

DEPARTMENT OF CIVIL, MIT Manipal
MTech CONSTRUCTION ENGINEERING AND MANAGEMENT
Program Structure (Applicable to 2023 admission onwards)

YEAR	FIRST SEMESTER						SECOND SEMESTER					
	SUB CODE	SUBJECT NAME	L	T	P	C	SUB CODE	SUBJECT NAME	L	T	P	C
I	CIE ****	OPTIMIZATION TECHNIQUES IN CONSTRUCTION MANAGEMENT	3	1	0	4	CIE ****	CONSTRUCTION CONTRACTS MANAGEMENT	3	1	0	4
	CIE ****	PROJECT FORMULATION AND APPRAISAL	3	1	0	4	CIE ****	RESEARCH METHODOLOGY AND TECHNICAL COMMUNICATION	1	0	3	2
	CIE ****	ADVANCED CONSTRUCTION METHODS AND AUTOMATION	3	1	0	4	CIE ****	CONSTRUCTION QUALITY & SAFETY MANAGEMENT	3	1	0	4
	CIE ****	RESOURCE MANAGEMENT	3	1	0	4	CIE ****	ELECTIVE I	3	1	0	4
	CIE ****	CONSTRUCTION PROJECT MANAGEMENT	3	1	0	4	CIE ****	ELECTIVE II	3	1	0	4
	CIE ****	RESEARCH METHODOLOGY AND TECHNICAL COMMUNICATION	1	0	3	-	CIE ****	ELECTIVE III	3	1	0	4
	CIE ****	BUILDING INFORMATION MODELLING LAB I	0	0	3	1	*** ****	OPEN ELECTIVE	3	0	0	3
	CIE ****	PROJECT MANAGEMENT LAB	0	0	3	1	CIE ****	CONSTRUCTION QUALITY ASSESSMENT & CONTROL LAB	0	0	3	1
	CIE ****	MINI PROJECT	0	0	3	1	CIE ****	BUILDING INFORMATION MODELLING LAB II	0	0	3	1
	Total		15	5	9	23			19	5	9	27
	THIRD AND FOURTH SEMESTER											
II	CIE ****	PROJECT WORK AND INDUSTRIAL TRAINING							0	0	0	25

PROGRAM ELECTIVES		OPEN ELECTIVES	
CIE ****	MODERN CONSTRUCTION MATERIALS & BUILDINGS (E1)	CIE ****	ADVANCED STRENGTH OF MATERIALS
CIE ****	VALUATION & REAL ESTATE MANAGEMENT (E1)	CIE ****	ENERGY AND ENVIRONMENT
CIE ****	BUILDING SERVICES ENGINEERING (E1)	CIE ****	NON-DESTRUCTIVE TESTING OF MATERIALS
CIE ****	CONSTRUCTION RISK MANAGEMENT (E2)		
CIE ****	MAINTENANCE AND REHABILITATION OF STRUCTURES (E2)		
CIE ****	SUPPLY CHAIN MANAGEMENT (E3)		
CIE ****	ENTREPRENEURSHIP AND PROFESSIONAL ETHICS (E3)		

I SEMESTER

CIE ** OPTIMIZATION TECHNIQUES IN CONSTRUCTION MANAGEMENT [3 1 0 4]**

Basic Statistics: The Histogram, Measures of central tendency, Mean Deviation, Standard Deviation, Data Analysis: Correlation and Causation Analysis of variance – One-way and two-way classifications – Completely randomized design – Randomized block design – Latin square design, factor analysis, cluster analysis, Design of experiments, Linear programming: Formulation of LP problems: Basic variables, constraints, corner points, augmented form, maximization and minimization problems. Solution methods: Graphical method, Algebraic method, Simplex method (Tabular and Matrix form). Integer linear programming, Big M method, Two phase method. Transportation problem: Basic feasible solutions using N-W Corner rule, Minimum cost method, Vogel's approximation method. Optimal solutions using Stepping Stone Method, Modified distribution method. Assignment problems: Hungarian algorithm. Assignment Models: Introduction - Solution methods – Hungarian assignment method. Decision theory: Decision in certainty: Analytical hierarchy approach, Comparison Matrix, Consistency test, Oil exploration problem, Manpower planning problem. Probabilistic decision making: Expected value approach, Optimal decision strategy. Game theory: simulations applied to construction: $n \times m$ person zero sum games with finite strategies, Maximin & Minimax strategies, Saddle points, Rule of dominance.

References:

- Quantitative Analysis for Management, Render, B., & Stair Jr, R. M., Pearson Education India, 2017, 12th Edition.
- Bronson Richard, (1983) Theory and Problem of operations Research Schaum's outline series, McGraw Hill Book Co,
- Hamdy Taha A., (1989) Operations Research: An Introduction, Maxwell Macmillan International Edition, IV Edition
- Shenoy G.V., Srivastav U.K., Sharma S.C. (1988) Operations Research for Management - Wiley Eastern Limited
- Gupta M.P., Sharma J.K. (1987) Operations Research for Management National Publishing House, II Edition
- McClain John O. and Thomas Joseph (1987) Operations Management Prentice Hall of India Private Limited, New Delhi
- Gupta R.C. (1986) Quantitative methods and operations Research – CBS Management Series
- N.D. Vohra., (2001) Quantitative Techniques in Management – Tata McGraw Hill Book Co
- Operations research: an introduction, Taha, H. A., Pearson Education India, 2013, 9th Edition.
- Probability and Statistics for Engineers, Freund, J.E. and Miller, I.R., Prentice - Hall of India, New Delhi, 1994. 5th Edition.

CIE ** PROJECT FORMULATION AND APPRAISAL [3 1 0 4]**

Project development cycle - Generation and Screening of Project Ideas -Formulation of projects: Project identification – Preliminary Analysis, Market, Technical, Financial, Economic and Ecological - Pre- Feasibility Report and its Clearance, Project Estimates and Techno-Economic Feasibility Report, Detailed Project Report – Different Project Clearances required, project life cycle analysis (LCA), Construction economics and accounts: Construction industry and related government policies, Accounting process, preparation of profit and loss account and balance sheet, preparation of contract accounts for each project, methods of recording and reporting site accounts between project office and head office, Ratio Analysis. Project cost determination: Sources of finance, Profitability Estimates, Project Cash Flows – Time Value of Money – Cost of Capital. Project Appraisal: Technical, Marketing, Financial, Economic and Managerial, NPV – BCR – IRR – ARR – Urgency – Pay Back Period – Assessment of Various Methods – Indian Practice of Investment Appraisal – International Practice of Appraisal – Analysis of Risk –Private sector participation in Infrastructure Development Projects - BOT, BOLT, BOOT -Technology Transfer and Foreign Collaboration - Scope of Technology Transfer.

References:

- Gray, C. F., Larson, E. W., & Desai, G. V. (2008). Project management: The managerial process (Vol. 97). New York: McGraw-Hill/Irwin.
- Joy P.K., "Total Project Management - The Indian Context", New Delhi, Macmillan India Ltd., 1992
- Prasanna Chandra, "Projects – Planning, Analysis, Selection, Implementation Review", McGraw Hill Publishing Company Ltd., New Delhi. 2006.
- I.D.B.I: Manual of Industrial Project Analysis in Developing Countries.
- O.E.C.D: (i) Manual for Preparation of Industrial Feasibility Studies, (ii) Guide to Practical Project Appraisal.

CIE ** ADVANCED CONSTRUCTION METHODS AND AUTOMATION [3 1 0 4]**

Computing productivity, economics and planning of Construction Equipment for excavation, compaction, concrete and bitumen mixing any laying, drilling, tunneling, boring, hoisting and lifting operations. Advancement in bridge / Culvert construction: Segmental, Girder pushing, Box pushing, In-situ methods. Methods for fast-track construction: Aluminium shuttering, Pre-cast, Rapid wall, Other wall panels for prefabricated construction, Modular construction method, 3D printing. Digitization in Construction: Building automation using IoT, Introduction to applications of BIM, Robotics in construction, Augmented reality and Virtual Reality applications.

References:

- Construction equipment management for engineers, estimators, and owners, Gransberg, D. D., & RuedaBenavides, J. A., CRC Press, 2020, 2nd Edition.

- Construction planning, equipment, and methods, Peurifoy, R. L., Schexnayder, C. J., Schmitt, R. L., McGraw-Hill Education, 2018, 9th Edition.
- Construction Equipment and Management, Sharma S.C. Khanna Publishers New Delhi, 2019, 1st Edition.
- Construction equipment management, Schaufelberger, J.E. and Migliaccio, Routledge, 2019, 1st Edition.

CIE ** RESOURCE MANAGEMENT [3 1 0 4]**

Integrated Material Management- Meaning, Functions, and Advantages, Selective control - ABC, HML techniques, Standardization and Material codification-traditional systems to modern connected approaches using barcodes, IR, RFID, Purchase under uncertainties- Quantitative techniques in forecasting process using Time series (average method, moving average method, exponential smoothing), Regression analysis, Inventory Management- Inventory related costs, Risk models, EOQ, JIT, Deterministic and Probabilistic Inventory Models, ERP systems, Personnel Management- Organization structure and Hierarchy, Staffing, Recruitment strategy, Leadership, Queuing / Waiting Line Theory- General structure of a queuing system, operating characteristics of queuing system, Lean concepts and principles- Productivity measurements in projects, Lean construction, Lean project delivery systems, Lean Tools and Techniques, Lean concepts and principles; Productivity measurements in projects.

References

- Zipkin P.H., Foundations of inventory management, McGraw-Hill, 2000.
- Wood J.M., Chapman J.A., Fromholtz M, Wallace J.J., Zeffane R., Organisational behaviour: A global perspective, 2004.
- Sun M., Howard R., Understanding IT in construction, Routledge, 2004.
- Dainty A., Loosemore M., Human resource management in construction projects, Routledge, 2013.
- Dessler G., Biju Varkkey., Human Resource Management, (16E), Pearson, Delhi, 2020.
- Tang S.L., Quantitative Techniques for Decision Making in Construction, Hong Kong University Press, Hong Kong, 2004.
- Gao S., Sui Pheng Low, Lean Construction Management the Toyota Way, Springer Singapore, 2014.
- Oakland J.S., Marton Marosszeky, Total Construction Management Lean Quality in Construction Project Delivery, Abingdon, Oxon, New York, 2017.
- Forbes L.H., Ahmed S.M., Lean project delivery and integrated practices in modern construction, Routledge, 2020.
- Emuze F.A., Saurin T.A., Wastes in construction: Concepts and types, In Value and Waste in Lean Construction, Routledge, 2015.
- González V.A., Hamzeh F., Alarcón L.F., Lean Construction 4.0: Driving a Digital Revolution of Production Management in the AEC Industry, Taylor & Francis, 2022.

CIE ** CONSTRUCTION PROJECT MANAGEMENT [3 1 0 4]**

Project life cycle, Relevance of Project Management, Project stakeholders, Project Feasibility, Project Manager traits, Construction Plan-types and preparing a construction plan, key terminologies-WBS, EPS, OBS, Activities- Defining Activity Relationships and Durations, GANTT chart, Critical Path Method- AON, Precedence Diagramming Method (PDM), Line of balance (LOB), Constraints, Monte Carlo simulation in scheduling, Project Resources- Creating Resource Pool, Estimating Resource Requirements, Resource Allocation, and Levelling and Smoothing, Project Control- Project updating, Time-cost tradeoff, Earned Value Analysis, GERT, Network Analysis- Minimum Span Problems, Shortest Route problems, Maximal Flow Problems.

References

- Mubarak S.A., Construction project scheduling and control, John Wiley & Sons, 2015.
- Jha K.N., Construction project management: Theory and practice, Pearson Education India, 2011.
- Project Management Institute, Guide to the project management body of knowledge (7E), Pennsylvania, Project Management Institute, 2021.
- IS:15883, Construction Project Management - Guidelines: Part 1, General, Bureau of Indian Standards, 2009.
- IS 15883, Construction Project Management - Guidelines: Part 2, Time Management ,Bureau of Indian Standards, 2013.
- Shrivastava U.K., Construction Planning and Management (2E) Galgotia Publications Pvt. Ltd., New Delhi, 2000.
- Chitkara K.K., Construction project management, Tata McGraw-Hill Education,1998.

CIE ** BUILDING INFORMATION MODELLING LAB I [0 0 3 1]**

Creating 2D model using software tools, Introduction to 3D modelling software, exploring tools, defining the space, levels, and elements of building, constructing 3D model, quantity take off and preparation of BOQ, executing a residential multistory project, exploring tools of electrical and mechanical ventilation design.

References:

- Kim, Marcus, Lance Kirby, and Eddy Krygiel. Mastering Autodesk Revit 2017 for architecture. 1st ed. INpolis, IN: John Wiley & Sons, 2016.
- Garber, Richard. BIM Design: Realizing the Creative Potential of Building Information Modeling. AD Smart 02. Chichester, U.K.: Wiley, 2004.
- Open Building Designer Learning Path:
Short-Term Course: <https://education.bentley.com/LearningPaths/guided-learningpaths-851311>
- Detail Course: <https://learn.bentley.com/app/Public/BrowseLearningPaths?aftkn=dfcc685d-aeaa-4e1e-9741-bdbca62f305d&productLineId=36021>

CIE ** PROJECT MANAGEMENT LAB [0 0 3 1]**

Study the plan – identify WBS, activities, rate analysis, duration calculation, estimation and costing, activity interdependency, scheduling, Zero Cost Report (ZCR), Job cost ledger (JCL), Job cost report (JCR), site visits, and execution of the project using Project planning and management software.

References:

- Stackpole C.S., A User's Manual to the PMBOK Guide, John Wiley & Sons, 2013.
- Jha K.N., Construction project management: Theory and practice, Pearson Education India, 2011.
- Winter R.M., Construction Scheduling with Primavera Project Planner, Cost Engineering, 2003.
- Liberatore M.J., Pollack-Johnson B., Smith C.A., Project management in construction: Software use and research directions, Journal of construction engineering and management, 2001.
- Willis E.M., Scheduling construction projects, John Wiley & Sons, 1986.
- Chitkara K.K., Construction project management, Tata McGraw-Hill Education, 1998.

CIE ** MINI PROJECT [0 0 3 1]**

Realtime Project development- Development of BIM 3D model, Quantity Take-off, Integrating the 3D models, Developing the model further up to 5D. Quantity- take off, Scheduling and risk evaluation, Extension of Time (EOT), Time Impact Analysis/Window Analysis, Delay Analysis using Primavera P6 tool.

References

- Cicala G., Cicala G., Understanding Project Definition, The Project Managers Guide to Microsoft Project 2019: Covers Standard, Professional, Server, Project Web App, and Office 365 Versions, 2020.
- Lewis C., Chatfield C., Johnson T., Microsoft Project 2019 step by step, Microsoft Press, 2019.
- Feigenbaum L., Construction scheduling with primavera project planner, Pearson College Division, 2002.
- Eastman C.M., Teicholz P., Sacks R., Liston K., BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors, John Wiley & Sons, 2011.
- Hardin B., McCool D., BIM and construction management: proven tools, methods, and workflows, John Wiley & Sons, 2015.
- Rad N.K., Project Scheduling Rules, by bookboon. Com, 2013.

Online Resources

<http://www.mosaicprojects.com.au/Planning.html>

<https://www.coursera.org/courses?query=bim>

II SEMESTER

CIE **: CONSTRUCTION CONTRACT MANAGEMENT (3 1 0 4)**

The terms and definitions of an engineering contract, types of contracts and classification, apply in different work/s with case studies or illustrative examples; the list of documents required in a tendering process for enquiry, tender and contract stages; receipt, opening, evaluation of tender with case examples and the award of contract; the various issues in tendering process and Risk management in tendering process or Pre-tender design elements; the Responsibilities of Principal & Contractor, Project Monitoring and Quality control/assurance, significance of maintaining DPR & MPR, related case studies, settlement of claims – advances, bills, extension for time, extras & variations, cost escalations; the Currency of bid and Payment in International Contracts, escalation in Foreign Currency, financing of projects; the definition and classification of breach of contract, common breaches by – principal, contractor, damage assessment, claims for damages, Quantum Meruit, Force Majeure or Frustration; the various judicial and non-judicial methods for dispute resolution; the Conciliation, Dispute Resolution Boards (DRB), Arbitration and the applicable law and settlement of disputes in International Contracts / International Arbitration.

References:

- Prakash V. A, Contracts Management in Civil Engineering Projects, NICMAR, 1997.
- Patil B. S, Civil Engineering Contracts and Estimates, University Press, 2009.
- 3. John G. Betty, Engineering Contracts, McGraw Hills, 1993.
- Albett Robert W, Engineering Contracts and Specifications, John Willey and Sons, New York, 1961.
- Vaid K.N, Global perspective on International Construction Contracting Technology and Project Management, NICMAR, Mumbai, 1998.

RESEARCH METHODOLOGY AND TECHNICAL COMMUNICATION (1 0 3 2)

Research Methodology: Basic concepts: Types of research, Significance of research, Research framework. Sources of data, Methods of data collection. Research formulation: Components, selection and formulation of a research problem, Objectives of formulation, and Criteria of a good research problem. Research hypothesis: Criterion for hypothesis construction, Nature of hypothesis, Characteristics and Types of hypothesis, Elements of research design, Introduction to various sampling methods Sources of data, Collection of data, Research reports, references styles, Effective Presentation techniques, Research Ethics.

References:

- Sekaran, U., & Bougie, R. (2016). Research methods for business: A skill building approach. John Wiley & Sons.

- Zikmund, W. G., Babin, B. J., Carr, J. C., & Griffin, M. (2013). Business research methods. Cengage Learning.
- Creswell, J. W., & Creswell, J. D. (2017). Research design: Qualitative, quantitative, and mixed methods approaches. Sage Publications.
- Donald R Cooper & Pamela S Schindler, Business Research Methods, McGraw Hill International, 2018.
- Fellows RF, Liu AM, Research methods for construction, John Wiley & Sons, 2021.

CIE ** CONSTRUCTION QUALITY AND SAFETY MANAGEMENT [3 1 0 4]**

Foundations of TQM: Understanding quality, TQM philosophy, Cost of quality, Concept of Deming, Juran, Crosby, Imai, Ishikawa, Taguchi, Shingo philosophies, Customer satisfaction ergonomics. TQM tools: Flowcharts, Check sheets, Histogram, Cause and effect diagrams, Pareto diagram, Scatter diagram and Control charts. Quality management systems, Quality Assurance & Quality control, Six sigma concept, DMAIC, Quality function deployment, DFMEA models, Continuous improvement, Process capability. Safety Programs and organization: Introduction to safety, challenges in the construction sector, accident statistics, accident causation theories, Cost of Safety, Safety acts and Regulations, Safety audit, accident investigation and prevention Techniques, Environmental safety, Social and environmental factors, Application of digital technology in construction safety.

References:

- Quality Management in Construction Projects, Abdul Razzak Rumane, CRC Press, 2018, Second Edition
- Construction Safety Management, Prof Jha, Patel and Singh, 2021
- Oakland John S (2006) "TQM", Text with cases, Butterworth- Heinemann, Oxford.
- Bhat Sridhara K (2007) "Total Quality Management", Himalaya Publication House, Mumbai
- Zairi Mohamed, (1992) "Total Quality Management for Engineers", Aditya Books, NewDelhi.

CIE ** MODERN CONSTRUCTION MATERIALS AND BUILDINGS [3 1 0 4]**

Cement and concrete composites, alternative materials for concrete production (cement, coarse and fine aggregate), masonry (AAC, stabilized mud block, fly ash bricks, FAL-G), Concretes – Geopolymer concrete, Self-compacting concrete, Alkali activated concrete, self-healing concrete, Fiber reinforced concrete, polymer concrete, High-volume fly ash concrete, Sources of supplementary cementitious materials, chemical and mineral admixtures, Construction and demolition waste, Principles of concrete mix proportioning – Prescriptive and performance based approach, Guidelines for concrete mix proportioning: IS 10262-2019, ACI and BS codes for concrete mixture proportioning, Durability of concrete: Permeability, water absorption, sorptivity, chloride, sulfate, and acid exposure, alkali - aggregate reaction, corrosion due to chloride ingress, carbonation, resistance to freeze-thaw cycles, shrinkage and creep in concrete, microstructural analysis of concrete, characterization of concrete – analytical techniques – TGA, DTA, DSC, FTIR, NMR, SEM – EDX, XRD Climate

Change- carbon footprint, ecological footprint; Sustainability – thermal conductivity Energy efficient buildings; Green buildings and Green Architecture; Net zero energy buildings; 3D printed; Prefabricated and Pre-cast Buildings; Green Building Councils – IGBC, GRIHA, TERI, Life cycle costing principles, practice, tools, and case studies.

References:

- Delgado J.M., Sustainable materials in building construction, Springer Nature, 2020.
- Kubba S., Handbook of green building design and construction: LEED, BREEAM, and Green Globes, Butterworth-Heinemann, 2012.
- McLennan J.F., The philosophy of sustainable design: The future of architecture, Ecotone publishing, 2004.
- Mike Montoya, Green Building Fundamentals , Pearson, 2nd edition, 2010.
- Kibert C.J, Sustainable construction: green building design and delivery, John Wiley & Sons, 2016.
- Leffers M.R., Sustainable Construction and Design, Pearson Education/Prentice Hall, 2010.
- Mehta P.K., Monteiro P.J., Concrete: microstructure, properties, and materials, McGraw-Hill Education, 2014.
- Neville A.M., Properties of concrete, London: Longman, 1995.
- Page C.L., Page M.M., Durability of concrete and cement composites. Elsevier, 2007.
- Thomas M., Supplementary cementing materials in concrete, CRC press, 2013.
- Ramachandran V.S., Beaudoin J.J, Handbook of analytical techniques in concrete science and technology: principles, techniques and applications, Elsevier, 2000.
- Chhachhia A., Concrete mix design by IS, ACI and BS methods: A Comparative Analysis, Journal of Building Material Science, 2020.
- IS:456, Indian Standard code of practice for plain and reinforced cement concrete, Bureau of Indian Standards, 2000.
- SP 23, Handbook on Concrete Mixes, Bureau of Indian Standards, 1982.
- IS:10262, Guidelines for Concrete Mix Design Proportioning, Bureau of Indian Standards, 2019.
- Caspeele R., Taerwe L., Frangopol D.M., Life Cycle Analysis and Assessment in Civil Engineering: Towards an Integrated Vision: Proceedings of the Sixth International Symposium on Life-Cycle Civil Engineering (IALCCE 2018), Belgium,, CRC Press, 2018.

CIE ** VALUATION AND REAL ESTATE MANAGEMENT [3 1 0 4]**

Cost Price and Value, Essential characteristics of value, Different forms of values, Purpose of valuation, Outgoings- Municipal & Govt. Taxes, insurance, Loss of rent, collection charges, sinking fund, Annual repairs & maintenance. Depreciation. Methods of calculation of depreciation, Year's Purchase, Capitalized value, Obsolescence, and Amortization. Methods of valuation- Open land valuation, Factors affecting intrinsic values of land, Comparative method, Abstractive method, Belting method, Rent- Definition, Forms of rents, Cost of structure, BIS rules for measuring plinth area and

cubical contents, Valuation of land with buildings- Rental method, Land and building method, Valuation on a profit basis, Direct comparison of capital value, Residual or Development method, Valuation of agricultural/farmlands, Rights and Liabilities of Lessor & Lessee, Leasehold properties, freehold Properties, Real Estate (Regulation and Development) Act 2016, (RERA), Easements- Self-imposed, Legally created, Dominant and Servient heritage, Effect of easements on valuation, Market-Real Estate market and market value, fair market value, open market value, affecting parameters, Case Studies- Valuation of real properties and real estate.

References:

- Shyamales Dutta, “Valuation of Real Property” Eastern Law House, Kolkata.
- Banerjee D.N (1998) “Principles and Practice of Valuation ". Eastern law house.
- S.C. Rangwala, “Valuation of Real Properties” Charotar Publishing House Pvt. Ltd, Anand, Ninth edition (2013).
- Roshan H. Namavathi,(2001) "Professional Practice "Lakhani Book Depot.
- Mitra A.K., (1986)"Theory and Practice of Valuation "Eastern law house
- Rao Gopinath C H,(2002) “Valuation Practices of Immovable Properties.” Edition 12, Publisher, C H Gopinath Rao, Chennai.
- RERA Karnataka, Gujarat, Maharashtra.

CIE ** BUILDING SERVICES ENGINEERING [3 1 0 4]**

Functional planning buildings: Optimization of space, Spatial Synthesis graphical techniques, heuristic procedures. Space requirements and relationships for typical buildings, like residential offices, hospitals, etc. Standard fire, fire resistance, classification of buildings, means of escape, alarms, etc., Engineering services in a building as system Lifts, escalators, cold and hot water systems, waste water systems, and electrical systems. Building Maintenance: Scheduled and contingency maintenance planning. Maintenance standards. Economic maintenance decisions. Environmental factors: Thermal performance of buildings; Comfort factors and measurements; climatic design; Solar control and shading devices, Louver design, ventilation. Introduction to lighting: units of light, colour lamps, luminaries, Daylight design of general lighting schemes; Energy management and lighting; acoustical design of auditoria and noise control in buildings.

References:

- Chiara Joseph, Koppelman Lee, (1975) 'Urban planning and design criteria', Van Nostrand Reinhold, New York.
- Catanese Anthony J , Snyder James C, (1979) 'Introduction to urban planning', MGH, New York.
- Kut Euring David, (1993) 'Illustrated encyclopedia of building services ', E and F N Spon, London.
- Building Services Research Information Association, (1987) 'Building services material hand book', E and FN Span, London.

- Chadderton David V, (1991) 'Building services engineering', E and FN Span, London.
- Shear Mel A, (1983) 'Hand book of building maintenance management', Reston Publishing, Reston.
- Miller Elmo J, Blood Jerome W, (1971) 'Modern maintenance management', Taraporevala, Bombay.
- Newbrough E T, (1967) 'Effective maintenance management', MGH New York.
- Cowan Henry J, (1980) 'Solar energy applications in the design of buildings', Applied Science Publishers, London.
- Durrant D W, (1977) 'Interior lighting design', Lighting Industry Federation, London.
- Watson Lee, (1990) 'Lighting design handbook', Mc Graw Hill, New York.
- Development Control Regulation, bylaws

CIE *** CONSTRUCTION RISK MANAGEMENT [3 1 0 4]**

Project Risk Management Definition, Role of Project Risk Management in Project Management, Good Risk Management Practice, Strategic Management process, SWOT analysis, Macro and Micro environmental factors, Importance of value chain, Critical Success Factors for Project Risk Management, Definition of Risk, Individual Risks and Overall project Risks, Stake holders Risk Attitude, Responsibility for Project Risk Management, Project Manager's Role, Project Risk Management Process, Roles and responsibilities of Board of Directors, structure and composition role of top management, key factors for success in organisation Critical Success Factors, Barriers, Tools, Documentation Process, Qualitative Risk Analysis, Risk Responses, Monitoring and Controlling Risks, Case studies of construction companies. Simulation: Monte-Carlo Simulation, Sensitivity Analysis and Analytical Hierarchy Process (AHP).

References:

- Flanagan Roger, Norman George, 'Risk Management and Construction', Blackwel Science Ltd., Oxford, 1999
- Chapman Robert J., 'The Rules of Project Risk Management: Implementation Guidelines for Major Projects', Routledge, London, 2014
- Revere John J., 'Construction Risk: A Guideline to Identification and Mitigation of Construction Risks', Marketing Technologies, London, 2003
- Meyer Christian, Quell Peter, 'Risk Model Validation', Risk Books, London, 2016
- Smith Nigel J., Merena Tony, Jobling Paul, 'Managing Risks in Construction Projects', Willey Blackwell, Network.
- Strategic management in construction, David Langford, Steven Male, John-Wiley and sons, 2008 and 2nd edition.
- Construction management in practice, Richard Fellows, Blackwell science, 2001 and 2nd edition.

CIE ** MAINTENANCE AND REHABILITATION OF REINFORCED CONCRETE STRUCTURES [3 1 0 4]**

Maintenance planning and repair Strategies: Significance of maintenance, principles of maintenance management, types of maintenance, maintenance planning, causes of structural deterioration, quality management. Diagnostic methods for Concrete deterioration: Causes of deterioration, Visual inspection, Non-destructive test methods: strength, durability and chemical methods, Load testing Repair Materials and their properties: Special concrete and mortar, polymer concrete, fiber reinforced concrete, bonding aids, sealants and curing compounds, resins and their applications Repair techniques for reinforced concrete structure: Crack repair, epoxy injection, grooving and stitching, dry pack mortar, corrosion protection, cathodic protection, electro osmosis, corrosion inhibitor, water proofing systems, foundation repair, underpinning Structural health monitoring and Repair of special structure: Structural health monitoring, its significance and applications, Damage assessment and restoration techniques for bridge structure, Seismic rehabilitation and retrofitting techniques, Repair of fire damaged structure

References:

- Allen R.T.L., Edwards S. C., (1987) 'The Repair of Concrete Structures', Blackie & Sons Ltd., Glasgow, London.
- Peter H Emmons., (2001), "Concrete Repair and Maintenance Illustrated", Galgotia Publications Pvt. Ltd., New Delhi.
- Tedkay, (1992)'Assessment and Renovation of Concrete Structures', Longman Scientific & Technical, Harlow, England.
- Jagadisa R., (1995)'Structural Failures- Case Histories', Gcford & IBH Publishing Co. Ltd., New Delhi.
- Raikar R.N., (1994) 'Diagnosis and Treatment of Structures in Distress', R & D Centre Structural Designers & Consultants Pvt. Ltd., Vashi, New Bombay

CIE ** SUPPLY CHAIN MANAGEMENT [3 1 0 4]**

Introduction to Supply chain Management: Supply Chain, Objectives, importance, decision phases, supply chain enablers, supply chain performance in India; Supply Chain Performance Measures: Achieving strategic fit and scope, Supply chain performance measures, supply chain drivers and metrics. Outsourcing: Sourcing decisions in a supply chain-in-house/outsourcing, third and fourth party logistics providers, suppliers scoring assessment, contracts and supply chain performance; Transportation, network design and operations: Introduction, drivers of transportation decisions, choices comparison; performance measures, total cost approach, impact of speed of delivery and demand uncertainty; Strategy for transportation Network Design and Operations, case studies – Network planning and transportation issues, Demand forecasting methods; Supply Chain Integration: Co-ordination in a supply chain; Bullwhip effect - causes and remedial measures; IT in Supply Chain: Role of IT in SCM, key challenges in adapting IT to improve the efficiency of Supply chain, case study - RFID technology; Agile Supply Chain: Situations for the necessary forecast updating, differentiation

among responsive and speculative supply chains, sources of supply chain disruptions and their risk mitigation; Green supply chain; Enterprise application software

References:

- Supply Chain management- Strategy, Planning and Operation”, Sunil Chopra, Peter Meindel – Fifth Edition, Pearson- Prentice Hall
- Supply chain – Text and cases, Janat shah, Pearson publication
- Green Supply Chains- An action manifesto, Stuart Emmet and Vivek Sood, Wiley Publication.
- ERP demystified, Alexis Leon, Tata Mcgraw- Hill education private limited, second edition

CIE ** ENTREPRENEURSHIP AND PROFESSIONAL ETHICS [3 1 0 4]**

Organizational Behaviour- Nature of organizational behavior, Definition, key elements, scope, model, roles of a manager. Understanding Individual Behavior- Personality, Perception, Learning Attitudes, Values and Job satisfaction, Concepts of motivation, application of theory in practice with case studies, Foundations of Group Behavior- Small groups in an organization, smart selection of Organization structure, new trends in organization structure, Leadership models, effective utilization of power and dealing with politics, importance of effective communication, Organization-culture, work stress management, organizational changes, and development, Construction Economics- Cost Concepts, Theory of Costs and Break-Even Analysis, Client’s Estimation of Project Costs., Professional Ethics in Construction Industry- Professional Ethics and Social Values in Construction industry, Impact of Professional Ethics on Construction Quality, Code of Ethics, Unethical Conduct and mitigation.

References

- Langford D., Male S., Strategic management in construction, John Wiley & Sons, 2008.
- Fellows R.F., Langford D., Newcombe R., Urry S., Construction management in practice, John Wiley & Sons, 2009.
- Varshney R.L., Maheswari K.L, Managerial Economics, Sultan Chanda and Sons, New Delhi, 2005.
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CIE ** CONSTRUCTION QUALITY ASSESSMENT AND CONTROL [0 0 3 1]**

Quality – definition, quality timelines, quality appraisal: quality control tools, quality assurance plan, and checklists, Activity - vendor selection and appraisal, Quality assessment: Soil, structural grade concrete, bitumen, pavements, structural distress assessment –Building, bridge, pavement using visual and Non – Destructive Testing

References:

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CIE ** BUILDING INFORMATION MODELLING LAB II [0 0 3 1]**

Introduction to Open Road Designer, exploring the tools in ORD, design of a stretch including median, culvert, junction, and a minor bridge. Creating 3D model and simulation, estimation of design, preparation of BOQ. Creating 3D model of the given stretch of highway and estimation of quantities as a case study.

References:

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- Garber, Richard. BIM Design: Realizing the Creative Potential of Building Information Modeling. AD Smart 02. Chichester, U.K.: Wiley, 2004.

OPEN ELECTIVES

CIE ** ADVANCED STRENGTH OF MATERIALS [3 0 0 3]**

Torsion: Torsion of non-circular and thin walled sections. Unsymmetrical bending of straight beams, thin-walled beam cross sections – shear centre for thin walled sections. Bending of curved beams: crane hooks, closed rings - correction factor for flanged cross sections. Bending of beams curved in plan. Beams on Elastic foundation.

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CIE ** ENERGY AND ENVIRONMENT [3 0 0 3]**

Introduction: Energy consumption, crisis, Policies, Laws and Principles. Renewable sources of energy and Environmental aspects: example: solar energy, Hydro power, etc. Non-renewable sources of energy and Environmental aspects – coal, oil, natural gas. Global and regional impacts of Climate change: Greenhouse effects, global warming and Acid rain

References:

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- Rao S., Parulekar B.B., Energy Technology: Non-conventional, renewable and conventional, (3e), Khanna Publication, 2012.

CIE ** NON- DESTRUCTIVE TESTING OF MATERIALS [3 0 0 3]**

Introduction, Liquid Penetrant Tests, Magnetic particle testing, Acoustic Emission Test, Ultrasonic test, Electromagnetic Testing Method, Leak Testing Methods, Radiographic Testing Method.

References

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