edition				
Title		Manual on Water supply and Treatment		
Author		CPHEEO		
Publisher		Govt. of India Publication		
Edition				
Title		Water treatment plant for practising engineers		
Author		R.L.Sank		
Publisher		Ann Arbor Science		
Edition				

Content	Water quality criteria and standards, Requirement of water treatment facilities, Unit operation & Unit process, Synthesizing water treatment system, Site selection, Process selection, Theory and Application of water treatment process- aeration, coagulation, flocculation, sedimentation, filtration, disinfection. Hydraulic design of water treatment plant, Advances/ modification/ modern development in water treatment, Control of water treatment process, O&M of water treatment plant, Water treatment plant residuals management. Industrial Water Quality requirement, Specific treatment for industrial purpose; Softening, Lime Soda and Ion Exchange, Desalination- Distillation processes, Reverse Osmosis, Electrodialysis; Flouride Removal, Arsenic Removal, Fe and Mn removal, Taste and Odor and color Removal, Adsorption, Ultrafiltration, Water treatment for Swimming Pool.
Course No.	CEL 502

Head of The Department of Civil Engineering

Department : Civil Engineering

Course No.	CEP 501	Open Course (Y/N)	HM Course (Y/N)	Discontinued (Y/N)
Course Title	Environmental Monitoring Laboratory – I			
Course Coordinator	Dr. (Mrs.) M. V. Latkar			
Slot in which offered. If not offered write N	Odd		Even	
	G1, G3		-	
Structure	Lecture	Tutorial	Practical	Credits
	0	0	2	2
Prerequisite Course Codes As per proposed Course Numbers	-			
Prerequisite credits				
Equivalent Course Codes. As per proposed courses and old courses	CEP452			
Overlap course codes As per proposed Course Numbers				
Text Book (Max. 2)	Title			
	Author			
	Publisher			
	Edition			
	Title			
	Author			
	Publisher			
	Edition			
Reference Books	Title	Standard Methods for the Examination of Water & Wastewater		
	Author	-		
	Publisher	APHA, AWWA, WEF		
	Edition	Latest		
	Title			
	Author			
	Publisher			
	Edition			
	Title			
	Author			
	Publisher			
	Edition			
	Title			
	Author			
Publisher				
Edition				

	Title	
	Author	
	Publisher	
	Edition	
	Title	
	Author	
	Publisher	
	Edition	
Content	I) Determination of following parameters in water 1) Alkalinity 2) Chloride 3) Hardness 4) Sulphate 5) Turbidity 6) Dissolved oxygen 7) Kjeldahl nitrogen 8) Iron 9) Manganese 10) Heavy metals II) Determination of COD and BOD of wastewater III) MTD method for enumeration of indicator bacteria in water IV) Heterotrophic plate count for enumeration of bacteria	
Course No.	CEP 501	

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Department : Civil Engineering

Course No.	CEL503	Open Course (Y/N)	HM Course (Y/N)	Discontinued (Y/N)
Course Title	MUNICIPAL WASTEWATER TREATMENT			
Course Coordinator	Dr. V.A. Mhaisalkar			
Slot in which offered. If not offered write N	Odd		Even	
Structure	C			
	Lecture	Tutorial	Practical	Credits
	3	0	0	6
Prerequisite Course Codes As per proposed				
Prerequisite Credits				
Equivalent Course Codes. As per proposed Courses & Old courses				
Overlap Course Codes As per proposed Course numbers				
Text Book (max. 2)	Title	Wastewater Engineering, Treatment, Disposal and Reuse		
	Author	Metcalf and Eddy		
	Publisher	McGraw Hill		
	Edition	Fourth Edition, 2002		
	Title	Wastewater Treatment and Disposal		
	Author	S.J. Arceivala		
	Publisher	Marcel Dekker		
Reference Books	Title	Introduction to Environmental Engineering		
	Author	Davis & Cornwell		
	Publisher	McGraw Hill		
	Edition	International, 1998		
	Title	Wastewater Treatment Plant Planning, Design and Operation		
	Author	Qasim S.R		
	Publisher	Holt Rinehart & Winston, N. Y		
Content	Edition	1990		
	<p>Objectives of municipal wastewater treatment, constituents of sewage and sewage characteristics, conventional municipal wastewater treatment flow sheet, functions of different unit processes, treatment requirements. Process analysis : Reaction and reaction kinetics, mass balance analysis, reactors and hydraulic characteristics, reactor selection, practical aspects of reactor design.</p> <p>Preliminary treatment : Screening grit removal; Primary Treatment : Principles of sedimentation</p> <p>Biological treatment : Principles of biological treatment, Role of microorganisms in WWT, types of biological processes for WWT, introduction to microbial metabolism, kinetics of biological growth, aerobic and anaerobic treatment of sewage, suspended and attached growth biological treatment processes - Activated sludge, tricking filters, biological disc. Packed bed and fluidized bed treatment, stabilization ponds, combined biological treatment processes.</p> <p>Biological phosphorus and nitrogen removal</p> <p>Sludge treatment : Sludge treatment flowsheets, sludge quality and quantity, various methods of sludge treatment,</p>			

	<p>aerobic and anaerobic sludge digestion, sludge conditioning, dewatering of sludge, conveyance, storage and disposal.</p> <p>Water reclamation technologies</p> <p>Advanced waste water treatment : Principles of tertiary treatment, Reuse and resource recovery, and recent developments.</p>
Course No.	CEL503

Department : Civil Engineering

Course No.	CEL 504	Open Course (Y/N)	HM Course (Y/N)	Discontinued (Y/N)
Course Title	Water Supply and Wastewater Collection Systems			
Course Coordinator	Dr. Rajesh Gupta			
Slot in which offered. If not offered write N	Odd	Even		
	D	-		
Structure	Lecture	Tutorial	Practical	Credits
	3	0	0	6
Prerequisite Course Codes As per proposed Course Numbers	-			
Prerequisite credits				
Equivalent Course Codes. As per proposed courses and old courses	CEL 499			
Overlap course codes As per proposed Course Numbers				
Text Book (Max. 2)	Title	Analysis of Water Distribution Networks		
	Author	Bhave P. R. And Gupta R.		
	Publisher	Narosa Publishing Co., New Delhi (2006)		
	Edition	-		
	Title	Water & Wastewater Engg. Vol. I & II		
	Author	Fair G. M., Geyer J. C. & Okun D. A.		
	Publisher	John-Willey & Sons, New York		
	Edition	-		
Reference Books	Title	Wayter supply and saewerage		
	Author	McGhee N. J. & Steel E. W.		
	Publisher	McGraw hill publications		
	Edition	1991		
	Title	Manual on water supply and treatment		
	Author	CPHEEO		
	Publisher	Ministry of urban development , GoI		
	Edition	-		
	Title	Manual on Sewerage and Sewage Treatment		
	Author	CPHEEO		
	Publisher	Ministry of urban development , GoI		
	Edition	-		
	Title	Optimal design of water distributiomn networks		
	Author	Bhave P.R.		
	Publisher	Narosa Publishing Co., New Delhi (2003)		
	Edition	-		

	Title	
	Author	
	Publisher	
	Edition	
	Title	
	Author	
	Publisher	
	Edition	
Content	<p>Analysis of flow in pipe network using Hardy Cross, Newton-Raphson and Linear Theory method, Reservoirs, Pumps and Valves in Water distribution systems, Pumps and Pumping Stations, Pipe Appurtenances, Pipe material selection, laying and jointing of pipes, Water supply to multi-storeyed buildings, Water supply during fairs, festivals and emergencies. Maintenance of distribution system.</p> <p>Design of pumping main including water hammer consideration, Critical path method for design of water distribution networks.</p> <p>Objectives, Type of systems and sewers, requisites for sewerage system design, Hydraulics of sewers, Velocity of equal cleansing, Sewer shape vis-a-vis their usefulness, sewer invert drop.</p>	
Course No.	CEL 504	

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Department : Civil Engineering

Course No.	CEL 405	Open Course (Y/N)	HM Course (Y/N)	Discontinued (Y/N)
Course Title	INDUSTRIAL WASTE WATER TREATMENT, REUSE AND RECYCLING			
Course Coordinator	Dr. A. R.Tembhurkar			
Slot in which offered. If not offered write N	Odd		Even	
	-		E	
Structure	Lecture	Tutorial	Practical	Credits
	3	0	0	6
Prerequisite Course Codes As per proposed Course Numbers	Environmental Engg - I			
Prerequisite credits				
Equivalent Course Codes. As per proposed courses and old courses	CEL454			
Overlap course codes As per proposed Course Numbers				
Text Book (Max. 2)	Title	Theories and Practices of Industrial Waste Treatment		
	Author	Nemerow N.L		
	Publisher	Addison Wesley Publishing CO. NY.		
	Edition	2 nd		
	Title	Industrial Water Pollution Control		
	Author	W.W.Ecenfelder		
	Publisher	Mc-Graw Hill Book Co.		
	Edition	2 nd		
Reference Books	Title	Industrial Pollution Prevention Handbook		
	Author	Freeman H. M.		
	Publisher	McGraw Hill		
	Edition	1 st		
	Title	Comprehensive Industry Document Series		
	Author	Central Pollution Control Board, India		
	Publisher			
	Edition			
	Title	The Treatment of Industrial Waste		
	Author	E.B. Besselievre		
	Publisher	Mc-Graw Hill Book Co.		
	Edition	1 st		
Content	Industrial pollution and its measurement; Generation of Industrial wastewater, Disposal standards; Quantification and characterization of wastewater and			

	<p>its variations; Environmental impacts due to discharge of wastewater on streams, land and sewerage system; Industrial waste survey; Stream sanitation, stream sampling, Stream survey; Principles and techniques for Industrial Pollution prevention and control; Waste minimization; recent trends in industrial waste management, Cleaner technologies; Reuse, Recycling and Resource recovery; Volume and strength reduction; Equalization and proportioning; Neutralization; Methods of Disposal and treatment for removal of organic, inorganic, solids, pathogens, heavy metals and other pollutants; Alternatives and Synthesizing industrial waste treatment system; Joint treatment of industrial waste; CETP; Pollution control measures and Treatment of wastes from various industries viz. Pulp and paper, tanning, Sugar, Dairy, Chemical, Cement, Petroleum, Fertilizers, Metal Finishing, Etc.</p>
Course No.	CEL 405

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Department : Civil Engineering

Course No.	CEL 505	Open course (Y/N)	HM Course (Y?N)	Discontinued (Y/N)
Course Title	Municipal solid waste management			
Course Coordinator	Prof. R. R. Gawalpanchi			
Slot in which offered. If not offered write N	Odd		Even	
	-		G	
Structure	Lecture	Tutorial	Practical	Credits
	3	0	0	6
Prerequisite Course Codes As per proposed Course Numbers	-			
Prerequisite credits	-			
Equivalent Course Codes. As per proposed courses and old courses	CEL453			
Overlap course codes As per proposed Course Numbers				
Text Book (Max. 2)	Title	Solid Waste Management, Collection, Processing and Disposal		
	Author	Bhide A.D., Sundaresan B.B		
	Publisher	Mundrashilp offset printers, Nagpur		
	Edition	2001		
	Title	Solid Waste Engineering		
	Author	Vesilind A. P., Worrell W., Reinhart		
	Publisher	Thomson Books Cole.		
Reference Books	Edition	2002		
	Title	Integrated Solid Waste Management Engineering Principles and Management Issues		
	Author	Techobanoglous G., Theisen H, Vigil S.A.		
	Publisher	Tata McGraw Hill International Editions Civil Engg. Series,		
	Edition	1993		
	Title	CPHEEO manual on municipal solid waste managemnt		
	Author	CPHEEO, MoUD		
	Publisher	GoI, New Delhi		
	Edition			
	Title	Sanitary landfill leachate generation control and treatment		
	Author	Syed R. Qasim, Walterchiang		
	Publisher	Techromic publishing co. Inc.		
Edition	1994			

	Title	Design of landfills & integrated solid waste management
	Author	Amalendu bagchi
	Publisher	John wiley & sons. Inc.
	Edition	
	Title	A text book of environmental chemistry and pollution control
	Author	S. S. Dara
	Publisher	S. Chand & Co. Ltd.
	Edition	2002
	Title	Municipal refuse disposal
	Author	American public works association
	Publisher	Public administration service, Chicago
	Edition	1970
Content	<p>Sources, Classification, Composition – Quality – characteristics-Physical, Chemical and microbiology involved , Quantity-generation of municipal refuse, per capita contribution, Density, Sampling; Collection and transportation of waste-refuse transportation vehicles ; optimization of routes, maintenance of vehicles; industrial waste management; reduction, Recycle, Reuse, Recovery and Reporting; hazardous waste management;</p> <p>Disposal of waste by land filling, site selection, leachate and gas collection, lining; composting of waste, methods, factors affecting, Incineration, types, energy recovery and products of incineration; Processing of waste for useful products-pyrolysis, RDF; Legislation and regulatory trends</p>	
Course No.	CEL 505	

Head of The Department of Civil Engineering

Department : Civil Engineering

Course No.	CEL 506	Open Course (Y/N)	HM Course (Y/N)	Discontinued (Y/N)
Course Title	Air Pollution Control			
Course Coordinator	Prof. R. R. Gawalpanchi			
Slot in which offered. If not offered write N	Odd		Even	
	E		-	
Structure	Lecture	Tutorial	Practical	Credits
	3	0	0	6
Prerequisite Course Codes As per proposed Course Numbers	-			
Prerequisite credits	-			
Equivalent Course Codes. As per proposed courses and old courses	CEL457			
Overlap course codes As per proposed Course Numbers				
Text Book (Max. 2)	Title	Air Pollution		
	Author	Rao M.N. and Rao H.V. N.		
	Publisher	Tata Mc-Graw Hill Publsihing Co. New Delhi,		
	Edition	Third Edition, 1992		
	Title	A textbook of air pollution & control technology		
	Author	Y. Anjaneyulu		
	Publisher	Allied publishers		
	Edition			
Reference Books	Title	Air Pollution control Engineerg.		
	Author	Nevers N.D		
	Publisher	Editions Civil Engineering series,		
	Edition	1995		
	Title	Environmental Pollution Control Engg.		
	Author	Rao C.S.		
	Publisher	New Age International Pvt. Ltd. publishers,		
	Edition	2006		
	Title	Air pollution		
	Author	Stern A. C.		
	Publisher	Tata McGraw Hill International		
	Edition	Vol I to IX		
	Title	Air Pollution		
	Author	Kudesia v. P.		
Publisher	Pragati prakashan, meerut			
Edition	2 nd 1980			

	Title	
	Author	
	Publisher	
	Edition	
	Title	
	Author	
	Publisher	
	Edition	
Content	<p>Sources, Classification, Causes and effects of air pollution; Metrological parameters of dilution, dispersion, distribution of emission of stack pollutants, Air quality monitoring, sampling and analysis of air from ambient and other sources of pollutants, Monitoring Instrumentation and principles of operation, Exhaust pollution, Control equipment for gaseous and particulate pollutants, Legislation and regulatory trends, Impacts of air pollution.</p>	
Course No.	CEL 506	

Head of The Department of Civil Engineering

Course No.	CEL507	Open Course (Y/N)	HM Course (Y/N)	Discontinued (Y/N)
Course Title	Environmental Engineering System Design			
Course Coordinator	Dr. V.A. Mhaisalkar			
Slot in which offered. If not offered write N	Odd		Even	
	N		N	
Structure	Lecture	Tutorial	Practical	Credits
	0	0	0	2
Prerequisite Course Codes As per proposed				
Prerequisite Credits				50
Equivalent Course Codes. As per proposed Courses & Old courses				
Overlap Course Codes As per proposed Course numbers				
Text Book (max. 2)	Title	Wastewater Treatment Plant Planning, Design and Operation		
	Author	Qasim S.R		
	Publisher	Holt Rinehart & Winston, N. Y		
	Edition	1990		
	Title	Water Treatment Plant Design		
	Author	Dr. A.G. Bhole		
	Publisher	Indian Water works Association		
Edition	1 st			
Reference Books	Title	Design of landfill & Integrated Solid waste Management		
	Author	Amalendu Bagchi		
	Publisher	John Willey & Sons, Inc.		
	Edition	2 nd		
Content	Design aspects of water and waste water systems ranging from pipeline to treatment plant; sanitary landfill; a detailed design of atleast one unit will be completed as either an individual or class project			
Course No.	CEL507			

Head of the Department of Civil Engg.

Department : Civil Engineering

Course No.	CEL 508	Open Course (Y/N)	HM courses (Y/N)	Discontinued (Y/N)		
Course Title	ENVIRONMENTAL GEO-TECHNICS					
Course Coordinator	Prof. D. J. Katyayan					
Slot in which offered. If not offered write N	Odd		Even			
	B		-			
Structure	Lecture	Tutorial	Practical	Credits		
	3	0	0	6		
Prerequisite Course Codes As per proposed Course Numbers	CEL 501					
Prerequisite credits						
Equivalent Course Codes. As per proposed courses and old courses	CEL456					
Overlap course codes As per proposed Course Numbers	-	-	-	-		
Text Book (Max. 2)	Title	Geotechnical Practice for Waste Disposal				
	Author	Daniel, D. E.				
	Publisher	Chapman and Hall, London				
	Edition	1993				
	Title	Geoenvironmental Engineering - Principles and Applications				
	Author	Reddi, L. N., and Inyang, H. F.				
	Publisher	Marcel Dekker, Inc.,				
	Edition	2000				
	Reference Books	Title	Introduction to Environmental Geotechnology,			
		Author	Hsai-Yang Fang			
Publisher		CRC Press,				
Edition		1997.				
Content	Title	Journals & research Papers				
		<ol style="list-style-type: none"> 1. Source, Production and Classification of Wastes. 2. Soil Pollution Processes; Physical-chemical and Biological Interactions in Soil. 3. Effects on Geotechnical Properties and Case Studies. 4. Waste Disposal Facilities such as Landfills and Impoundments, Slurry walls, etc. 5. Barrier Systems- Basic concepts, Stability, compatibility and performance, Geo-membranes. 6. Monitoring Sub surface contamination; Stabilization/ Solidification of Wastes. 7. Remediation Methods 				
Course No.	CEL 5xx					

Department : Civil Engineering

Course No.	CEL 509	Open Course (Y/N)	HM course (Y/N)	Discontinued (Y/N)	
Course Title	Bioremediation: Principles and Applications				
Course Coordinator					
Slot in which offered. If not offered write N	Odd		Even		
	A		-		
Structure	Lecture	Tutorial	Practical	Credits	
	3	0	0	6	
Prerequisite Course Codes As per proposed Course Numbers	-				
Prerequisite credits					
Equivalent Course Codes. As per proposed courses and old courses	-				
Overlap course codes As per proposed Course Numbers					
Text Book (Max. 2)	Title	Bioremediation			
	Author	Baker H. and Herson D.S.			
	Publisher	McGraw Hill			
	Edition	1994			
	Title	Bioremediation Principles			
	Author	Eweis J.B., Ergas S.J., Chang D.P.Y. and Schroeder E.D.			
	Publisher	McGraw Hill			
	Edition	1998			
Reference Books	Title				
	Author				
	Publisher				
	Edition				
	Title				
	Author				
	Publisher				
	Edition				
	Title				
	Author				
	Publisher				
	Edition				
	Title				
	Author				
	Publisher				
	Edition				

	Title	
	Author	
	Publisher	
	Edition	
	Title	
	Author	
	Publisher	
	Edition	
Content	<p>An overview of the current bioremediation practice and its application: Microbial system of bioremediation, Factors influencing bioremediation, Environmental factors (physical and chemical). Microbial transformation reactions: Aerobic and anaerobic biotransformation, Microbial detoxification of specially chemicals like insecticides, herbicides, fungicides, polychlorinated biphenyls, heavy metals. Response of microorganisms to the presence of pollutants: Inducible degradative enzymes and mechanics, Application of genetically engineered microorganisms for hazardous waste management. Bioremediation systems and process: Solid and slurry phase bioremediation (land farming, composting, slurry bioreactors and lagoons), Microbial cleaning of gases (biofiltration and bioscrubbing), Liquid phase bioremediation. In-situ bioremediation: Assessment for an in-situ bioremediation, Microbial activity, Sub-surface delivery systems, In-situ oxygenation. Management of bioremediation projects: Defining project goals, Project team, Review of remediation, Supportive elements of projects.</p>	
Course No.	CEL 509	

Head of The Department of Civil Engineering

Course No.	CEL510	Open Course (Y/N)	HM Course (Y/N)	Discontinued (Y/N)
Course Title	ENVIRONMENTAL MANAGEMENT			
Course Coordinator	Dr. V.A. Mhaisalkar			
Slot in which offered. If not offered write N	Odd		Even	
	D			
Structure	Lecture	Tutorial	Practical	Credits
	3	0	0	6
Prerequisite Course Codes As per proposed				
Prerequisite Credits				
Equivalent Course Codes. As per proposed Courses & Old courses				
Overlap Course Codes As per proposed Course numbers				
Text Book (max. 2)	Title	Corporate Environmental Management Systems and Strategies		
	Author	Richard Welford		
	Publisher	Universities Press(I) Ltd. , Hyderabad		
	Edition	1996		
	Title	Pollution Prevention : Fundamental and Practice		
	Author	Paul L. Bishop		
	Publisher	McGraw Hill		
	Edition	International, 2000		
Reference Books	Title	Industrial Pollution Prevention Handbook		
	Author	Freeman, H.M.,		
	Publisher	McGraw Hills		
	Edition	1995		
Content	Sustainable development and strategies, Waste minimization and pollution prevention strategies – cleaner technologies, Tools of corporate environmental management; Environmental policy, Environmental management systems; ISO : 14000; Environmental Impact assessment, Indian environmental legislations and environmental acts such as Water Act (1974), Air Act (1981), Environmental (Protection) Act (1986); International Environmental Treaties; Life cycle assessment; environmental labeling, environmental audit, Environmental performance assessment; regulatory standards for industrial wastewaters and atmospheric emission.			
Course No.	CEL510			

Head of the Department of Civil Engg.

Course No.	CEL 511	Open Course (Y/N)	HM Course (Y/N)	Discontinued (Y/N)	
Course Title	Environmental Engineering Systems Optimization				
Course Coordinator	Dr. Rajesh Gupta				
Slot in which offered. If not offered write N	Odd		Even		
	-		F		
Structure	Lecture	Tutorial	Practical	Credits	
	3	0	0	6	
Prerequisite Course Codes As per proposed Course Numbers	-				
Prerequisite credits	-				
Equivalent Course Codes. As per proposed courses and old courses	CEL551				
Overlap course codes As per proposed Course Numbers					
Text Book (Max. 2)	Title	Environmental systems optimization			
	Author	Haith D. A.			
	Publisher	John Willey , New York			
	Edition	1982			
	Title	Optimal design of eater distribution networks			
	Author	Bhave P.R.			
	Publisher	Narosa Publishing Co., New Delhi			
	Edition				
Reference Books	Title	Optimization for engineering design			
	Author	Kalyanmoy Deb			
	Publisher	Practice Hall			
	Edition				
	Title	Water resources systems-modelling techniques and analysis			
	Author	Vedula S. And Majumdar Y. P.			
	Publisher	McGraw Hills Co.			
	Edition				
	Title				
	Author				
	Publisher				
	Edition				
	Title				
	Author				
Publisher					
Edition					

	Title	
	Author	
	Publisher	
	Edition	
	Title	
	Author	
	Publisher	
	Edition	
Content	Principles of economic analysis, mathematics of economic analysis, discounting factors and different discounting techniques. Optimization methods for environmental engg. Systems e.g. pumping main, water transmission & distribution networks, wastewater collection systems, water treatment systems, wastewater treatment systems, solid waste management systems and air pollution control systems.	
Course No.	CEL 511	

Head of The Department of Civil Engineering

Course Content Proforma

Department: Civil Engineering

Course No.:	CEL417	Open Course (Y/N)	HM Course (Y/N)	Discontinued (Y/N)	
Course Title: Hazardous Waste Management					
Course Coordinator: Dr. Dilip H. Lataye					
Slot in which offered, if not offered write N	Odd		Even		
	B				
Structure	Lecture	Tutorial	Practical	Credits	
	3	0	0	6	
Prerequisite Course Codes As per proposed Course numbers					
Prerequisite Credits					
Equivalent Course Course Codes. As per proposed Courses & old courses					
Overlap Course Codes As per proposed Course numbers					
Text Book (Max. 2)		Title	Hazardous Waste Management,		
		Author	M. D. LaGrega, P.L.Buckingham and J.C.Evans		
		Publisher	McGraw-Hill, Inc., New York		
		Edition	1994		
		Title	International Perspective on Hazardous Waste Management,		
		Author	W.S.Forester and J.H.Skinner		
		Publisher	Mudra Offset Printers, Bajaj Nagar Nagpur		
		Edition	2001		
		Title	Hazardous Waste Management,		
		Author	G.W.Dawson and B.W.Mercer,		
Publisher	Academic Press, Inc., London, England				
Edition	1987				
Reference Books		Title	Standard Handbook of Hazardous Waste Treatment and Disposal		
		Author	H.M.Freeman		
		Publisher	McGraw-Hill, Inc., New York		
		Edition	1989		
		Title	Hazardous Waste Management Engineering,		
		Author			

	Author	E.J.Martin and J.H.Johnson, Jr.,
	Publisher	Van Nostrand Reinhold Co. Inc. New York.
	Edition	1987
Content	Generation, storage, transportation, treatment, disposal, exchanges and minimization, legislative and technical aspects, current management practices; Environmental audits, pollution prevention, facility development and operations, treatment and disposal methods; physical, chemical, thermal, biological processes, land disposal with general applications to the industrial and energy-producing sectors, Site remediation. Special wastes, such as, infectious and radioactive waste.	
Course No.	CEL417	

Department : Civil Engineering

Course No.	CEL 512	Open Course (Y/N)	HM Course (Y/N)	Discontinued (Y/N)	
Course Title	Environmental Biotechnology				
Course Coordinator	Dr. (Mrs.) M. V. Latkar				
Slot in which offered. If not offered write N	Odd		Even		
	-		H		
Structure	Lecture	Tutorial	Practical	Credits	
	3	0	0	6	
Prerequisite Course Codes As per proposed Course Numbers	Environmental Chemistry & Microbiology				
Prerequisite credits					
Equivalent Course Codes. As per proposed courses and old courses	CEL499				
Overlap course codes As per proposed Course Numbers					
Text Book (Max. 2)	Title				
	Author				
	Publisher				
	Edition				
	Title				
	Author				
	Publisher				
	Edition				
Reference Books	Title	Concepts in Biotechnology			
	Author	Balasubramaniyan et al.			
	Publisher	Sangam Books ltd.			
	Edition	Latest			
	Title	Text book of Biotechnology			
	Author	Dubey			
	Publisher				
	Edition	Latest			
	Title				
	Author				
	Publisher				
	Edition				
	Title				
	Author				
	Publisher				
	Edition				

	Title	
	Author	
	Publisher	
	Edition	
	Title	
	Author	
	Publisher	
	Edition	
Content	<p>Basic concepts of Microbial Biochemistry of carbohydrates, proteins and fats; structure of nucleic acids Deoxyribose nucleic acid - DNA and Ribose nucleic acid - RNA</p> <p>Basic concepts of biodegradation, biotransformation, bioleaching and biobeneficiation; Different types of microbial associations or interactions.</p> <p>Environmental monitoring – significance of monitoring bacterial, viral and protozoan pathogens; Techniques of monitoring – gene probes, biosensors and immunoassay.</p> <p>Basic concepts of Genetic Engineering – genes, chromosomal DNA, plasmid DNA, replication of DNA, genetic code, transformation, transduction and conjugation processes in bacteria, mutation, recombinant DNA techniques.</p> <p>Biotransformation of biomass / organic waste into value added chemicals and energy, Single cell proteins, Microorganisms involved and biochemical changes of different pollutants present in liquid wastes, Types of reactors, pathways of bioenergy production – biomethane production, bioethanol production etc.</p>	
Course No.	CEL 512	

Head of The Department of Civil Engineering

Department : Civil Engineering

Course No.	CEL 513	Open Course (Y/N)	HM Course (Y/N)	Discontinued (Y/N)	
Course Title	Environmental Systems modelling				
Course Coordinator	Dr. Rajesh Gupta				
Slot in which offered. If not offered write N	Odd		Even		
	N		N		
Structure	Lecture	Tutorial	Practical	Credits	
	3	0	0	6	
Prerequisite Course Codes As per proposed Course Numbers	-				
Prerequisite credits	-				
Equivalent Course Codes. As per proposed courses and old courses	CEL553				
Overlap course codes As per proposed Course Numbers					
Text Book (Max. 2)	Title	Introduction To Env. Engg. and Science			
	Author	Gilbert M. Masters			
	Publisher	Practice hall, india			
	Edition				
	Title	Principles of surface water quality modelling and control			
	Author	Thomann R. V. And Muller J. A.			
	Publisher	Harper international edition			
	Edition	1987			
Reference Books	Title	Water quality			
	Author	Technobangolous G. , Schroader E. D.			
	Publisher	Addison-Wesley publishing co. Reading Massachusetts			
	Edition				
	Title				
	Author				
	Publisher				
	Edition				
	Title				
	Author				
	Publisher				
	Edition				
	Title				
	Author				
Publisher					
Edition					

	Title	
	Author	
	Publisher	
	Edition	
	Title	
	Author	
	Publisher	
	Edition	
Content	<p>Definition; Classification; Examples and Models of Environmental Systems.</p> <p>Introduction to Air Quality Models; Metrology; Atmospheric Stability and Turbulence; Gaussian Plume Model and Modifications; Numerical Models, Urban Diffusion Models;</p> <p>Introduction to river, estuarine and lake thermodynamics, Stratification of lakes, Dissolved Oxygen Model for streams, Temperature Models, Prediction of fate of organisms and toxic substances.</p> <p>Models for predicting water quality changes in water distribution systems</p> <p>Computational methods in Environmental Modelling</p>	
Course No.	CEL 513	

Head of The Department of Civil Engineering

Course No.	CE- 5xx	Open Course (Y/N)	HM Course (Y/N)	Discontinued (Y/N)
Course Title	Seminar			
Course Coordinator	Dr. V. A. Mhaisalkar			
Slot in which offered. If not offered write N	Odd		Even	
	-		-	
Structure	Lecture	Tutorial	Practical	Credits
	0	0	0	2
Prerequisite Course Codes As per proposed Course Numbers	-			
Prerequisite credits	-			
Equivalent Course Codes. As per proposed courses and old courses	-			
Overlap course codes As per proposed Course Numbers				
Text Book (Max. 2)	Title			
	Author			
	Publisher			
	Edition			
	Title			
	Author			
	Publisher			
	Edition			
Reference Books	Title			
	Author			
	Publisher			
	Edition			
	Title			
	Author			
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	Title	
	Author	
	Publisher	
	Edition	
Content	<p>The seminar should cover in depth study and/or critical review of a specific topic of current interest in the field of environmental engg./science/management assigned by the course coordinator.</p> <p>The study on the topic may be carried out by an individual or a group of two students each having earned minimum 50 credits. The students shall be required to submit a report and deliver seminar.</p>	
Course No.	CE- 5xx	

Head of The Department of Civil Engineering

Course No.	CEP 502	Open Course (Y/N)	HM Course (Y/N)	Discontinued (Y/N)	
Course Title	Environmental Monitoring Laboratory – II				
Course Coordinator	Dr. (Mrs.) M. V. Latkar/Prof. R. R. Gawalpanchi				
Slot in which offered. If not offered write N	Odd		Even		
	-		G1		
Structure	Lecture	Tutorial	Practical	Credits	
	0	0	2	2	
Prerequisite Course Codes As per proposed Course Numbers	Environmental Monitoring Laboratory – I				
Prerequisite credits					
Equivalent Course Codes. As per proposed courses and old courses	-				
Overlap course codes As per proposed Course Numbers					
Text Book (Max. 2)	Title				
	Author				
	Publisher				
	Edition				
	Title				
	Author				
	Publisher				
	Edition				
Reference Books	Title	Standard Methods for the Examination of Water & Wastewater			
	Author				
	Publisher	APHA, AWWA, WEF			
	Edition				
	Title	IS Code No. 5182 Parts 1 to 20			
	Author				
	Publisher				
	Edition				
	Title	IS Code No. 10158, 9234 & 9235			
	Author				
	Publisher				
	Edition				
	Title				
	Author				
Publisher					
Edition					

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	Publisher	
	Edition	
	Title	
	Author	
	Publisher	
	Edition	
Content	<ol style="list-style-type: none"> 1. Collection, preservation and analysis of samples from water treatment plants, municipal wastewater treatment plants or industrial wastewater treatment plants. 2. Collection and analysis of air samples for SPM, RSPM, SO₂ & NO_x 3. Characterization of municipal solid wastes 	
Course No.	CEP 502	

Head of The Department of Civil Engineering

Course Content Proforma

Department: Civil Engineering

Course No.:	CEL412	Open Course (Y/N)	HM Course (Y/N)	Discontinued (Y/N)
Course Title: Spatial Analysis for Resource Management				
Course Coordinator: Dr. Y.B.Katpatal				
Slot in which offered, if not offered write N		Odd		Even
				C
Structure		Lecture	Tutorial	Practical
		3	0	2
Prerequisite Course Codes As per proposed Course numbers				
Prerequisite Credits				
Equivalent Course Course Codes. As per proposed Courses & old courses				
Overlap Course Codes As per proposed Course numbers				
Text Book (Max. 2)	Title	Concepts and techniques of Geographic Information Systems		
	Author	C.P LO Albert KW Yeung		
	Publisher	Pritince Hall of India		
	Edition	2002		
	Title	Text Book on Remote Sensing		
	Author	C.S. Agrawal & P K Garg		
	Publisher	Wheeler		
Reference Books	Edition	First		
	Title	Geographic Information Systems and Science		
	Author	Paul A. Longley, M. Goodchild, David Maguire, David Rhind		
	Publisher	Wiley		
	Edition	First		
	Title	Keith C. Clerk, Bradely O Parks, Michel P Crane		
	Author	Geographic Informaiton System and Enviornment Modeling		
	Publisher	Pritince Hall of India		
	Edition	2002		
	Title	Remote Sensing of the Environment ..an Earth Resource Perspective		
	Author	John R Jensen		
	Publisher	Pearson Education		
	Edition	2006		

Content	<p>Fundamentals of Geoinformatics: raster and Vector Data, Resolutions of RS data, Thermal and Radar Sensing, spatial and non spatial information, attribute data collection, data formats, data conversions. RS as a technology for data extraction technique, multithematic data extraction using multispectral sensors, thematic map generation.</p> <p>Overlay analyses, Buffer analyses, Query shell. Spatial analysis, Modeling of spatial data, Network analysis, digital terrain elevation models, Customization and Decision Support Systems.</p> <p>Applications of Geoinformatics for spatial management of resources: Run-off estimations, infiltration characteristics, groundwater potential and recharge characteristics, Watershed management, watershed prioritization, Sediment yield estimation, reservoir capacity studies, Spatial analyses for Environment Impact assessment, Monitoring and feedback, Natural indices, Concept of E-Governance using Geoinformatics. Integrated applications using various technologies within Geoinformatics; methods and approach. Real time and temporal analysis using Geoinformatics.</p>
Practical	<p>Multidisciplinary applications of Geoinformatics; integration of various segments. Geoinformatics for resources management and utilities management.</p> <p>Spatial Digital Data and its Formats Digital Image analysis and Classification Vector Data generation, topology building and attribution Overlay, Buffer and Network analysis Models for Resource analysis</p>
Course No.	

Head of The Department

Department : Civil Engineering

Course No.	CEL 418	Open Course (Y/N)	HM Course (Y/N)	Discontinued (Y/N)	
Course Title	ENERGY CONVERSION AND ENVIRONMENT				
Course Coordinator	Dr. A. R. Tembhurkar				
Slot in which offered. If not offered write N	Odd		Even		
	D		-		
Structure	Lecture	Tutorial	Practical	Credits	
	3	0	0	6	
Prerequisite Course Codes As per proposed Course Numbers	-				
Prerequisite credits					
Equivalent Course Codes. As per proposed courses and old courses	-				
Overlap course codes As per proposed Course Numbers					
Text Book (Max. 2)	Title	Energy and the Environment			
	Author	Fowler J. M.			
	Publisher	McGraw Hill New York			
	Edition	2 nd			
	Title	Biomass for Energy in the Developing Countries, Current Roles, Potentials, Problems, Prospects			
	Author	D. O. Hall, G. W. Barnard and P. A. Moss			
	Publisher	Pergamon Press Ltd			
	Edition	1 st			
Reference Books	Title	Energy Management Handbook			
	Author	W. C. Turner			
	Publisher	Wiley Newyork			
	Edition	1 st			
	Title	Energy System Analysis for Developing countries			
	Author	P. Meier			
	Publisher	Sringer Verlag			
	Edition	1 st			
	Title	Energy from Bioconversion of Wate materials			
	Author	Dorthy J De Renzo			
	Publisher	Noyes data Corporation USA			
	Edition	1 st			
Title	Energy from Solid Waste – Recent Development				

	Author	Francis A.Domino
	Publisher	Noyes data Corporation USA
	Edition	1 st
	Title	Natural Resource Conservation – Management for Sustainable Future
	Author	Oliver S. Owen , Daniel D. Chiras
	Publisher	Prentice Hall Publications
	Edition	6 th
	Title	Integrated Solid Waste Management
	Author	George Tachonobanoglous, Hilary Thesin, Samuel Vigil
	Publisher	McGraw Hill
	Edition	1 st International Edn.
Content	<p>Overview of Global and Indian Energy Scenario; Resource Conservation and Environmental Movement; Flow of Energy Through Ecosystem; Renewable and Non- Renewable Energy Sources; Sustainable System of Energy; Energy and Resources Conservation Strategies and Policies; Energy audit; Energy Conversion Methods: Thermal, hydro, nuclear, solar, wind, tidal, Energy Analysis; Energy economics; Future Energy Systems; Introduction to Fuel combustion fundamentals, formation of Pollutants, Measurements and Control; Alternative Energy sources Utilizations; Classification of Waste as Fuel; Waste to Energy options: Combustion, Gasification, anaerobic digestion, fermentation, pyrolysis; Fuels Derived from Waste to Energy Technology; Power Generation using Waste to Energy technology, Gas generations and collection in landfills, Potential for biomass and Biogas Energy system</p>	
Course No.	CEL 418	

Course No.	CEL 432	Open Course (Y/N)	HM Course (Y/N)	Discontinued (Y/N)
Course Title	Environmental Impact Assessment			
Course Coordinator				
Slot in which offered. If not offered write N	Odd		Even	
	-		H	
Structure	Lecture	Tutorial	Practical	Credits
	3	0	0	6
Prerequisite Course Codes As per proposed Course Numbers	-			
Prerequisite credits				
Equivalent Course Codes. As per proposed courses and old courses	CEL458			
Overlap course codes As per proposed Course Numbers				
Text Book (Max. 2)	Title	Environmental Impact Assessment of Water Resource Projects		
	Author	Canter L.		
	Publisher	McGraw Hill		
	Edition	1996		
	Title	Environmental Impact Analysis Handbook		
	Author	Rau G. L. and Wooten C. D.		
	Publisher	McGraw Hill		
	Edition	1980		
Reference Books	Title			
	Author			
	Publisher			
	Edition			
	Title			
	Author			
	Publisher			
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	Author	
	Publisher	
	Edition	
Content	<p>Evolution and history of EIA at International and Indian level, Definition, benefits and importance of EIA, Environmental clearance process in India, EIA at project, regional and policy level, EIA process in India, Collection of baseline data, Identification of impacts on physical, biological, socioeconomic environment and land use pattern, Prediction and evolution of impacts, Screening and scoping criteria, Prediction models, EIA methodologies: checklist, matrix, overlay, BEES and other techniques of impact assessment, Uncertainties in EIA, Rapid and comprehensive EIA, Public participation in EIA, Environmental management plan, Post project monitoring, EIA reports, Environmental impact statement, Application of EIA for water resource projects, industrial projects, infrastructural projects etc.</p>	
Course No.	CEL 4xx	

Head of The Department of Civil Engineering

COURSE CONTENT PROFORMA				
Course No.	CEL3xx	Open Course (Y/N)	HM Course (Y/N)	Discontinued (Y/N)
Course Title	Energy Efficient Buildings			
Course Coordinator	Dr. Rahul V. Ralegaonkar			
Slot in which Offered	Even			
Structure	Lecture	Tutorial	Practical	Credits
	3	1	0	8
Prerequisite Course Codes				
Prerequisite Credits				
Equivalent course Codes				
Overlap Course Codes				
Text Books	Title	Energy Efficient Buildings In India		
	Author	Mili Majumdar		
	Publisher	Tata Energy Research Institute		
	Edition			
	Title	Energy-Efficient Building Systems		
	Author	Lal Jayamaha		
	Publisher	McGraw Hill Publication		
	Edition			
	Title	Solar Energy Fundamentals & Applications		
	Author	H P Garg, J Prakash		
Publisher	Tata MacGraw Hill Publishing			
Edition				
Title	Solar Energy and thermal processes			
Author	J A Duffie & W A Beckman			
Publisher	John Wiley			
Edition				
Title	Solar Energy Applications in Buildings			
Author	A A M Sayigh			
Publisher	Academic Press			
Edition				
Title				
Author				
Publisher				
Edition				
Content	Theory: 1. Conservation & energy efficiency concepts-overview of significance			

	<p>of energy use and energy processes in buildings</p> <ol style="list-style-type: none"> 2. Passive solar energy fundamentals & practices in building design- solar astronomical relations and radiation physics and measurements, human thermal comfort, climatological factors, material specifications and heat transfer principles. 3. Passive solar energy practice in building design- design decisions in building-location, orientation, form, material, Thermal performance evaluation 4. Passive Solar technologies- trombe wall, thermosiphoned mass wall, water wall, sunspaces, roof ponds, glazed windows, cool towers, under slab rock beds 5. Design Guidelines & Economic Optimization- Concept of cost/benefit of energy conservation & passive solar technologies 6. Advances in computational energy conservation- implementation of computer energy simulation programs into solar designs. <p>Tutorials: Numerical & Graphical problems will be discussed and solved based on the above mentioned topics.</p>
Course No.	

Head of the Department of **CIVIL ENGINEERING**

