

**ANNA UNIVERSITY, CHENNAI**  
**UNIVERSITY DEPARTMENTS**  
**REGULATIONS – 2015**  
**CHOICE BASED CREDIT SYSTEM**

**M.E. CONSTRUCTION ENGINEERING AND MANAGEMENT**

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) :**

- I. To prepare students to excel in research or to succeed in Construction Engineering and Management profession through global, rigorous post graduate education.
- II. To provide students with a solid foundation in mathematical, scientific and construction engineering fundamentals required to solve Construction Engineering and Management problems
- III. To train students with efficient and effective construction knowledge in project formulation, planning, scheduling techniques, quantitative methods, costing, quality control and assurance techniques for the existing and new construction projects.
- IV. To inculcate students in professional and ethical attitude, effective communication skills, teamwork skills, leadership quality, safety management, energy management in construction, multidisciplinary approach, and an ability to relate Construction Engineering and Management issues in broader social context.
- V. To provide student with an academic environment aware of excellence, leadership, written ethical codes and guidelines, and the lifelong learning needed for a successful professional career

**PROGRAMME OUTCOMES (POs):**

On successful completion of the programme,

1. Graduates will demonstrate knowledge of statistical methods and queuing theory and its applications science and construction engineering.
2. Graduates will demonstrate an ability to identify, formulate, plan and schedule construction engineering projects.
3. Graduate will demonstrate an ability to understand and structure the construction engineering activities and its management.
4. Graduates will demonstrate an ability to design a required man, material, equipment, cost and time as per needs and specifications.
5. Graduates will demonstrate an ability to visualize and work on laboratory in advanced concrete technology.
6. Graduate will demonstrate skills to use modern construction engineering tools, software and equipment .
7. Graduates will demonstrate knowledge of professional and ethical responsibilities.
8. Graduate will be able to communicate effectively in both verbal and written form.
9. Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.
10. Graduate will develop confidence in self education and ability for lifelong learning.

Programme Educational Objectives	Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
I	✓	✓					✓			
II			✓		✓	✓	✓			
III				✓	✓	✓	✓			
IV			✓	✓			✓	✓	✓	
V		✓	✓				✓		✓	✓

			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	
YEAR 1	SEM 1	Statistical Methods for Engineers	✓						✓	✓	✓		
		Construction Equipment				✓	✓				✓	✓	
		Modern Construction Materials		✓		✓							
		Project Formulation and Appraisal		✓			✓		✓	✓	✓		
		Elective I											
		Elective II											
	SEM 2	Advanced Construction Techniques		✓		✓			✓	✓		✓	✓
		Computer Applications in Construction Engineering and Planning		✓	✓	✓			✓			✓	✓
		Construction Planning, Scheduling and Control		✓	✓	✓			✓			✓	✓
		Contract Laws and Regulations				✓			✓	✓	✓	✓	✓
		Elective III											
		Elective IV											
		Advanced Construction Engineering and Computing Techniques Laboratory		✓		✓	✓	✓				✓	
YEAR 2	SEM 1	Elective V											
		Elective VI											
		Elective VII											
		Practical Training (2 weeks)		✓		✓			✓	✓	✓	✓	
		Project Work (Phase I)		✓		✓			✓	✓	✓	✓	
		Seminar							✓	✓	✓		
	SEM 2	Project Work (Phase II)		✓		✓			✓	✓	✓	✓	

### Professional Electives (PE)

S. No.	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
1	Construction Personnel Management		✓		✓			✓	✓	✓	✓
2	Construction Project Management		✓			✓	✓		✓	✓	✓
3	Design of Energy Efficient Buildings		✓	✓	✓		✓		✓	✓	✓
4	Economics and Finance Management in Construction		✓		✓				✓	✓	✓
5	Management Information Systems		✓				✓		✓	✓	✓
6	Project Safety Management		✓				✓	✓	✓	✓	✓
7	Quality Control and Assurance in Construction		✓				✓	✓	✓	✓	✓
8	Quantitative Techniques in Management	✓	✓		✓		✓		✓	✓	✓
9	Resource Management and Control in Construction		✓					✓	✓	✓	✓
10	Shoring, Scaffolding and Formwork		✓		✓		✓		✓	✓	✓
11	System Integration in Construction			✓			✓		✓	✓	✓
12	Advanced Concrete Technology		✓	✓					✓	✓	✓

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**CURRICULA AND SYLLABI**  
**SEMESTER I**

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	CN7101	Construction Equipment	PC	3	3	0	0	3
2.	CN7102	Modern Construction Materials	PC	3	3	0	0	3
3.	CN7103	Project Formulation and Appraisal	PC	3	3	0	0	3
4.	MA7160	Statistical Methods for Engineers	FC	4	4	0	0	4
5.		Elective I	PE	3	3	0	0	3
6.		Elective II	PE	3	3	0	0	3
<b>TOTAL</b>				<b>19</b>	<b>19</b>	<b>0</b>	<b>0</b>	<b>19</b>

**SEMESTER II**

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.	CN7201	Advanced Construction Techniques	PC	3	3	0	0	3
2.	CN7202	Computer Applications in Construction Engineering and Planning	PC	3	3	0	0	3
3.	CN7203	Construction Planning, Scheduling and Control	PC	3	3	0	0	3
4.	CN7204	Contract Laws and Regulations	PC	3	3	0	0	3
5.		Elective III	PE	3	3	0	0	3
6.		Elective IV	PE	3	3	0	0	3
<b>PRACTICAL</b>								
7.	CN7211	Advanced Construction Engineering and Computing Techniques Laboratory	PC	4	0	0	4	2
<b>TOTAL</b>				<b>22</b>	<b>18</b>	<b>0</b>	<b>4</b>	<b>20</b>

**SEMESTER III**

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>THEORY</b>								
1.		Elective V	PE	3	3	0	0	3
2.		Elective VI	PE	3	3	0	0	3
3.		Elective VII	PE	3	3	0	0	3
<b>PRACTICAL</b>								
4.	CN7311	Practical Training (2 weeks)	EEC	0	0	0	0	1
5.	CN7312	Seminar	EEC	2	0	0	2	1
6.	CN7313	Project Work (Phase I)	EEC	12	0	0	12	6
<b>TOTAL</b>				<b>23</b>	<b>9</b>	<b>0</b>	<b>14</b>	<b>17</b>

**SEMESTER IV**

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
<b>PRACTICAL</b>								
1.	CN7411	Project Work (Phase II)	EEC	24	0	0	24	12
<b>TOTAL</b>				<b>24</b>	<b>0</b>	<b>0</b>	<b>24</b>	<b>12</b>

**TOTAL NO. OF CREDITS: 68**

### FOUNDATION COURSES (FC)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.		Statistical Methods for Engineers	FC	4	4	0	0	4

### PROFESSIONAL CORE (PC)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.		Construction Equipment	PC	3	3	0	0	3
2.		Modern Construction Materials	PC	3	3	0	0	3
3.		Project Formulation and Appraisal	PC	3	3	0	0	3
4.		Advanced Construction Techniques	PC	3	3	0	0	3
5.		Computer Applications in Construction Engineering and Planning	PC	3	3	0	0	3
6.		Construction Planning, Scheduling and Control	PC	3	3	0	0	3
7.		Contract Laws and Regulations	PC	3	3	0	0	3
8.		Advanced Construction Engineering and Computing Techniques Laboratory	PC	4	0	0	4	2

### PROFESSIONAL ELECTIVES (PE)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CN7001	Advanced Concrete Technology	PE	3	3	0	0	3
2.	CN7002	Construction Personnel Management	PE	3	3	0	0	3
3.	CN7003	Construction Project Management	PE	3	3	0	0	3
4.	CN7004	Design of Energy Efficient Buildings	PE	3	3	0	0	3

5.	CN7005	Economics and Finance Management in Construction	PE	3	3	0	0	3
6.	CN7006	Management Information Systems	PE	3	3	0	0	3
7.	CN7007	Project Safety Management	PE	3	3	0	0	3
8.	CN7008	Quality Control and Assurance in Construction	PE	3	3	0	0	3
9.	CN7009	Quantitative Techniques in Management	PE	3	3	0	0	3
10.	CN7010	Resource Management and Control in Construction	PE	3	3	0	0	3
11.	CN7011	Shoring, Scaffolding and Formwork	PE	3	3	0	0	3
12.	CN7012	System Integration in Construction	PE	3	3	0	0	3

#### **EMPLOYABILITY ENHANCEMENT COURSES (EEC)**

<b>S.No.</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>CATEGORY</b>	<b>CONTACT PERIODS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.		Practical Training (2 weeks)	EEC	-	-	-	-	1
2.		Project Work (Phase I)	EEC	12	0	0	12	6
3.		Seminar	EEC	2	0	0	2	1
4.		Project Work (Phase II)	EEC	24	0	0	24	12



**OBJECTIVE:**

- To study and understand the various types of equipments used for earthwork, tunneling, drilling, blasting, dewatering, material handling conveyors and its applications in construction projects.

**UNIT I CONSTRUCTION EQUIPMENTS AND MANAGEMENT 9**

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

**UNIT II EQUIPMENT FOR EARTHWORK 9**

Fundamentals of Earth Work Operations - Earth Moving Operations - Types of Earth Work Equipment - Tractors, Motor Graders, Scrapers, Front end Waders – Dozer, Excavators, Rippers, Loaders, trucks and hauling equipment, Compacting Equipment, Finishing equipment.

**UNIT III OTHER CONSTRUCTION EQUIPMENT 9**

Equipment for Dredging, Trenching, Drag line and clamshells, Tunneling – Equipment for Drilling and Blasting - Pile driving Equipment - Erection Equipment - Crane, Mobile crane - Types of pumps used in Construction - Equipment for Dewatering and Grouting – Equipment for Demolition.

**UNIT IV ASPHALT AND CONCRETE PLANTS 9**

Aggregate production- Different Crushers – Feeders - Screening Equipment - Handling Equipment - Batching and Mixing Equipment - Pumping Equipment – Ready mix concrete equipment, Concrete pouring equipment. Asphalt Plant, Asphalt Pavers, Asphalt compacting Equipment

**UNIT V MATERIALS HANDLING EQUIPMENT 9**

Forklifts and related equipment - Portable Material Bins – Material Handling Conveyors – Material Handling Cranes- Industrial Trucks.

**TOTAL : 45 PERIODS****OUTCOME:**

- At the end of this course students will be able to know various types of equipments to be used in the constructions projects.

**REFERENCES:**

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

**OBJECTIVE:**

- To study and understand the properties of modern construction materials used in construction such as special concretes, metals, composites, water proofing compounds, non weathering materials, and smart materials.

**UNIT I SPECIAL CONCRETES****9**

Concretes, Behaviour of concretes – Properties and Advantages of High Strength and High Performance Concrete – Properties and Applications of Fibre Reinforced Concrete, Self compacting concrete, Alternate Materials to concrete on high performance & high Strength concrete.

**UNIT II METALS****9**

Types of Steels – Manufacturing process of steel – Advantages of new alloy steels – Properties and advantages of aluminium and its products – Types of Coatings & Coatings to reinforcement – Applications of Coatings.

**UNIT III COMPOSITES****9**

Types of Plastics – Properties & Manufacturing process – Advantages of Reinforced polymers – Types of FRP – FRP on different structural elements – Applications of FRP.

**UNIT IV OTHER MATERIALS****9**

Types and properties of Water Proofing Compounds – Types of Non-weathering Materials and its uses – Types of Flooring and Facade Materials and its application.

**UNIT V SMART AND INTELLIGENT MATERIALS****9**

Types & Differences between Smart and Intelligent Materials – Special features – Case studies showing the applications of smart & Intelligent Materials.

**TOTAL : 45 PERIODS****OUTCOME:**

- On completion of this course the students will have the knowledge of modern construction materials used in the field.

**REFERENCES:**

- ACI Report 440.2R-02, "Guide for the design and construction of externally bonded RP systems for strengthening concrete structures", American Concrete Institute, 2002.
- Aitkens, High Performance Concrete, McGraw Hill, 1999
- Ashby, M.F. and Jones.D.R.H.H. "Engineering Materials 1: An introduction to Properties, applications and designs", Elsevier Publications, 2005.
- Deucher, K.N, Korfiatis, G.P and Ezeldin, A.S, Materials for civil and Highway Engineers, Prentice Hall Inc., 1998.
- Ganapathy, C. "Modern Construction Materials", Eswar Press, 2015.
- Mamlouk, M.S. and Zaniewski, J.P., Materials for Civil and Construction Engineers, Prentice Hall Inc., 1999.
- Santhakumar.A.R. "Concrete Technology", Oxford University press, New Delhi.
- Shan Somayaji, Civil Engineering Materials, Prentice Hall Inc., 2001
- Shetty M.S, Concrete Technology: Theory and Practice, S.Chand & Company Ltd., 2005.

**CN7103**

**PROJECT FORMULATION AND APPRAISAL**

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

**OBJECTIVE:**

- To study and understand the formulation, costing of construction projects, appraisal, finance and private sector participation.

**UNIT I PROJECT FORMULATION**

**9**

Project – Concepts – Capital investments - Generation and Screening of Project Ideas - 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.

**UNIT II PROJECT COSTING**

**9**

Project Cash Flows – Time Value of Money – Cost of Capital.

**UNIT III PROJECT APPRAISAL**

**9**

NPV – BCR – IRR – ARR – Urgency – Pay Back Period – Assessment of Various Methods – Indian Practice of Investment Appraisal – International Practice of Appraisal – Analysis of Risk – Different Methods – Selection of a Project and Risk Analysis in Practice.

**UNIT IV PROJECT FINANCING**

**9**

Project Financing – Means of Finance – Financial Institutions – Special Schemes – Key Financial Indicators – Ratios.

**UNIT V PRIVATE SECTOR PARTICIPATION**

**9**

Private sector participation in Infrastructure Development Projects - BOT, BOLT, BOOT - Technology Transfer and Foreign Collaboration - Scope of Technology Transfer.

**TOTAL : 45 PERIODS**

**OUTCOME:**

- On completion of this course the students will be able to know the formulations of projects, projects costing, appraisal and financing.

**REFERENCES:**

1. Barcus, S.W. and Wilkinson.J.W., Hand Book of Management Consulting Services, McGraw Hill, New York, 1986.
2. Joy P.K., Total Project Management - The Indian Context, New Delhi, Macmillan India Ltd., 1992
3. Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation Review, McGraw Hill Publishing Company Ltd., New Delhi. 2006.
4. United Nations Industrial Development Organisation (UNIDO) Manual for the Preparation of Industrial Feasibility Studies, (IDBI Reproduction) Bombay, 1987.

**MA7160**

**STATISTICAL METHODS FOR ENGINEERS**

**L T P C**  
**4 0 0 4**

**OBJECTIVES:**

- This course aims at providing the necessary basic concepts of a few statistical methods and apply them to various engineering problems.

**UNIT I ESTIMATION THEORY 12**  
Estimators: Unbiasedness, Consistency, Efficiency and Sufficiency – Maximum Likelihood Estimation – Method of moments.

**UNIT II TESTING OF HYPOTHESIS 12**  
Tests based on Normal, t,  $X^2$  and F distributions for testing of means, variance and proportions – Analysis of r x c tables – Goodness of fit.

**UNIT III CORRELATION AND REGRESSION 12**  
Multiple and Partial Correlation - Method of Least Squares- Plane of Regression - Properties of Residuals - Coefficient of Multiple Correlation - Coefficient of Partial Correlation - Multiple Correlation with total and partial correlations - Regression and Partial correlations in terms of lower order coefficients.

**UNIT IV DESIGN OF EXPERIMENTS 12**  
Analysis of variance – One-way and two-way classifications – Completely randomized design – Randomized block design – Latin square design.

**UNIT V MULTIVARIATE ANALYSIS 12**  
Random vectors and Matrices – Mean vectors and Covariance matrices – Multivariate Normal density and its properties – Principal components: Population principal components – Principal components from standardized variables.

**TOTAL : 60 PERIODS**

**OUTCOME:**

- It helps the students to have a clear perception of the power of statistical ideas, tools and would be able to demonstrate the applications of statistical techniques to problems drawn from industry, management and other engineering fields.

**REFERENCES:**

1. Johnson, R. A. and Gupta, C. B., “Miller & Freund’s Probability and Statistics for Engineers”, Pearson Education, Asia, Seventh Edition, 2007.
2. Devore, J.L., “Probability and statistics for Engineering and the Sciences”, Thomson and Duxbury, Singapore, Fifth Edition, 2002.
3. Johnson, R.A., and Wichern, D.W., “Applied Multivariate Statistical Analysis”, Pearson Education, Asia, Sixth Edition, 2007.
4. Gupta, S.C., and Kapoor, V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, Eleventh Edition, 2002.
5. Spiegel, M.R. and Stephens, L.J., ”Schaum’s outlines,-Statistics”, Tata McGraw-Hill, Third Edition, 2000.
6. Freund, J.E., “Mathematical Statistics”, Prentice Hall of India, Fifth Edition, 2001.

**CN7201**

**ADVANCED CONSTRUCTION TECHNIQUES**

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

**OBJECTIVE:**

- To study and understand the latest construction techniques applied to engineering construction for sub structure, super structure, special structures, rehabilitation and strengthening techniques and demolition techniques.

**UNIT I SUB STRUCTURE CONSTRUCTION 9**

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 for underground open excavation.

**UNIT II SUPER STRUCTURE CONSTRUCTION FOR BUILDINGS 9**

Vacuum dewatering of concrete flooring – Concrete paving technology – Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections – Erection techniques of tall structures, Large span structures – launching techniques for heavy decks – in-situ prestressing in high rise structures, Post tensioning of slab- aerial transporting – Handling and erecting lightweight components on tall structures.

**UNIT III CONSTRUCTION OF SPECIAL STRUCTURES 9**

Erection of lattice towers - 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 – Construction of jetties and break water structures – Construction sequence and methods in domes – Support structure for heavy equipment and machinery in heavy industries – Erection of articulated structures and space decks.

**UNIT IV REHABILITATION AND STRENGTHENING TECHNIQUES 9**

Seismic retrofitting - Strengthening of beams - Strengthening of columns - Strengthening of slab - Strengthening of masonry wall, Protection methods of structures, Mud jacking and grouting for foundation – Micro piling and underpinning for strengthening floor and shallow profile - Sub grade water proofing, Soil Stabilization techniques.

**UNIT V DEMOLITION 9**

Demolition Techniques, Demolition by Machines, Demolition by Explosives, Advanced techniques using Robotic Machines, Demolition Sequence, Dismantling Techniques, Safety precaution in Demolition and Dismantling.

**TOTAL : 45 PERIODS**

**OUTCOME:**

- On completion of this course the students will know the modern construction techniques used in the construction of buildings and special structures and also rehabilitation, strengthening techniques and demolition.

**REFERENCES:**

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

**OBJECTIVE:**

- To study and understand the hardware and software requirements of computer, programming, optimization techniques, inventory models and scheduling techniques applied to construction engineering.

**UNIT I INTRODUCTION****6+6**

Overview of IT Applications in Construction – Construction process – Computerization in Construction – Computer aided Cost Estimation – Developing application with database software.

**UNIT II OPTIMIZATION TECHNIQUES****6+6**

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****6+6**

Deterministic and Probabilistic Inventory Models - Software applications.

**UNIT IV SCHEDULING APPLICATION****6+6**

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

**UNIT V OTHER PROBLEMS****6+6**

Sequencing problems – Simulation – Enterprises – Introduction to ERP systems.

**TOTAL (L:30+P:30) : 60 PERIODS****OUTCOME:**

- On completion of this course the students will know the computer applications in construction, different optimization techniques and sequencing problems.

**REFERENCES:**

- Billy E. Gillet., Introduction to Operations Research – A Computer Oriented Algorithmic Approach, Mc Graw Hill, 2008.
- Feigenbaum, L., Construction Scheduling with Primavera Project Planner Prentice Hall Inc., 2002.
- Ming Sun and Rob Howard, "Understanding I.T. in Construction, Spon Press, Taylor and Francis Group, 2004.
- Paulson, B.R., Computer Applications in Construction, Mc Graw Hill, 1995.

**OBJECTIVE:**

- To study and understand the concept of planning, scheduling, cost and quality control, safety during construction, organization and use of project information necessary for construction project.

**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 PERIODS****OUTCOME:**

- On completion of this course the students will know the development of construction planning, scheduling procedure and controls.

**REFERENCES:**

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

**OBJECTIVE:**

- To study the various types of construction contracts and their legal aspects and provisions.
- To study the type of tenders, arbitration, legal requirement, and labour regulations.

**UNIT I CONSTRUCTION CONTRACTS 9**

Indian Contracts Act – Elements of Contracts – Types of Contracts – Features – Suitability – Design of Contract Documents – International Contract Document – Standard Contract Document – Law of Torts.

**UNIT II TENDERS 9**

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.

**UNIT III ARBITRATION 9**

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.

**UNIT IV LEGAL REQUIREMENTS 9**

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.

**UNIT V LABOUR REGULATIONS 9**

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 PERIODS****OUTCOME:**

- On completion of this course the students will know different types of contracts in construction, arbitration and legal aspect and its provisions.

**REFERENCES:**

1. Gajaria G.T., Laws Relating to Building and Engineering Contracts in India, 2000
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. M.M.Tripathi Private Ltd., Bombay, 1982.
5. Patil. B.S, Civil Engineering Contracts and Estimates, Universities Press (India) Private Limited, 2006.



CN7211

**ADVANCED CONSTRUCTION ENGINEERING AND  
COMPUTING TECHNIQUES LABORATORY**

**L T P C  
0 0 4 2**

**(A) ADVANCED CONSTRUCTION ENGINEERING LABORATORY**

**OBJECTIVE:**

- This course provides a thorough knowledge of material selection through the material testing based on specification.

**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 – Demonstration

**TOTAL : 30 PERIODS**

**OUTCOME:**

- On completion of this laboratory course students will be able to test the concrete mixes designed as per IS, ACI and BS methods.
- Students will also be able to know various tests on hardened concrete.

**(B) ADVANCED COMPUTING TECHNIQUES LABORATORY**

**OBJECTIVE:**

- This course gives an exposure to students in utilizing the sophisticated spread sheets programs, estimation software and other package programs.

**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 PERIODS**

**OUTCOME:**

- On completion of this laboratory course the students will be able to do the scheduling of constructions projects using tools like primavera and MS projects.

CN7311

**PRACTICAL TRAINING (2 Weeks)**

**L T P C  
0 0 0 1**

**OBJECTIVE:**

- To train the students in the field work so as to have a firsthand knowledge of practical problems related to Construction Management in carrying out engineering tasks.
- To develop skills in facing and solving the problems experiencing in the field.

**SYLLABUS:**

The students individually undertake training in reputed engineering companies doing construction during the summer vacation for a specified duration of four weeks. At the end of training, a detailed report on the work done should be submitted within ten days from the commencement of the semester. The students will be evaluated through a viva-voce examination by a team of internal staff.

**CN7312****SEMINAR**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**OBJECTIVE:**

- To work on a specific technical topic in Construction Engineering and Management in order to acquire the skills of oral presentation.
- To acquire technical writing abilities for seminars and conferences.

**SYLLABUS:**

The students will work for two hours per week guided by a group of staff members. They will be asked to talk on any topic of their choice related to construction engineering and management and to engage in dialogue with the audience. A brief copy of their talk also should be submitted. Similarly, the students will have to present a seminar of not less than fifteen minutes and not more than thirty minutes on the technical topic. They will also answer the queries on the topic. The students as audience also should interact. Evaluation will be based on the technical presentation and the report and also on the interaction during the seminar.

**TOTAL: 30 PERIODS****CN7313****PROJECT WORK (PHASE I)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>12</b>	<b>6</b>

**OBJECTIVE:**

- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

**SYLLABUS:**

The student individually works on a specific topic approved by the head of the division under the guidance of a faculty member who is familiar in this area of interest. The student can select any topic which is relevant to the area of construction engineering and management. The topic may be theoretical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

**TOTAL: 180 PERIODS****OUTCOME:**

- At the end of the course the students will have a clear idea of his/her area of work and they are in a position to carry out the remaining phase II work in a systematic way.



**UNIT V CONCRETING METHODS****9**

Process of manufacturing of concrete, methods of transportation, placing and curing. Extreme weather concreting, special concreting methods. Vacuum dewatering – Underwater Concrete.

**TOTAL : 45 PERIODS****OUTCOME:**

- On completion of this course the students will know various tests on fresh, hardened concrete, special concrete and the methods of manufacturing of concrete.

**REFERENCES:**

1. Gambhir.M.L., Concrete Technology, McGraw Hill Education, 2006.
2. Gupta.B.L., Amit Gupta, "Concrete Technology, Jain Book Agency, 2010.
3. Neville, A.M., Properties of Concrete, Prentice Hall, 1995, London.
4. Santhakumar.A.R. ;"Concrete Technology",Oxford University Press,2007.
5. Shetty M.S., Concrete Technology, S.Chand and Company Ltd. Delhi, 2003.

**CN7002****CONSTRUCTION PERSONNEL MANAGEMENT**

L	T	P	C
3	0	0	3

**OBJECTIVE:**

- To study the various aspects of manpower management such as man power planning, organization, human relations, welfare and development methods in construction.

**UNIT I MANPOWER PLANNING****9**

Manpower Planning process , Organising, Staffing, directing, and controlling – Estimation, manpower requirement – Factors influencing supply and demand of human resources – Role of HR manager – Personnel Principles.

**UNIT II ORGANISATION****9**

Requirement of Organisation – Organisation structure – Organisation Hierarchical charts – Staffing Plan - Development and Operation of human resources - Managerial Staffing – Recruitment – Selection strategies – Placement and Training.

**UNIT III HUMAN RELATIONS AND ORGANISATIONAL BEHAVIOUR****9**

Basic individual psychology – Approaches to job design and job redesign – Self managing work teams – Intergroup – Conflict in organizations – Leadership-Engineer as Manager – al aspects of decision making – Significance of human relation and organizational – Individual in organization – Motivation – Personality and creativity – Group dynamics, Team working – Communication and negotiation skills.

**UNIT IV WELFARE MEASURES****9**

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

**UNIT V MANAGEMENT AND DEVELOPMENT METHODS****9**

Wages and Salary, Employee benefits, Employee appraisal and assessment – Employee services – Safety and Health Management – Special Human resource problems – Productivity in human resources – Innovative approach to designing and managing organization – Managing New Technologies – Total Quality Management – Concept of quality of work life – Levels of change in the organizational Development – Requirements of organizational Development – System design and methods for automation and management of operations – Developing policies, practices and establishing process pattern – Competency upgradation and their assessment – New methods of training and development – Performance Management.

**TOTAL : 45 PERIODS****OUTCOME:**

- On completion of this course the students will know various processes in manpower planning, organizational and welfare measures.

**REFERENCES:**

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

**CN7003****CONSTRUCTION PROJECT MANAGEMENT****L T P C  
3 0 0 3****OBJECTIVE:**

- To study the various management techniques for successful completion of construction projects.
- To study the effect of management for project organization, design of construction process, labour, material and equipment utilization, and cost estimation.

**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 III DAYLIGHTING AND ELECTRICAL LIGHTING 9**

Materials, components and details – Insulation – Optical materials – Radiant Barriers – Glazing materials – Glazing Spectral Response – Day lighting – Sources and concepts – Building Design Strategies – Case Studies – Daylight apertures – Light Shelves – Codal requirements – Day lighting design – Electric Lighting – Light Distribution – Electric Lighting control for day lighted buildings – Switching controls – Coefficient of utilization – Electric Task Lighting – Electric Light Zones – Power Adjustment Factors.

**UNIT IV HEAT CONTROL AND VENTILATION 9**

Hourly Solar radiation – Heat insulation – Terminology – Requirements – Heat transmission through building sections – Thermal performance of Building sections – Orientation of buildings – Building characteristics for various climates – Thermal Design of buildings – Influence of Design Parameters – Mechanical controls – Examples. Ventilation – Requirements – Minimum standards for ventilation – Ventilation Design – Energy Conservation in Ventilating systems – Design for Natural Ventilation – Calculation of probable indoor wind speed.

**UNIT V DESIGN FOR CLIMATIC ZONES 9**

Energy efficiency – An Overview of Design Concepts and Architectural Interventions – Embodied Energy – Low Embodied Energy Materials – Passive Downdraft Evaporative Cooling – Design of Energy Efficient Buildings for Various Zones – Cold and cloudy – Cold and sunny – Composite – Hot and dry – Moderate – Warm and humid – Case studies of residences, office buildings and other buildings in each zones – Commonly used software packages in energy efficient building analysis and design - Energy Audit – Certification.

**TOTAL : 45 PERIODS**

**OUTCOME:**

- On completion of this course the students will be able to know various components which makes the building energy efficient such as lighting, space conditioning, heat control and energy efficient.

**REFERENCES:**

1. Brown, G.Z. and DeKay, M., Sun, Wind and Light - Architectural Design Strategies, John Wiley and Sons Inc, 2001
2. Energy Conservation Building Code, Bureau of Energy Efficiency, New Delhi, 2007.
3. Handbook on Functional Requirements of Buildings Part 1 to 4 SP : 41 ( S and T) 1995
4. Majumdar, M (Ed), Energy - Efficient Buildings in India, Tata Energy Research Institute, Ministry of Non Conventional Energy Sources, 2002.
5. Moore, F., Environmental Control System, McGraw Hill Inc. 2002.
6. Tyagi, A.K. (Ed). Handbook on Energy Audits and Management Tata Energy Research Institute, 2000.

**CN7005 ECONOMICS AND FINANCE MANAGEMENT IN CONSTRUCTION L T P C  
3 0 0 3**

**OBJECTIVE:**

- To study the concepts of Construction Economic and Finance such as comparing alternatives proposals, evaluating alternative investments, management of funds, and management of accounting.

<b>UNIT I</b>	<b>BASIC PRINCIPLES</b>	<b>9</b>
Time Value of Money – Cash Flow diagram – Nominal and effective interest- continuous interest . Single Payment Compound Amount Factor (P/F,F/P) – Uniform series of Payments (F/A,A/F,F/P,A/P)– Problem time zero (PTZ)- equation time zero (ETZ). Constant increment to periodic payments – Arithmetic Gradient(G), Geometric Gradient (C).		
<b>UNIT II</b>	<b>COMPARING ALTERNATIVES PROPOSALS</b>	<b>9</b>
Comparing alternatives- Present Worth Analysis, Annual Worth Analysis, Future Worth Analysis, Rate of Return Analysis (ROR) and Incremental Rate of Return (IROR)Analysis, Benefit/Cost Analysis, Break Even Analysis.		
<b>UNIT III</b>	<b>EVALUATING ALTERNATIVE INVESTMENTS</b>	<b>9</b>
Real Estate - Investment Property, Equipment Replace Analysis, Depreciation – Tax before and after depreciation – Value Added Tax (VAT) – Inflation.		
<b>UNIT IV</b>	<b>FUNDS MANAGEMENT</b>	<b>9</b>
Project Finance – Sources of finance - Long-term and short -term finance, Working Capital Management, Inventory valuation, Mortgage Financing - International financial management-foreign currency management.		
<b>UNIT V</b>	<b>FUNDAMENTALS OF MANAGEMENT ACCOUNTING</b>	<b>9</b>
Management accounting, Financial accounting principles- basic concepts, Financial statements – accounting ratios - funds flow statement – cash flow statement.		

**TOTAL : 45 PERIODS**

**OUTCOME:**

- On completion of this course the students will be able to know the concepts in economics and finance in constructions.

**REFERENCES:**

1. Blank, L.T., and Tarquin,a.J Engineering Economy,4th Edn. Mc-Graw Hill Book Co., 1988
2. Collier C and GlaGola C Engineering Economics & Cost Analysis, 3rd Edn. Addison Wesley Education Publishers.,1998.
3. Patel, B M Project management- strategic Financial Planning, Evaluation and Control, Vikas Publishing House Pvt. Ltd. New Delhi, 2000
4. Shrivastava,U.K., Construction Planning and Management,2<sup>nd</sup> Edn. Galgotia Publications Pvt. Ltd. New Delhi., 2001.
5. Steiner, H.M. Engineering Economic principles, 2nd Edn. Mc-Graw Hill Book, 1996

<b>CN7006</b>	<b>MANAGEMENT INFORMATION SYSTEMS</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVE:**

- To study the concepts of information systems and their applications, system development and information systems, implementation and control, and system audit.

<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>9</b>
Information Systems – Establishing the Framework – Business Models – Information System Architecture – Evolution of Information Systems.		





**UNIT III CONTRACTUAL OBLIGATIONS 9**

Safety in Construction Contracts – Substance Abuse – Safety Record Keeping.

**UNIT IV DESIGNING FOR SAFETY 9**

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 9**

Owner's responsibility for safety – Owner preparedness – Role of designer in ensuring safety – Safety clause in design document.

**TOTAL : 45 PERIODS**

**OUTCOME:**

- On completion of this course the students will be able to know various constructions safety concepts.

**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, Tamilnadu. Health Management, Prentice Hall Inc., 2001.

<b>CN7008</b>	<b>QUALITY CONTROL AND ASSURANCE IN CONSTRUCTION</b>	<b>L T P C</b>
		<b>3 0 0 3</b>

**OBJECTIVES:**

- To study the concepts of quality assurance and control techniques in construction.
- To study the design of philosophy, design of special elements, flat slabs and yield line based design, and ductile detailing.

**UNIT I QUALITY MANAGEMENT 9**

Introduction – Definitions and objectives – Factors influencing construction quality – Responsibilities and authority – Quality plan – Quality Management Guidelines – Quality circles.

**UNIT II QUALITY SYSTEMS 9**

Introduction - Quality system standard – ISO 9000 family of standards – Requirements – Preparing Quality System Documents – Quality related training – Implementing a Quality system – Third party Certification.

**UNIT III QUALITY PLANNING 9**

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.

**UNIT IV QUALITY ASSURANCE AND CONTROL 9**

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.



**OUTCOME:**

- On completion of this course the students will be able to know operations research, production management, financial management and cost concepts.

**REFERENCES:**

1. Frank Harrison, E., The Managerial Decision Making Process, Houghton Mifflin Co., Boston, 1999.
2. Hamdy A.Taha, Operations Research: An Introduction, Prentice Hall, 2010.
3. Levin, R.I, Rubin,D.S., and Stinson J., Quantitative Approaches to Management, McGraw Hill College, 1993.
4. Tang S.L., Irtishad U.Ahmad, Syed M.Ahmed, Ming Lu, Quantitative Technique for Decision making in Construction, Hongkong University Press, HKU, 2004.
5. Schroeder, R.G, Operations Management, McGraw Hill, 2009.
6. Vohra, Nd., Quantitative Techniques in Management, Third Edition, Tata McGraw-Hill Company Ltd, 2007.

**CN7010****RESOURCE MANAGEMENT AND CONTROL  
IN CONSTRUCTION****L T P C  
3 0 0 3****OBJECTIVE:**

- To study the management and control of various resources involved in construction.
- To study the effect of resource planning, labour management, material and equipment, time management, and resource allocation and resource leveling in construction.

**UNIT I RESOURCE PLANNING****9**

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****9**

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****9**

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****9**

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****9**

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

**TOTAL : 45 PERIODS****OUTCOME:**

- On completion of this course the students will be able to know resource planning, management, allocation and resource leveling in construction.

**REFERENCES:**

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

**CN7011**

**SHORING, SCAFFOLDING AND FORMWORK**

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

**OBJECTIVE:**

- To study and understand the overall and detailed planning of formwork, plant and site equipment.
- To understand the Design and erection of forms for various elements such as slabs, beams, columns, walls, shells and tunnels.
- To know the latest methods of form construction.

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

Introduction - Forms for foundations, columns, beams walls etc., General objectives of formwork building - Planning for safety - Development of a Basic System - Key Areas of cost reduction - Planning examples. Overall Planning - Detailed planning - Standard units - Corner units - Pass units - Calculation of labour constants - Formwork hours - Labour Requirement - Overall programme - Detailed programme - Costing - Planning crane arrangements - Site layout plan - Transporting plant - Formwork beams - Scaffold frames - Framed panel formwork - Formwork accessories.

**UNIT II MATERIALS ACCESSORIES PROPRIETARY PRODUCTS & PRESSURES 9**

Lumber - Types - Finish - Sheathing boards working stresses - Repetitive member stress - Plywood - Types and grades - Jointing Boarding - Textured surfaces and strength - Reconstituted wood - Steel - Aluminum - Hardware and fasteners - Nails in Plywood - Allowable withdrawal load and lateral load. Pressures on formwork - Examples - Vertical loads for design of slab forms - Uplift on shores - Laterals loads on slabs and walls.

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

Basic simplification - Beam formulae - Allowable stresses - Deflection, Bending - Lateral stability - Shear, Bearing - Design of Wall forms - Slab forms - Beam forms - Column forms - Examples in each. Simple wood stresses - Slenderness ratio - Allowable load vs length behaviour of wood shores - Form lining Design Tables for Wall formwork - Slab Formwork - Column Formwork - Slab props - Stacking Towers - Free standing and restrained - Rosett Shoring - Shoring Tower - Heavy Duty props.

**UNIT IV BUILDING AND ERECTING THE FORM WORK 9**

Carpentry Shop and job mill - Forms for Footings - Wall footings - Column footings - Sloped footing forms - Strap footing - Stepped footing - Slab form systems - Sky deck and Multiflex - Customized slab table - Standard Table module forms - Swivel head and uniportal head - Assembly sequence - Cycling with lifting fork - Moving with table trolley and table prop. Various causes of failures - ACI - Design deficiencies - Permitted and gradual irregularities.

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

Hemispherical, Parabolic, Translational shells - Typical barrel vaults Folded plate roof details - Forms for Thin Shell roof slabs design considerations - 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 - Bulk head method - Pressures on tunnels - Continuous Advancing Slope method - 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 - Types of scaffolds - Putlog and independent scaffold -Single pole scaffolds - Truss suspended - Gantry and system scaffolds.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- On completion of this course the students will be able to know the detailed planning of framework, design of forms and erection of form work.

**REFERENCES:**

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

**CN7012 SYSTEM INTEGRATION IN CONSTRUCTION**

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

**OBJECTIVE:**

- To study and understand the construction system integration, environmental factors, services, maintenance and safety systems.

**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 PERIODS****OUTCOME:**

- On completion of this course the students will be able to know various Structural systems, Services, Safety and Maintenance requirements in construction.

**REFERENCES:**

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