Draft of Proposed Course Structure

For Post Graduate Degree Programme

M. Tech. in Civil Engineering

with Specialization in

Construction Technology and Management

Presented to Academic Council

On 15 April 2017

Dr. Babasaheb Ambedkar Technological University

Lonere 402 103, Dist- Raigad, Maharashtra, INDIA

Program Objectives

Goal of the Civil engineering with a specialization in Construction Technology and Management (CTM) at Dr. Babasaheb Ambedkar technological University, Lonere (BATU) is to provide students with preparation to become worthy of professional careers in the field and to be motivated for lifelong learning. All prescribed courses have definite objectives and outcomes. Program objectives are expected qualities of engineers as under:

a) Preparation: To prepare students to excel in various educational programmes or to succeed in industry / technical profession through further education/training;
b) Core Competence: To provide students with a solid foundation in mathematical, scientific fundamentals required to solve E&T related problems;
c) Breadth: To train students with a breadth of scientific knowledge to comprehend, analyze, design & create novel products and solutions for real life problems;
d) Professionalism: To inculcate in students professional/ethical attitude, effective team work skills, multidisciplinary approach and to relate engineering issues to a broader context;
e) Learning Environment: To provide students with academic environment of excellence, leadership, ethical guidelines and life-long learning needed for a long / productive career.

In addition to above DBATU graduate is expected to be

1. Taking pride in their profession and have commitment to highest standards of ethical practices,
2. Able to design structural system that is safe, economical and efficient.
3. Capable of using modern tools efficiently in all aspects of professional practices.
4. Dealing successfully with real life civil engineering problems and achieve practical solutions based on a sound science and engineering knowledge.
5. Shall represent the highest standards of Structural engineering and related technical disciplines.
6. Shall be engage in continuous research, development and exchange of knowledge for professional development.
7. Be honest in their control and performing their duties and promote effective use of resources through open, honest and impartial services to the public.
8. Act in such a manner which will uphold the honour, integrity, or dignity of the engineering profession, and avoid knowingly engaging in business or professional practices of a fraudulent, dishonest or unethical nature.
9. Recognize that the lives, safety, health and welfare of the general public are dependent upon engineering, decision and practices.
10. Continue their professional development throughout their careers and provide opportunities for the professional development.
11. Consistently and successfully apply Fundamental Structural Engineering principles within their chosen engineering application area.

First Semester

Sr. No.	Subject Code	Name of Subject	Hours /Week			Credit	Examination Scheme				
							Theory		CA	PR/ OR	Total
			L	P	T		TH	MTE			
01	CVCTM 101	Management and Project Planning	03	--	1	04	60	20	20	--	**100**
02	CVCTM 102	Cost and Quality Management	03	--	1	04	60	20	20	--	**100**
03	CVCTM 103	Contract Administration and Management	03	--	1	04	60	20	20	--	**100**
04	CVCTM 104	Communication Skills	02	--	--	02	--	--	25	25	**50**
05	CVCTM -L01	PG Lab-I	--	03	--	02	--	--	25	25	**50**
06	CVCTM-E1	Elective-I	03	--	--	03	60	20	20	--	**100**
07	CVCTM-E2	Elective-II	03	--	--	03	60	20	20	--	**100**
		Total for Semester I	**17**	**03**	**03**	**22**	**300**	**100**	**150**	**50**	**600**

Elective-I

CVCTM-E1/01: Advanced Construction Materials and Techniques

CVCTM-E1/02: Advanced Construction Equipment

CVCTM-E1/03: Retrofitting of Structures

Elective-II

CVCTM-E2/01: Construction Disaster Management

CVCTM-E2/02: Applications of Statistical Methods

CVCTM-E2/03: Advanced Sustainable Building Technology

Second Semester

Sr. No.	Subject Code	Name of Subject	Hours /Week			Credit	Examination Scheme				
							Theory		CA	PR/ OR	Total
			L	P	T		TH	MTE			
01	CVCTM 201	Project Economics and Finance	03	--	1	04	60	20	20	--	**100**
02	CVCTM 202	Construction Safety	03	--	1	04	60	20	20	--	**100**
03	CVCTM-S01	Seminar-I	--	04	--	02	--	--	50	50	**100**
04	CVCTM-L02	PG Lab-II or Mini -Project	--	04	--	02	--	--	50	50	**100**
05	CVCTM-E3	Elective-III (Departmental)	03	--	--	03	60	20	20	--	**100**
06	CVCTM-E4	Elective-IV (Departmental)	03	--	--	03	60	20	20	--	**100**
07	CVCTM-E5	Elective-V (Open)	03	--	--	03	60	20	20	--	**100**
		Total for Semester II	**15**	**08**	**02**	**21**	**300**	**100**	**200**	**100**	**700**

Elective-III

CVSE-E3/01: Architecture and Town planning

CVSE-E3/02: Operation Research

CVSE-E3/03: Value Engineering and Valuation

Elective- IV

CVSE-E4/01: Resource Management

CVSE-E4/02: Building Environment and Services

CVSE-E4/03: Risk Analysis and Decision Making

Elective-V (Open)

CVSE-E5/01: Research Methodology

CVSE-E5/02: Infrastructure Development

Third Semester

Sr. No.	Subject Code	Name of the subject	Hours/ Week			Credit	Examination scheme				
							Theory		CA	PR / OR	Total
			L	P	T		TH	Test			
1	CVCTM301	Project Management and Intellectual Property Rights (Self Study)*	--	--	--	02	--	--	50	50	**100**
2	CVCTMPS1	Project Stage -I	--	--	--	10	--	--	50	50	**100**
		Total for Semester III	**--**	**--**	**--**	**12**	**--**	**--**	**100**	**100**	**200**

Fourth Semester

Sr. No.	Subject Code	Name of the subject	Hours/Week			Credit	Examination scheme				
							Theory		CA	PR/ OR	Total
			L	P	T		TH	Test			
1	CVCTMPS2	Project Stage-II	-	-	-	20	-	-	100	100	**200**
		Total for Semester IV	**-**	**-**	**-**	**20**	**-**	**-**	**100**	**100**	**200**
GRAND TOTAL											**1700**

* Student may select this course either from NPTEL/MOOC pool or any other approved reputed source. The submission of course completion certificate is mandatory.

Semester I

CVCTM101 Management and Project Planning

Teaching Schemes: 3 Lect. + 1 Tut hrs/week; Evaluation **Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Contents

Module 1: General Management

Comparison between traditional management and modern scientific management, Contribution of Taylor, Fayol, Maslow, Mayo and Mcgregor, Management functions, Management styles, Objectives of Management, Management techniques & use, organizations, forms of organizations. **(06 Lectures)**

Module 2: Project Management

Project life cycle, concept of s-curve between time and cost of project, planning for achieving time, cost, quality, safety requirements of projects, project feasibility reports based on socio-techno-economic-environmental impact analysis, project clearance procedures and necessary documentation for major works like dam, highway, railway, airport, multi-storied structures, ports, tunnel, Qualities, role, and responsibilities of projects Manager, Role of Project Management Consultants on major projects. **(08 Lectures)**

Module 3: Construction Scheduling & Controlling

Construction Scheduling, LOB technique, Mass haul diagrams. Precedence Network Analysis, Activity cost and time estimation in Bar Chart, CPM, PERT, RPM, Work break down structure, Applications for major construction projects, Monitoring and Control of construction project, Resource Leveling and Smoothening. **(08 Lectures)**

Module 4: Cost Analysis

Direct and Indirect cost, Cost analysis, cost curve, optimization and crashing of network for civil engineering projects, updating of network. Torsion **(06 Lectures)**

Module 5: Construction Management

Job layout, Site mobilization – Demobilization, Mass housing, small scale industries, Co-ordinating, communicating & reporting techniques, Organizing and monitoring of the construction work with respect to cost-time schedules, Staffing its Nature and purpose, selection, appraisal, organizational development. **(08 Lectures)**

Module 6: Advanced Software

Application of managing information software (MIS), Primavera, Web based project management to construction management, MSP managed service Providers. **(06 Lectures)**

Guidelines for Assignments: Minimum Six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of minimum Three Modules.

References:

- T. R. Banga and S. C. Sharma, Industrial Engineering and Management including Production Management, Khanna Publishers.

- Khanna O P, Industrial Engineering and Management, Dhanpat Rai Publication.
- P.S. Gahlot & B. M. Dhir, Construction Planning & management, New Age int. (p) Ltd.
- K Nagrajan, Project Management, New Age International Ltd.
- Barrie – Paulson, Professional Construction Management, McGraw Hill Institute Edition.
- Ahuja H. N, John Wiely, Project Management, New York.
- Sengupta and Guha, Construction Management and Planning, Tata McGraw Hill publication.

Outcomes:

Upon completion of the course the students will be able to:

- Highlight the contributions of Henry Fayol, Fredrick Taylor, Abraham Maslow, Elton Mayo and Douglas McGregor
- Classify organizations into various forms, explain the concept of project Life cycle, jolt down the responsibilities of project managers & PMCs, define the scope of the Project and various documentations required on major projects
- Optimize a network manually as well as with using software.
- Highlight the various domains of construction management as regards to mobilization, demobilization, co-coordinating, communicating, reporting and training aspects
- Study the methods of a construction system and hence measure works.

CVCTM102 Cost and Quality Management

Teaching Schemes: 3 Lect. + 1 Tut hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Contents

Module 1: Construction Costing

Costing of construction Works, different methods of costing, types of costs, demand and supply, cost elements in a project, Analysis of rates, Non-scheduled items of work, Cost estimation for a small construction job, Purpose, methods and stages of cost control, cost monitoring, cost forecasting methods. **(06 Lectures)**

Module 2: Cash Flow

Determining the funds required for a construction job, preparing cash flow statements, Cash inflow and outflow during contract period, Project expectations and performance models. **(06 Lectures)**

Module 3: Cash and Payment of Works

Precautions in custody of cash, Maintenance of temporary advance and advance account, different types of payment, first running advance and final payments. **(06 Lectures)**

Module 4: Preparation of Bill and Report

Preparation of bills for payment, measurement book, mode of payment, running account bill, Ledger and Cash book details, Arbitration, Completion report of the project; Checking of Plan, Details of various works and issue of completion report of the project. **(06 Lectures)**

Module 5: Quality and Quality Assurance

Necessity for improving Quality in the context of Global Challenges, Factors influencing construction quality, Concept of Quality Control, Quality Management and Total Quality Management (TQM), Designing of quality manuals, checklists and inspection reports, installing the quality assurance system, monitoring and control. Quality Assurance Department and quality control

responsibilities of the line organization, Quality in foundations and piling work, structural work, Concreting, electrical system building facilities, waste recycling and maintenance. **(10 Lectures)**

Module 6: Quality Systems

Introduction, Quality system standard, ISO 9000, ISO 14000 and QS 9000 family of standards & requirements, Preparing Quality System Documents, Quality related training, Implementing a Quality system, Bench-marking quality, Design of Quality manuals, checklist and inspection reports, Nonlinear Analysis**.** **(07 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover syllabus of any three Modules.

References:

- Chitkara, K.K. Construction Project Management, Tata-McGraw Hil
- P. S. Gahlot & B. M. Dhir, Construction Planning & management, New Age int. (p) Ltd.
- Mueller, F.W. Integrated cost and schedule control for construction projects.
- Gopalakrishanan, P, Sundaresan, Material Management- an Integrated Approach, Prentice Hall.
- Datta, material Management procedures, Text and Cases, 2e. Prentice Hall
- Dobbler and Bart, Purchasing and supplies Management, Text and Cases, 6e.
- ISO 9000, ISO 14000 and QS 9000 standards and certifications.
- Schedule of rates, specification manuals etc from PWD.

Outcomes:

Upon completion of the course the students will be able to:

- Study the methods of a construction system and hence measure works.
- Apply control concepts for improving the quality of construction.
- Maintain the records of quality assurance processes and audits.
- Know various quality improvements techniques.
- Implement safety policies, methods, training provided on any ISO approved construction policies.

CVCTM103 Contract Administration and Management

Teaching Schemes: 3 Lect. + 1 Tut hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Contents

Module 1: Contracts Administration

Professional ethics, standard forms of building contracts, conditions of contracts, Contract formation, contracts with various stakeholders on a major Construction projects, rights of owners, adjoining owners and third parties, project management consultants, contractor, contract performance, contract correspondence and contract closure, Global tenders and B.O.T. System. **(07 Lectures)**

Module 2: Contract System and Acts

Various types, Importance & clauses of contract, The Indian Contract Act (1872): Objectives of the act, Definition of the contract, Valid, Voidable, and Void contracts, Sale of Goods Act. **(06 Lectures)**

Module 3: Construction Claims, Injunctions and Bailment

Extra items and causes of claims, Types of construction claims, documentation, settlement of claims, and extension of time, Injunctions, Types:- temporary, perpetual, mandatory, Indemnity & Guarantee- difference between the two, Contracts of Guarantee & Indemnity, Consideration for Guarantee, Surety's liability, discharge of surety, Bailment- Nature of transaction, delivery of bailee. **(08 Lectures)**

Module 4: Arbitration Awards & Dispute Resolving boards

Indian Arbitration Act, arbitration agreement, conduct of arbitration, power and duties of arbitrator, rules of evidence/ preparation and publication of awards, methods of enforcement, impeding and award, Limitations of arbitration in the Indian context (DRB"s) Dispute resolving boards-necessity, formation, functioning advantages, Causes of disputes and importance of role of various stakeholders in prevention of disputes, Alternate Dispute Resolution methods- mediation, conciliation. **(08 Lectures)**

Module 5: Industrial Act and Labour Laws

Industrial Dispute Acts, payment of wages act, Minimum Wages Act, Indian Trade Union Act, and Workmen's Compensation Act. Labour welfare fund act 1953. **(06 Lectures)**

Module 6: Administration of Incentive Schemes

Necessity, Merit rating, job evaluation, installation, modification and maintaining and incentive scheme based on implementation experience. **(06 Lectures)**

Guidelines for Assignments: Minimum Six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- B. N Dutta, Estimating and Costing in Civil Engineering: Theory and Practice Published S. Dutta & Company, Lucknow.
- B. S. Patil, Civil Engineering Contracts and Estimates -Universities Press (India) Private Limited, 2006.
- Joseph T. Bockrath, Contracts and the Legal Environment for Engineers and Architects, McGraw Hill, 2000.
- Kwaku, A., Tenah, P.E. Jose M. Guevara, P.E., Fundamentals of Construction Management and Organisation, Printice Hall, 1985.M.M.Tripathi Private Ltd., Bombay, 1982.
- Gajaria G.T., Laws Relating to Building and Engineering Contracts in India,
- Jimmie Hinze, Construction Contracts, McGraw Hill, 2001.
- Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India.
- Dennis Lock, Project Management, Gower Publishing England.
- Gopalan, Project Management, Wiley India.
- The Indian Contract Act (9 of 1872), 1872- Bare Act- 2006 edition, Professional Book Publishers.
- The Arbitration and Conciliation Act, (1996), 1996 (26 of 1996)- 2006 Edition, Professional Book Publisher.

Outcomes:

Upon completion of the course the students will be able to:

- Understand the basic procedure of bidding for construction projects.
- Demonstrate the all the types of contract along with their suitability in construction practices.
- Know various industrial acts & their relevance to construction Industry.
- Understand different methods for resolving the disputes arisen.
- Demonstrate the important terms associated with Indian Contract Act.

CVCTM104 Communication Skill

Teaching Schemes: 2 Lect. hrs/week; **Evaluation Scheme:** Class Assessment 25; Oral examination 25

Course Contents

Module 1: Language for Technical Purpose and Presentation Tools

Technical vocabulary, Sentence structures, Microsoft office, Graphical presentations **(03 Lectures)**

Module 2: Formal Written Communication

Drafting Letters, e-Mails, Memos, Notices, Circulars, Schedules **(03 Lectures)**

Module 3: Project Research Proposals and Reports

Research Proposal: Essentials, Abstract, Aims, Background & significance, Design & methods, writing a sample proposal

Project Report: Types of reports, planning a report, Collection & organization of information, Structure & style, Proofreading etc., writing a sample report. **(06 Lectures)**

Module 4: Leadership Skill and Team Building, Working.

Leadership Skills**:** Leadership quality and styles, Emotional intelligence, Diplomacy and Tact and effective communication, Case studies.

Need of team, Effective teams, Group development, Roles in group, Case studies. **(06 Lectures)**

Module 5: Business Meetings

Understanding role of meetings, planning meetings, developing meeting agendas, scheduling meetings, conducting meetings effectively, Taking notes and publishing minutes and concluding meetings, action plans, Demo meetings. **(06 Lectures)**

Module 6: Presentation Skills

Preparation, Understanding audience, Use of presentation tools, Presentation, nonverbal techniques, handling questions, Demo presentations

(04 Lectures)

References:

- S. Hariharan, et.al. Soft Skills; MJP Publishers, 2010.
- John Seely, Oxford Guide to Effective Writing and Speaking; Oxford University Press, 2009.
- Thomas N. Huckin and Leslie A. Olsen, Technical Writing and Professional Communication for Nonnative Speakers of English; Tata McGraw Hills, International Edition, 1991.
- Jeff Butterfield,Soft Skills for Everyone,cengage Learning India Private Limited,2010.
- L. Ann Masters & Harold R. Wallace, Personal Development for Life & Work,10e,Cengage
- Learning India Private Limited, 2011.

Outcomes:

PG Lab-I

CVCTM-L01

Laboratory Work:
The students are expected to perform **any three** experiments out of list given below and submit report of same;

1. Minimum Two site visits to study construction techniques and use of major construction equipment associated with ongoing major construction works, Visit Report to be submitted.
2. Minimum one site visit to Ready Mix Concrete Plant use for major construction, Visit report to be submitted.
3. To prepare study report on Earthquake Resistant Building Construction.
4. Collection of techno-commercial information as regards new construction materials, new construction methods.

Elective I

CVCTM-E1/01 Advanced Construction Materials and Techniques

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Contents

Module 1: Metals & Alloy

Types of structural steels, special steel, alloy steel, stainless steel, light gauge steel, Corrosion of concrete in various environments, Corrosion of reinforcing steel, methods/treatments to overcome the corrosion, Electro-chemical process, Ferro-cement, material and properties, fibers and composites, Architectural use and Aesthetics of composites, Adhesives and sealants, Structural elastomeric bearings and resilient seating. Moisture barriers, Glass facade, materials and techniques, Use of titanium dioxide, transparent Aluminum. **(08 Lectures)**

Module 2: Use of Waste Materials

Material composition and properties, production, storage, distribution, testing, acceptance criteria, applications, limitations of use, economic consideration, and recent development related to the following materials to be studied: Fly Ash, coal ash, Blast furnace slag, Red mud, Waste glass, Rice husk. **(07 Lectures)**

Module 3: Special Concrete

Light weight concrete, high strength concrete, Fly ash concrete, Fibre reinforced concrete, Sulphur impregnated concrete, Polymer Concrete, High performance fiber reinforced concrete, Self-Compacting-Concrete, Geo Polymer Concrete, Ready mixed concrete, Silica fume concrete. **(07 Lectures)**

Module 4: Special concrete operations

Shortcrete, grouting, grunting, under water concreting, hot and cold weather concrete, pumpabale concrete, special concreting methods. **(07 Lectures)**

Module 5: High Rise Structure & Prefabricated structure

Construction systems for High Rise structures, Special techniques required for construction and maintenance, Prefabricated Construction techniques & System planning for pre-casting, selection of equipment for fabrication, transport and erection, quality measures, safety measure during erection. **(07 Lectures)**

Module 6: Formwork Design

Design and requirement of different types of formwork, Types of formwork: Timber, steel, aluminum, scaffoldings, jump form, modular shuttering, Doka shuttering. Mivan technology and its applications and safety measures for tall structures, slip form, vertical slip forming, lifting techniques, horizontal slip forming, and safety measures for tall structures. **(06 Lectures)**

Guidelines for Assignments: Minimum Six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References

- Rangawala S.C, Engineering Materials, Charotar Publications
- S. K. Duggal, Building Materials, , New Age International Publications
- Bruntley L. R, Building Materials Technology Structural Performance & Environmental Impact, , McGraw Hill Inc Construction Technology, Vol I - IV, R Chudley, Longman Group Construction Ltd
- Verghese, Building Material, PHI EEE New Delhi -2012
- Ashby, M. F. and Jones, Engineering Materials: An introduction to Properties, applications and designs.
- Jerry Irvine, Advanced Construction Techniques, CA Rocketr, 1984

Outcomes:

Upon completion of the course the students will be able to:

- Understand the mechanism behind the behavior/performance of a particular material individually as well as in combination. This will help them to make the apt choice of materials.
- Knowledge of the recent advances in materials used for structural and non-structural elements of a building will help students to keep pace with the industry and make them more industry-ready product.

Elective I

CVCTM-E1/02 Advanced Construction Equipment

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Contents

Module 1: Introduction

Identification, Planning, Equipment management in projects, various costs associated with equipments, Maintenance management, Replacement, Cost control of equipment, Depreciation Analysis, Fundamentals of earthwork operations-Earth moving operations, Types of Earthwork Equipment, Tractors, Motor Graders, Scrapers, Front end waders, Earth Movers Equipment for Dredging, Trenching, Tunneling, Drilling, Blasting, Equipment for compaction-Erection. **(08 Lectures)**

Module 2: Pumps

Types of pumps used in construction, Equipment for Dewatering and Grouting, Foundation and Pile Driving Equipment, Forklifts and Related Equipment, Portable Material Bins, Conveyors. **(06 Lectures)**

Module 3: Excavating Equipments

Power shovels; size, basic parts, selection, factors affecting output, Draglines: - types, size, basic parts, and effect of job and management conditions on the output of dragline. **(06 Lectures)**

Module 4: Hauling Equipments

Clamshells – clamshell buckets, Hoes- basic parts working ranges, Bulldozers-types, moving earth with bull dozers. **(06 Lectures)**

Module 5: Compacting Equipments

Types of compacting equipments, Such as tamping rollers, smooth wheel rollers, pneumatic tyred rollers, and Hoisting equipments: Chain, hoist, fork trucks. **(06 Lectures)**

Module 6: Cranes and Crushers

Classification, derrick crane, mobile crane, Tower crane, Hydraulic crane, overhead or gantry crane, Safety in crane operation, Use of cranes in steel construction, Use of cranes in concrete construction. Crushers - Types, primary, secondary, tertiary crushers, jaw, gyratory, stone crushers, hammer mills, roll crushers, rod and ball mills screening aggregate, revolving, vibrating screens.

(08 Lectures)

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- Patrick Powers. J., Construction Dewatering: New Methods and Applications, John Wiley & Sons, 1992.
- Peter. H. Emmons, "Concrete repair and maintenance illustrated", Golgotha Publications Pvt. Ltd., 2001.Press, 2008.
- Robertwade Brown, Practical foundation engineering hand book, McGraw Hill Publications, 1995.
- Sankar, S. K. and Saraswati, S., Construction Technology, Oxford University Press, New Delhi, 2008.

Outcomes:

Upon completion of the course the students will be able to:

Elective I

CVCTM-E1/03 Retrofitting of Structures

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Contents

Module 1: Serviceability and Durability

Quality Assurance for Concrete Construction, Permeability, Thermal Properties and Cracking, Distress Monitoring, Causes for Distress, Effects of Climate, Temperature, Chemicals, Wear and Erosion, Design and Construction Errors, Corrosion Mechanism, Effects of Cover Thickness and Cracking,

Non Destructive Testing: Ultrasonic and Sonic Test, Rebound Hammer Test, Strength Evaluation of Existing Structures.

(06 Lectures)

Module 2: Cracks in Structures

Causes, Thermal and Shrinkage cracks, Cracks due to Vegetation and Trees, Foundation Movements, Types and their Fatality, Diagnosis Techniques for Repair.

Moisture Penetration

Sources of Dampness, Moisture Movement from Ground, Reasons for Ineffective Damping, Leakage in Concrete Slabs, Pitched Roofs, Dampness in Solid Walls, Condensation, Remedial treatments, Chemical Coatings. **(06 Lectures)**

Module 3: Steel Structures and Masonry

Types and Causes of Deterioration, Preventive Measures, Repair Procedure, Brittle Failure, Defects in Connections, Welded Joints: Test for Defects; Mechanism of Corrosion , Methods of Corrosion Protection, Corrosion Inhibitors, Corrosion Resistant Steels, Coatings, Cathodic Protection. Design and Fabrication Errors, Distress during Erection.

Masonry Structures

Discoloration and Weakening of Stones, Preservation, Chemical Preservatives, Brick Masonry Structures, Distress and Remedial Measures. **(06 Lectures)**

Module 4: Materials for Repairs

Essential Parameters for Repair Material, Premixed Cement Concrete and Mortar, Sulphur Infiltrated Concrete, Fiber Reinforced Concrete, Special Elements for Accelerated Strength Gain, Expansive Cement, Polyester Resin.

Polymer Concrete: Physical and Mechanical Properties, General Guidelines and Precautions for Use, Field Application

Polymer Modified Concrete: Physical and Mechanical Properties, General Guidelines and Precautions for Use, Field Application, Epoxy Concrete and Mortar: Epoxies, Physical and Mechanical Properties, General Guidelines and Precautions for Use, Field Application.

Surface Coatings: Essential Parameters, Types, Characteristics. **(06 Lectures)**

Module 5: Maintenance and repair strategies

Definitions: Maintenance, Repair and Rehabilitation, Facets of Maintenance, Importance of Maintenance, Preventive Measures on Various Aspects Inspection, Assessment Procedure for Evaluating a Damaged Structure, Causes of Deterioration, Testing Techniques.

Techniques for Repairs

Repairs using Mortars and Dry Packs**,** Concrete Replacement, Surface Impregnation, Rust Eliminators and Polymers Coating for Rebar during Repair Foamed Concrete, Vacuum Concrete, Gunite and Shotcrete, Injection: Epoxy, Resin, Polymer Modified Cement Slurry; Shoring and Underpinning. Propping and Supporting: False Work, Requirement of Good False Work, Design Brief for False Work, Execution Procedure. **(06 Lectures)**

Module 6: Strengthening of Existing Structures

General Principle, Relieving Loads, Stress Reduction, Strengthening of Super Structures (Beam, Column, Slab including Joints) for Tension, Compression, Flexural, and Shear respectively, Jacketing (RCC, Plate, Fiber ,Wrap), Bonded Overlays, Reinforcement Addition, Strengthening the Substructures, Increasing the Load Capacity of Footing, Strengthening of Masonry Structure. **(06 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- Johnson. S.M., "Deterioration, maintenance and repair of structures", McGraw-Hill book company, New York, 1965.
- R. T. Allen and S. C. Edwards, "Repair of concrete structures", Blakie and Sons, UK, 1987.
- Denison Campbell, Allen and Harold Roper, "Concrete structures", Materials, Maintenance and Repair, Longman Scientific and technical UK, 1991.
- SP25-84, "Hand book on causes and prevention of cracks on buildings", Indian standards.
- M. S. Shetty, "Concrete Technology- Theory and Practice", S. Chand and Company, New Delhi, 1992.
- Gambhir, "Concrete Technology".

- Santhakumar, A.R., " Training Course notes on Damage Assessment and repair in Low Cost Housing "," RHDC–NBO " Anna University, July, 1992.
- Raikar, R.N., "Learning from failures – Deficiencies in Design ", Construction and Service – R & D Centre (SDCPL), Raikar Bhavan, Bombay, 1987.

Outcomes:

Upon completion of the course the students will be able to:

- Understand factors of Serviceability and Durability of Structures.
- Determine crack width, effect of crack on materials, effect of moisture on structures.
- Understand methods for protection of steel structures and masonry structures.
- Understand various materials and methodologies used for repairing of structures.
- Understand and implement techniques used for repairing and maintenance of structure.
- Understand procedure to strengthen the existing structures and structural elements.

Elective II

CVCTM-E2/01 Construction Disaster Management

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Contents

Module 1: Disasters

Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change. Natural Disasters - Natures and extent of disasters, natural calamities such as earthquake, floods, drought, coasts hazards, cloud burst, Avalanches, Cyclone, landslides etc. **(06 Lectures)**

Module 2: Manmade Disasters

Chemical and industrial hazards, nuclear hazards, fire hazards, etc., Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters. **(06 Lectures)**

Module 3: Aspect and Management

Objective of disaster management policy, Paradigm shift in disaster management, Policy and administration: Importance and principles of disaster management policies, command and coordination in disaster management. Financing relief expenditure, legal aspects, rescue operations, casualty management, and risk management, study of flowchart showing the entire process, Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams, International relief aid agencies and their role in extreme events. **(08 Lectures)**

Module 4: Emergency Management Programme

Administrative setup and organization, Hazard analysis, training of personnel, information management, emergency facilities and equipment necessary **(06 Lectures)**

Module 5: Public Awareness & Management

Importance of public awareness, Preparation and execution of emergency management programme, Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India, Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations, Use of Internet and softwares for effective disaster management, Applications of GIS, Remote sensing and GPS in this regard. **(08 Lectures)**

Module 6: Disaster Management

Pre-disaster, during disaster and post-disaster measures in some events in general Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication, Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans, Do's and don'ts in case of disasters and effective implementation of relief aids, Disaster Management for high rise building structures, bridges, chimney, dams, earthquake. **(08 Lectures)**

Guidelines for Assignments:

- Minimum Six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- S. Vaidyanathan, Ikon Books, An Introduction to Disaster Management , Natural Disasters and Man Made Hazards.
- Seetharaman, Construction Engineering and Management, Umesh Publ.
- K Nagarajan, Project Management, New Age International Ltd.
- Jack Pinkowski, Disaster Management Handbook, CRC Press (Taylor and Francis group).

Outcomes:

Upon completion of the course the students will be able to:

- Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
- Plan of national importance structures based upon the previous history.
- Get acquainted with government policies, acts and various organizational structures associated with an emergency.
- Get to know the simple do's and don'ts in such extreme events and act accordingly.

Elective II

CVCTM-E2/02 Applications of Statistical Methods

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Contents

Module 1: Probability and Distributions

Probability theory and its importance, Definition of probability, Rules of Probability, The Baye's theorem, Random variable, Probability distribution, Mean or Expectation of Random variable, Properties of Mean of Expectation. Distributions: Theoretical probability Distributions: Binomial Distribution, Poisson distribution. Normal Distribution, Exponential Distribution, Beta, Gamma. **(07 Lectures)**

Module 2: Sampling

Sampling and sampling distribution: Probability samples, Non-probability samples, sample Random sampling, Other sampling schemes, sampling distribution and standard error, some Sampling and Quality control, Use of concepts of standard deviation, coefficient of variance, range in quality control of concreting and similar such activities. **(06 Lectures)**

Module 3: Testing Hypothesis

Sampling of distribution, Test based on Normal Distribution, students- t test, chi square, K-S test for goodness of fit and distribution, Analysis of variance- one way & two way classification. **(06 Lectures)**

Module 4: Correlation and Regression Analysis

Correlation types, co-efficients, Bi-variate Frequency Distribution, Scatter Diagram, Correlation Analysis, Regression and Multivariate Analysis, Multiple Regression Analysis, Non linear Regression, Use of regression analysis in resources management. **(07 Lectures)**

Module 5: Simulation

Simulation, Types, case studies in construction using simulation techniques, simulation software's used, Griffi's waiting line Method. **(06 Lectures)**

Module 6: Applications

Use of mathematical models based on probabilistic and statistical methods, simulation in risk identification, analysis and mitigation of project risk, EOQ in civil engineering, Sensitivity analysis, ABC analysis. **(06 Lectures)**

Guidelines for Assignments: Minimum Six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- Montgomery and Runger, Applied Statistics and Probability for Engineers, Wiley, India.
- Miller, Freund-Hall, Probability and Statistics for Engineers, Prentice India Ltd. 2009
- Sampling techniques-Cochran, Wiley Series, 2008.
- David S. Moore, Statistics-Concepts and Controversies, Freeman Company, New York.
- Shrivastava, Shenoy & Sharma, Quantitative Techniques for Managerial Decisions, Wiley, 1989.
- Applied Statistics for Civil and Environmental Engineers by Kottegoda.- Stratford Books**.**

Outcomes:

Upon completion of the course the students will be able to:

- Critically review the quantitative data and draw results from it using probability and statistics
- Model a construction system, so the maximum output from a particular input may be obtained
- Correlate and hence develop linear regression equation between various civil engineering parameters
- Apply Griffi's waiting line models and other such models to decide the optimum number of servicing units required for a prime mover (sizing-matching operation)
- Predict the performance of a particular system, based on past performance using simulation and other tool
- Decide the optimum ordering quantity and ordering period of construction materials/ equipments using mathematical models.

Elective II

CVCTM-E2/03 Advanced Sustainable Building Technology

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Contents

Module 1: Concept of Green Building

Sustainable Development concept, Buildings and climate, important considerations for the design of sustainable buildings, Green Building Assessment, Current version of the LEED rating system. **(06 Lectures)**

Module 2: Energy and Buildings

The design of a sustainable building, Lighting - day lighting; Ventilation - natural ventilation; Indoor air quality; Passive and Active systems for energy production and conservation, Elements of successful design of a building envelope. **(07 Lectures)**

Module 3: Sustainable Building Materials

Environmental issues related to building materials, Local, Building materials from agricultural waste and Industrial waste. **(06 Lectures)**

Module 4: Cost Effective Techniques for Sustainable Building

Stabilized Mud blocks, Stone masonry blocks, solid and hollow concrete blocks, Selection of building blocks, Ferro- Concrete, Properties and Uses, Practical aspects. **(06 Lectures)**

Module 5: Alternative sustainable Roofing Systems

Concepts in Roofing alternatives, Filler slab roofs, Composite Slab panel roofs, hollow block roofs, Masonry Domes. **(06 Lectures)**

Module 6: Environmental Techniques

Waste water Management, Rain water harvesting and conservation, recycling, waste water treatment processes, external drainage system in building. **(05 Lectures)**

Guidelines for Assignments: Minimum Six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- K. S. Jagadish, B. V. V. Reddy, “Alternative Building Materials and Technologies”, New Age International Publishers
- Gevorkian ,”Green Buildings” Mac Graw hill.
- P. N. Balaguru and S.P. Shah, “Fibre reinforced Cement Composites”, McGraw Hill.
- The engineering guide to LEED- new construction-sustainable construction for engineer’s haselbach.
- D. J. Hannant, John Wiley and Sons, Fibre cements and Fibre Concretes.
- A. M. Neville, Properties of Concrete, ELBS, Longman.
- Miller G. T Jr Living in the environment, Cengage Publisher.
- Cunningham W, Principles of Environmental Science, TMH
- Harris CE, Prichard MS, Rabins MJ, Engineering Ethics, Cengage Pub.

Outcomes:

Upon completion of the course the students will be able to:

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

Semester II

CVCTM201 Project Economics and Finance

Teaching Schemes: 3 Lect. + 1 Tut hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Contents

Module 1: Principles of Economics

Importance of the economic background to measurement, objectives of business firm, Factors bearing on size of firms, Motives to growth, Obstacles to growth of firms, Study of present economy. **(06 Lectures)**

Module 2: Capital

Analysis of need working capital, Estimation of requirements of working capital, Credit Management, Cash Management, Managing payments to suppliers and out standings. **(06 Lectures)**

Module 3: Economic Analysis

Cost implication to different forms of construction and maintenance and maintenance and replacement lives of material, Installation and running cost of services, Capital investment in project, Cost analysis by traders and by functional element, Cost planning techniques, Cost control during design and Construction, Depreciation, Various Appraisal Criteria Methods. Break-even analysis, Cash flow analysis, Risk Analysis and Management Practice, Role of Lender's Engineer.

(07 Lectures)

Module 4: Financial Planning and Budgeting

Long term finance planning, Stock, Borrowings, Debentures, Loan Capital, Public Deposit, Dividend Policies, Bonus Shares, Market value of shares, Reserves, Over and under capitalization.

Budget: Budgetary control system. Types of budgets, Procedure for master budgets, Budget manual, Cash now forecast. **(Lectures 07)**

Module 5: Corporate Finance

Corporate tax planning, Public policies on ICRA grading of exchange, World financial market, Role of financing institutes in Construction, CIDC- grading of construction entities, Venture Capital Financing- Indian Venture Capital scenario, SEBI regulation, Problems of expansion and merger of companies. **(06 Lectures)**

Module 6: Construction Accounts

Accounting process, preparation of profit and loss account and balance sheet as per the companies Act, 1956, preparation of contract accounts for each project, methods of recording and reporting site accounts between project office and head office, Ratio Analysis, Escrow Account for PPP Project. **(06 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting of theoretical as well as numerical aspects of the course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- Prasanna Chandra, Projects planning, Analysis Selection, Implementation and Review , Tata McGraw Hill, New Delhi
- Oliver, Lianabel, The cost management toolbox, A Managers guide to controlling costs and boosting profits, Tata McGraw Hill
- Singh H., Construction Management and Accounts, Tata McGraw Hill, New Delhi.
- Cormican D., Construction Management, Planning and finance, Constru. Press, London.
- Brealey R. A., "Principles of Corporate Finance, Tata McGraw Hill, New Delhi.
- Leland T. Blank., Anthony Tarquin, Engineering Economy, McGraw Hill.
- David Bedworth, Sabah Randhawa, Engineering Economics ,McGraw Hill
- Bruggeman., Fishr, Real Estate, Finance and investment, McGraw Hill.
- Block Hirt, Foundations of Financial Management, McGraw Hill.
- Burner, Case studies in finance, McGraw Hill
- DeMello, Cases in Finance, McGraw Hill.

Outcomes:

Upon completion of the course the students will be able to:.

- Highlight the basic principles of economics
- Estimate the working capital required on a construction project
- Manage cash and credit of suppliers
- Demonstrate the impact of exchange rate fluctuations on international projects
- Perform capital budgeting and project portfolio analysis
- Prepare various types of budgets required in civil works
- Illustrate the concepts of Corporate tax planning, World financial market, Role of financing institutes
- Construction and CIDC-ICRA grading of construction entities
- Preparation accounts and balance sheet as per the companies Act, 1956
- Financial perform ratio analysis
- Summarize the case studies in Indian construction industry for financial successes and failures.

CVCTM202 Construction Safety

Teaching Schemes: 3 Lect. + 1 Tut hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Contents

Module 1: Construction Accidents

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

Accident Prevention: Principles of accident prevention; job safety analysis; fault tree analysis; accident management.

(06 Lectures)

Module 2: Construction Safety Management

Introduction to Construction Safety and Safety Technology Government's policy in industrial safety, safety & health legislation in India, Construction Sites (Safety) Regulations, Codes of practice, Role of various parties, duties and responsibilities of top

management, site managers, supervisors etc. role of safety officers, responsibilities of general employees, safety committee, safety training, incentives and monitoring, Writing safety manuals, preparing safety checklists and inspection reports. **(08 Lectures)**

Module 3: Safety in Typical Civil Structures

Safety of accidents on various construction sites such as buildings, dams, tunnels, bridges, roads, water Tanks, Retaining walls, etc. safety at various stages of construction, Critical factors for failure, Prevention of accidents, Regular Inspection and monitoring, Safety measures. **(06 Lectures)**

Module 4: Safety in Use of Construction Equipment

Vehicles, cranes, hoist and lifts etc., Safety of scaffolding and working platforms, Safety in Erection and closing operation, Safety while using electrical appliances, Explosives. **(06 Lectures)**

Module 5: Designing for Safety

Workplace ergonomics, first aid and emergency preparedness, 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. **(06 Lectures)**

Module 6: Safety Training Programmes and Safety Policies

Construction Safety Management and Accident Prevention Safety training, safety policy, Safety Meetings, safety committees, safety inspection, safety audit, reporting accidents and dangerous occurrences, Safety Incentives. Problem areas in Construction Safety, Elements of an Effective Safety Programme , Job-Site Safety Assessment, , Methods, equipment, and training provided on any ISO approved Construction Company, safety in office. **(07 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting of theoretical as well as numerical aspects of the course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- Safety Management in Construction Industry – A manual for project managers. NICMAR Mumbai.
- Davies V. S. Thomasin ,K, Thomas, Construction Safety Handbook – (Telford, London.)
- ISI for safety in Construction – Bureau of Indian Standards.
- Giri maldi and Simonds, Safety management – (AITBS, New Delhi)
- Construction Safety Manual - Published by National Safety Commission of India.

Outcomes:

Upon completion of the course the students will be able to:

- Summarize safety policies, methods, equipments, training provided on any ISO approved construction company.
- Study and understand the various safety concepts, requirements applied to construction Project

Elective III

CVCTM-E3/01 Architecture and Town planning

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Contents

Module 1: Architecture Design

Introduction history & concept of Architecture, Principles of architecture, an analysis, integration for function and aesthetics, Role of "urban planner and architect" in planning and designing, Architectural composition and elements of design. **(06 Lectures)**

Module 2: Town Planning

Objectives, scheme, planning for transportation and utility services, stages in town development, Urban renewal & planning for rural development, Surveys-site Analysis, Development control, zoning regulations, Layout regulations, Urban planning standards, , green belt. **(07 Lectures)**

Module 3: Landscaping

Objectives, scope, Environmental art and design for urban landscape, objectives, principles, elements, material, soft landscaping, hard landscaping, and garden styles: modern and historical, water body conservation and creation, Layout design concepts, Plant characteristics & planting design, Environmental considerations in landscape planning. **(06 Lectures)**

Module 4: Concept of Master Plan

Structure plan, detailed town planning scheme and action plan, Estimating future needs, planning standards for different land use allocation for commerce, industries, public amenities, open areas etc, Planning concepts-application of anthropometry and space standards, Interrelationships of functions, planning standards for density distributions, density zones, Safety standards, planning standards for traffic network, standard of roads, Building Rules & Regulations, Integration of building services, Plan implementation. **(07 Lectures)**

Module 5: Town planning legislations and municipal acts

Planning of control development schemes, urban financing, land acquisition, slum clearance schemes, and pollution control aspects and planning agencies for various levels of planning, their organization and purpose, CIDCO-MHADA-MIDC. **(06 Lectures)**

Module 6: Climate Responsive Design and Site Planning

Factors that determine climate, Characteristics of climate types, Design for various climate types, Passive and active energy controls. Urban renewal- conservation, Issues related to site choice, unwanted site. Study of planned towns like New Mumbai, Gandhinagar, Chandigarh, New Delhi. **(06 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- G. K .Hiraskar, "Town planning", Dhanpatrai Publication 2002
- S. Rangwala, "Town planning", Charotar Publishing House Pvt. Ltd., 2009
- G Muthu, Shobha, Mohan, "Principles of Architecture" 2006 MRTP act 1966
- UDPFI guidelines, ministry of urban affairs and employment, Govt. & India.
- koenigsbeger, "Manual of tropical housing and building", Universities Press (India)
- Sustainable Building - Design Manual: Sustainable Building Design Practices, 2009 TERI
- Shah, Kale, Patki, "Building Drawing", Tata McGraw-Hill Education, 5th edition
- Gevorkian, "Green Buildings", Mc Graw hill.
- Haselbach, "The engineering guide to LEED", new construction-sustainable construction for engineers, The McGraw-Hill, 2008.
- Satish Chandra Agarwala , "Architecture & Town Planning", Dhanpat Rai & Co (P) Ltd.
- Prakash Apte, "The building of Gandhinagar", Power publishers.

- Annapurna Shaw, "The making of new Mumbai", Orient Blackswan, 2004

Outcomes:

Upon completion of the course the students will be able to:

Elective III

CVCTM-E3/02 Operation Research

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Contents

Module 1: Introduction to Operations Research

Introduction, Use of Operations Research in Civil Engineering and Managerial Decision making process, Structure of the Mathematical Model, Limitations of Operations Research, Identification of civil engineering systems and their methods of analysis, Introduction to Optimization Techniques and their application in Engineering Planning, Design and Construction, Multivariable optimization with and without constraints, Gradient vector and Hessian Matrix, Gradient techniques, steepest ascent/decent technique, Newton's Method, Lagrange Multiplier Technique, Objective function and constraints, convex and concave functions, regions and sets. **(07 Lectures)**

Module 2: Linear Programming

Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, duality, Sensitivity Analysis, Civil engineering applications. **(06 Lectures)**

Module 3: Transportation Problem

Formulation, solution, unbalanced Transportation problem, finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. **(06 Lectures)**

Module 4: Integer, Dynamic and Non-Linear programming

Integer programming Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique, Introduction to Decomposition algorithms.

Dynamic programming Multi stage decision processes, Principle of optimality, Recursive equation, Application of D.P., Decision theory.

Non-Linear programming: Single variable unconstrained optimization –Local & Global optima, Uni-modal Function- Sequential Search Techniques: Dichotomous, Fibonacci, Golden Section methods. **(08 Lectures)**

Module 5: Simulation

Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte- Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation. **(06 Lectures)**

Module 6: Queuing Theory and Game Theory

Queuing Theory, Simulation, Sequencing model, n jobs through 2, 3 and M machines, Competitive games, rectangular game, saddle point, minimax, maximin method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle, Rectangular games without saddle point – mixed strategy for 2 X 2 games. **(06 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
- Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
- Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
- S. D. Sharma, Operations Research, KedarNath Ram Nath-Meerut.
- KantiSwarup, P. K. Gupta and Man Mohan, Operations Research, Sultan Chand & Sons

Outcomes:

Upon completion of the course the students will be able to:

- Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
- Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
- Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
- Understand the applications of integer programming and a queuing model and compute important performance measures.

Elective III

CVCTM-E3/03 Value Engineering and Valuation

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Contents

Module 1: Value

Meaning of value, basic and secondary functions, factor contributing to value such as aesthetic, ergonomic, technical, economic etc., Difference between value engineering, value analysis & value management, Habits, roadblocks, attitudes & their relevance in value engineering. **(07 Lectures)**

Module 2: Job Plan

Definition & Terms related to Value Engineering Job Plan, Various versions of job plan, Phases involved in job plan.

(06 Lectures)

Module 3: Function Analysis

Function- Definition, Role of function in achieving value, Types of function, Function Analysis System Techniques (FAST), Graphical function Analysis. **(06 Lectures)**

Module 4: Value Analysis

Principles of value analysis, Benefits & applications of value analysis, Methods for improving the effectiveness of value analysis

(06 Lectures)

Module 5: Life cycle costing

Life cycle costing, Forecasting of Capital as well as operating & maintenance costs, time value, present worth analysis, DCF methods, ROR analysis, sensitivity analysis, Different methods of performing value engineering. **(06 Lectures)**

Module 6: Valuation

Types of value, purposes of valuation factors affecting value, Different methods of valuation for different types of assets such as land and building, horticulture, historical places, Valuation Report: Valuation Report, contents, standard formats, Case study of any one Report. **(07 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- O. P. Khanna Industrial Engg. & Mgt., Dhanpat Rai Publ.
- T. R. Banga, S. C. Sharma Industrial Organization & Engg. Economics, Khanna Publ.
- B.N. Dutta, Estimating and Costing in Civil Engineering: Theory and Practice Published S. Dutta & Company, Lucknow.
- M. Chakraborty, Estimating, Costing Specifications & valuation in Civil Engineering Published By: Author.
- G. S .Birdie Estimating and Costing
- Rangwala, Estimating and Costing , Charotar Publishing House
- P. T. Joglekar, Practical Information for Quantity Surveyors, Property valuers, Architects Engineers and Builders, Pune Vidyarthi Griha Prakashan, 2008 reprint.

Outcomes:

Upon completion of the course the students will be able to:

- Illustrate the concept and importance of Value Engineering
- Demonstrate their capability for Value analysis and management.
- Use of Life cycle costing for the construction project.

Elective IV

CVCTM-E4/01 Resource Management

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Contents

Module 1: Materials Management

Importance of materials management and its role in construction industry-scope, objectives and functions, integrated approach to materials management, Role of materials manager. **(05 Lectures)**

Module 2: Material Planning and Analysis

Classification and Codification of materials of construction, ABC analysis-Procedure and its use, Standardization in materials and their management, Procurement, identification of sources of procurement, vendor analysis, Vendor analysis concept of (MRKP) Material requirement planning, planning, purchase procedure, legal aspects. **(06 Lectures)**

Module 3: Inventory Management

Inventory Control techniques. EOQ, Advantages and limitation of use of EOQ, Periodic ordering, order point control, safety stock, stock outs, application of ABC analysis in inventory control, Stores Management: Receipt and inspection, care and safety in handling, loss on storage, wastage, Bulk purchasing, site layout and site organization, scheduling of men, materials and equipment.

(07 Lectures)

Module 4: Applications of MMS

Materials Management Systems in materials planning, procurement, inventory, control, cost control etc **(05 Lectures)**

Module 5: Equipment Management

Working out number of construction equipment required based on the individual equipment work cycle, and based on the total time available and quantum of work, working out the total hourly cost and the cost per unit of item for the various construction machinery, Concept of equipment log book, Concept of equipment selection based on optimal used. **(07 Lectures)**

Module 6: Human Resource Development

Flow diagram of human resource development and human resource management, Training, competency development, capacity building of resources required at grass root level and at the managerial level in construction. **(06 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References

- K. S. Menon, Purchasing and Inventory Control , Wheeler Publication
- Dr. Mahesh Verma, Construction equipment planning and applications
- Peurifoy, Construction planning, equipment and methods, Tata McGraw Hill pub.
- Biswajeet Pattanayak, Human Resource Management
- Bohlander & Snell, Managing Human Resources

Outcomes:

Upon completion of the course the students will be able to:

- Understand the resource requirements of different kinds of civil engineering projects.
- Know different techniques of classification and codification of materials. They will be able to understand the purchase and procurement procedures and get acquainted with the concept of MRP, EOQ, JIT, MMS, QC, etc.
- Understand the different kinds of equipments and knowledge gained will help them to make optimum utilization of equipments on construction site.
- Realize the importance of recruiting and retaining the relevant, enthusiastic and hardworking staff for the betterment of the organization.
- Understand the concepts, aspects, techniques and practices of the human resource management.
- Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
- Gain knowledge about the latest developments and trends in HRM.
- Apply the knowledge of behavioral skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Elective IV

CVCTM-E4/02 Building Environment and Services

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Contents

Module 1: Acoustics and Lighting

Acoustical Designs, Noise and its control, Natural and artificial Light in Building, Lighting, Measurement, Design of Lighting system **(07 Lectures)**

Module 2: Energy Conservation in Buildings

Thermal properties of buildings, Thermal insulation and insulating material, Thermal design of enclosures, Thermal environment inside building, cooling & heating loads, Centralized Systems of air-conditioning. **(07 Lectures)**

Module 3: Electrical Services

Electric wiring system in building, conductor, cable & conduits, Elevators, Escalators and conveyer, Design, Type, Location, bye-laws etc **(07 Lectures)**

Module 4: Water Supply Systems

Domestic and commercial Hot water and water supply system for multi-storeyed buildings, Swimming pools-Design criteria, Springboards, pressure filters for recirculation, maintenance.

Drainage system: Nature of Drainage phenomenon, Ant siphon & vent piping - Installation, pipe joinery, External drainage System in building, Design aspects of Sewage Treatment Plants. **(07 Lectures)**

Module 5: Fire Fighting in Buildings

Controlling features in architectural planning Norms for fire prevention and mitigation measures, Fire rating of materials, Fire control devices **(07Lectures)**

Module 6: Other services and Approvals

Gas services & distribution piping, Roof water harvesting & water conservation, Approval of authorities for water supply **(07 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References

- National Building code, Bureau of Indian standard
- V .O.Kusen &C.M.Harris, Acoustical designing in Architecture, John.Wiley & Son.
- R. L. Suri, Acoustic designing & practice, Asia Publishing House.
- B. Govoni, Main climate & Architecture, Elsvire Publishing co
- J. P Van Stratten, Thermal Performance of Building, Elsvier Publishing Co.
- Functional requirement of building (other than Industrial Building), BIS Handbook

Outcomes:

Upon completion of the course the students will be able to:

- Understand the important of Energy and Conservation of energy in facility design.
- Outline the Principles and objectives of Energy Management and Energy Auditing.
- Describe the technologies, codes and policies for energy conservation in buildings
- Design of energy efficient buildings and environment friendly building.
- Explain the Energy Saving Opportunities in Various Building facilities and Services

Elective IV

CVCTM-E4/03 Risk Analysis and Decision Making

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Contents

Module 1: Introduction to Risk Management

Importance of risk, development of risk management system, Identifying risk events, cost of risk, types of risk and classification, Benefits of risk management, responsibilities of those involved in risk management, Risk management standards, decision making strategies effects of tax laws, government rulings, conflict resolution, money, time and technical risks, Risks in the context of global project teams. **(06 Lectures)**

Module 2: Risk Analysis and Management for Projects (RAMP)

Probability distribution, Stages in Investment life-cycle, Determination of NPV and its standard deviation for perfectly co-related, moderately co-related and uncorrelated cash. **(06 Lectures)**

Module 3: Risk Analysis Techniques

Sensitivity analysis, Uncertainty, cost factors and benefit factors, Scenario analysis, scenario analysis simulation, Decision tree analysis, risk profile method, certainly equivalent method, risk adjusted discount rate method, certainty index method, 3 point estimated method, Use of risk prompts, use of risk assessment tables, details of RAMP process, utility of grading of construction entities for reliable risk assessment, Entrepreneurial risks, pure risks, Contract review and legal conflicts. **(06 Lectures)**

Module 4: Risk Mitigation

By elimination, reducing, transferring, avoiding, absorbing or pooling, Residual risk, mitigation of unqualified risk, Coverage of risk through CIDC's. **(06 Lectures)**

Module 5: Risk Mitigation Policies

Actuarial Society of India programs: through risk premium such as (BIP), Bidding Indemnity Policy (DIMO), Delay in meeting obligation by client policy, (SOC), Settlement of claims policy (LOP), Loss of profit policy (TI), Transit Insurance policy (LOPCE) Loss of performance of construction equipment policy. **(06 Lectures)**

Module 6: Risk Management and Internal Control

Internal audit works, control systems, Auditing risk management, setting up internal audit function. **(06 Lectures)**

References

- Kit Sadgrove, Complete guide to business risk management Gower Publishing Ltd.
- Hans Buhlmann, Mathematical Methods in Risk Theory Springer Verlang
- Prasanna Chandra, Project planning analysis selection implementation and review Tata McGraw Hill
- Christopher Marrison, Fundamentals of risk measurements Tata McGraw Hill

- Ian Cameron, Raghu Raman Process Systems Risk Management Elsevier Academic Press
- Seetharaman, Construction Engineering and Management Umesh Publications

Outcomes:

Upon completion of the course the students will be able to:

- Classify and compute risks and risk containment and risk reduction policies.
- Manage risk effectively and thus have better decision making.
- Understand financial savings and better productivity due to effective use of resources and thus have enhanced success rates of ongoing as well new projects.

Elective V

CVCTM-E5/01 Research Methodology (Open Elective)

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Contents

Module 1:

Introduction, meaning of research, objectives, types and role of scientific and engineering related research in advancing the knowledge, defining a research problem, formulation of a hypothesis, research design and features of good design, methods of data collection, approaches and techniques for data acquisition, processing, analyses and synthesis, Designing a questionnaire, Interpretation of results, Report Writing, Aspects of literature review, Different ways of communication and dissemination of research results. **(06 Lectures)**

Module 02:

Descriptive Statistics, Probability and Distribution: Basic statistical concepts, Measures of central tendency and dispersion, Elements of Probability, Addition and multiplication theorems of probability, Examples, probability distributions, Binomial, Poisson and normal distributions. **(06 Lectures)**

Module 03:

Sampling Techniques: Random sampling, simple random sampling and stratified random sampling, Non-sampling errors. **(06 Lectures)**

Module 04:

Correlation and Regression: Product moment correlation coefficient and its properties. Simple linear regression and multiple linear regressions, Statistical Inference: Statistical hypotheses, Error Types, level of significance, Chi-square Test and F distributions. Central limit theorem, Tests for the mean, equality of two means, variance, large sample tests for proportions, Confidence interval. **(06 Lectures)**

Module 05:

Design of Experiments: Analysis of variance. Data Classification, Completely randomized, randomized block, Factorial experiments, Yates technique. **(06 Lectures)**

Module 06:

Multivariate Data Analysis: Multivariate normal distributions. Mean vector, variance, covariance matrix and correlation matrix, Step wise regression, Selection of best subject of variables, Classification and discrimination problems, Factor analysis, and Principal component analysis. Data analysis using software's. **(06 Lectures)**

Term Work

Student shall critically read recent three to four journal articles within the broader field of their prospective specializations to identify research and knowledge gaps and accordingly formulate specific research questions. On the basis of these research questions student will retrieve additional relevant information and prepare well-articulated and content rich introductory problem description as well as proposed research methodology notes. This shall be assessed jointly by the subject teacher and research guide of the student.

References

- Gupta S. C. and Kapoor V. K, "Fundamentals of Mathematical Statistics", Sultan Chand & Company New Delhi.
- Gupta S. C. and Kapoor V. K, "Fundamentals of Applied Statistics", Sultan Chand & Com. N.Delhi.
- Montogomery D. C., "Probability and Applied Statistics for Engineers", Wiley Int.Student Edition
- Walpole Ronald E, Myers Raymond H and Myers Sharon L, "Probability & Statistics for Engineers and Scientists", 6thEdition, Prentice Hall.
- Ross S. M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edi, Elsevier
- Miller and Freund: Probability and Statistics for Engineers", EEE
- Johnson R. and Wichern, "Applied Multivariate Statistical Analysis", 3rd Edi, Prentice Hall India
- Douben K. J., "Research Methodologies – Principles and Guidelines of Applied Scientific Research", UNESCO-IHE Lecture Notes LN0317/06/01, Delft, the Netherlands.
- Holtom D. and E. Fisher, "Enjoy Writing Your Science Thesis - a Step by Step Guide to Planning and Writing Dissertations and Theses for Undergraduate and Graduate Science Students", Imperial College Press. ISBN 1-86094-207-5, London, UK.
- Kumar R., "Research Methodology- a Step-by-step Guide for Beginners", Sage Publications. ISBN 0-7619-6213-1. London, UK.

Outcomes:

Upon completion of the course the students will be able to:

- Understand concept of research, its types, methods, detailed procedure to identify and solve a research problem.
- Understand various mathematical techniques useful in research work.
- Understand various sampling techniques useful in research work.
- Understand various techniques for correlating and predicting different parameters with each other based on data collected.
- Design the experiments for research work.
- Analyze and interpret the data, results and to conclude the final results.

Elective V

CVCTM-E5/02 Infrastructure Development (Open Elective)

Teaching Schemes: 3 Lect. hrs/week; **Evaluation Scheme:** Theory: 60; Mid-semester Exam 20; Class Assessment 20

Course Contents

Module 1: Construction Industry

Nature, characteristics, size and structure, Role of infrastructure development in employment generation and improving of the National economy **(06 Lectures)**

Module 2: Infrastructure Policies and Agencies

Indian government policy, Five year plan of government, Various Agencies associated with infrastructure development in India as regards various sectors. **(06 Lectures)**

Module 3: Status of Infrastructure in India

Roads and buildings, communication, water supply, irrigation, power energy sectors, ports and aviation, health and educational services, rural development. **(06 Lectures)**

Module 4: Infrastructure Development

Issues related with infrastructure development, Government sector management, public sector management, private sector management. **(06 Lectures)**

Module 5: Funding and Consultant

Funding and managing infrastructure projects, role, and responsibility of project management consultants, 2 DoF Systems **(06 Lectures)**

Module 6: Project Development

BOT projects, PPP projects, related to role of government, concern Construction Company, benefits and limitations. **(06 Lectures)**

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the Course shall be performed by the candidate.

Guidelines for Class Test: Class Test shall cover Syllabus of any Three Modules.

References:

- Rakesh Mohan, India Infrastructure Report
- Infrastructure Today - Magazine
- Document of five year plans, published by Govt. of India
- CE & CR Magazine.
- Construction World Magazine.

Outcomes:

- Upon completion of the course the students will be able to:

CVCTM-S01 Seminar I

Laboratory Scheme:

Seminar I shall be delivered on one of the advanced topics chosen in consultation with the supervisor after compiling the information from the latest literature. The concepts must be clearly understood and presented by the student. All modern methods of presentation should be used by the student. Minimum 03 presentations are expected within period of semester by the student. A hard copy of the report (20 to 25 pages, A4 size, 12 fonts, Times New Roman, 1.5 line spacing with normal margin on all sides, both side printed, as per format) should be submitted to the Department Post Graduate Committee (DPGC) before delivering the seminar. A copy of the report in soft form must be submitted to the Supervisor along with other details, if any.

CVCTM-L02 PG Lab 2

Term work should consist of any (Three) exercises from the following.

- One site visit to study the feasibility aspects, Tendering procedures, accounting systems, funds raising and other financial management aspects, billing procedures etc. associated with on-going major construction work-visit report to be submitted.
- Collection and study of Tender notices, tender documents of contract document associated with Civil Engineering works.
- Study and use of various computer software"s, use in the field associated with Project
- Management (MSP or Primavera).
- Web based project management.

CVCTM-L02 Mini Project

Laboratory Scheme:

Mini project shall be based on one of the topic chosen in consultation with the supervisor. Mini project may be interdisciplinary nature. Areas of recent techno-management development shall be explored. Research innovations may be considered as prospective areas. Mini project may be related with main project to explore possibilities of continuation further and to study the pre-requisites.

Semester- III

Project Management and Intellectual Property Rights

Teaching Schemes: Self Study; **Evaluation Scheme:** Class Assessment 25; Oral Examination 25

Course Content

Project Management

Module 1: Introduction to Project Management

Brief history of project management, Role of a Project Manager, benefits of project management, Project vs. operation, Project lifecycle: Initiating, Planning, Executing, Controlling, and Closing processes. Project Integration Management - Project plan development, Project plan execution, and Overall change control. **(06 Lectures)**

Module 2: Beginning a Project

Project Selection, Defining criteria, Project selection methods, Sacred Cow, Comparative Benefit Model (CBM), Quality functional deployment (QFD), Scope Definition, Project Charter development **(06 Lectures)**

Module 3: Risk Management

Project Risk Management Processes, Types of Risk, Risk Defined, Risk Factors, Risk Factors Risk identification, Qualitative risk analysis, Quantitative risk analysis, Risk planning, Risk control. **(06 Lectures)**

Module 4: Professional Responsibility (Ethics)

Ensuring Integrity and Professionalism, Project Management Knowledge Base, Enhancing Individual Competence, Balancing Stakeholder Interests, Interactions with Team Members and Stakeholders, Templates, Tools and Techniques. **(06 Lectures)**

Intellectual Property Rights

Module 5: Introduction to Intellectual Property Rights

Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.

International Scenario

International cooperation on Intellectual Property, Procedure for grants of patents, Patenting under PCT **(06 Lectures)**

Module 6: Patent Rights

Scope of Patent Rights, Licensing and transfer of technology, Patent information and databases, Geographical Indications

Recent Developments in IPR

Administration of Patent System, New developments in IPR, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies **(06 Lectures)**

References

- PMBOK® Guide 5th Edition, ISBN 978-1935589679
- Managing Across Cultures: The 7 Keys to Doing Business with a Global Mindset 1st Edition, ISBN 978-0071605854
- The PMP Exam: How to Pass on Your First Try 5th Edition, ISBN 978-0982760857
- The PMP Exam: Quick Reference Guide 5th Edition, ISBN 978-0982760895
- T. Hegazy, Computer-based construction project management, Prentice Hall, New Jersey, 2002.
- S. M. Levy, Project management in construction, 5 th ed., McGraw Hill, New York, 2007.
- PMI, A guide to the project management body of knowledge, 3 rd ed., Project Management Institute, Pennsylvania, 1996.
- Prabuddha Ganguly, “Intellectual Property Rights”,Tata Mc-Graw Hill.
- Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd, 2007.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley “Intellectual Property in New Technological Age”.

CVCTMPS1 Project Stage I

Evaluation Scheme: Class Assessment 25; Oral Examination 25

Dissertation Stage I and Synopsis Approval Presentation:

It is a course requirement under the guidance of faculty Supervisor. PG student from second year is required to do innovative and research oriented applied work related to various theory and laboratory courses. Dissertation work may cover analytical formulation, experimentation or survey based project or combination of these. Student are encouraged to undertake an interdisciplinary type project.

- **Synopsis:**

It is expected from the student to carry out exhaustive literature survey with consultation of his/her Supervisor for not less than 15 reputed national, international journal and conference papers. Student should present the Synopsis Submission Presentation (SSP) with literature survey report to justify about the research gap, innovativeness, applicability, relevance and significance of the work. Student shall undertake project work after approval of synopsis.

- **Dissertation Stage I presentation:**

It is expected that student shall present preliminary results from his/her work during the semester with report as per prescribed format. If student is not showing satisfactory performance, then he/she will be given grace period of 2 weeks. After 2 weeks student will be again evaluated with grade penalty. Minimum 02 ISE presentations should be delivered by the student during semester.

Semester- IV

CVCTMPS2 Project Stage II

Evaluation Scheme: Class Assessment 25; Oral Examination 25

Based on the guidelines and progress of stage II works, all the desired work should be completed and final dissertation report will be prepared and presented during examination. It is desirable that student presents/publishes the research paper in peer reviewed conference/research journals. If student is not showing satisfactory performance, then he/she will be given grace period of 4 weeks. After 4 weeks student will be again evaluated with grade penalty.