REGULATION 2015-10-24
M.TECH – CONSTRUCTION ENGG AND MANAGEMENT
CURRICULUM AND SYLLABUS

SEMESTER I

Code No.	Course Title	L	T	P	C
MMA101	Statistical Methods and Queuing Theory	3	1	0	4
MCM101	Modern Construction Materials	3	0	0	3
MCM102	Construction Equipment	3	0	0	3
MCM103	Project Formulation and Appraisal	3	0	0	3
MCM1E1	Elective I	3	0	0	3
MCM1E2	Elective II	3	0	0	3
	Total	18	1	0	19

SEMESTER II

Code No.	Course Title	L	T	P	C
MCM201	Advanced Construction Techniques	3	0	0	3
MCM202	Contract Laws and Regulations	3	0	0	3
MCM203	Construction Planning, Scheduling and Control	3	0	0	3
MCM204	Safety Practices in Construction	3	0	0	3
MCM2E3	Elective III	3	0	0	3
MCM2E4	Elective IV	3	0	0	3
MCM2L1	Advanced Construction Engineering Laboratory	0	0	4	2
	Total	18	0	4	20

SEMESTER III

Code No.	Course Title	L	T	P	C
MCM3P1	Project Work (Phase-1)	0	0	12	6
MCM301	Computer Applications in Construction Engineering and Planning	3	0	0	3
MCM3E5	Elective V	3	0	0	3
MCM3E6	Elective VI	3	0	0	3
	Total	9	0	12	15

SEMESTER IV

Code No.	Course Title	L	T	P	C
MCM4P1	Project Work (Phase – II)	0	0	24	12
	Total	0	0	24	12

Total Credits for the Programme – 66

LIST OF ELECTIVES (Construction Engineering and Management)

Code	Course Title	L	T	P	C
MCM051	Advanced Concrete Technology	3	0	0	3
MCM052	Construction of Pavements	3	0	0	3
MCM053	System Integration in Construction	3	0	0	3
MCM054	Energy Conservation Techniques in Building Construction	3	0	0	3
MCM055	Shoring, Scaffolding and Formwork	3	0	0	3
MCM056	Construction Project Management	3	0	0	3
MCM057	Quantitative Techniques in Management	3	0	0	3
MCM058	Construction Personnel Management	3	0	0	3
MCM059	Business Economics and Finance Management	3	0	0	3
MCM060	Quality Control and Assurance in Construction	3	0	0	3
MCM061	Resource Management and Control in Construction	3	0	0	3
MCM062	Project Safety Management	3	0	0	3
MCM063	Management Information Systems	3	0	0	3
MCM064	Energy-Efficient Buildings	3	0	0	3
MCM065	Maintenance and Rehabilitation of Structures	3	0	0	3
MCM066	Condition Assessment and Evaluation Engineering	3	0	0	3
MCM067	Prefabrication and Construction Techniques	3	0	0	3
MCM068	Design of Industrial Structures	3	0	0	3
MCM069	GIS in Construction Engineering & Management	3	0	0	3
MCM070	Infrastructure Development	3	0	0	3
MCM071	Building Services	3	0	0	3
	Research Methodology	3	0	0	3

MMA 101 STATISTICAL METHODS AND QUEUEING THEORY

L	T	P	C
3	1	0	4

OBJECTIVES:

To develop analytical capability and to impart knowledge in statistical methods and Queuing theory and their applications in Engineering and Technology and to apply these concepts in engineering problems they would come across.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Analyze the one dimensional random variable and their properties and functions.

CO2: Analyze and study about the estimation theory using various methods.

CO3: Analyze and test the hypotheses based on different distributions and attributes.

CO4: Analyze the variance and perform randomised block and latin square design.

CO5: Analyze and work on different queuing models.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M			S								
CO2	M			S								
CO3	M			S								
CO4	M			S								
CO5	M			S								

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

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, .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

Queuing 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: 60 PERIODS

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.

L	T	P	C
3	0	0	3

MCM 101 MODERN CONSTRUCTION MATERIALS

OBJECTIVES:

To bring about an exposure to design concepts structures, the loads, systems, structural materials, design procedures, repair and rehabilitation of systems.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Identify the various types of concretes and their constituents and properties.

CO2: Identify the various types of metals, their properties and applications.

CO3: Identify the various composite materials, their properties and applications.

CO4: Understand the concept of water-proofing and identify the purpose of flooring and façade materials.

CO5: Design and develop smart intelligent buildings.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M				S		M			W		
CO2	M				S		M					
CO3	M				S		M		W			
CO4	M				S		M					
CO5	M				S		M					

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

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 Façade Materials

UNIT V

Smart and Intelligent Materials **5**

Smart and Intelligent Materials for intelligent buildings - Special features

TOTAL: 45 PERIODS

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.

L	T	P	C
3	0	0	3

MCM 102 CONSTRUCTION EQUIPMENT AND MANAGEMENT

OBJECTIVES:

To introduce various construction equipment and study the efficient utilization of the same using scientific principles.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Manage the equipment, cost control and maintenance of a project.

CO2: Identify and understand the working principle of earthwork equipments.

CO3: Identify and understand the working of various equipments for different construction process.

CO4: Identify and understand the working principle of material handling equipments.

CO5: Understand the working of aggregate production and concreting equipments.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		M		S				W			
CO2	M		M		S							
CO3	M		M		S							
CO4	M		M		S		W					

CO5	M		M		S							

Course Assessment Methods:

Direct		**Indirect**	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

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 PERIODS

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.

L	T	P	C
3	0	0	3

MCM 103 PROJECT FORMULATIONS AND APPRAISAL

OBJECTIVES:

To introduce and study formulation, costing, appraisal and finance of construction projects.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Formulate and generate the project and prepare reports for executing the work.

CO2: Understand the costing and cash flows of a project.

CO3: Assess various methods of project appraisal.

CO4: Understand the project financing and special schemes.

CO5: Know about private sector participation in Infrastructure Development Projects.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M				S	M		M				
CO2	M				S	M		M		W		
CO3	M				S	M		M				
CO4	M				S	M		M				
CO5	M				S	M		M				

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

UNIT I

Project Formulation **10**

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 **10**

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

UNIT III

Project Appraisal **15**

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 **5**

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

UNIT V

Private Sector Participation **5**

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

TOTAL: 45 PERIODS

REFERENCES:

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

L	T	P	C
3	0	0	3

MCM 201 ADVANCED CONSTRUCTION TECHNIQUES

OBJECTIVES:

To bring about a complete understanding of advanced construction techniques in sub structure super structure and repair construction.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Understand the various processes involved in sub-structure construction.

CO2: Understand the various processes involved in super-structure construction.

CO3: Understand the construction process of special structures and offshore structures.
CO4: Know about the rehabilitation techniques carried out for a structure.
CO5: Know about the demolition techniques carried out for a structure.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		M		S							
CO2	M		M		S	W				W		
CO3	M		M		S							
CO4	M		M		S							
CO5	M		M		S							

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

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 PERIODS

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.

L	T	P	C
3	0	0	3

MCM 202 CONTRACT LAWS AND REGULATIONS

OBJECTIVES:

To study contract laws and regulations so that adequate knowledge on formulating and managing construction contracts is gained.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know the elements of concluding and the process of administering contracts.

CO2: Understand the various processes involved in tenders.

CO3: Achieve awareness on arbitrations and powers and duty of an arbitrator.

CO4: Know about the legal requirements and the corresponding government laws.

CO5: Know about the labour requirements and administration and the corresponding government laws.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M					S	M	S		W		
CO2	M					S	M	S				
CO3	M					S	M	S				
CO4	M					S	M	S		W		
CO5	M					S	M	S				

Course Assessment Methods:

Direct		**Indirect**	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

UNIT I

Construction Contracts **10**

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 **10**

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 **5**

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 **10**

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 **10**

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

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.
6.

MCM 203 CONSTRUCTION PLANNING, SCHEDULING AND CONTROL

L	T	P	C
3	0	0	3

OBJECTIVES:

To study the finer aspects of planning, scheduling and controlling of construction projects.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know the elements of construction planning and estimating activity durations and resource requirements.

CO2: Know the elements of scheduling and to apply appropriate tools and techniques like networks and coding systems.

CO3: Understand the monitoring and accounting of projects through cost control.

CO4: Know the elements of quality control and safety of construction projects.

CO5: Know the concept of gathering and using project information.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M			M			M	S				
CO2	M			M			M	S				
CO3	M			M			M	S				
CO4	M			M			M	S				
CO5	M			M			M	S				

Course Assessment Methods:

Direct	Indirect

1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

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-Node 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 during Construction **9**

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

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

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.

L	T	P	C
3	0	0	3

MCM 204 SAFETY PRACTICES IN CONSTRUCTION

OBJECTIVES:

To study various safety practices that has to be adopted in construction and to know the finer aspects of safety programs, sampling and audit.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know the safety concepts that have to be adopted in construction.

CO2: Understand the elements of safety programmes.

CO3: Know the awareness on safety practices that has to be ensured during construction.

CO4: Know about the accident prevention, safety sampling and audit.

CO5: Know the safety concepts in hand tools, grinding, lifting works and while operating fire fighting equipments.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M					S	M	S				
CO2	M					S	M	S				
CO3	M					S	M	S				
CO4	M					S	M	S				
CO5	M					S	M	S				

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

UNIT – I

Safety Concepts **9**

Construction accidents - Construction Safety Management: Importance - causes of accident, safety measures- Environmental issues in construction-Construction industry related laws. Human factors in safety – legal and financial aspects of accidents in construction – occupational and safety hazard assessment.

UNIT – II

Safety Programmes **9**

Safety Programmes - Construction Safety - Elements of an Effective Safety Programmes - Job-site assessment - Safety Meetings - Safety Incentives. Contractual Obligations - Safety in construction contracts- Substance Abuse - safety Record Keeping.

UNIT – III

Safety Practices **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 – IV

Safety Sampling and Audit **9**

Accident prevention-cost of accidents-Safety and productivity-safety provision in the factories act-accident reporting investigation and statistics-total loss control and damage control-Safety sampling- safety audit - critical incident technique- safety equipment - planning and site preparation- safety system of storing construction materials-Excavation - blasting- timbering-scaffolding- safe use of ladders- safety in welding.

UNIT – V

Safety in Lifting and Fire **9**

Safety in hand tools- Safety in grinding- Hoisting apparatus and conveyors- Safety in the use of mobile cranes-Manual handling- Safety in demolition work- Trusses, girders and beams-First- aid- Fire hazards and preventing methods-Interesting experiences at the construction site against the fire accidents.

TOTAL: 45 PERIODS

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. Hand Book on Construction Safety Practices, SP:70, BIS, 2001.

MCM 2L1 ADVANCED CONSTRUCTION ENGINEERING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

To expose the students to the testing of concrete under the action of various minerals and admixtures and determination of their characteristics experimentally and also to calculate mix design and perform NDT.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know the Mix design of concrete as per IS, ACI & BS methods for high performance concrete.

CO2: Understand the Flow Characteristics of Self Compacting concrete.

CO3: Know the Effect of minerals and chemical admixtures in concrete at fresh and hardened state with relevance to workability, strength and durability.

CO4: Perform NDT on hardened concrete.

CO5: Know the Permeability tests on hardened concrete.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	S		M	S						W	
CO2	M	S		M	S							
CO3	M	S		M	S			W				
CO4	M	S		M	S							
CO5	M	S		M	S							

Course Assessment Methods:

Direct		Indirect	
1	Lab Exercise	1	Course End Survey
2	Model Exam	2	
3	Observation	3	
4	Viva-Voce	4	

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 PERIODS

L	T	P	C
3	0	0	3

MCM 301 COMPUTER APPLICATIONS IN CONSTRUCTION ENGINEERING AND PLANNING

OBJECTIVES:

To bring about an understanding of use of computers for solving scheduling and other related problems by applying critical path methods.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know the system hardware and system management.

CO2: Understand the optimisation techniques and software problems.

CO3: Know the Deterministic and Probabilistic Inventory Models.

CO4: Know the scheduling techniques.

CO5: Understand other concepts regarding estimation, planning, scheduling and accounting.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		M	M					W			
CO2	M		M	M								
CO3	M		M	M								
CO4	M		M	M								
CO5	M		M	M								

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

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 PERIODS

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.

MCM 051 ADVANCED CONCRETE TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

To study the properties of concrete, special types of concrete, concreting techniques and mix design procedure.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know the concrete making materials.

CO2: Understand the properties of fresh and hardened concrete.

CO3: Know the Mix design adopted for casting of concrete.

CO4: Know the special types of concrete.

CO5: Understand the various concreting methods adopted.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		M		S							

CO2	M		M		S	W				W		
CO3	M		M		S							
CO4	M		M		S							
CO5	M		M		S							

Course Assessment Methods:

Direct		**Indirect**	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

UNIT - I

Concrete Making Materials **9**

Aggregates classification, IS Specifications, Properties, Grading, Methods of combining aggregates, specified gradings, Testing of aggregates. Cement, Grade of cement, Chemical composition, Testing of concrete, Hydration of cement, Structure of hydrated cement, special cements. Water Chemical admixtures, Mineral admixture.

UNIT – II

Concrete **9**

Properties of fresh concrete, Hardened concrete, Strength, Elastic properties, Creep and shrinkage, Variability of concrete strength, durability of concrete.

UNIT – III

Mix Design **9**

Principles of concrete mix design, Methods of concrete mix design, Testing of Concrete. Statistical quality control- sampling and acceptance criteria.

UNIT – IV

Special Concrete **9**

Light weight concrete, Fly ash concrete, Fibre reinforced concrete, Sulphur impregnated concrete, Polymer Concrete, Super plasticised concrete, hyper plasticized concrete, Epoxy resins and screeds for rehabilitation - properties and applications - high performance concrete. High performance fiber reinforced concrete, self-compacting-concrete.

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, special form work.

TOTAL: 45 PERIODS

REFERENCES:

1. Neville, A.M., Properties of Concrete, Prentice Hall, 1995, London.
2. Shetty M.S., Concrete Technology, S.Chand and Company Ltd. Delhi, 2003.
3. A.R.Santhakumar ;"Concrete Technology",Oxford University Press,2007.
4. Rudhani G. Light Weight Concrete Academic Kiado, Publishing Home of Hungarian Academy of Sciences, 1963.

MCM 052 CONSTRUCTION OF PAVEMENTS

L	T	P	C
3	0	0	3

OBJECTIVES:

To bring about an understanding of construction of pavements and the properties of pavements.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know the materials in pavement construction.

CO2: Understand the design and properties of bituminous mixtures.

CO3: Know the properties of pavement quality and the construction practice.

CO4: Know the road making machineries.

CO5: Be aware of the latest advancements in pavement engineering.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		M	M	M							
CO2	M		M	M	M						W	
CO3	M		M	M	M							
CO4	M		M	M	M							
CO5	M		M	M	M							W

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

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 PERIODS

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.

L	T	P	C
3	0	0	3

MCM 053 SYSTEM INTEGRATION IN CONSTRUCTION

OBJECTIVES:

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

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know about the structural integration and systems.

CO2: Understand the environmental factors and its relevant structural integration.

CO3: Know the services regarding plumbing and electricity.

CO4: Know the maintenance techniques and the materials involved.

CO5: Understand the safety and preventive systems.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		M				S	M				
CO2	M		M				S	M				
CO3	M		M				S	M				
CO4	M		M				S	M				
CO5	M		M				S	M				

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

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

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.

L	T	P	C
3	0	0	3

MCM 054 ENERGY CONSERVATION TECHNIQUES IN BUILDING

OBJECTIVES:

To bring about an exposure to different sources and production systems of energy and their effective management adopting appropriate design methodology in construction.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know the energy production systems and energy economic analysis.

CO2: Understand the environmental aspect and resource conservation.

CO3: Know the energy efficient design strategies.

CO4: Know the energy audit, energy flow diagram and energy consumption.

CO5: Understand the concepts of energy management programme.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		M		M		M					

CO2	M		M		M		M	W				
CO3	M		M		M		M	W				
CO4	M		M		M		M					
CO5	M		M		M		M					

Course Assessment Methods:

Direct		**Indirect**	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

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 PERIODS

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.

MCM 055 SHORING, SCAFFOLDING AND FORMWORK

L	T	P	C
3	0	0	3

OBJECTIVES:

To bring about a thorough exposure to shoring, scaffolding and formwork procedures in construction practice by studying the materials, planning and design aspects and erection procedures.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Study the materials associated with formwork.

CO2: Study the design aspects of formwork under various requirements.

CO3: Know the design of forms and shores.

CO4: Study the planning and erection aspects of form work for buildings.

CO5: Understand few other special types of forms.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M		S	M						
CO2			M		S	M		W				
CO3			M		S	M						
CO4			M		S	M						
CO5			M		S	M						

Course Assessment Methods:

Direct	Indirect

1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

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 – Aluminium 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 Practices for scaffolds 9

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 PERIODS

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.

L	T	P	C
3	0	0	3

MCM 056 CONSTRUCTION PROJECT MANAGEMENT

OBJECTIVES:

To study the elements of construction project management; consisting of owners' perspective, organization, design and construction procedures, resource utilization and cost estimation.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know the types and financing of construction and changing environment of the industry.

CO2: Understand the organisation of project management.

CO3: Know the design and construction process as an integrated system.

CO4: Know the labour, material and equipment utilisation.

CO5: Understand Cost Estimates and the Costs Associated with Construction Facilities.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	M				W	M		M				
CO2	M					M		M				
CO3	M					M		M		W		
CO4	M					M		M				
CO5	M					M		M				

Course Assessment Methods:

Direct		**Indirect**	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

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 PERIODS

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.

L	T	P	C
3	0	0	3

MCM 057 QUANTITATIVE TECHNIQUES IN MANAGEMENT

OBJECTIVES:

To bring about an understanding of quantitative techniques in management and managerial economics.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know the operations research and optimality analysis.

CO2: Understand the production management.

CO3: Understand the financial management.

CO4: Know decision making under conditions of certainty, risk and uncertainty.

CO5: Understand managerial economics and game theory applications.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M					M		M				
CO2	M					M		M				
CO3	M					M		M				
CO4	M					M		M				
CO5	M					M		M				

Course Assessment Methods:

Direct	Indirect

1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

UNIT I

Operations Research **12**

Introduction to Operations Research - Linear Programming – Graphical and Simplex Methods, Duality and Post – Optimality Analysis – Transportation and Assignment Problems.

UNIT II

Production Management **12**

Inventory Control - EOQ - Quantity Discounts - Safety Stock – Replacement Theory – PERT and CPM – Simulation Models – Quality Control.

UNIT III

Financial Management **7**

Working Capital Management – Compound Interest and Present Value methods – Discounted Cash Flow Techniques – Capital Budgeting.

UNIT IV

Decision Theory **7**

Decision Theory – Decision Rules – Decision making under conditions of certainty, risk and uncertainty – Decision trees – Utility Theory.

UNIT V

Managerial Economics **7**

Cost Concepts – Break-even analysis – Pricing Techniques – Game theory Applications.

TOTAL: 45 PERIODS

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.

MCM 058 CONSTRUCTION PERSONNEL MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

To introduce the elements of human behaviour and their impact on construction personnel management.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know about the Manpower Planning and Organising.

CO2: Understand the Development and Operation of human resources.

CO3: Understand the awareness on fundamentals of human behavior under varying stress conditions.

CO4: Know the welfare measures and Laws related to welfare measures.

CO5: Understand Management and Development Methods Productivity of Human resources.

.**CO/PO Mapping**

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						M		M				
CO2						M		M				
CO3						M		M				
CO4						M		M				
CO5						M		M				

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

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 - ob 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 PERIODS

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. Familaro, Handbook of Human Resources Administration, McGraw- Hill International Edition, 1987.
4. Charles D Pringle, Justin Gooderi Longenecter, Management, CE Merril Publishing Co.1981.
5. Dwivedi R.S, Human Relations and Organisational Behaviour, Macmillian IndiaLtd.,2005.

MCM 059 BUSINESS ECONOMICS AND FINANCE MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

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

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know about the engineering economics and Quality Audit in economic law of returns governing production.

CO2: Understand the Construction development in Housing, transport energy and other infrastructures.

CO3: Know the financial control and the need of financial management.

CO4: Know the Accounting for tax reporting purposes and financial reporting purposes.

CO5: Understand the interim construction financing.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						M	S		M			
CO2						M	S		M			
CO3		W				M	S		M			
CO4						M	S		M			
CO5						M	S		M			

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

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 PERIODS

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.

L	T	P	C
3	0	0	3

MCM 060 QUALITY CONTROL AND ASSURANCE IN CONSTRUCTION

OBJECTIVES:

To create a complete understanding on quality planning, quality assurance, quality control and safety management.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know the Quality plan and Quality Management Guidelines.

CO2: Understand the Quality system and standard Documents and Quality related training.

CO3: Know the quality planning, Contract and construction programming, Inspection procedures, Processes and products.

CO4: Know the quality assurance, appraisals and quality control by reliability testing.

CO5: Understand how the quality techniques can be improved.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						M	M	M				

CO2						M	M	M				
CO3						M	M	M		W		
CO4						M	M	M				
CO5	W					M	M	M				

Course Assessment Methods:

Direct		**Indirect**	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

UNIT I

Quality Management **9**

Introduction – Definitions and objectives – Factor 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.

UNIT V

Quality Improvement Techniques **9**

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.

TOTAL: 45 PERIODS

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.

L	T	P	C
3	0	0	3

MCM 061 RESOURCE MANAGEMENT AND CONTROL IN CONSTRUCTION

OBJECTIVES:

To study the resources required for construction like material, equipment, labour and time and comprehend the effective management of the same towards fruitful completion of the project.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know the Resource Planning, Procurement and Identification.

CO2: Understand the Labour, Classes of Labour, Cost of Labour, Labour schedule, optimum use Labour.

CO3: Study and evaluate the resources - material, equipment, labour and time.

CO4: Know to manage time on the project and forecasting the future.

CO5: Understand other concepts regarding resource allocation and levelling.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					M	M		M	M			W
CO2					M	M		M	M			
CO3					M	M		M	M			W
CO4					M	M		M	M			

CO5					M	M		M	M			

Course Assessment Methods:

Direct		**Indirect**	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

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 PERIODS

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, Obsorne- McGraw Hill C.A.Publishing Co., Inc. 1988.
4. Oxley Rand Poslcit, Management Techniques applied to the Construction Industry, Granda Publishing Ltd., 1980.

L	T	P	C
3	0	0	3

MCM 062 PROJECT SAFETY MANAGEMENT

OBJECTIVES:

To study and understand the various safety concepts and requirements applied to construction projects and to study the nature of construction accidents, safety programmes, contractual obligations, and design for safety.

.**COURSE OUTCOMES:**

After successful completion of this course, the students should be able to

CO1: Know the nature of construction accidents and their causes.

CO2: Understand the Elements of an Effective Safety Programme.

CO3: Know the Safety in Construction Contracts, Substance Abuse and Safety Record keeping.

.**CO4:** Know the Safety Culture and Project Coordination and Safety Procedures.

CO5: Understand other concepts regarding safety sampling and audit.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					M	S	S	M				
CO2					M	S	S	M				
CO3					M	S	S	M			W	
CO4					M	S	S	M				
CO5					M	S	S	M				

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

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 **10**

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

Safety Sampling and Audit **10**

Safety sampling- safety audit - Components of safety audit – review of inspection critical incident technique- safety records, formats – implementation of audit indication check list – identification of unsafe acts of workers and unsafe conditions safety equipment - planning and site preparation- safety system of storing construction materials.

TOTAL: 45 PERIODS

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.

MCM 063 MANAGEMENT INFORMATION SYSTEM

L	T	P	C
3	0	0	3

OBJECTIVES:

To study the various models of management information systems and their application to project management.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know the exposure to information systems in a formal manner.

CO2: Understand the development of information systems.

CO3: Know the means of applying information systems models to project management.

CO4: Know to assess the value and risk of Information System.

CO5: Understand other concepts regarding system audit and its associated features.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			M			M	M					
CO2			M			M	M					
CO3			M			M	M					
CO4			M			M	M					
CO5			M			M	M					

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

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 PERIODS

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, Structureand 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 Huge J Watson, Decision Support for Managers, Prentice Hall, 1996.
5. Michael W. Evans and John J Marciniah, Software Quality assurance and Management, John Wiley and Sons, 1987.
6. Card and Glass, Measuring Software Design quality , Prentice Hall, 1990.

MCM 064 ENERGY-EFFICIENT BUILDINGS

L	T	P	C
3	0	0	3

OBJECTIVES:

To study the design of energy efficient buildings which balances all aspects of energy, lighting, space conditioning and ventilation by providing a mix of passive solar design strategies and to learn the use of materials with low embodied energy.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know the energy requirement of the building construction.

CO2: Understand the key design principles for energy efficient buildings.

CO3: Know the concepts of daylighting and components of daylight factor.

CO4: Know the Heat transmission, heat control and ventilation.

CO5: Know about the Energy efficient buildings for various zones.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M				M	M	S					
CO2	M				M	M	S					
CO3	M				M	M	S					
CO4	M				M	M	S					
CO5	M				M	M	S					

Course Assessment Methods:

Direct	Indirect

1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

UNIT I

Introduction **9**

Energy required for building construction - Heat Transfer – Measuring Conduction – Thermal Storage – Measurement of Radiation – The Green house Effect – Psychrometry Chart – Measuring latent and sensible heat. Thermal Comfort – Site Planning and Development – Temperature – Humidity – Wind – Optimum Site Locations – Sun Protection – Types of Shading Devices – Conservation – Heating and Cooling loads.

UNIT II

Passive Solar Heating and Cooling **9**

General Principles of passive Solar Heating – Key Design Elements -Direct gain – Trombe Walls, Water Walls, Convective Air loops – Concepts – Case Studies – General Principles of Passive Cooling – Ventilation – Predicting ventilation in buildings – window ventilation calculations -Radiation – Evaporation and dehumidification – Mass Effect – Load Control – Air Filtration and odor removal – Heat Recovery in large buildings.

UNIT III

Day lighting and Electrical Lighting **9**

Materials, components and details -Insulation – Optical materials – Radiant Barriers – Glazing materials -Daylighting – Sources and concepts – Building Design Strategies – Case Studies – Electric Lighting –Light Distribution – Electric Lighting control for daylighted buildings – Illumination requirement – Components of Daylight factor – Recommended Daylight factors – Daylighting analysis – Supplementary Artificial Lighting Design.

UNIT IV

Heat Control and Ventilation **9**

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.

UNIT V

Design for Climatic Zones **9**

Energy efficiency – an overview of design concepts and architectural interventions – 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 – Energy Audit – Certification.

Total 45 hours

REFERENCES:

1. Moore, F., Environmental Control System, McGraw Hill Inc. 2002
2. Brown, G.Z. and DeKay, M., Sun, Wind and Light – Architectural Design Strategies, John Wiley and Sons Inc, 2001
3. Chilogioji, M.H., and Oura, E.N., Energy Conservation in Commercial and Residential Buildings -Marcel Dekker Inc., New York and Basel, 1995.
4. Cook, J., Award-winning Passive Solar Designs, McGraw Hill Book Company, 1984
5. Dubin, F.S. and Long, C.G., Energy Conservation Standards – For Building Design, Construction and Operation - McGraw Hill Book Company 1990.
6. Majumdar, M. (Ed), Energy – efficient Buildings in India, Tata Energy Research Institute, Ministry of Non Conventional Energy Sources, 2002.
7. Tyagi, A. K.(Ed), Handbook on energy audits and management Tata Energy Research Institute, 2000.
8. Handbook on Functional Requirements of Buildings Part 1 to 4 SP: 41 (S and T) -1995
9. Energy Conservation Building Code, Bureau of Energy Efficiency, New Delhi, 2007.

L	T	P	C
3	0	0	3

MCM 065 MAINTENANCE AND REHABILITATION OF STRUCTURES

OBJECTIVES:

To study the damages, repair and rehabilitation of structures.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know about maintenance and repair strategies.

CO2: Know about serviceability and durability of concrete.

CO3: Know the materials and techniques for repair.

CO4: Know the stabilization techniques for repair.

CO5: Understand the engineered demolition techniques for structures.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M				S	M		M				
CO2	M				S	M		M				
CO3	M				S	M		M				
CO4	M				S	M		M				
CO5	M				S	M		M				

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry

4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

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, Gunite 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 PERIODS

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.

L	T	P	C
3	0	0	3

MCM 066 CONDITION ASSESSMENT AND EVALUATION ENGINEERING

OBJECTIVES:

To bring about an understanding of use of methods, techniques and equipments for condition assessment and evaluation engineering.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know the Procedure for the condition assessment of concrete structures.
CO2: Understand the working of NDT equipments.
CO3: Know the electro-chemical methods performed.
CO4: Know the chemical analysis for cement content.
CO5: Understand other concepts regarding performance and integrity tests.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M				S	M		M				
CO2	M				S	M	W	M				
CO3	M				S	M		M				
CO4	M				S	M		M				
CO5	M				S	M		M				

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

UNIT – I

Condition Assessment **9**

Introduction – Procedure for the condition assessment of concrete structures – walk over Survey –collation information – Establishment of in-service conditions – field visits – inspection – sampling – structural capacity –load testing – condition assessment of structures and health monitoring.

UNIT –II

Non-Destructive Testing **9**

Strength Tests - Rebound Hammer – Ultrasonic Pulse Velocity Measurement – Pull-out test – Pull-off test – Break-off test –Windsor Probe test –Core cutting.

UNIT –III

Electro-Chemical Methods **9**

Half–Cell Potential measurements - Resistivity – Permeability – Cover survey –tests for rebar corrosion assessment – Abrasion resistance test.

UNIT- IV

Chemical Analysis **9**

Chemical analysis for cement content and type – Depth of carbonation –original water content –Chloride content –Sulphate content.

UNIT –V

Performance and Integrity Tests **9**

Radiography –Radar – Resonant Frequency method-Acoustic Emission –Impact echo method –Dynamic Response.

TOTAL: 45 PERIODS

REFERENCES:

1. Basheer, P. A. M., Proceedings of a Special Technical Session on ―Near-surface Testing for Strength and Durability of Concrete‖, Fifth CANMET/ACI International Conference on Durability of Concrete, Barcelona, Spain, 4-9 June 2000.
2. R.Holland., Appraisal & Repair of Reinforced Concrete, Thomas Telford
3. Michael Stratton, Structure and Style, E& FN Spon.
4. Recommendations for inspection, maintenance and management of Car Park structure-Institution of Civil Engineers – 2202, Typeset by Gray Publishers, Thomas Telford James Douglas, Building Adaptation, Elsevier.
5. Neville, A.M., Properties of Concrete, Pearson Education Asia (P) Ltd, England, 2000.

L	T	P	C
3	0	0	3

MCM 067 PREFABRICATION AND CONSTRUCTION TECHNIQUES

OBJECTIVES:

To bring about an understanding of the prefabrication and construction techniques adopted.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know the standardization and tolerances-system for prefabrication.

CO2: Understand the Pre-casting and handling techniques.

CO3: Know the Curing techniques including accelerated curing.

CO4: Know the Pre-cast and pre-fabricating technology for low cost and mass housing schemes.

CO5: Understand the Repairs and economical aspects on prefabrication.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		M		S							
CO2	M		M		S				W			
CO3	M		M		S							
CO4	M		M		S							
CO5	M		M		S							

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

UNIT-I **9**

Materials - Modular co-ordination, standardization and tolerances-system for prefabrication. Pre-cast concrete manufacturing techniques, Moulds –construction design, maintenance and repair.

UNIT-II **9**

Pre-casting techniques - Planning, analysis and design considerations - Handling techniques - Transportation Storage and erection of structures.

UNIT-III **9**

Joints -Curing techniques including accelerated curing such as steam curing, hot air blowing etc., -Test on precast elements - skeletal and large panel constructions - Industrial structures.

UNIT-IV **9**

Pre-cast and pre-fabricating technology for low cost and mass housing schemes. Small pre-cast products like door frames, shutters, Ferro-cement in housing - Water tank service core unit.

UNIT-V **9**

Quality control - Repairs and economical aspects on prefabrication.

TOTAL: 45 PERIODS

REFERENCES:

1. Levitt. M., Precast concrete - Materials, Manufacture Properties and Usage, Applied Science Publs. 1982,
2. Konex.T., Handbook of Pre-cast Construction, Vol.1.2&3.
3. Richardson,J.G., Pre-cast concrete Production, Cement and Concrete Association, London, 1973.
4. Madhava Rao.A-G., Modern Trends in Housing in Developing Countries, Oxford & UBH Publishing co., 1985. -
5. Lewicki.B., Building with Large Pre-fabrications, Elsevier Publishers.
6. Large Panel Prefabricated Constructions, Proc. of Advance Course conducted by SERC, Madras.
7. Bruggeling.A.S.G., & Huyghe.G.F., Prefabrication with Concrete, A.s.A., Balkema Publishers, Netherland, 1991.

L	T	P	C
3	0	0	3

MCM 068 DESIGN OF INDUSTRIAL STRUCTURES

OBJECTIVES:

To bring about an understanding of the design of Industrial structures and construction techniques for Industrial Structures.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know the Specific requirements for industries.

CO2: Understand the Planning of building work of industrial structures.

CO3: Know the use of modern hoisting and other construction equipments.

CO4: Know the working of lifts, cranes, continuous conveyors.

CO5: Understand the Functional requirements of industrial structures.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M			M	S		M					
CO2	M			M	S		M					
CO3	M			M	S		M			W		
CO4	M			M	S		M					
CO5	M			M	S		M					

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey

3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

UNIT-I **9**

Specific requirements for industries, like textile, sugar, cement, chemical etc., site layout and external facilities.

UNIT-II **9**

Planning of building work-standards-structural materials including plastics, polymers, fibre glass, pressed cardboards, etc., multi-storey buildings; steel skeletal structures, reinforced concrete frames; workshops; ware houses; single storey buildings; sheds in steel and reinforced concrete; north lights; single span spherical and other special constructions; cooling towers and chimneys; bunkers and silos; prefabrication; construction.

UNIT-III **9**

Construction Techniques-Expansion joints-machine foundations; water proofing; roofs and roofing; roof drainage; floors and flooring joists; curtain walling; outer wall facing; sound and shock proof mountings; use of modern hoisting and other construction equipments.

UNIT-IV **9**

Circulation, communication and transport; fixed points (central cores); stair cases; grid floor sections; lifts; cranes; continuous conveyors; mobile cranes; transporters; doors; sliding gates

UNIT-V **9**

Functional requirements- Lighting: natural lighting; protection from the sun-sky lights; window cleaning installations. Services: layout; wiring; fixtures, cable and pipe bridges; electrical installations; lighting substation; effluent. Ventilation and fire protection: ventilation; air conditioning; fire escapes and chutes; fire alarms; extinguishers and hydrants.

TOTAL: 45 PERIODS

REFERENCES

1. Dunham, C.W ,Planning of industrial structures-Mc Graw Hill book Co. 1948.
2. Subramanian N, Design of Steel Structures, Oxford University Press, New Delhi, 2008.
3. Dayaratnam, P, Design of Steel Structures- Chand & Co, New Delhi, 2008.
4. SP32-1986, Handbook on Functional requirements of industrial buildings, BIS,New Delhi

L	T	P	C
3	0	0	3

MCM 069 GIS IN CONSTRUCTION ENGINEERING AND MANAGEMENT

OBJECTIVES:

To introduce the elements of GIS as applied to construction management and achieve awareness on application techniques.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know the characteristics of map and map projections.

CO2: Understand the the various types of data, data analysis methods and data quality requirements.

CO3: Know the concepts of raster and vector data structure and applications of DEM.

CO4: Know the Measurement, Buffering, Overlaying and Components of data quality.

CO5: Understand means of getting suitable data output and to use the data output for construction management using GIS tools.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M			M	S		M					
CO2	M			M	S		M					
CO3	M			M	S		M					
CO4	M			M	S		M					
CO5	M			M	S		M					

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

UNIT I **9**

GIS - Definition - Components of GIS -Maps - Definition - Types of Maps - Characteristics of Maps - Map Projections -- Hardware, Software and Organizational Context - GIS software

UNIT II **9**

Data Types - Spatial and Non-Spatial - Spatial Data - Points, Lines and areas- Non-spatial data - Nominal, Ordinal, Interval and Ratio - Digitizer - Scanner - Editing and Cleaning - Geo reference data

UNIT III **9**

Raster and Vector Data Structure - Raster data storage - Run length, Chain and Block Coding - Vector Data Storage - Topology - Topological Models - Arc Node Structure - Surface Data - DEM - Grid DEM and TIN structure- Applications of DEM

UNIT IV **9**

Reclassification - Measurement - Buffering - Overlaying - SQL for Queries - Neighbourhood and zonal operations - Data Quality - Components of data quality - Sources of errors in GIS - Meta data

UNIT V **9**

Output - Maps, Graphs, Charts, Plots , Reports - Printers - Plotters - Fields of application - Natural Resource Management, construction management-Parcel based, AM/FM applications examples - Case study

TOTAL: 45 PERIODS

REFERENCES

1. Burrough P.A., Principles of GIS for Land Resources Assessment, Oxford Publication, 1998
2. Robert Laurini and Derek Thompson, Fundamentals of Spatial Information Systems, Academic Press, 1996
3. Anji Reddy, Remote Sensing and Geographical Information Systems , BS Publications 2001
4. Srinivas M.G. (Edited by), Remote Sensing Applications, Narosa Publishing House, 2001
5. Rhind, D., Understanding of GIS, The ARC / INFO Method, ESRI Press. 1990

L	T	P	C
3	0	0	3

MCM 070 INFRASTRUCTURE DEVELOPMENT

OBJECTIVES:

To bring about an understanding of the infrastructure development, status of infrastructure in India and the agencies associated with it.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know the Role of infrastructure development in employment generation.

CO2: Know the Agencies associated with infrastructure development in India.

CO3: Know the status of Infrastructure in India.

CO4: Know the issues related to infrastructure development.

CO5: Understand the funding and managing of infrastructure projects.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						M	M		M			
CO2			W			M	M		M			
CO3						M	M		M			
CO4						M	M		M			
CO5						M	M		M			

Course Assessment Methods:

Direct		**Indirect**	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

UNIT I **9**

Construction Industry – Nature, characteristics, size and structure - Role of infrastructure development in employment generation and improving of the National economy. Agencies associated with infrastructure development in India as regards various sectors.

UNIT II **9**

Agencies associated with infrastructure development in India as regards various sectors.

UNIT III **9**

Status of Infrastructure in India- Indian government policy, Roads and buildings, communication, water supply, irrigation, power energy sectors, ports and aviation, health and educational services, rural development.

UNIT IV **9**

Issues related to infrastructure development – pre – requisites necessary to ensure success for switching over from public sector management to private sector management, issues in developing,

UNIT V **9**

Funding and managing infrastructure projects, role, responsibility of project management consultants.

TOTAL: 45 PERIODS

REFERENCES

1. India Infrastructure Report – Rakesh Mohan
2. Infrastructure Today - Magazine
3. Document of five year plans, published by Govt. of India.

MCM 071 BUILDING SERVICES

L	T	P	C
3	0	0	3

OBJECTIVES:

To study the elements of building services like water supply sanitation, electrical installations air conditioning, and fire safety.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Know the components of water supply and sanitation arrangements in a building.

CO2: Understand the the rudiments of electrical installations in a building.

CO3: Know the ventilation and design principles of lifts and staircases for vertical mobility inside buildings.

CO4: Know the safety regulations to be adopted in the building.

CO5: Understand to design and develop intelligent and smart buildings.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		M		S		M					
CO2	M		M		S		M					
CO3	M		M		S		M					
CO4	M		M		S		M					
CO5	M		M		S		M					

Course Assessment Methods:

Direct		Indirect	
1	Internal Tests	1	Course and Survey
2	Assignments	2	Faculty Survey
3	Seminar	3	Industry
4	Online test	4	Alumni
5	Quiz		
6	End Semester Examinations		

UNIT I

Water Supply Systems **9**

Plumbing system for buildings-internal water supply in buildings-relevant municipal bye laws and regulations - Rain Water Harvesting -Sanitation in buildings-arrangement of sewerage systems in housing – pipe systems- storm water drainage from buildings -septic tank – principles of collection, conveyance and disposal of town refuse.

UNIT II

Wiring Systems **9**

Types of wires , wiring systems and their choice –planning electrical wiring for building – main and distribution boards –transformers and switch gears –modern theory of light and

colour –synthesis of light –luminous flux –candela- laws of illumination-lighting design-design for modern lighting.

UNIT III

Ventilation and vertical Mobility **9**

Ventilation and its importance-natural and artificial systems-Window type and packaged air-conditioners-chilled water plant –fan coil systems-water piping –cooling load –air conditioning systems for different types of buildings –design principles of lifts and staircases for vertical mobility inside buildings.

UNIT IV

Safety Regulations **9**

Causes of fire in buildings-safety regulations-NBC-planning considerations in buildings like Non-combustible materials, construction, staircases and electrical wiring and A.C. systems, special features required for physically handicapped and elderly in building types-heat and smoke detectors-dry and wet risers-Automatic sprinklers.

UNIT V

Intelligent Buildings **9**

Intelligent buildings-Building automation-Smart buildings- Building services in high rise buildings-Green buildings-Energy efficient buildings for various zones-Case studies of residence, office buildings and other buildings in each zones.

Total 45 hours

REFERANCES

1. G.M. Fair, J. C. Geyer and D. Okun, "*Water and waste Engineering*", Vol.II, John Wiley &sons, Inc., New York. 2008.
2. R. G. Hopkinson and J. D. Kay, *"The Lighting of buildings"*, Faber and Faber, London, 2009.
3. *"Hand book for Building Engineers in Metric systems"*, NBC, NewDelhi, 2008..
4. *"Philips Lighting in Architecture Designs"*,McGraw Hill, New York,2004.
5. *"Time saver Standards for Architecture Design Data"*, CallendarJH,McGraw Hill, 2004.
6. William H. Severns and Julian R. Fellows, "*Air conditioning and refrigeration"*, John Wily and sons, London,2008.
7. E.C. Butcher and A.C. Parnell, Designing *for Fire Safety*, John Wiley and Sons, 1993.

RESEARCH METHODOLOGY

Objectives

- To Get adequate knowledge about research concepts
- To describe mathematical modeling and simulation

- To understand experimental modeling
- To get knowledge about the interpretation of result

Course Outcomes after successful completion of this course, the students should be able to

CO 1: To describe research concepts.
CO 2: To Get adequate knowledge about mathematical modeling
CO 3: To describe experimental modeling
CO 4: To understand analysis of results.
CO 5: To know about report writing

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak							
COs	Programme Outcomes(POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	S	M				M	M
CO 2	S	M				M	M
CO 3	S	M				M	M
CO 4	S	M				M	M
CO 5	S	M				M	M

ASSESSMENT METHOD:

DIRECT		**INDIRECT**	
1.	Internal Test	**1.**	Student exit survey
2.	Assignment	**2.**	Faculty Survey
3.	Seminar	**3.**	Industry
4.	Online Test	**4.**	Alumni
5.	End Semester Exam		

1. RESEARCH CONCEPTS 9

Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, Applied & Experimental).
Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantification of Cause Effect Relations, Discussions, Field Study, Critical Analysis of Generated Facts, Hypothetical proposals for future development and testing, selection of Research task.

2. MATHEMATICAL MODELING AND SIMULATION 9

Concepts of modeling, Classification of Mathematical Models, Modeling with Ordinary differential Equations, Difference Equations, Partial Differential equations, Graphs, Simulation, Process of formulation of Model based on Simulation.

3 EXPERIMENTAL MODELING 9

Definition of Experimental Design, Examples, and Single factor Experiments, Guidelines for designing experiments. Process Optimization and Designed experiments, Methods for study

of response surface, determining optimum combination of factors, Taguchi approach to parameter design.

4 ANALYSIS OF RESULTS 9

Parametric and Non-parametric, descriptive and Inferential data, types of data, collection of data (normal distribution, calculation of correlation coefficient), processing, analysis, error analysis, different methods, analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity and non-linearity of model.

5 REPORT WRITING 9

Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, references, tables, figures, conclusion, appendices.

TOTAL: 45

TEXT BOOKS

1. Wilkinson K. L, Bhandarkar P. L, „Formulation of Hypothesis", Himalaya Publication.
2. Schank Fr.,"Theories of Engineering Experiments", Tata Mc Graw Hill Publication.

REFERENCE BOOKS

1. Douglas Montgomery, "Design of Experiments", Statistical Consulting Services, 1990.
2. Douglas H. W. Allan, "Statistical Quality Control: An Introduction for Management", Reinhold Pub Corp, 1959.
3. Cochran and Cocks, „Experimental Design", John Willy & Sons.
4. John W. Besr and James V. Kahn, „Research in Education", PHI Publication.
5. Adler and Granovky, "Optimization of Engineering Experiments", Meer Publication.
6. S. S. Rao, „Optimization Theory and Application", Wiley Eastern Ltd., New Delhi, 1996.