

**ANNA UNIVERSITY OF TECHNOLOGY MADURAI**  
**MADURAI – 625002**

**REGULATIONS 2010**

**CURRICULAM & SYLLABI**

**M.E CONSTRUCTION ENGINEERING AND MANAGEMENT**

**SEMESTER I**

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1	10277SQ101	<a href="#">Statistical Methods and Queuing Theory</a>	3	1	0	4
2	10211CN102	<a href="#">Modern Construction Materials</a>	3	0	0	3
3	10211CN103	<a href="#">Construction Equipment</a>	3	0	0	3
4	10211CN104	<a href="#">Project Formulation and Appraisal</a>	3	0	0	3
5	E01	<a href="#">Elective I</a>	3	0	0	3
6	E02	<a href="#">Elective II</a>	3	0	0	3
<b>TOTAL</b>						<b>19</b>

**SEMESTER II**

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1	10211CN201	<a href="#">Advanced Construction Techniques</a>	3	0	0	3
2	10211CN202	<a href="#">Contract Laws and Regulations</a>	3	0	0	3
3	10211CN203	<a href="#">Construction Planning, Scheduling and Control</a>	3	0	0	3
4	10211CN204	<a href="#">Computer Applications in Construction Engineering and Planning</a>	2	0	2	3
5	E03	<a href="#">Elective III</a>	3	0	0	3
6	E04	<a href="#">Elective IV</a>	3	0	0	3
<b>PRACTICAL</b>						
7	10211CN207	<a href="#">Advanced Construction Engineering and Computing Techniques Laboratory</a>	0	0	4	2
<b>TOTAL</b>						<b>20</b>

### SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>THEORY</b>						
1	E05	Elective V	3	0	0	3
2	E06	Elective VI	3	0	0	3
3	E07	Elective VII	3	0	0	3
<b>PRACTICAL</b>						
4	10211CN304	Practical Training (4 Weeks)	0	0	0	1
5	10211CN305	Project Work (Phase-1)	0	0	6	3
6	10211CN306	Seminar	0	0	2	1
		<b>TOTAL</b>	<b>9</b>	<b>0</b>	<b>8</b>	<b>14</b>

### SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
<b>PRACTICAL</b>						
1	10211CN401	Project Work (Phase – II)	0	0	30	15
		<b>TOTAL</b>	<b>0</b>	<b>0</b>	<b>30</b>	<b>15</b>

**TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 68**

#### ELECTIVES FOR M.E. CONSTRUCTION ENGINEERING AND MANAGEMENT

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
<b>ELECTIVE I (E01)</b>						
1	10211SEE11	<a href="#">Advanced Concrete Technology</a>	3	0	0	3
2	10211CNE12	<a href="#">Shoring, Scaffolding and Formwork</a>	3	0	0	3
<b>ELECTIVE I (E02)</b>						
3	10211CNE21	<a href="#">System Integration in Construction</a>	3	0	0	3
4	10211CNE22	<a href="#">Energy Conservation Techniques in Building Construction</a>	3	0	0	3
<b>ELECTIVE I (E03)</b>						
5	10211CNE31	<a href="#">Construction of Pavements</a>	3	0	0	3
6	10211CNE32	<a href="#">Construction Project Management</a>	3	0	0	3
7	10211SFE33	<a href="#">Geoenvironmental Engineering</a>	3	0	0	3
<b>ELECTIVE I (E04)</b>						
8	10211CNE41	<a href="#">Quantitative Techniques in Management</a>	3	0	0	3
9	10211CNE42	<a href="#">Construction Personnel Management</a>	3	0	0	3
<b>ELECTIVE I (E05)</b>						
10	10211CNE51	<a href="#">Business Economics and Finance Management</a>	3	0	0	3
11	10211CNE52	<a href="#">Quality Control and Assurance in Construction</a>	3	0	0	3
12	10211SEE72	<a href="#">Stability of Structures</a>	3	0	0	3

<b>ELECTIVE I (E06)</b>							
13		10211CNE61	<a href="#">Resource Management and Control in Construction</a>	3	0	0	3
12		10211CNE62	<a href="#">Project Safety Management</a>	3	0	0	3
<b>ELECTIVE I (E07)</b>							
13		10211CNE71	<a href="#">Management Information Systems</a>	3	0	0	3
14		10211SEE42	<a href="#">Maintenance and Rehabilitation of Structures</a>	3	0	0	3

**UNIT I ONE DIMENSIONAL RANDOM VARIABLE 9+3**

Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random Variable.

**UNIT II ESTIMATION THEORY 9+3**

Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation - Curve fitting by Principle of least squares – Regression Lines.

**UNIT III TESTING OF HYPOTHESES 9+3**

Sampling distributions - Type I and Type II errors - Tests based on Normal, t,  $\chi^2$  and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

**UNIT IV DESIGN OF EXPERIMENTS 9+3**

Analysis of variance – One-way and two-way classifications – Completely randomized design – Randomized block design – Latin square design.

**UNIT V QUEUEING MODELS 9+3**

Poisson Process – Markovian queues – Single and Multi Server Models – Little's formula Machine Interference Model – Steady State analysis – Self Service queue.

**TOTAL (L: 45+T: 15): 60**

**REFERENCES:**

1. Jay L. Devore, Probability and Statistics and Probability for Engineers, CENGAGE Learning, Indian Edition, Singapore, 2008.
2. D. C. Montgomery, G. C. Runger, Applied Statistics and Probability for Engineers, Third Edition, John Wiley and Sons, 2007.
3. D. Gross, C. M. Harris, Fundamentals of Queuing Theory, Third Edition, John Wiley and Sons, 2002.
4. Walpole, R.E., Myer, R.H., Myer, S.L. and Ye, K., Probability and Statistics for Engineers and Scientists, 7th edition, Pearson Education, Delhi, 2002.
5. Vohra, N.D. "Quantitative Techniques in Management", Tata McGraw – Hill Company Limited, 2007.
6. Gupta, S. C. and Kapoor, V. K., Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi, 2001.
7. Taha, H. A., Operations Research: An Introduction, Seventh Edition, Pearson Education Edition, Asia, New Delhi , 2002.

**UNIT I SPECIAL CONCRETES 10**

Concretes, Behaviour of concretes - High Strength and High Performance Concrete – Fibre Reinforced Concrete, Self compacting concrete, Alternate Materials to concrete

**UNIT II METALS 10**

Steels - New Alloy Steels – Aluminum and its Products –Coatings to reinforcement – Applications.

**UNIT III COMPOSITES 10**

Plastics –Reinforced Polymers – FRP – Applications

**UNIT IV OTHER MATERIALS 10**

Water Proofing Compounds – Non-weathering Materials – Flooring and Facade Materials

**UNIT V SMART AND INTELLIGENT MATERIALS 5**

Smart and Intelligent Materials for intelligent buildings - Special features

**TOTAL: 45**

**REFERENCES:**

1. Santhakumar.A.R., Concrete Technology, Oxford University press, New Delhi. 2007.
2. Mamlouk, M.S. and Zaniewski, J.P., Materials for Civil and Construction Engineers, Prentice Hall Inc., 1999.
3. Ashby, M.F. and Jones.D.R.H.H. “Engineering Materials 1: An introduction to Properties, applications and designs”, Elsevier Publications, 2005.
4. Shan Somayaji, Civil Engineering Materials, Prentice Hall Inc., 2001
5. Aitkens , High Performance Concrete, McGraw Hill, 1999
6. Deucher, K.N, Korfiatis, G.P and Ezeldin, A.S, Materials for civil and Highway Engineers, Prentice Hall Inc., 1998.
7. Shetty M.S, Concrete Technology: Theory and Practice, S.Chand & Company Ltd., 2005.
8. ACI Report 440.2R-02, “Guide for the design and construction of externally bonded RP systems for strengthening concrete structures”, American Concrete Institute, 2002.

10211CN103

**CONSTRUCTION EQUIPMENT**

**L T P C**  
**3 0 0 3**

**UNIT I CONSTRUCTION EQUIPMENT MANAGEMENT 10**

Identification – Planning - Equipment Management in Projects - Maintenance Management – Replacement - Cost Control of Equipment - Depreciation Analysis – Safety Management

**UNIT II EQUIPMENT FOR EARTHWORK 10**

Fundamentals of Earth Work Operations - Earth Moving Operations - Types of Earth Work Equipment - Tractors, Motor Graders, Scrapers, Front end Waders, Earth Movers

**UNIT III OTHER CONSTRUCTION EQUIPMENTS 10**

Equipment for Dredging, Trenching, Tunneling, Drilling, Blasting - Equipment for Compaction - Erection Equipment - Types of pumps used in Construction - Equipment for Dewatering and Grouting – Foundation and Pile Driving Equipment – Equipment for Demolition.

**UNIT IV MATERIALS HANDLING EQUIPMENT 5**

Forklifts and related equipment - Portable Material Bins – Conveyors - Hauling Equipment

**UNIT V EQUIPMENT FOR PRODUCTION OF AGGREGATE AND CONCRETING 10**

Crushers – Feeders - Screening Equipment - Handling Equipment - Batching and Mixing Equipment - Hauling, Pouring and Pumping Equipment – Transporters

**TOTAL: 45**

**REFERENCES:**

1. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., Construction Planning, Equipment and Methods, McGraw Hill, Singapore, 2006.
2. Sharma S.C. Construction Equipment and Management, Khanna Publishers, New Delhi, 1988.
3. Deodhar, S.V. Construction Equipment and Job Planning, Khanna Publishers, New Delhi, 1988.
4. Dr.Mahesh Varma, Construction Equipment and its planning and Application, Metropolitan Book Company, New Delhi. 1983.



**UNIT I SUB STRUCTURE CONSTRUCTION 15**

Box jacking - pipe jacking - Under water construction of diaphragm walls and basement - Tunneling techniques - piling techniques - driving well and caisson - sinking cofferdam - cable anchoring and grouting - driving diaphragm walls, sheet piles - laying operations for built up offshore system - shoring for deep cutting - large reservoir construction - well points - dewatering and stand by plant equipment for underground open excavation.

**UNIT II SUPER STRUCTURE CONSTRUCTION FOR BUILDINGS 10**

Vacuum dewatering of concrete flooring – concrete paving technology – techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections – launching techniques – suspended form work – erection techniques of tall structures, large span structures – launching techniques for heavy decks – insitu prestressing in high rise structures, aerial transporting handling erecting lightweight components on tall structures.

**UNIT III CONSTRUCTION OF SPECIAL STRUCTURES 10**

Erection of lattice towers and rigging of transmission line structures – construction sequence in cooling towers, silos, chimney, sky scrapers, bow string bridges, cable stayed bridges – launching and pushing of box decks – Advanced construction techniques for offshore structures – construction sequence and methods in domes and prestress domes – support structure for heavy equipment and conveyor and machinery in heavy industries – erection of articulated structures, braced domes and space decks.

**UNIT IV REHABILITATION TECHNIQUES 6**

Mud jacking grout through slab foundation - micropiling for strengthening floor and shallow profile - pipeline laying - protecting sheet piles, screw anchors - sub grade water proofing, underpinning, crack stabilization techniques.

**UNIT V DEMOLITION 4**

Advanced techniques and sequence in demolition and dismantling.

**TOTAL: 45****REFERENCES:**

1. Robertwade Brown, Practical foundation engineering hand book, McGraw Hill Publications, 1995.
2. Patrick Powers. J., Construction Dewatering: New Methods and Applications, John Wiley & Sons, 1992.
3. Jerry Irvine, Advanced Construction Techniques, CA Rocketr, 1984
4. Peter.H.Emmons, "Concrete repair and maintenance illustrated", Galgotia Publications Pvt. Ltd., 2001.
5. Sankar, S.K. and Saraswati, S., Construction Technology, Oxford University Press, New Delhi, 2008.



<b>UNIT – I</b>	<b>CONSTRUCTION CONTRACTS</b>	<b>10</b>
Indian Contracts Act – Elements of Contracts – Types of Contracts – Features – Suitability – Design of Contract Documents – International Contract Document – Standard Contract Document – Law of Torts		
<b>UNIT – II</b>	<b>TENDERS</b>	<b>10</b>
Prequalification – Bidding – Accepting – Evaluation of Tender from Technical, Contractual and Commercial Points of View – Contract Formation and Interpretation – Potential Contractual Problems – World Bank Procedures and Guidelines – Tamilnadu Transparency in Tenders Act.		
<b>UNIT – III</b>	<b>ARBITRATION</b>	<b>5</b>
Comparison of Actions and Laws – Agreements – Subject Matter – Violations – Appointment of Arbitrators – Conditions of Arbitration – Powers and Duties of Arbitrator – Rules of Evidence – Enforcement of Award – Costs		
<b>UNIT – IV</b>	<b>LEGAL REQUIREMENTS</b>	<b>10</b>
Insurance and Bonding – Laws Governing Sale, Purchase and Use of Urban and Rural Land – Land Revenue Codes – Tax Laws – Income Tax, Sales Tax, Excise and Custom Duties and their Influence on Construction Costs – Legal Requirements for Planning – Property Law – Agency Law – Local Government Laws for Approval – Statutory Regulations		
<b>UNIT – V</b>	<b>LABOUR REGULATIONS</b>	<b>10</b>
Social Security – Welfare Legislation – Laws relating to Wages, Bonus and Industrial Disputes, Labour Administration – Insurance and Safety Regulations – Workmen’s Compensation Act – Indian Factory Act – Tamilnadu Factory Act – Child Labour Act - Other Labour Laws		

**TOTAL: 45****REFERENCES:**

1. Gajaria G.T., Laws Relating to Building and Engineering Contracts in India, M.M.Tripathi Private Ltd., Bombay, 1982
2. Jimmie Hinze, Construction Contracts, McGraw Hill, 2001
3. Joseph T. Bockrath, Contracts and the Legal Environment for Engineers and Architects, McGraw Hill, 2000.
4. Kwaku, A., Tenah, P.E. Jose M.Guevara, P.E., Fundamentals of Construction Management and Organisation, Printice Hall, 1985.
5. Patil. B.S, Civil Engineering Contracts and Estimates, Universities Press (India) Private Limited, 2006.

**10211CN203 CONSTRUCTION PLANNING, SCHEDULING AND CONTROL** **L T P C**  
**3 0 0 3**

**UNIT – I CONSTRUCTION PLANNING 9**

Basic Concepts in the Development of Construction Plans - Choice of Technology and Construction Method - Defining Work Tasks - Defining Precedence Relationships among Activities - Estimating Activity Durations - Estimating Resource Requirements for Work Activities - Coding Systems

**UNIT – II SCHEDULING PROCEDURES AND TECHNIQUES 9**

Construction Schedules - Critical Path Method – Scheduling Calculations - Float - Presenting Project Schedules - Scheduling for Activity-on-Arrow and with Leads, Lags, and Windows - Scheduling with Resource Constraints and Precedences - Use of Advanced Scheduling Techniques - Scheduling with Uncertain Durations - Calculations for Monte Carlo Schedule Simulation - Crashing and Time/Cost Tradeoffs - Improving the Scheduling Process.

**UNIT – III COST CONTROL, MONITORING AND ACCOUNTING 9**

The Cost Control Problem - The Project Budget - Forecasting for Activity Cost Control - Financial Accounting Systems and Cost Accounts - Control of Project Cash Flows - Schedule Control - Schedule and Budget Updates - Relating Cost and Schedule Information.

**UNIT – IV QUALITY CONTROL AND SAFETY DURING CONSTRUCTION 9**

Quality and Safety Concerns in Construction - Organizing for Quality and Safety - Work and Material Specifications - Total Quality Control - Quality Control by Statistical Methods - Statistical Quality Control with Sampling by Attributes - Statistical Quality Control with Sampling by Variables - Safety

**UNIT – V ORGANIZATION AND USE OF PROJECT INFORMATION 9**

Types of Project Information - Accuracy and Use of Information - Computerized Organization and Use of Information - Organizing Information in Databases - Relational Model of Databases - Other Conceptual Models of Databases - Centralized Database Management Systems - Databases and Applications Programs - Information Transfer and Flow.

**TOTAL: 45**

## REFERENCES:

1. Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control, Tata McGraw-Hill Publishing Company, New Delhi, 1998.
2. Calin M. Popescu, Chotchai Charoenngam, Project Planning, Scheduling and Control in Construction: An Encyclopedia of terms and Applications, Wiley, New York, 1995.
3. Chris Hendrickson and Tung Au, Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.
4. Willis, E. M., Scheduling Construction Projects, John Wiley & Sons, 1986.
5. Halpin, D. W., Financial and Cost Concepts for Construction Management, John Wiley & Sons, New York, 1985.

**10211CN204 COMPUTER APPLICATIONS IN CONSTRUCTION ENGINEERING AND PLANNING**      **L T P C**  
**3 0 0 3**

**UNIT I INTRODUCTION 9**

Introduction to System Hardware – Languages – Feasibility study and analysis – procurement, training, implementation and system management – procedural language - developing application with spread sheet -developing application with files and database software.

**UNIT II OPTIMIZATION TECHNIQUES 9**

Linear, Dynamic and Integer Programming - Branch and Bound Techniques – Application to Production Scheduling, Equipment Replacement, Material Transportation and Work Assignment Problems – Software applications

**UNIT III INVENTORY MODELS 9**

Deterministic and Probabilistic Inventory Models - Software applications

**UNIT IV SCHEDULING APPLICATION 9**

PERT and CPM - Advanced planning and scheduling concepts – Computer applications – case study.

**UNIT V OTHER PROBLEMS 9**

Estimating – project planning and scheduling- accounting and cost engineering – Enterprises – Introduction to ERP systems - operations simulation

**TOTAL: 45**

**REFERENCES:**

1. Billy E.Gillet., Introduction to Operations Research – A Computer Oriented Algorithmic Approach, Tata Mc Graw Hill, 1990
2. Paulson, B.R., Computer Applications in Construction, Mc Graw Hill, 1995
3. Feigenbaum,L., Construction Scheduling with Primavera Project Planner Prentice Hall Inc., 2002
4. Ming Sun and Rob Howard, "Understanding I.T. in Construction, Spon Press, Taylor and Francis Group, London and New York, 2004.

**(A) ADVANCED CONSTRUCTION ENGINEERING LABORATORY**

**LIST OF EXPERIMENTS**

1. Mix design of concrete as per IS, ACI & BS methods for high performance concrete.
2. Flow Characteristics of Self Compacting concrete
3. Effect of minerals and chemical admixtures in concrete at fresh and hardened state with relevance to workability, strength and durability.
4. NDT on hardened concrete - UPV, Rebound hammer and core test.
5. Permeability tests on hardened concrete

**TOTAL: 30**

**LIST OF EQUIPMENTS REQUIREMENTS:**

1. Concrete making equipments.
2. Equipments for self- compacting concrete.
3. Workability and slump equipments for HPC & SCC.
4. Equipments for compression testing with very high precision with automated graph
5. NDT equipments - UPV, rebound hammer, core cutting machine (electrically operated)
6. Permeability apparatus
7. Oven (Range 0 to 600 degree C)

## **(B) ADVANCED COMPUTING TECHNIQUES LABORATORY**

### **LIST OF EXPERIMENTS**

1. Quantity takeoff, Preparation and delivery of the bid or proposal of an engineering construction project.
2. Design of a simple equipment information system for a construction project.
3. Scheduling of a small construction project using Primavera scheduling systems including reports and tracking.
4. Scheduling of a small construction project using tools like MS project scheduling systems including reports and tracking.
5. Simulation models for project risk analysis.

**TOTAL: 30**

### **LIST OF EQUIPMENTS / SOFTWARES / TOOLS REQUIREMENTS**

1. MS OFFICE
2. QE PRO
3. MS OFFICE SUIT
4. PRIMAVERA POWER USER
5. PRIMAVERA CONTRACTOR STANDARD
6. PERT MASTER
7. PRIMAVERA MONTE CARLO SIMULATION
8. PRIMAVERA EXPEDITION

**UNIT I CONCRETE INGREDIENTS 15**

Composition of OPC – Manufacture – Modified Portland Cements – Hydration Process of Portland Cements – Structure of Hydrated Cement Pastes

Mineral Admixtures – Slags – Pozzolanas and Fillers – Chemical Admixtures – Solutes – Retarders – Air Entraining Agents – Water Proofing Compounds – Plasticizers and Super Plasticizers

Aggregates – Properties and testing of fine and course aggregates – combining of aggregates – Substitute material for aggregates – recent advancements.

**UNIT II SPECIAL CONCRETES 5**

Fibre Reinforced Concrete – Self Compacting Concrete – Polymer Concrete – High performance concrete – Sulphur concrete.

**UNIT – II CONCRETE MIX DESIGN 10**

Mix Proportioning – Mixes incorporating Fly ash, Silica fume, GGBS – Mixes for High Performance Concrete – High strength concrete – variations in concrete strength.

**UNIT IV MECHANICAL PROPERTIES OF CONCRETE 7**

Interfacial Transition Zone – Fracture Strength – Compressive strength – Tensile strength - Impact strength - Bond strength.

**UNIT V DURABILITY OF CONCRETE 8**

Factors affecting durability – Chemical Attack – Permeability – chloride penetration – water absorption – creep – Shrinkage.

**TOTAL: 45****REFERENCES:**

1. Santhakumar.A.R., Concrete Technology, Oxford University press, New Delhi. 2007.
2. Gambhir.M.L., Concrete Technology – Tata McGraw Hill Book Co. Ltd.,Delhi, 2004.
3. Neville, A.M., Properties of Concrete, Longman, 1995.
4. Metha P.K.and Montreio P.J.M., Concrete Structure Properties and Materials, Prentice Hall, 1998.
5. Gupta.B.L. and Amit Gupta, Concrete Technology, Standard Publishers Distributer, New Delhi, 2004.

**UNIT I PLANNING AND SITE EQUIPMENT & PLANT FOR FORM WORK 9**

At Tender stage – Development of basic system – Planning for maximum reuse – Economical form construction – Planning examples – Crane size, effective scheduling estimate – Recheck plan details – Detailing the forms.

Overall Planning – detail planning – Standard units – Corner units – Schedule for column formwork – Formwork elements – Planning Crane arrangements – Site layout plan – Transporting plant – Formwork beams – Formwork ties – Wales and ties – scaffold frames from accessories – Vertical transport table form work.

**UNIT II FORM MATERIALS 9**

Lumber – Types – Finish – Sheathing boards working stresses – Repetitive member stress – Plywood – Types and grades – Textured surfaces and strength – Reconstituted wood – Steel – Aluminum Form lining materials – Hardware and fasteners – Nails in Plywood

Concrete density – Height of discharge – Temperature – Rates of Placing – Consistency of concrete – Live loads and wind pressure – Vibration Hydrostatic pressure and pressure distribution – Examples – Vertical loads - Uplift on shores – Adjustment for non standard conditions.

**UNIT III DESIGN OF FORMS AND SHORES 9**

Basic simplification – Beam formulas – Allowable stresses – Deflection bending lateral stability – Shear, Bearing – Examples in wall forms – Slab forms – Beam forms – Ties, Anchors and Hangers – Column forms – Examples in each.

Simple wood stresses – Slenderness ratio – Allowable load – Tubular steel shores patented shores – Site Preparation, Size and spacing – Steel Tower Frames – Safety practices – Horizontal shores shoring for multistories – More concentrated shore loads T- heads – Tow Tier wood shores – Ellis shores – Dayton sure grip and Baker Roofs shores – Safeway Symons shores – Beaver – advance shores Dead shore – Raking and Flying shores.

**UNIT IV FORMWORK FOR BUILDINGS 9**

Location of job mill – Storage – Equipment – Footings – Wall footings – Column footings Sloped footing forms – Curb and gutter forms – Wall forms – Prefabricated panel systems – Giant forms curved wall forms – Column heads – Beam or girder forms – Beam pockets – Suspended forms – Concrete joint construction – Flying system forms.



Causes of failures – Inadequate shoring inadequate bracing of members – improper vibration – Premature stripping – Errors in design – Failure to follow codes – How formwork affects concretes quality – ACI – Case studies – Finish of exposed concrete design deficiencies – Safety factors – Prevention of rotation – Stripping sequence – Advantages of reshoring.

## **UNIT V FORMS FOR DOMES AND TUNNELS, SLIP FORMS AND SAFETY 9 PRACTICES FOR SCAFFOLDS**

Hemispherical, Parabolic, Translational typical barrel vaults, Hyperbolic Folded plates – Shell form design considerations loads – Inserts , Anchors bolts – Building the forms- Placing concrete – Form removed – Strength requirements – Tunnel forming components – Curb forms invert forms – Arch forms – Concrete placement methods – Cut and cover construction – Tolerances – Form construction – Shafts.

Slip Forms - Principles – Types – advantages – Functions of various components – Planning – Desirable characteristics of concrete – Common problems faced – Safety in slip forms special structures built with slip form Technique – Codal provisions - Types of scaffolds – Putlog and independent scaffold – Single pole scaffolds – Fixing ties – Spacing of ties plan – bracing – knots – safety net – General safety requirements – precautions against particular hazards – Truss suspended – Gantry and system scaffolds.

**TOTAL: 45**

### **REFERENCES:**

1. Robert L. Peurifoy and Garold D. Oberlender, Formwork For Concrete Structures, McGraw – Hill , 1996.
2. Hurd, M.K., Formwork for Concrete, Special Publication No.4, American Concrete Institute, Detroit, 1996
3. Michael P. Hurst, Construction Press, London & New York, 2003
4. Austin, C.K., Formwork for Concrete, Cleaver – Hume Press Ltd., London, 1996.

**UNIT I      STRUCTURAL INTEGRATION      9**

Structural System, Systems for enclosing Buildings, Functional aesthetic system, Materials Selection and Specification.

**UNIT II      ENVIRONMENTAL FACTORS      9**

Qualities of enclosure necessary to maintain a specified level of interior environmental quality – weather resistance – Thermal infiltration – Acoustic Control – Transmission reduction – Air quality – illumination – Relevant systems integration with structural systems.

**UNIT III      SERVICES      9**

Plumbing – Electricity – Vertical circulation and their interaction - HVAC

**UNIT – IV      MAINTENANCE      9**

Component longevity in terms of operation performance and resistance to deleterious forces - Planning systems for least maintenance materials and construction – access for maintenance – Feasibility for replacement of damaged components – equal life elemental design – maintenance free exposed and finished surfaces.

**UNIT – V      SAFETY      9**

Ability of systems to protect fire – Preventive systems – fire escape system design – Planning for pollution free construction environmental – Hazard free Construction execution.

**TOTAL: 45**

**REFERENCES:**

1. William T. Mayer, Energy Economics and Building Design , McGraw-Hill Book Company, 1983.
2. Peter R. Smith and Warren G. Julian, Building Services, Applied Science Publishers Ltd., London, 1993.
3. A.J.Elder and Martiz Vinden Barg, Handbook of Building Enclosure, McGraw-Hill Book Company, 1983.
4. Jane Taylor and Gordin Cooke, The Fire Precautions Act in Practices, 1987.
5. David V.Chadderton, Building Services Engineering, Taylar and Francis, 2007.

**UNIT I INTRODUCTION 6**

Fundamentals of energy- Energy Production Systems-Heating, Ventilating and Air-conditioning – Solar Energy and Conservation – Energy Economic Analysis – Energy conservation and audits – Domestic energy consumption – savings - challenges – primary energy use in buildings - Residential – Commercial – Institutional and public buildings – Legal requirements for conservation of fuel and power in buildings.

**UNIT II ENVIRONMENTAL 7**

Energy and resource conservation – Design of green buildings – Evaluation tools for building energy – Embodied and operating energy – Peak demand – Comfort and Indoor Air quality – Visual and acoustical quality – Land, water and materials - Airborne emissions and waste management.

**UNIT III DESIGN 8**

Natural building design consideration – Energy efficient design strategies – Contextual factors – Longevity and process Assessment – Renewable Energy Sources and design – Advanced building Technologies – Smart buildings – Economies and cost analysis.

**UNIT IV SERVICES 12**

Energy in building design – Energy efficient and environment friendly building – Thermal phenomena – thermal comfort – Indoor Air quality – Climate, sun and Solar radiation, - Psychometrics – passive heating and cooling systems - Energy Analysis – Active HVAC systems - Preliminary Investigation – Goals and policies – Energy audit – Types of Energy audit – Analysis of results – Energy flow diagram – Energy consumption / Unit Production – Identification of wastage- Priority of conservative measures – Maintenance of energy management programme

**UNIT V ENERGY MANAGEMENT 12**

Energy management of electrical equipment - Improvement of power factor – Management of maximum demand – Energy savings in pumps – Fans – Compressed air systems – Energy savings in Lighting systems – Air conditioning systems – Applications – Facility operation and maintenance – Facility modifications – Energy recovery dehumidifier – Waster heat recovery – Steam plants and distribution systems – Improvement of boiler efficiency – Frequency of blow down – Steam leakage – steam Flash and condense return.

**TOTAL: 45**

## **REFERENCES:**

1. Moore F., Environmental Control system Mc Graw Hill, Inc. 1994.
2. Brown, GZ, Sun, Wind and light: Architectural design strategies, John Wiley & Sons, 1985.
3. Cook, J, Award – Winning passive Solar Design, Mc Graw Hill, 1984.
4. J.R. Waters, Energy conservation in Buildings: A Guide to part L of the Building Regulations, Blackwell Publishing, 2003.

**UNIT I ROAD MAKING MATERIALS FOR FLEXIBLE AND RIGID PAVEMENTS 9**

Classification, testing and applications of road making aggregates – Road binders – Bitumen - Cement

**UNIT II PROPERTIES OF BITUMINOUS MIXTURES 10**

Resistance of bituminous mixtures to permanent deformation – Flexibility and brittleness - Common mechanical tests – Permeability characteristics – Weathering of bituminous road surfacing – Adhesion of bituminous binders to road aggregates – Effect of aggregate size in bituminous courses – Temperature susceptibility of bituminous courses – Design of bituminous mixes.

**UNIT III PROPERTIES OF PAVEMENT QUALITY CONCRETE MIXTURES AND CONSTRUCTION PRACTICE 11**

Properties of fresh and hardened concrete – laboratory tests – Design of concrete mixes for Pavement Quality Concrete.

Construction of various layers in rigid and flexible pavements – Quality assurance during construction – sampling and analysis.

**UNIT IV MACHINERIES 8**

Road making machineries – Road formation, bituminous constructions - Road surface evaluation

**UNIT V LATEST ADVANCEMENTS 7**

Methods to improve bitumen quality – Rheological and chemical additives – Polymer modified bitumen – Super pave concepts – Recycling of bituminous courses – Smart materials for cement concrete pavement – Use of admixtures and fibres.

**TOTAL: 45****REFERENCES:**

1. Mix Design Methods for Asphalt Concrete and other Hot mix types MS 2, Sixth Edition, The Asphalt Institute, 1997.
2. Edwin J.Barth, Asphalt Science and Technology, Gordon and Breach Science Publishers, New York, 1984.
3. Bituminous materials in road construction, The English Language Book Society and Her Majesty's Stationery Office, 1966.

**UNIT I      THE OWNERS' PERSPECTIVE      9**

Introduction - Project Life Cycle - Types of Construction - Selection of Professional Services - Construction Contractors - Financing of Constructed Facilities - Legal and Regulatory Requirements - Changing Environment of the Construction Industry - Role of Project Managers

**UNIT II      ORGANIZING FOR PROJECT MANAGEMENT      9**

Project Management – modern trends - Strategic Planning - Effects of Project Risks on Organization - Organization of Project Participants -Traditional Designer-Constructor Sequence - Professional Construction Management - Owner-Builder Operation - Turnkey Operation - Leadership and Motivation for the Project Team

**UNIT III      DESIGN AND CONSTRUCTION PROCESS      9**

Design and Construction as an Integrated System - Innovation and Technological Feasibility - Innovation and Economic Feasibility - Design Methodology - Functional Design - Construction Site Environment

**UNIT – IV      LABOUR, MATERIAL AND EQUIPMENT UTILIZATION      9**

Historical Perspective - Labour Productivity - Factors Affecting Job-Site Productivity - Labour Relations in Construction - Problems in Collective Bargaining - Materials Management - Material Procurement and Delivery - Inventory Control - Tradeoffs of Costs in Materials Management. - Construction Equipment - Choice of Equipment and Standard Production Rates - Construction Processes Queues and Resource Bottlenecks

**UNIT V      COST ESTIMATION      9**

Costs Associated with Constructed Facilities - Approaches to Cost Estimation - Type of Construction Cost Estimates - Effects of Scale on Construction Cost - Unit Cost Method of Estimation - Methods for Allocation of Joint Costs - Historical Cost Data - Cost Indices - Applications of Cost Indices to Estimating - Estimate Based on Engineer's List of Quantities - Estimation of Operating Costs.

**TOTAL: 45**

## **REFERENCES:**

1. Chris Hendrickson and Tung Au, Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.
2. Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control, Tata McGraw-Hill Publishing Company, New Delhi, 1998.
3. Frederick E. Gould, Construction Project Management, Wentworth Institute of Technology, Vary E. Joyce, Massachusetts Institute of Technology, 2000.
4. Choudhury, S , Project Management, Tata McGraw-Hill Publishing Company, New Delhi, 1988.
5. George J.Ritz , Total Construction Project Management - McGraw-Hill Inc, 1994.

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**GEOENVIRONMENTAL ENGINEERING**

**L T P C**

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UNIT I SOIL – POLLUTANT INTERACTION

8

Introduction to Geoenvironmental engineering – environmental cycle – sources, production and classification of waste – causes of soil pollution – factors governing soil-pollutant interaction – failures of foundations due to pollutants – case studies.

UNIT II SITE SELECTION AND SAFE DISPOSAL OF WASTE

10

Safe disposal of waste – site selection for land fills – characterization of land fill sites and waste - Risk assessment - . Stability of land fills – current practice of waste disposal – monitoring facilities - passive containment system – application of geosynthetics in solid waste management – rigid or flexible liners.

UNIT III TRANSPORT OF CONTAMINANTS

8

Contaminant transport in sub surface – advection – diffusion – dispersion – governing equations – contaminant transformation – sorption – biodegradation – ion exchange – precipitation – hydrological consideration in land fill design – ground water pollution – bearing capacity of compacted fills – foundation for waste fill ground – pollution of aquifers by mixing of liquid waste – protecting aquifers.

UNIT IV WASTE STABILIZATION AND DISPOSAL

10

Hazardous waste control and storage system – stabilization/ solidification of wastes – micro and macro encapsulation – absorption, adsorption, precipitation - detoxification – mechanism of stabilization – organic and inorganic stabilization – utilization of solid waste for soil improvement – case studies.

UNIT V REMEDIATION OF CONTAMINATED SOILS

9

Rational approach to evaluate and remediate contaminated sites – monitored natural attenuation – exsitu and insitu remediation – solidification, bio – remediation, incineration, soil washing, electro kinetics, soil heating, vetrification, bio venting – Ground water remediation – pump and treat, air sparging, reactive well – case studies.

TOTAL: 45



## REFERENCES:

1. Daniel B.E, Geotechnical Practice for waste disposal, Chapman & Hall, London, 1993.
2. Hari D. Sharma and Krishna R.Reddy, Geo-Environmental Engineering – John Wiley and Sons, INC, USA, 2004.
3. Westlake, K., Landfill Waste pollution and Control, Albion Publishing Ltd., England, 1995.
4. Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989.
5. Proceedings of the International symposium of Environmental Geotechnology (Vol.I and II), Environmental Publishing Company, 1986 and 1989.
6. Ott, W.R., Environmental Indices, Theory and Practice, Ann Arbor, 1978.
7. Fried, J.J., Ground Water Pollution, Elsevier, 1975.
8. ASTM Special Tech. Publication 874, Hydraulic Barrier in Soil and Rock, 1985.
9. Lagrega, M.d., Buckingham, P.L., and Evans, J.C., Hazardous Waste Management, McGraw Hill, Inc. Singapore, 1994.

<b>UNIT I</b>	<b>OPERATIONS RESEARCH</b>	<b>12</b>
Introduction to Operations Research - Linear Programming – Graphical and Simplex Methods, Duality and Post – Optimality Analysis – Transportation and Assignment Problems		
<b>UNIT II</b>	<b>PRODUCTION MANAGEMENT</b>	<b>12</b>
Inventory Control - EOQ - Quantity Discounts - Safety Stock – Replacement Theory – PERT and CPM – Simulation Models – Quality Control		
<b>UNIT III</b>	<b>FINANCIAL MANAGEMENT</b>	<b>7</b>
Working Capital Management – Compound Interest and Present Value methods – Discounted Cash Flow Techniques – Capital Budgeting		
<b>UNIT IV</b>	<b>DECISION THEORY</b>	<b>7</b>
Decision Theory – Decision Rules – Decision making under conditions of certainty, risk and uncertainty – Decision trees – Utility Theory		
<b>UNIT V</b>	<b>MANAGERIAL ECONOMICS</b>	<b>7</b>
Cost Concepts – Break-even analysis – Pricing Techniques – Game theory Applications		

**TOTAL: 45**

**REFERENCES:**

1. Vohra, N.D., Quantitative Techniques in Management, Tata McGraw-Hill Company Ltd, New Delhi, 1990.
2. Schroeder, R.G, Operations Management, McGraw Hill, USA, 1982.
3. Levin, R.I, Rubin,D.S., and Stinson J., Quantitative Approaches to Management, McGraw Hill Book Co., 1988.
4. Frank Harrison, E., The Managerial Decision Making Process, Houghton Mifflin Co., Boston, 1975.
5. Hamdy A.Taha, Operations Research: An Introduction, Prentice Hall, 2002.

**UNIT I MANPOWER PLANNING 10**

Manpower Planning, Organising, Staffing, directing, and controlling – Personnel Principles

**UNIT II ORGANISATION 10**

Organisation – Span of Control – Organisation Charts – Staffing Plan - Development and Operation of human resources - Managerial Staffing – Recruitment – Selection - Placement, Training and Development.

**UNIT III HUMAN BEHAVIOUR 10**

Introduction to the field of people management - basic individual psychology; motivation - Job design and performance management - Managing groups at work - self-managing work teams - intergroup behaviour and conflict in organisations – Leadership - Behavioural aspects of decision-making; and communication for people management

**UNIT IV WELFARE MEASURES 5**

Compensation – Safety and health – GPF – EPF – Group Insurance – Housing - Pension – Laws related to welfare measures.

**UNIT V MANAGEMENT AND DEVELOPMENT METHODS 10**

Compensation - Wages and Salary, Employee Benefits, employee appraisal and assessment - Employee services - Safety and Health – Discipline and discharge - Special Human resource problems, Performance appraisal. - Employee hand book and personnel manual - Job descriptions and organization structure and human relations – Productivity of Human resources.

**TOTAL: 45**

**REFERENCES:**

1. Carleton Counter II and Jill Justice Coutler , The Complete Standard Handbook of Construction Personnel Management, Prentice-Hall, Inc., New Jersey, 1989.
2. Memoria,C.B., Personnel Management, Himalaya Publishing Co., 1997.
3. Josy.J. Familiaro, Handbook of Human Resources Administration, McGraw-Hill International Edition, 1987.
4. Charles D Pringle, Justin Gooderi Longenecter, Management, CE Merrill Publishing Co. 1981.
5. Dwivedi R.S, Human Relations and Organisational Behaviour, Macmillian India Ltd.,2005.

**UNIT I ECONOMICS 10**

Role of Civil Engineering in Industrial Development – Advances in Civil Engineering - Engineering Economics – Support Matters of Economy related to Engineering – Market demand and supply – Choice of Technology – Quality Audit in economic law of returns governing production.

**UNIT II CONSTRUCTION ECONOMICS 10**

Construction development in Housing, transport energy and other infrastructures – Economics of ecology, environment, energy resources – Local material selection – Form and functional designs – Construction workers – Urban Problems – Poverty – Migration – Unemployment – Pollution.

**UNIT III FINANCING 13**

The need for financial management - Types of financing – Financing instruments– short term borrowing – Long term borrowing – Leasing – Equity financing – Internal generation of funds – External commercial borrowings – Assistance from government budgeting support and international finance corporations – Analysis of financial statements – Balance Sheet - Profit and Loss account – Cash flow and Fund flow analysis – Ratio analysis – Investment and financing decision – Financial Control - centralized management.

**UNIT IV ACCOUNTING METHOD 6**

General Overview – Cash basis of a accounting – Accrual basis of accounting – Percentage completion method – Completed contract method – Accounting for tax reporting purposes and financial reporting purposes – Accounting Standards

**UNIT V LENDING TO CONTRACTORS 6**

Loans to Contractors – Interim construction financing – Security and risk aspects.

**TOTAL: 45****REFERENCES:**

1. Prasanna Chandra, Project Selection, Planning, Analysis, Implementation and Review, Tata McGraw Hill Publishing Company, 1995.
2. Halpin, D.W., Financial and Cost Concepts for Construction Management, John Wiley & Sons, New York, 1985.
3. Warneer Z Hirsch, Urban Economics, Macmillan, New York, 1993.
4. Kwaku A, Tenah and Jose M.Guevara, Fundamental of Construction Management and Organisation, Prentice – Hall of India, 1995.
5. Madura, J and Veit, E.T., Introduction to Financial Management, West Publishing Co., St. Paul, 1988.

<b>UNIT I</b>	<b>QUALITY MANAGEMENT</b>	<b>9</b>
<p>Introduction – Definitions and objectives – Factor influencing construction quality - Responsibilities and authority - Quality plan - Quality Management Guidelines – Quality circles.</p>		
<b>UNIT II</b>	<b>QUALITY SYSTEMS</b>	<b>9</b>
<p>Introduction - Quality system standard – ISO 9000 family of standards – Requirements – Preparing Quality System Documents – Quality related training – Implementing a Quality system – Third party Certification.</p>		
<b>UNIT III</b>	<b>QUALITY PLANNING</b>	<b>9</b>
<p>Quality Policy, Objectives and methods in Construction industry - Consumers satisfaction, Ergonomics - Time of Completion - Statistical tolerance – Taguchi’s concept of quality – Codes and Standards – Documents – Contract and construction programming – Inspection procedures - Processes and products – Total QA / QC programme and cost implication.</p>		
<b>UNIT IV</b>	<b>QUALITY ASSURANCE AND CONTROL</b>	<b>9</b>
<p>Objectives - Regularity agent, owner, design, contract and construction oriented objectives, methods - Techniques and needs of QA/QC - Different aspects of quality - Appraisals, Factors influencing construction quality - Critical, major failure aspects and failure mode analysis, -Stability methods and tools, optimum design - Reliability testing, reliability coefficient and reliability prediction.</p>		
<b>UNIT – V</b>	<b>QUALITY IMPROVEMENT TECHNIQUES</b>	<b>9</b>
<p>Selection of new materials - Influence of drawings, detailing, specification, standardization - Bid preparation - Construction activity, environmental safety, social and environmental factors - Natural causes and speed of construction - Life cycle costing - Value engineering and value analysis.</p>		

**TOTAL: 45**

## REFERENCES:

1. James, J.O' Brian, Construction Inspection Handbook – Quality Assurance and Quality Control, Van Nostrand, New York, 1989.
2. Kwaku, A., Tena, Jose, M. Guevara, Fundamentals of Construction Management and Organisation, Reston Publishing Co., Inc., Virginia, 1985.
3. Juran Frank, J.M. and Gryna, F.M. Quality Planning and Analysis, Tata McGraw Hill, 1993
4. Hutchins.G, ISO 9000, Viva Books, New Delhi, 2000
5. Clarkson H. Oglesby, Productivity Improvement in Construction, McGraw-Hill, 1989.
6. John L. Ashford, The Management of Quality in Construction, E & F.N.Spon, New York, 1989.
7. Steven McCabe, Quality Improvement Techniques in Construction, Addison Wesley Longman Ltd, England. 1998.



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**RESOURCE MANAGEMENT AND CONTROL**

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**IN CONSTRUCTION**

**UNIT I RESOURCE PLANNING 10**

Resource Planning, Procurement, Identification, Personnel, Planning for material, Labour, time schedule and cost control, Types of resources, manpower, Equipment, Material, Money, Time.

**UNIT II LABOUR MANAGEMENT 5**

Systems approach, Characteristics of resources, Utilization, measurement of actual resources required, Tools for measurement of resources, Labour, Classes of Labour, Cost of Labour, Labour schedule, optimum use Labour.

**UNIT III MATERIALS AND EQUIPMENT 10**

Material: Time of purchase, quantity of material, sources, Transportation, Delivery and Distribution.

Equipment: Planning and selecting by optimistic choice with respect to cost, Time, Source and handling.

**UNIT IV TIME MANAGEMENT 10**

Personnel time, Management and planning, managing time on the project, forecasting the future, Critical path measuring the changes and their effects - Cash flow and cost control

**UNIT V RESOURCE ALLOCATION AND LEVELLING 10**

Time-cost trade off, Computer application - resource leveling, resource list, resource allocation, Resource loading, Cumulative cost - Value Management.

**TOTAL: 45**

**REFERENCES:**

1. Andrew,D., Szilagg, Hand Book of Engineering Management, 1982.
2. James.A., Adrain, Quantitative Methods in Construction Management, American Elsevier Publishing Co., Inc., 1973.
3. Harvey, A., Levine, Project Management using Micro Computers, Osborne-McGraw Hill C.A.Publishing Co., Inc. 1988.
4. Oxley Rand Poslcit, Management Techniques applied to the Construction Industry, Granda Publishing Ltd., 1980.



**UNIT I CONSTRUCTION ACCIDENTS 10**

Accidents and their Causes – Human Factors in Construction Safety - Costs of Construction Injuries – Occupational and Safety Hazard Assessment – Legal Implications

**UNIT II SAFETY PROGRAMMES 10**

Problem Areas in Construction Safety – Elements of an Effective Safety Programme – Job-Site Safety Assessment – Safety Meetings – Safety Incentives

**UNIT III CONTRACTUAL OBLIGATIONS 5**

Safety in Construction Contracts – Substance Abuse – Safety Record Keeping

**UNIT IV DESIGNING FOR SAFETY 15**

Safety Culture – Safe Workers – Safety and First Line Supervisors – Safety and Middle Managers – Top Management Practices, Company Activities and Safety – Safety Personnel – Sub contractual Obligation – Project Coordination and Safety Procedures – Workers Compensation

**UNIT V OWNERS' AND DESIGNERS' OUTLOOK 5****TOTAL: 45****REFERENCES:**

1. Jimmy W. Hinze, Construction Safety, Prentice Hall Inc., 1997.
2. Richard J. Coble, Jimmie Hinze and Theo C. Haupt, Construction Safety and Health Management, Prentice Hall Inc., 2001.
3. Tamilnadu Factory Act, Department of Inspectorate of factories, Tamil nadu.

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**MANAGEMENT INFORMATION SYSTEM**

**L T P C**  
**3 0 0 3**

**UNIT I INTRODUCTION 7**

Information Systems - Establishing the Framework - Business Models - Information System Architecture - Evolution of Information Systems.

**UNIT II SYSTEM DEVELOPMENT 8**

Modern Information System - System Development Life Cycle - Structured Methodologies - Designing Computer Based Methods, Procedures, Control - Designing Structured Programs.

**UNIT III INFORMATION SYSTEMS 10**

Integrated Construction Management Information System - Project Management Information System - Functional Areas, Finance, Marketing, Production, Personnel - Levels, DSS, EIS, and ES - Comparison, Concepts and Knowledge Representation - Managing International Information System.

**UNIT IV IMPLEMENTATION AND CONTROL 10**

Control - Testing Security - Coding Techniques - Defection of Error - Validating - Cost Benefit Analysis - Assessing the value and risk of Information System.

**UNIT V SYSTEM AUDIT 10**

Software Engineering qualities - Design, Production, Service, Software specification, Software Metrics, Software quality assurance - Systems Methodology - Objectives - Time and Logic, Knowledge and Human Dimension - Software life cycle models - Verification and Validation.

**TOTAL: 45**

**REFERENCES:**

1. Kenneth C Laudon and Jane Price Laudon, Management Information Systems - Organisation and Technology, Prentice Hall, 1996.
2. Gordon B. Davis, Management Information System: Conceptual Foundations, Structure and Development, McGraw Hill, 1974.
3. Joyce J Elam, Case series for Management Information Systems , Simon and Schuster, Custom Publishing, 1996.
4. Ralph H Sprague and Huges J Watson, Decision Support for Managers, Prentice Hall, 1996.
5. Michael W. Evans and John J Marciniak, Software Quality assurance and Management, John Wiley and Sons, 1987.
6. Card and Glass, Measuring Software Design quality , Prentice Hall, 1990.

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**MAINTENANCE AND REHABILITATION OF  
STRUCTURES**

**L T P C**  
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**UNIT I MAINTENANCE AND REPAIR STRATEGIES 8**

Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration.

**UNIT II SERVICEABILITY AND DURABILITY OF CONCRETE 8**

Quality assurance for concrete construction concrete properties- strength, permeability, thermal properties and cracking. - Effects due to climate, temperature, chemicals, corrosion - design and construction errors - Effects of cover thickness and cracking

**UNIT III MATERIALS AND TECHNIQUES FOR REPAIR 15**

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement and polymers coating for rebars loadings from concrete, mortar and dry pack, vacuum concrete, Guniting and Shotcrete, Epoxy injection, Mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels and cathodic protection.

**UNIT IV REPAIRS TO STRUCTURES 10**

Repair of structures distressed due to earthquake – Strengthening using FRP- Strengthening and stabilization techniques for repair.

**UNIT V DEMOLITION OF STRUCTURES 4**

Engineered demolition techniques for structures - case studies

**TOTAL: 45**

**REFERENCES:**

1. Denison Campbell, Allen and Harold Roper, "Concrete Structures, Materials, Maintenance and Repair", Longman Scientific and Technical UK, 1991.
2. Allen R.T and Edwards S.C, "Repair of Concrete Structures", Blakie and Sons, UK, 1987.
3. Raikar, R.N., "Learning from failures - Deficiencies in Design, Construction and Service" - R&D Centre (SDCPL), Raikar Bhavan, Bombay, 1987.
4. Santhakumar A.R., "Concrete Technology" Oxford University Press, Printed in India by Radha Press, New Delhi, 2007.
5. Peter H.Emmons, "Concrete Repair and Maintenance Illustrated", Galgotia Publications pvt. Ltd., 2001.