DEPARTMENT OF CIVIL ENGINEERING

Course Book for
M. Tech. in Transportation
Engineering

Visvesvaraya National Institute of Technology, Nagpur

JULY 2015

Brief about Civil Engg Department:

Civil Engineering Department is the oldest department in this institute right from the establishment of Government College of Engineering in Nagpur 1956. The department offers the undergraduate course of B.Tech in Civil Engineering and Four Postgraduate Courses of M.Tech as given below.

Program	Description
UG in Civil Engineering	Started with 60 seats in 1956 Intake increased to 71 in 2008 Intake increase to 82 in 2009 Intake increase to 92 in 2010

PG in Civil Engineering Department
1. Environmental Engineering — Started in 1966 (32 seats)
2. Water Resources Engineering — Started in 2005 (20 seats)
3. Construction Technology and Mgt — Started in 2010 (20 seats)
4. Transportation Engineering — Started in 2012 (20 seats)

VISION:

To contribute effectively to the National Endeavour of producing quality human resource of world class standard in Civil Engineering by developing a sustainable technical education system to meet the changing technological needs of the Country incorporating relevant of social concerns and to build an environment to create and propagate innovative technologies for the economic development of Nation.

MISSION:

The Mission of the undergraduate Civil Engineering program is to develop students into capable civil engineering graduates by imparting appropriate high quality education in Civil Engineering so that they could be readily adapted by the service sector to meet the challenges faced by the Nation. The program strives for excellence in engineering education and profession. It also aims to promote all round development of the personality of students by suitably involving them in Co-curricular and extra-curricular activities.

TABLE 1. CREDIT REQUIREMENTS FOR POST GRADUTE STUDIES

Postgraduate Core (PC)		Postgraduate Elective (PE)	
Category	Credit	Category	Credit
Departmental Core (DC)	37	Departmental Electives (DE)	15
Grand Total PC + PE			52

The number of credits attached to a subject depends on number of classes in a week. For example a subject with 3-1-0 (L-T-P) means it has 3 Lectures, 1 Tutorial and 0 Practical in a week. This subject will have eight credits (3x2 + 1x1 + 0x1 = 8). If a student is declared pass in a subject, then he/she gets the credits

associated with that subject. Depending on marks scored in a subject, student is given a Grade. Each grade has got certain grade points as follows:

Grades	AA	AB	BB	BC	CC	CD	DD	FF
Grade Points	10	09	08	07	06	05	04	Fail

The performance of a student will be evaluated in terms of two indices, viz. the Semester Grade Point Average (SGPA) which is the Grade Point Average for a semester and Cumulative Grade Point Average (CGPA) which is the Grade Point Average for all the completed semesters at any point in time. SGPA and CGPA are:

$$SGPA = \frac{\sum_{semester}(Course\ credits\ X\ Grade\ points) for\ all\ courses\ except\ audit}{\sum_{semester}(Course\ credits\ ) for\ all\ courses\ except\ audit}$$

$$CGPA = \frac{\sum_{All\ semester}(Course\ credits\ X\ Grade\ points) for\ all\ courses\ with\ pass\ grade\ except\ audit}{\sum_{All\ semester}(Course\ credits\ ) for\ all\ courses\ except\ audit}$$

Students can Audit a few subjects. i.e., they can attend the classes and do home work and give exam also, but they will not get any credit for that subject. Audit subjects are for self enhancement of students.

Details about Faculty members of Civil Engineering Department

Name of Faculty Member	Designation	Qualifications	Areas of specialization
Mhaisalkar V.A	Professor	B.E, M.Tech , Ph.D	Environmental Engg
Gupta Rajesh	Professor	B. E, M.Tech., Ph.D.	Environmental Engg.
Katpatal Y.B	Professor	B.Sc, M.Tech, MBA, Ph.D	Remote Sensing and GIS
Tembhurkar. A.R.	Associate Professor	B.E, M.Tech , Ph.D	Environmental Engg
Latkar M.V	Associate Professor	B.Sc., M.Sc, Ph.D	Environmental Biochemistry
Lataye.D.H	Assistant. Professor	B.E, M.Tech , Ph.D	Environmental Engg
Ralegaonkar R.V	Associate Professor	B.E, M.E, Ph.D	Energy Efficient Building, Disaster Management, Construction Technology & Mgt.
Ghare A.D	Associate Professor	B.E, M.Tech , Ph.D	Hydraulic Engg
Landge.V.S	Associate Professor	B. E., M.E, Ph.D	Traffic Engineering
Mondal .A	Associate Professor	B. E., M.E, Ph.D	Soil Mechanics and Foundation Engg
Vasudeo. A.D.	Assistant. Professor	B.E, M.Tech , Ph.D	Water Resources Engg
Patel Anjan	Assistant. Professor	B.E, M.Tech , Ph.D	Soil Mechanics and Foundation Engg
Dongre.S.R	Assistant. Professor	B.E., M.Tech, Ph.D	Environmental Engg.
Wanjari. S. P.	Assistant. Professor	B.E., M.Tech, Ph.D	Construction Technology and Management, Concrete Technology
Tawalare.A.G	Assistant. Professor	B.E., M.Tech	Structural Engg, Construction Technology & Mgt.
Mirajkar A.B	Assistant Professor	B.E, M.E, Ph.D	Water Resources Engg.

Scheme of Instructions for M Tech (Transportation Engineering)

Program Core(PC)		Program Elective (PE)	
Category	Credit	Category	Credit
Departmental Core(DC)	37	Departmental Elective(DE)	15
		Total	
Grand total PC+PE			52

I Semester				II Semester			
CORE				CORE			
Code	Course	L-T-P	Cr	Code	Course	L-T-P	Cr
CEL 570	Advanced Traffic Engineering	3-1-0	4	CEL 572	Urban Transport Planning	3-0-0	3
CEL571	Highway Soil mechanics	3-0-0	3	CEL585	Pavement analysis and Design	3-0-0	3
CEL 531	Spatial Analysis for resources Management	3-0-0	3	CEL573	Designing of Highway structures	3-0-0	3
CEP 531	Spatial Analysis for resources Management*	0-0-2	1				
CEP 588	Field Studies in Transportation Engineering	0-0-4	2				
CEL404	Railway and Airport engineering	3-0-0	3				
	Core Credits = 16				Core Credits =9		
	ELECTIVE (Any One)				**ELECTIVE (Any Three)**		
CEL 417	Disaster Management	3-0-0	3	CEL 575	Ground improvement technique	3-0-0	3
CEL595	Highway Planning and Material	3-0-0	3	CEL 581	Design of underground structure	3-0-0	3
CEL559	Energy Efficient Building	3-0-0	3	CEL 590	Pavement management system	3-0-0	3
CEL413	Pre-stressed Concrete Structures	3-1-0	4	MAL407	statistics and Optimization techniques	3-0-0	3
				CEL576	Intelligent Transportation system	3-0-0	3
				CEL561	Risk Analysis and Decision Making	3-0-0	3
				CEL562	Sustainable Construction Engineering	3-0-0	3
				MAL409	Application of Operation Research Techniques in Construction	3-0-0	3
				CEL425	Financial and Business Management	3-0-0	3
	5 DC + 1 DE = 19/20 Credits				**3DC + 3 DE = 18 Credits**		
	III Semester				**IV Semester**		
CED501	Project Phase-I	-	3	CED502	Project Phase-II	-	9
	ELECTIVE (Any One)						
CEL 589	Transportation economics and Evaluation	3-0-0	3				
CEL409	Quality and Safety in Construction	3-0-0	3				
CEL488	Computer aided analysis and design*	3-0-0	3				
CEP488	Computer aided analysis and design*	0-0-2	1				
CEL418	Energy Conversion and Environments	3-0-0	**3**				
CEL582	Advanced Construction Technology	3-0-0	3				
	1 DC + 1 DE =6/7 Credits				**1 DC = 9 Credits**		

* Student must register both for practical and Theory of a course.

CEL 570- ADVANCED TRAFFIC ENGINEERING [(3-0-0); CREDITS 3]

Traffic Engineering & Studies: Scope, traffic elements, characteristics-vehicle, road user and road; traffic studies- volume, O & D, parking, safety , study methodology, data collection & presentation,

Traffic Analysis: Speed, volume, parking & accident data analysis, statistical approach, conflict points, traffic stream characteristics- relationship between speed, flow and density, LOS & capacity analysis, traffic forecasting.

Traffic Design: Channelisation of islands, design of rotaries, intersections, pedestrian & bicycle ways,

Traffic Control Devices: Traffic signs, markings and signals; Traffic Regulation & Management: Speed, vehicle, parking, enforcement regulations, mixed traffic regulation, management various techniques

Geometric design provisions for various transportation facilities as per AASHTO, IRC design

Reference Books:

1. Traffic Engineering – Theory & Practice, Pignataro L.J. , John Wiley publishing house
2. Highways- Traffic Planning & Engineering, O'Flaherty , Edward Arnold, UK
3. Traffic Engineering and Transport Planning, Kadiyali L.R., Khhanna Publishers
4. Relevant IS and IRC codes

CEL 585 - PAVEMENT ANALYSIS AND DESIGN [(3-0-0); CREDITS 3]

History of Pavements, Pavements types, Advantages and Dis advantages

Pavement Mix Analysis: Aggregate blending, bituminous mix design – Marshall stability approach, concrete mix design for roads.

Pavement Basics: Types & comparison, vehicular loading pattern, loading pattern on airport pavement, factors affecting design and performance of pavements, airport pavement, environmental impact on pavements, sub grade requirements

Design of Flexible Pavements: Analytical approach, flexible pavement layers, ESWL, repetitions of load, techniques of design methods, wheel load analysis, traffic analysis, stress distribution in subgrade soil, Burmister's theories, group index method, CBR approach, IRC guidelines, CRV method, triaxial & McLeod method, present practices, shoulder design.

Design of Concrete Pavements: Westergaard's approach, temperature & frictional stresses, design of expansion & longitudinal joints, design of dowel & tie bars, IRC guidelines, present design practices

Reference Books:

1. Principles of Pavement Design, Yoder and Witezak, John Wiley and sons
2. Design of functional pavements, Yang , McGraw-Hill
3. Principles & Practice of Highway Engineering,
4. IRC codes , 37, 58,15 and other relevant codes

CEL571 HIGHWAY SOIL MECHANICS   [(3-0-0); CREDITS 3]

Classification of Soil. HRB classification. Group Index Method.

Subsoil drainage in Highway Engineering, Design of filters, perforated pipe drainage., Methods of sub soil drainage for roads, permeable blankets , longitudinal and transverse under drains , horizontal drains, stabilizing trenches. Sub soil drainage in highways, runways and railways.

Compaction: Mechanics of compaction. Field-compaction equipment; their suitability and choice. Compaction quality control and measurement.

Shear Strength: Terzaghi's effective stress principle, effective shear parameters, measurement of pore pressures. Stability Analysis of slopes: Friction circle method, Taylor's Stability No.

Earth Pressure Theories: Coloumb's Wedge Theory, Culman's method. Sheet pile walls and their analysis.

Deep foundations: Meyorhoff's theory for bearing Capacity. Well foundations, their types, components, well sinking and rectification. Stability analysis.

Rock Engineering: Fundamental of rock Mechanics; Rock Properties; Rock Mass Classification Systems, Rock load classification according to Terzaghi, RQD index as a qualitative description of the rock mass, limitations and advantages, Geomechanics Classification: General Comments on Application of Rock Mass Classification Schemes, Comparison of Rock Mass Classification Schemes.

Practicals: Experiments and design exercises based on above syllabus and also from courses of other subjects where provision of practical is not available

REFERENCE:

1 Soil Mechanics in Highway Engineering, Rodriguez,A,R, Castillo del.h, Trans Tech Publications
2 Essentials of Soil Mechanics and Foundations, David McCarthy, Pearson Education
3 Basic Soil Mechanics, R. Whitlow, Pearson Education
4 Relevant IS and IRC codes

CEL572 URBAN TRANSPORT PLANNING   **[(3-0-0); CREDITS 3]**

Introduction to Urban transportation planning; systems approach to Urban transportation planning; types of models; concept of travel demand and supply; socio-economic, Urban land use, network, and transport system characteristics affecting urban transportation planning; study area definition, zoning principles, cordon and screen lines, data collection through primary

and secondary sources, sampling techniques; four-stage sequential modelling approach; trip generation; trip distribution; modal split; trip assignment; land use-transport models; public transport planning, integration of different modes; travel demand management

measures; case studies

REFERENCE:

1. Transportation Engineering and Planning, C. S. Papacostas and P. D. Prevedouros, Trans Tech Publications
2. Urban Transportation Planning, Michael D. Meyer, Eric J. Miller, McGraw-Hill
3. Public Transportation, G. E. Gray and L. A. Hoel, New Jersey, 1992
4. Relevant IRC and IS codes.

CEL573 DESIGN of HIGHWAY STRUCTURES [(3-0-0); CREDITS 3]

Introduction to highway Hydraulic Design of Bridges, Design Loads for Bridges, Design of Pipe Culverts , Design of Box Culvert, Design of Slab Bridges ,Design of Beam & Slab Bridges , Design of Plate Girder Bridges, Design of Composite Bridges , Design of Bridge Abutment , Design of Bridge Piers

Design of Bridge Foundation , Design of Bearings

Design of slab culverts, box culverts, pipe culverts, RCW,s retaining walls, abutments, bridge foundations , open wells, caisson sinking

REFERENCE:

1. Design of Bridge Structures, T.R. Jagadeesh, Prentice Hall of India Ltd
2. Theory and Design of Bridges, Petros P. Xanthakos, John Wiley & Sons
3. Hydraulic factors in bridge design, R. V. Farraday, F. G. Charlton, Hydraulics Research,
4. Relevant IS Codes

CEL 404- RAILWAYS, AIRPORTS AND PORTS AND HARBORS ENGINEERING   [(3-0-0); CREDITS 3]

Railway Transportation and its development, Long term operative plans for Indian Railways. Classification of Railway lines and their track standards, Railway terminology, Traction and tractive Resistance, Hauling capacity and tractive effort of locomotives, different Types of Tractions. Permanent Way: Alignment Surveys, Requirement, gauges, track section, Coning of wheels, Stresses in railway track, high speed track. Geometric design of railway track, Gauge, Gradient, speed, super elevation, cant deficiency, Negative super elevation, curves, length of transition curves, grade compensations.

Airports

Development of Air Transportation in India :, Airport site election. Modern aircraft's. Airport obstructions: Zoning Laws, Imaginary surfaces, Approach and Turning zone, clear zone, vert. Clearance for Highway & Railway. Runway and taxiway design : Windrose, cross wind component, Runway Orientation and confuguration. Basic runway length and corrections, runway geometric design standards. Taxiway Layout and geometric design standards. Taxiway and other areas. Air traffic control : Need, Network, control aids, Instrumental landing systems

Ports and Harbours:

Importance of ports and harbours. Impact on Indian trade and economy, Plan of harbour, various components, jetty, dolphins, bollards, their design and functions.

Tunnels: Importance, surveys, designs, alignments, linings,

REFERENCE:

1. Railway Engineering, Saxena;, Dhanpat Rai Publication,
2. Airport Planning & Design, Goyal & Praveen Kumar, Galgotia Publication
3. Harbour, Dock And Tunnel Engineerin, R. Srinivasan ,Charoter publishing house

CEL -531 SPATIAL ANALYSES FOR RESOURCES MANAGEMENT [(3-0-0); Credits: 3]

Course Objectives :
1. Understand Remote sensing process
2. Carry out georeferencing and Digital Image Analysis
3. Teach them the concept of GIS and its applications
4. Learn vision development through spatial analyses
5. Carry out analyses in absence of field data
6. Carry out spatial analyses for resource management
7. Generate research orientation in students

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.

Overlay analyses, Buffer analyses, Query shell. Spatial analysis, Modeling of spatial data, Network analysis, digital terrain elevation models, Customization and Decision Support Systems.

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.

Multidisciplinary applications of Geoinformatics; integration of various segments.Geoinformatics for resources management and utilities management.

REFERENCE BOOKS:

1. C.P LO Albert KW YeungConcepts and techniqes of Geographic Infromation Systems Pritince Hall of India, 2002.
2. C.S. Agrawal& P K Garg, Text Book on Remote Sensing Wheeler First.
3. Paul A. Longley, M. Goodchild, David Maguire, David Rhind, Geographic Information Systems and Science, Wiley, First.
4. Geographic Informaiton System and Enviornment Modeling, Keith C. Clerk, BradelyO Parks, Michel P Crane, Pritince Hall of India, 2002.
5. John R Jensen, Remote Sensing of the Environment ..an Earth Resource Perspective,   Pearson Education, 2006.

CEP 531 SPATIAL ANALYSIS FOR RESOURCES MANAGEMENT   [(0-0-2); Credits: 1]

Practical
1. Spatial Digital Data and its Formats
2. Digital Image analysis and Classification
3. Vector Data generation, topology building and attribution
4. Overlay, Buffer and Network analysis
5. Models for Resource analysis.

CEP 588 – FIELD STUDIES IN TRANSPORATION ENGINEERING [(0-0-4); Credits 2]

Practical: Field studies minimum 10 of the following

Speed studies , OD studies, Design of traffic signals, Design of intersection, design of rotaries, Road safety studies, traffic volume studies. Parking studies, (Any five) design of pavement, CRB , Bitumen Mix design, Soil classification, GI finding. Concrete mix designing, Highway designing using "HEAD", VISSUM (Any five)

Reference books

1. Manuals of the lab equipments
2. IRC and IS codes of practice

CEL 575 GROUND IMPROVEMENT TECHNIQUES   [(3-0-0); CREDITS 3]

Course Objective:

(i)   To be Introduced with various ground improvement techniques
(ii)   To have a knowledge of the various geotechnical issues related to the different techniques
(iii)   Planning and design for ground improvement techniques for different site conditions and for different types of projects

Introduction, Economic considerations, Consolidation by preloading and sand drains; strengthening by micropiles, granular columns, Stone columns; lime columns; Compaction by vibrofloatation, blasting ; dewatering, Improvement of deep strata of fine soils by vacuum dewatering, electroosmosis. Ground freezing and thermal stabilization; Grouting techniques and principles. Reinforced earth and applications of geosynthetics; retaining walls, slopes, road erosion. Ground anchors and soil nailing; Problems and case histories

Design aspects of water and waste water systems ranging from pipeline to treatment plant; sanitary landfill; a detailed design of at least one unit will be completed as either an individual or class project.

REFERENCE:

1. Foundation Analysis and Design, Bowels, J. E, McGraw-Hill International Edition Singapore, 1997

2. Ground Improvement, Moseley, M. P, Blackie Academic & Professional, Boca Raton, Florida, USA, 1993

3. Foundation Design, Teng, W. C, Prentice-Hall of India Pvt. Ltd

CEL 581-DESIGN OF UNDERGROUND STRUCTURES [(3-0-0); CREDITS 3]

Course Objective:
(i) Concept on rock classification methods.

(ii) Design aspects for underground opening with different technique of construction for tunnel and their application.

Syllabus:
Introduction to tunneling: Fundamental definitions, tunneling art and engineering, historical Development. Geological aspects of tunneling: Rock Mass Classification Systems, Rock load classification according to Terzaghi, RQD index as a qualitative description of the rock mass, limitations and advantages, Lauffer-Pacher classification, Rock structure rating (RSR), Geomechanics Classification: General Comments on Application of Rock Mass Classification Schemes, Comparison of Rock Mass Classification Schemes. Excavation Methodology: Soft ground conditions: Shield Tunnels, Advantages of shield tunneling, Conventional Tunneling Shields, rock conditions using drill and blast: Influence of rock strength on excavation, influence of tunnel size, summary of drilling and blasting method of tunnel excavation drilling blasting debris clearance, ground support drilling and blasting: Ground treatment in tunneling Ground control; general appreciation, weak cohesionless soils: water and instability problems, ground treatment methods, dewatering using well bores electro-osmosis, grouting, ground freezing, investigation procedures, consolidation grouting, compaction grouting, jet grouting. Design and support of tunnels: operational criteria and principal support types:Temporary ground support, constructability, geotechnical design, considerations, common support types used in civil engineering tunnels, mining engineering tunnels, mining legislation, , design methods: analytical methods, computational or numerical methods, empirical methods, rock reinforcement: Rock dowels, rock bolts, rock anchors, mechanisms of support, physical aspects of rock reinforcement. concrete and shotcrete linings, General Concepts of NATM. Stresses and displacements associated with excavation of tunnels: Stresses in the Earth, Effect of Tunnel Formation on the Stress Field, Gravity Loading of Near Surface Tunnels, Non-hydrostatic stresses, Rock Mass Failure and Displacements, Interaction of tunnel stress fields.

REFERENCE:
1. B.H.G. Brady and E.T. Brown, Rock Mechanics for underground mining ,Springer
2. D. Kolymbos, Tunnelling and Tunnel Mechanics, Springer
3. Bhawani Singh and R.K. Goel, Rock Mass Classification, Elsevier
4. Z. T. Bieniawski, A.A. Balkema, Rock mechanics design in mining and tunnelling
5. Evert Hoek, Edwin T. Brown., Underground Excavations in Rock, Institution of Mining and Metallurgy

CEL 595- HIGHWAY PLANNING AND MATERIALS   **[(0-0-3); CREDITS 3]**

Highway Planning: Highway development and planning in India, rural & urban road classification, planning surveys, highway alignment, computer aided planning.

Road making aggregates – classification, properties of aggregates, design of aggregate gradation; Bituminous road binders – penetration grade, emulsions, cut backs and modified binders; rheology of bituminous binders, modified binders; mix design – Marshall method and Superpave procedure; design of emulsified mixes, visco-elastic and fatigue properties of bituminous mixtures, resilient modulus of pavement materials;

requirements of paving concrete, design of mixes for recycling of bituminous and concrete pavement surfaces; soil stabilization techniques.

Highway Construction: Earthwork & embankment construction; construction of stabilized sub-bases & base courses, drainage – surface / subsurface, sub-base & base construction techniques – WBM base, wet mix macadam, bituminous macadam, low cost road construction, construction of shoulder, footpath, paver block areas.

Construction Of Bituminous Roads: Different bituminous courses surface dressing, penetration macadam, built-up spray grout, Premix construction to include BBM, carpet, Construction Of Cement Concrete Pavements: cement concrete slab, construction of various joints in plain and reinforced cement concrete pavements, quality control during construction, joint sealing, reinforced concrete pavement.

Roadside Development: Arboriculture, roadside drainages, landscaping on urban roads.

Highway Construction Equipments: Excavating, earth moving & compacting equipments, hot mix plant, pavers, and concrete mixers.

REFERENCE:

1. Highway Materials, Soils, and Concrete, Atkins Harold N - Principles and Applications, Marcel Dekker, Inc., 2000.

2. Relevant IRC codes , publisher IRC

CEL 586 INTELLIGENT TRANSPORTATION SYSTEMS   [(3-0-0) ;CREDITS 3]

Intelligent Transport Systems, Introduction , Using ITS , Traffic management and control , Tolling , Road pricing, Public transport travel information and ticketing, Driver information and guidance , Freight and fleet management, Vehicle safety , System integration , International comparisons, signal coordination, feeder system coordination various case studies and relevance to Indian traffic conditions

REFERENCE:
1. UTMC: The Way Forward for Urban Traffic Control, Routledge, Kemp and Radia
2. Traffic Engineering Design., Hewitt, R, Slinn, M and Eastman
3. Relevant IRC codes , publisher IRC

CEL 488 COMPUTER AIDED ANALYSIS AND DESIGN   [(3-0-0) ;CREDITS 3]

Introduction to CAAD and computer graphics: Overview, programming language, application area, software environment.

Data types, graphics devices, representation of images, transformations, computer aided drafting

Programming language and techniques: overview, variables & datatypes, operators, input-output, control structures, functions, arrays, pointers, strings, data-files, trees, recursion.

Database management system (DMBS): Introduction, Components of DBMS, Data Models, query language, design of database

Knowledge based expert system: Introduction, Artificial intelligence, components of expert system, knowledge representation, inference mechanism, building expert system

Simulation: Introduction, Concept of System, models & its purpose, types, approaches

Analytical Tools: Introduction & application of Finite Element Method, Optimization, Genetic Algorithm, Fuzzy Logic. Application of IT aides for Civil Engineering Applications like Building Technology and Construction Management

Reference
1. Caad primer, a general guide to computer aided design and drafting, Vijay duggal
2. Mathematical Elements of Computer Graphics, D F Rogers & J A Adams, Tata McGraw-Hill Publishing Company
3. Numerical Techniques in 'C', E V Kameshwar, BPB Publication

CEP 488 COMPUTER AIDED ANALYSIS AND DESIGN   [(0-0-2) ;CREDITS 1]

10 lab experiments will be conducted based on above topics

CEL 587- RESEARCH METHODOLOGIES [(3-0-0); CREDITS 3]

Fundamentals of Research, Research Proposal Formulation, Research Report Research Methods, Descriptive Studies, Assessment, Evaluation and Research Methods & Tools of Research, Data Analysis Case Studies

REFERENCE:

1. Research in Education , John W. Best and James V. Kahn , Prentice Hall of India

CEL 589 TRANSPORTATION ECONOMICS & EVALUATION [(3-0-0); CREDITS 3]

Principles of Economics: Supply and demand models, consumer's surplus and social surplus criteria, framework for social accounting: accounting rate of interest, social opportunity cost, rate of interest, social time preference rate of interest, accounting prices of goods and services, measuring input costs, applications o social accounting frame work.

Transport Costs and Benefits: Fixed and variable cost, cost of improvement, maintenance cost, cost estimating methods, accounting for inflation, external costs, pavement cost analysis. direct benefits-reduced vehicle operation costs, value of travel time savings, value of increased comfort and convenience, cost of accident reduction, reduction in maintenance cost.

Economic Analysis: Generation and screening of project alternatives, different methods of economic analysis: annual cost and benefit ratio methods, discounted cash flow methods, shadow pricing techniques, determination of IRR and NPV, examples of economic analysis, application economic theory in traffic assignment problem.

REFERENCE:

1. Highway Economic Analysis , Winfrey R , International Textbook Company
2. Transport : An Economics and Management Perspective, Oxford University Press

CEL 445- MANAGEMENT OF QUALITY AND SAFETY IN HIGHWAY CONSTRUCTION [(3-0-0); CREDITS 3]

Total quality Management (TQM) to the construction industry: Evolution, philosophy and principles for building client, the Deming Philip Crosby, J. M. Juran contribution to TQM. Quality as a management process, contractual options and integration.

TQM to Construction Projects : General application, TQM in pre contract, post contract, commissioning and maintenance phase, Project quality management,

Auditing: First party auditing, second party auditing, Contraction management adjudication.

Accidents: types, causes, direct and indirect cost of accidents, objective of accident prevention programmes.

Preventative measures: personal protective equipments, job requirements, tools, equipments and fire protection measures. Projection from radioactive,/ toxic material, laser and X-ray equipments.

Safety Organization and Management: Safety policies, safety organization, safety committees, safety representatives, outside agencies – Govt. intervention, international agreements

REFERENCE:
1. Total Quality in Construction Projects, Ron Baden Hellard , Thomas Telford, London

2. Engineering Quality in Construction, Michael T Kubal, Mc Graw Hill Inc.

3. Handbook of OSHA Construction Safety & Health, Charles D Reese & James V Eidson

CEL 590   PAVEMENT MANAGEMENT SYSTEM [(3-0-0); CREDITS 3]

Pavement Maintenance & Management Process: Application of system concepts to pavement management, pavement management levels-Network & Project level, functions - Data needs, Pavement life cycle, assessment of pavement performance, evaluation of pavement structural capacity, distress & safety, combined measures of **pavement quality, data management**

Determining Present and Future Needs: Establishing criteria – development of models for pavement deterioration – determining the future needs – rehabilitation and maintenance strategies – developing combined programmes for maintenance & rehabilitation

Project Level Design: Framework for pavement design, characterization of physical design inputs, basic structural response models – variability, reliability and risk – generating alternate design strategies, rehabilitation design procedures, Overlay design, economic evaluation of alternate pavement design strategies – selection of optimal design strategy.

Implementation: Major steps in implementing PMS – pavement construction management & pavement maintenance management – information's, research needs – cost and benefit of pavement management – future directions and need for innovations in pavement management, HDM applications

REFERENCE:
1. Modern Pavement Management, Haas R. C. G., Hudson W. Ronald, Zaniewski John P, Krieger Publishing Company, 1994

2. Pavement Management for Airports, Roads, and Parking Lots, **Shahin**, Mo Y., Springe publication

MAL 407 STATISTICS & OPTIMIZATION TECHNIQUES [(3-0-0); CREDITS 3]

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.

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- travelling salesman problem

Nonlinear programming problem (NLPP): Constrained NLPP, Lagrange's multipliers method – convex NLPP, Kuhn-Tucker conditions.

REFERENCE:
1. Probability and Statistics, M.R. Speigel, McGraw Hill
2. Operation Research, H.A. Taha, Prentice Hall of India Pvt. Ltd.
3. Introduction to Optimization : Operations Research, J.C. Pant, Jain Brothers, New Delhi
4. Probability and Statistics for Engineers, Miller and Freund

CEL 432 ENVIRONMENTAL IMPACT ASSESSMENTS   [(3-0-0); CREDITS 3]

Evolution of EIA; EIA at project; Regional and policy levels; EIA process in India and other countries; EIA methodologies; Screening and scoping criteria; Rapid and Comprehensive EIA; Environmental health impact assessment, Environment risk analysis; Uncertainties; Practical Applications of EIA; Baseline collection of data; Prediction and assessment of impacts of physical biological and socio-economic environment; Development of environment management plan; Post project monitoring; EIA report and EIS; Review process. Case histories of applications for industrial; Water resources and irrigation projects; ports and harbours, Mining, Transportation and other projects sectors

TEXT / REFERENCES:
1. Canter, L. Environmental Impact Assessment, McGraw Hill 1977

2. Rau, GJ. And Wooten, C.D., Environmental Impact Analysis Handbook, McGraw Hill 1980

3. Ministry of Environment and Forests, GoI, Current Documents on Guidelines for EIA.

CEL 417 DISASTER MANAGEMENT [(3-0-0); CREDITS 3]

Introduction to Disasters- Overview, Classifications, causes, loss of resources

Disaster Risk Management- Objectives, Processes, Events, analysis, base-line data, forecasting and warning.

Emergency operation centre and IT aids- physical environment, IT Aids, Applications.

Techno-legal & Techno-financial aspects- regulatory mechanism for compliance, administrative structure for legal framework, additional cost on infrastructure, building by-laws.

Public-private agency co-ordination- federal, state and local disaster response organization and network, citizen and community role in disaster response and recovery.

Case studies: Natural and man-made disasters, preparedness and planning.

REFERRENCE:

1. D B N Murthy Disaster Management: Text & Case Studies, Deep & Deep Pvt. Ltd.

2. S L Goel, Encyclopedia of Disaster Management, Deep & Deep Pvt. Ltd.

3. G K Ghosh, Disaster Management, A P H Publishing Corporation.

4. Satish Modh, Citizen's Guide to Disaster Management Macmilan.

CEL 409- QUALITY AND SAFETY IN CONSTRUCTION [(3-0-0); CREDITS 3]

Total quality management concepts; ISO9000; QA/QC systems and organizations, Quality Audits; Problem solving techniques; Statistical Quality Control; Quality Function Deployment; Material Quality Assurance; Specifications and Tolerances.

Safety issues; Injury accidents and their causes; Safety program components; Role of workers, Supervisors, Managers and Owners; Safety Procedures for various construction operations; Safety audits; Safety laws.

Safety Organization and Management: Safety policies, safety organization, safety committees, safety representatives, outside agencies – Govt. intervention, international agreements.

REFERRENCE:

1. Levitt, R.E. and Samelson, N.M., Construction Safety Management, Mc. Graw Hill Book Company, Inc., N.Y. 1991.

2. Juran Frank, J.M. and Gryna, F.M., Quality Planning and Analysis Tata McGraw Hill 1982.

3. Raymond Elliot Levitt & Nancy Morse Samelson Construction Safety Management Amazon Second edition.

4. Grant E.L. and Leavensworth Satistical quality Control McGraw Hill 1984.

5. Hutchins G, ISO 9000, Visa Books, New Delhi, 1993.

6. Ron Baden Hellard, Total Quality in Construction Projects, Thomas Telford, London.

CEL 425 FINANCIAL AND BUSINESS MANAGEMENT [(3-0-0); CREDITS 3]

Principles of management and Personnel management: Economic environment of business, Introduction to managerial economics, ; Role of a Manager: Tasks and responsibilities of a professional manager, Human Resource development systems Organization structure & design, manpower planning Processes Managerial skills and Management Systems, techniques and processes, SWOT Analysis.

Business Policy and Strategic Management; Assessment of capital requirement and sources of capital planning the establishment and development of business, fixed and current assets, liquid resources, Forecasting of business, cash flow, effect of taxation, Public and private sources of finance, methods of obtaining finance from external sources and internal sources, cost of capital, forms of capital structures.

Value engineering and quality assurance, marketing planning & organization, marketing research & Marketing strategies, determinants of consumer behaviour, Models of consumer behaviour, Pricing & promotion strategies., Business forecasting. Modern Control Systems, Total quality Management (TQM), JIT, DSS, ERP, Strategic Management, Technological innovation & creativity.

Financial Management; Meaning and Scope, Economics and Scope, Supply and Demand Mechanism, analysis and forecasting. balance sheet, profit & loss account, fund flow statement; Production and Cost theory, analysis. Pricing; objectives, determinants, absorption, marginal costing. Financial analysis, Decisions. Capital Budgeting, budgetary control, standard costing and variance, investment appraisal.

Construction Finance: Accounting information and application, Financial versus economic evaluation, financial statements and project appraisal. Project yield, taxation and inflation, risk and uncertainty, Turnkey activities; finance and working capital, depreciation and amortization; cost control, performance budgeting, equipment rentals. Bidding and awards, work pricing, cost elements of contracts, letters of credit, financing plans, multiple sources of finance. Qualifying, bidding, bidders, comparing the bids, under-writing. unforeseen revisions, costs and rates escalation, cost progress reporting. Legal aspects.

1. **Text / References :**

    1) Peterson, H.C., Lewis, W.C. Managerial Economics, Prentice Hall of India Pvt. Ltd., 2001
    2) Parkin, M. & Bade R., Modern Macroeconomics 4th Edition, Prentice Hall, 1996
    3) Werther & Davis, Human Resources & Personnel Management, McGraw Hill, 1996
    4) Edwards, John et.al., 1983 Manpower planning, John Wiley: New York
    5) Anthony, R.N. Govindrajan, V., Irwin, Management control systems, McGraw Hill 10th Edition, 2000
    6) Baumel, W.J., A.S. Blinder and W.M. Scarth, Economics: Principles and policy, Academic Press Canada, Tornoto, 1985
    7) Anthony & Reece, accounting Principles, AITBS, Sixth Edition,1998
    8) Koontz O'Donnel : Essentials of Management; Tata McGraw Hill, 1982
    9) Monappa A., Personnel Management, Tata McGraw Hill,

CEL 562- SUSTAINABLE CONSTRUCTION ENGINEERING [(3-0-0); CREDITS 3]

Fundamentals of Sustainable Construction Engineering- Sustainability and resources, need, present practices at national and international level, The Sustainability Quadrant- challenges & Issues, Government initiatives.

Construction Product, Process Design and Development- Sustainability of construction resources, process modifications, product performance evaluation.

Sustainability assessment using standard approaches- LEED/GRIHA rating evaluation process.

Socio-economic feasibility of sustainable construction products- Innovative & customized sustainable product design based on social constraints, tools & aids available for sustainable construction products.

Life Cycle Assessment and Costing-Various aspects related to construction cost, present value analysis, life cycle stages, cost calculation & measures, evaluation criteria, uncertainty assessment, sensitivity analysis, break even analysis.

REFERRENCE:

1. Sustainable Engineering Practice ASCE Publication 2010.
2. Hagger Sustainable Industrial Design and Waste Management, Techniz Book 2010.
3. Helmut Rechberger, Practical handbook of Material Flow Analysis, Taylor & Francis. 2010,
4. Michael Z. Hou, Heping Xie, Jeoungseok Yoon Underground Storage of CO2 and Energy Taylor & Francis, 2010
5. LEED for India: Reference Guide, 2011.

CEL 418 ENERGY CONVERSION AND ENVIRONMENT [(3-0-0); CREDITS 3]

Significance of Energy Conversion and Environment, Overview of Global and Indian Energy Scenario; Environmental Impacts of Energy Conversion, Principles of Waste Minimization and Energy Recovery, Renewable and Non- Renewable Energy Sources; Estimation of Potential of Energy Recovery form various Sources, Energy economics; Energy Conversion Methods: Thermal, hydro, nuclear, solar, wind, tidal etc their principles and application, Waste to Energy options: physical, thermo chemical and bio chemical processes: pelletization, bricquetiation, Combustion, Gasification, pyrolysis; Fuels Derived anaerobic digestion , Biogas Technology, Future Technologies for Waste to Energy Systems; Introduction to Microbial Fuel cell, Gas generations and collection in landfills, Measurements and Control; Energy and Resources Conservation Strategies and Policies; Environmental Appraisal, Energy audit, Carbon Foot prints, Sustainable Energy-Efficient systems, Intelligent Green Building, Case studies of sustainable Energy Projects in the field of Water Resources, Infrastructure and Environmental System.

REFERRENCE:

1. Fowler J. M. Energy and the Environment McGraw Hill New York 2nd edition.
2. B.H. Khan, Non Conventional Energy Resources, 2nd Edition , McGraw Hill Companies.
3. G.D.Rai, Non Conventional Energy Source, Standard Publishers Distributors.

4. D. O. Hall, G. W. Barnard and P. A. Moss, Biomass for Energy in the Developing Countries, Current Roles, Potentials, Problems, Prospects, Pergamon Press Ltd, 1st edition.
5. W. C. Turner, Energy Management Handbook Wiley Newyork 1st edition.
6. P. Meier, Energy System Analysis for Developing countries, Sringer Verlag 1st edition.
7. Dorthy J De Renzo, Energy from Bioconversion of Wate materials, Noyes data Corporation USA 1st edition.
8. Francis A.Domino Energy from Solid Waste – Recent Development, Noyes data Corporation USA 1st edition.
9. Oliver S. Owen , Daniel D. Chiras, Natural Resource Conservation – Management for Sustainable Future Prentice Hall Publications 6th edition.
10. McGraw Hill George Tachonobanoglous, Hilary Thesin, Samuel Vigil 1st International Edn.

CEL 561- RISK ANALYSIS AND DECISION MAKING [(3-0-0); CREDITS 3]

Need of Decisions and Risk analysis for construction management, Decision Models, Risk and Uncertainty, Theory and Techniques of Decision and Risk Analysis, Qualitative and Quantitative risk analysis tools /methods, Modelling Value Systems, Value Management for Construction, Competitive Bidding and Risk Sharing, Strategic and integral planning, Decisions making for site selection, construction , execution and operation of projects, Documentation, Project proposals, Economic Analysis, Legal Aspects of project management, Environmental appraisal, ISO 14000, Hazards identification, analysis and risk assessment, Accident and incident Analysis and control systems, IS 3786, S.H.E. Management IS15001, Training &Education Management Oversight and risk tree, Risk control and Treatment, Risk management and Internal control, Risk mitigation, Risk management plan, IT and IS for Risk management

REFERRENCE:

1. Melvin W. Lifson, Edward F. Shaifer, Decision and Risk Analysis for Construction Management, John Wiley & Sons 1st.

2. Ian Cameron, Raghu Raman, Process Systems Risk management Elseveir Academics Press 2005.

3. Chris Marrison Fundamentals of Risk Measurements Tata McGraw Hill 2002.

4. Han Buhliman, Mathematical Methods in Risk Theory Springler- Verlang Berlin Heidelberg 1970.

5. Calow P Hand book of Environmental Risk Assessment and Management Blackwell Science Ltd. Oxford, Uk 1998.

MAL 407- STATISTICS & OPTIMIZATION TECHNIQUE [(3-0-0); CREDITS 3]

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.

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.

REFERRENCE:

1. M.R. Speigel, Probability and Statistics, McGraw Hill,
2. H.A. Taha, Operation Research, Prentice Hall of India Pvt. Ltd.
3. J.C. Pant, Introduction to Optimisation : Operations Research, Jain Brothers, New Delhi.
4. Miller and Freund, Probability and Statistics for Engineers.

MAL 409- APPLICATION OF OPERATION RESEARCH TECHNIQUES IN CONSTRUCTION [(3-0-0); CREDITS 3]

Introduction, concepts in probability and statistics, linear programming, transportation and assignment problems. Dynamic programming waiting line models, Inventory Management, sequencing, Decision theory, Game theory, simulation as applied to construction. Modifications and improvements on CPM/PERT techniques.

REFERENCES:

Quantitative Techniques in Management, N.D.Vohra, The Mc. Graw Hill Companies, 3rd Edition