UNIVERSITY OF MUMBAI

Scheme for the

Instruction and Examination

M.E. (Civil with Structural Engineering Subjects)

Full-Time Degree Course

(With Effect from Academic-year 2016-17)

From Co-ordinator's Desk

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) give freedom to affiliated Institutes to add few (PEO's) course objectives course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, developed curriculum accordingly. In addition to outcome based education, **Choice Based Credit and Grading System** is also introduced to ensure quality of engineering education.

Choice Based Credit and Grading System enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes Faculty of Technology has devised a transparent credit assignment policy adopted ten points scale to grade learner's performance. Credit grading based system was implemented for First Year of Engineering from the academic year 2016-2017. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2017-2018, for Third Year Final Year Engineering in the academic years 2018-2019, 2019-2020, respectively.

Dr. S. K. Ukarande
Co-ordinator,
Faculty of Technology,
Member - Academic Council
University of Mumbai, Mumbai

Preamble

The engineering education in India in general is expanding in manifolds. Now, the challenge is to ensure its quality to the stakeholders along with the expansion. To meet this challenge, the issue of quality needs to be addressed, debated taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education reflects the fact that in achieving recognition, the institution or program of study is committed open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills knowledge that a student will have at the time of graduation from the program. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

I am happy to state here that, Program Educational Objectives were finalized in a meeting where syllabus committee members were also present. The Program Educational Objectives finalized for undergraduate program in civil Engineering are as follows:

1. To prepare Learner's with a sound foundation in the mathematical, scientific engineering fundamentals
2. To prepare Learner's to use effectively modern tools to solve real life problems
3. To prepare Learner's for successful career in Indian Multinational Organisations to excel in Postgraduate studies
4. To encourage motivate Learner's for self-learning
5. To inculcate professional ethical attitude, good leadership qualities commitment to social responsibilities in the Learner's

In addition to above each institute is free to add few (2 to 3) more Program Educational Objectives of their own. In addition to Program Educational Objectives, course objectives expected course outcomes from learner's point of view are also included in the curriculum for each course of undergraduate program to support the philosophy of outcome based education. I believe strongly that small step taken in right direction will definitely help in providing quality education to the stake holders.

Dr. S. K. Ukarande

Chairman, Board of studies in Civil Engineering

University of Mumbai, Mumbai

Semester I

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MSTR-C101	Theory of Elasticity, Plasticity and Stability	04	--	--	04	--	--	04
MSTR -C102	Foundation Analysis and Design	04	--	--	04	--	--	04
MSTR -C103	Advanced Prestressed Concrete Structures	04	--	--	04	--	--	04
MSTR IEC - E101X	Elective I (Institute Level)	03	--	--	03	--	--	03
MSTR DEC - E102X	Elective II (Departmental Level)	04	--	--	04	--	--	04
MSTR – L 101	Laboratory I	--	02	--	--	01	--	01
MSTR – L 102	Design Studio-I	--	02	--	--	01	--	01
Total		**19**	**04**	**--**	**19**	**02**	**--**	**21**

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract/ oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg.					
MSTR-C101	Theory of Elasticity, Plasticity and Stability	20	20	20	80	03	--	--	100
MSTR -C102	Foundation Analysis and Design	20	20	20	80	03	--	--	100
MSTR -C103	Advanced Prestressed Concrete Structures	20	20	20	80	04	--	--	100

MILO -101X	Elective I (Institute Level)	20	20	20	80	03	--	--	100
MDLO -102X	Elective II (Departmental Level)	20	20	20	80	03	--	--	100
MSTR - L101	Laboratory I	--	--	--	--	--	25	25	50
MSTR - L102	Design Studio-I	--	--	--	--	--	25	25	50
Total		**100**	**100**	**100**	**400**	**--**	**50**	**50**	**600**

Semester II

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MSTR -C201	Finite Element Analysis	04	--	--	04	--	--	04
MSTR -C202	Structural Dynamics	04	--	--	04	--	--	04
MSTR -C203	Advance Design of Concrete Structures	04	--	--	04	--	--	04
MILO 201X	Elective III (Institute Level)	03	--	--	03	--	--	03
MDLO 202X	Elective IV (Departmental Level)	04	--	--	04	--	--	04
MSTR- L201	Laboratory - II	--	02	--	--	02	--	01
MSTR-L202	Design Studio-II	--	02	--	--	02	--	01
Total		**19**	**04**	--	**19**	**04**	--	**21**

Subject Code	Subject Name	Examination Scheme							
		Theory					Term Work	Pract/ oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test 2	Avg.					
MSTR -C201	Finite Element Analysis	20	20	20	80	03	--	--	100
MSTR -C202	Structural Dynamics	20	20	20	80	03	--	--	100
MSTR -C203	Advance Design of Concrete Structures	20	20	20	80	04	--	--	100
MSTR IEC -E201X	Elective-III (Institute Level)	20	20	20	80	03	--	--	100
MDEC -E202X	Elective-IV	20	20	20	80	03/04	--	--	100

	(Departmental Level)							
MSTR –L 201	Laboratory - II	--	--	--	--	--	25	25	50
MSTR-L 202	Design Studio-II	--	--	--	--	--	25	25	50
Total		**100**	**100**	**100**	**400**	**--**	**50**	**50**	**600**

Semester III

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MSTR -S301	Seminar	--	06	--	--	03	--	03
MSTR -D301	Dissertation I	--	24	--	--	12	--	12
Total		--	30	--	--	15	--	15

Subject Code	Subject Name	Examination Scheme						
		Theory				Term Work	Pract./ Oral	Total
		Internal Assessment			End Sem. Exam.			
		Test1	Test 2	Avg.				
MSTR -S301	Seminar	--	--	--	--	50	--	50
MSTR -D301	Dissertation I	--	--	--	--	100	--	100
Total		--	--	--	--	**150**	--	**150**

Semester IV

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MSTR - D401	Dissertation II	--	30	--	--	15	--	15
Total		--	30	--	--	15	--	15

Subject Code	Subject Name	Examination Scheme						
		Theory				Term Work	Pract./ Oral	Total
		Internal Assessment			End Sem. Exam.			
		Test1	Test 2	Avg.				
MSTR - D401	Dissertation II	--	--	--	--	100	100	200
Total		--	--	--	--	**100**	**100**	**200**

Elective-I (Any One)	
MILO 1011: Product Life Cycle Management	MILO 1015: Operations Research
MILO 1012: Reliability Engineering	MILO 1016: Cyber Security and Laws
MILO 1013: Management Information Systems	MILO 1017: Disaster Management and Mitigation Measures
MILO: 1014: Design of Experiments	MILO 1018: Energy Audit and Management

Elective-II (Any One)	
MDLO 1011 :Design of Bridge Structures	MDLO 1014: Numerical Methods
MDLO 1012 Analysis and Design of Transportation Structure	MDLO 1015: Advance Concrete Technology

MDLO 1013: Analysis of Composite Structure	MDLO 1016: Analysis and Design of Multi-storey buildings

Elective-III (Any One)	
MILO 2021 : Project Management	MILO 2025: Professional Ethics and Corporate Social Responsibility (CSR)
MILO 2022: Finance Management	MILO: 2026:Research Methodology
MILO 2023:Entrepreneurship Development and Management	MILO 2027:Intellectual Property Rights and Patenting
MILO 2024: Human Resources Management	MILO 2028: Digital Business Management

Elective – IV (Any One)	
MDLO 2011 :Theory of plate and shells	MDLO 2014 :Health Monitoring and Rehabilitation of Structures
MDLO 2012 :Analysis and Design of Environmental and Hydraulic structures	MDLO 2015:Design of Green Building
MDLO 2013 :Design of Industrial Structures	MDLO 2016 :Earthquake Engineering

Subject Code	Subject Name	Credits
MSTR-C101	Theory of Elasticity, Plasticity and Stability	04

Teaching Scheme

Contact Hours			Credits assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
04	--	--	04	--	--	04

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03	-	--	--	100

Course Objectives

1. To analyse the stresses and strains for three-dimensional elements.
2. To understand the equilibrium and compatibility conditions.
3. To understand the concept of plasticity.
4. To understand geometric non-linearity.
5. To understand the concept of buckling and analyse various members subjected to buckling using various methods.
6. To understand and perform collapse load analysis for different types of frames and to comprehend various failure mechanisms and to study the effect of axial force and shear force on fully plastic moment of a section.

Module	Contents
I.	**Theory of Elasticity- I** Problems in Rectangular coordinates, Polynomial solutions, Cantilever loaded at the end, Simply supported load beam under uniformly distributed load, linear loading, Two dimensional problems in polar coordinates **(08)**
II.	**Theory of Elasticity - II** Effect of circular hole in plate under in-plane loading, Stresses in circular disk, Three dimensional problems in Elasticity, Differential equation of equilibrium in 3D, Condition of Compatibility, Principal of superposition **(08)**
III.	**Theory of Plasticity** Introduction to plasticity, Criteria of yielding, strain hardening, rules of plastic flow, different stress-strain relations, Total Strain theory, theorems of limit analysis, Elasto-plastic bending of bars **(08)**
IV.	**Elastic Stability** Geometric Non-linearity- Basic concepts, Analysis of beam-columns with various end conditions, Use of trigonometric series, Elastic buckling of bars, Euler's formula **(08)**
V.	**Buckling in Structural Members** Buckling of continuous beams, Buckling of non-prismatic members, effect of shear force on buckling of bars, Use of energy method and finite difference method, Buckling of single span portal frames **(08)**
VI.	**Collapse Load Analysis** Collapse load analysis of pin-jointed frames, Single/multiple span rigid jointed portal frames and single bay gable frames, Use of static and mechanism method for calculation of collapse load, Lower and upper bound theorems, Various types of failure mechanisms, Effect of axial fore and shear force on fully plastic moment of a section **(08)**

Detail Syllabus

On successful completion of the course, the learner shall be able to:

1. Understand the importance of the concepts of theory of elasticity and plasticity.
2. Understand the concept of geometric non-linearity and the difference between various failure mechanisms.
3. Perform non-linear analysis on various structural members.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester . The students shall be asked to appear for the either tests. However, at least one test is mandatory and the students may be asked to undertake the completion of assignment on live problems or course project solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
3. The students will have to attempt any **four**questions out of **total six** questions

Recommended Books:

1. Wang: 'Applied Elasticity', *McGraw Hill Book Co.*
2. Timoshenko:'Theory of Elasticity', *McGraw Hill Book Co.*
3. Mendelson A.: Theory of Elasticity', *McGraw Hill Book Co.*
4. Sadhu Singh:'Theory of Plasticity', *Dhanpat RaiSons Private Ltd.*
5. Chakrabarti, J.: 'Theory of Plasticity', *McGraw Hill Book Co.*
6. Timoshenko, S.:'Theory of Elastic Stability', *McGraw Hill Book Co.*
7. Aswini Kumar:'Stability Theory of Structures', *McGraw Hill Book Co.*
8. N.G.R. Iyengar:'Structural Stability of Columns and Plates', *Affiliated East West Press*
9. Brush, D.O. and. Almorth, B.O.:'Buckling of Bars, Plates and Shells', *McGraw Hill, Kogakusha Ltd.*
10. Baker and Hayman:'Plastic Design of Steel Frames', *Cambridge University Press*
11. Hodge: "Plastic Analysis of Structures", *McGraw Hill Book Co.*

Subject Code	Subject Name	Credits
MSTR-C102	**Foundation Analysis and Design**	**04**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	**--**	**--**	04	--	**--**	04

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	-	--	--	100

Course Objectives

- To study different types of foundations and to understand the geotechnical and allied parameters required for the analysis and design of foundations.
- To study the bearing capacity and settlement of shallow foundations
- To understand the design concepts for shallow foundations including strip and raft foundations
- To study different types of well foundations, including design by IRC method
- To study the load carrying capacity of pile and design of piled raft foundation
- To study different types of foundations adopted on expansive and weak soils

- To learn different types of machine foundations and understand the design philosophy; and carry out the design thereof.
- To study in brief different types of marine structures including substructures and coffer dams

<table>
<tr><td colspan="2" align="center">Detail Syllabus</td></tr>
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Module	Content
I.	**Introduction:** Foundation purpose and their importance; Classification of foundations, general requirement, selection of type; Soil classification andgeotechnical design parameters, Bearing capacity, bearing capacity theory, settlements and factors affecting settlement; Loads for design, depth of foundation and depth of soil exploration; Parameters for design of foundation on various types of soil
II.	**Shallow Foundation:** Basic requirements of foundation, types and selection of foundation, design of shallow foundations by Terzaghi's and IS code method; Structural design of strip and raft foundation.
III.	**Pile Foundation:** Introduction, Necessity of piles, Types of pile foundation, load carrying capacity of single pile and pile in group, , group efficiency, group settlements, design of single pile and pile cap, analysis of pile raft foundation, analysis of laterally loaded pile.
IV.	**Floating Foundation and Well Foundation:** Floating Foundation- Introduction, Floatation, bottom elastic heave, Design of floating foundation on piles, Well Foundation- Introduction, forces acting on well foundation, Terzaghi's method of analysis, depth of scour, grip length for wells in rivers, minimum thickness of R. C. wells, and design of well foundation by IRC method.
V.	**Special Foundation:** Condition for special foundation, Types of special foundation, foundation on expansion soils, design of under-reamed pile foundation, design of foundation for concrete chimney

VI.	**Machine Foundation:**
	Introduction, Dynamic soil properties, types of machine vibrations, basic principal of machine foundation, design of foundation for reciprocating machine and impact machine
VII	**Marine Sub-structures and Coffer Dams:**
	Introduction, Type of marine structures, loads acting on marine structures, design of Break waters, design of Wharf, Analysis and design of Cellular Coffer Dam

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Contributions to Outcomes

On successful completion of the course, the learner shall have an:

1. Ability to identify, formulate and solve geotechnical engineering problems
2. Ability to design a suitable foundation system from economic and safe aspects
3. Ability to design machine foundations
4. Ability to design of marine sub structures
5. Ability to relate easily to allied subjects such soil dynamics; advanced engineering geology, rock mechanics etc.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester . The students shall be asked to appear for the either tests. However, at least one test is mandatory and the students may be asked to undertake the completion of assignment on live problems or course project solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
3. The questions can be of **mixed nature** irrespective of modules.
4. The students will have to attempt any **four** questions out of **total six** questions

Recommended Books:

1. Bowels J.E.:'Analytical and Computer Methods in Foundation', *McGraw Hill Book Co. New York, 1974*

2. Das, B. M.:'Geotechnical Engineering Handbook', *J. Ross Publishing, 2010*

3. Verghese, P. C.: "Foundation Engineering", *PHI Learning Private Limited, Delhi, 2012*

4. Verghese, P. C.: "Design of Reinforced Concrete Foundations", *PHI Learning Private Limited, Delhi, 2011*

5. N. Subramanian: "Reinforced Concrete Structures", *Oxford University Press, 2013*

6. Alam Singh: "Soil Mechanics and Foundation Engineering", *Vol. I- II. Standard Book House, Delhi*

7. Swami Saran: "Analysis and design of substructures", *Oxford and IBH publishing company, Delhi 1998*

Subject Code	Subject Name	Credits
MSTR-C103	**Advanced Prestressed Concrete Structures**	04

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	--	--	04	--	--	04

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	04	-	--	--	100

Course Objectives

1. To bring the students to such a level so as to enable them to take the appropriate decision in respect of choice of prestressed section over R. C. C. as a civil engineer.

2. To make the student to be aware of such a highly mechanized technology in civil engineering construction.

3. To imbibe the culture of entrepreneurship in pre-cast and pre-stressed industry in mass housing, railway sleepers, electric transmission poles, etc.

4. To understand the basic design considerations in pre- stressed concrete structures in relation to its applications.

Module	Contents
I.	**Introduction:** Introduction to Prestressed concrete, system and devices, materials, losses in pre-stress, stresses at transfer and service loads, maintenance of pre-stressed concrete structure, limit state method-limit state of collapse against flexure, shear, torsion - limit state of serviceability, Design of end block - Anchorage zone stresses for post tensioned members **(05)**
II.	**Beam, Slab and Frame:** Introduction –advantages and disadvantages of continuity –Layouts for continuous beams-primary and secondary moments –Elastic analysis of continuous beams-Linear transformation-Concordant cable profile- Analysis and Design of continuous beam-frames-one way and two way slabs **(10)**
III.	**Folded Plate and Shells:** Folded Plate: Introduction, different cross section of folded plates, deformation characteristic of folded plate, Design of folded plates, Shells: method of pre-stressing, design of circular cylindrical shell and hyperboloid shell **(09)**
IV.	**Circumferential Pre-stressing:** Introduction, principal of circular pre-stressing, methods of design, General analysis and design of Prestressed concrete pipes, Liquid storage tanks, Ring beams, poles and Domes; Dam- stresses due various loads, design requirement, analysis and design of small dam **(08)**
V.	**Box girder bridge:** Introduction, Pre-tensioned and post tensioned concrete bridges; analysis of section for flexure, shear and bond; losses in pre-stress, deflection of girder; partial pre-stressing; analysis and design of anchorage block; box girder bridge **(08)**
VI.	**Composite Section:** Composite Section of pre-stressed concrete beam and cast in situ RC slab- analysis of stresses, deferent shrinkage, deflections, flexure, and shear strength of composite section, analysis and design of composite section **(08)**

On successful completion of the course, the students shall be able:

1. To understand the concept of pre-stressing, behavior of the pre-stressed structures vis-à-vis that of the RCC structure.
2. To take the decision with respect to the choice of pre-stressed section over RCC.
3. To understand the application of these techniques in civil engineering construction.
4. To analyze the various pre-stressed components of the structures and design the same.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester. The students shall be asked to appear for the either tests. However, at least one test is mandatory and the students may be asked to undertake the completion of assignment on live problems or course project solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will be compulsory and will have the weightage of 32 marks.
2. The students will have to attempt **any three** questions out of **remaining five** questions which will be having the weightage of 16 marks each.
3. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
4. The questions can be of **mixed nature** irrespective of modules

Recommended Books:

1. Krishna Raju (2000): 'Prestressed Concrete', *Tata McGraw Hill Publishing Co.*
2. Sinha.N.C.and.Roy.S.K. (1998):'Fundamentals of Prestressed Concrete', *S.Chand and Co.*
3. V. K. Raina (1994):'Concrete Bridge Practice Analysis Design and Economics', *Tata McGraw Hill, 2nd Edition, 1994.*
4. S. Ramamrutham (2013):'Prestressed Concrete', *Dhanpat Rai Publishing Company*
5. Lin, T.Y. and Burns, N.H. (2004):'Design of Prestressed Concrete Structures', *3rdEdition, John Wiley and Sons.*
6.   IS: 1343 – 1980, "Code of Practice of Prestressed Concrete", *Indian Standards Institution.*

Subject Code	Subject Name	Credits
MILO 1011	**Product Life Cycle Management**	**03**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	**--**	**--**	03	--	**--**	03

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	-	--	--	100

Course Objectives

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product
4. To familiarize the students with Virtual Product Development

Module	Contents
I.	**Introduction to Product Lifecycle Management (PLM):** Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM **(10)**
II.	**Product Design:** Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process. **(09)**
III.	**Product Data Management (PDM):** Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation **(05)**
IV.	**Virtual Product Development Tools:** For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies **(05)**
V.	**Integration of Environmental Aspects in Product Design:** Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into

Detail Syllabus

	the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design. **(05)**
VI.	**Life Cycle Assessment and Life Cycle Cost Analysis:** Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis. **(05)**

Contributions to Outcomes

On successful completion of the coursework, the learner will be able to:

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Internal Assessment:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Recommended Books:

1. John Stark: 'Product Lifecycle Management: Paradigm for 21st Century Product Realisation', *Springer-Verlag, 2004. ISBN: 1852338105*

2. Fabio Giudice, Guido La Rosa, AntoninoRisitano:'Product Design for the environment-A life cycle approach', *Taylor & Francis 2006, ISBN: 0849327229*

3. SaaksvuoriAntti, ImmonenAnselmie: 'Product Life Cycle Management', *Springer, Dreamtech, ISBN: 3540257314*

4. Michael Grieve: 'Product Lifecycle Management: Driving the next generation of lean thinking', *Tata McGraw Hill, 2006, ISBN: 0070636265*

Subject Code	Subject Name	Credits
MILO 1012	**Reliability Engineering**	**03**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	**--**	**--**	03	--	**--**	03

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	-	--	--	100

Course Objectives

1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To understand the various aspects of Maintainability, Availability and FMEA procedure

Module	Contents
I.	**Probability theory:** Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion:** Mean Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis. **(08)**
II.	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models:** Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis. **(08)**
III.	**System Reliability:** System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems. **(05)**
IV.	**Reliability Improvement:** Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method. **(08)**
V.	**Maintainability and Availability:** System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.**(05)**
VI.	**Failure Mode, Effects and Criticality Analysis:** Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols,

Detail Syllabus

	development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis **(05)**

Contributions to Outcomes

On successful completion of the coursework, the learner will be able to:

1. Understand and apply the concept of Probability to engineering problems
2. Apply various reliability concepts to calculate different reliability parameters
3. Estimate the system reliability of simple and complex systems
4. Carry out a Failure Mode Effect and Criticality Analysis

Internal Assessment:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper- Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Recommended Books:

1. L.S. Srinath: Reliability Engineering", Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
3. B.S. Dhillion, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
4. P.D.T. Conor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
6. Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.

Subject Code	Subject Name	Credits
MILO 1013	**Management Information System**	**03**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	**--**	**--**	03	--	**--**	03

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	-	--	--	100

Course Objectives

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
3. Define and analyse typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

Module	Contents
I.	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Imporance of IS to Society. Organizational Strategy, Competitive Advantages and IS**. (4)**
II.	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results. **(7)**
III.	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls. **(7)**
IV.	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.**(7)**
V.	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.**(6)**
VI.	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.**(8)**

Contributions to Outcomes

On successful completion of the coursework, the learner will be able to:

1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making

5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Internal Assessment:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Recommended Books:

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

Subject Code	Subject Name	Credits
MILO 1014	**Design of Experiments**	**03**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	**--**	**--**	03	--	**--**	03

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	-	--	--	100

Course Objectives

1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

	Detail Syllabus

Module	Contents
I.	**Introduction** 1.1 Strategy of Experimentation 1.2 Typical Applications of Experimental Design 1.3 Guidelines for Designing Experiments 1.4 Response Surface Methodology **(6)**
II.	**Fitting Regression Models** 2.1 Linear Regression Models 2.2 Estimation of the Parameters in Linear Regression Models 2.3 Hypothesis Testing in Multiple Regression 2.4 Confidence Intervals in Multiple Regression 2.5 Prediction of new response observation 2.6 Regression model diagnostics 2.7 Testing for lack of fit **(8)**
III.	**Two-Level Factorial Designs** 3.1 The 2^2 Design 3.2 The 2^3 Design 3.3 The General 2^k Design 3.4 A Single Replicate of the 2^k Design 3.5 The Addition of Center Points to the 2^k Design, 3.6 Blocking in the 2^k Factorial Design 3.7 Split-Plot Designs **(7)**
IV.	**Two-Level Fractional Factorial Designs**

	4.1 The One-Half Fraction of the 2^k Design	
	4.2 The One-Quarter Fraction of the 2^k Design	
	4.3 The General 2^{k-p} Fractional Factorial Design	
	4.4 Resolution III Designs	
	4.5 Resolution IV and V Designs	
	4.6 Fractional Factorial Split-Plot Designs	**(7)**
V.	**Response Surface Methods and Designs**	
	5.1 Introduction to Response Surface Methodology	
	5.2 The Method of Steepest Ascent	
	5.3 Analysis of a Second-Order Response Surface	
	5.4 Experimental Designs for Fitting Response Surfaces	**(7)**
VI.	**Taguchi Approach**	
	6.1 Crossed Array Designs and Signal-to-Noise Ratios	
	6.2 Analysis Methods	
	6.3 Robust design examples	**(4)**

Contributions to Outcomes

On successful completion of the course work, the learner will be able to:

1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action
2. Apply the methods taught to real life situations
3. Plan, analyze, and interpret the results of experiments

Internal Assessment:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Recommended Books:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition, John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss

Subject Code	Subject Name	Credits
MILO 1015	**Operations Research**	**03**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	**--**	**--**	03	--	**--**	03

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	-	--	--	100

Course Objectives

1. Formulate a real-world problem as a mathematical programming model.

2. Understand the mathematical tools that are needed to solve optimization problems.

3. Use mathematical software to solve the proposed models.

Module	Contents
I.	**Introduction to Operations Research**: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research **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, Revised simplex method, **Duality**, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis
	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.
	Assignment Problem: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem
	Integer Programming Problem: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms. **(14)**
II.	**Queuing models**: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population **(05)**
III.	**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. **(05)**
IV.	**Dynamic programming**. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems. **(05)**
V.	**Game Theory**. 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. **(05)**
VI.	**Inventory Models**: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model, **(05)**

On successful completion of the course work, the learner will be able to:

1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.

2. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.

3. 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.

4. Understand the applications of integer programming and a queuing model and compute important performance measures

Internal Assessment:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question

2. All question carry equal marks

3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)

4. Only Four question need to be solved.

Recommended Books:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.

2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.

3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.

4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.

5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

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Semester I

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Subject Code	Subject Name	Credits
MILO 1016	**Cyber Security and Laws**	**03**

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Teaching Scheme

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Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	**--**	**--**	03	--	**--**	03

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Evaluation Scheme

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Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	-	--	--	100

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Course Objectives

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1. To understand and identify different types cybercrime and cyber law

2. To recognized Indian IT Act 2008 and its latest amendments

3. To learn various types of security standards compliances

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Detail Syllabus

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Module	Contents
I.	**Introduction to Cybercrime:** Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes**. (4)**

II.	**Cyber offenses & Cybercrime:** How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops . **(9)**
III.	**Tools and Methods Used in Cyberline** Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft) **(6)**
IV.	**The Concept of Cyberspace** E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law **(8)**
V.	**Indian IT Act.** Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments**(6)**
VI.	**Information Security Standard compliances** SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI. **(6)**

Contributions to Outcomes

On successful completion of the course work, the learner will be able to:

1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development

Internal Assessment:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination.

In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Recommended Books:

1. Nina Godbole, SunitBelapure, *Cyber Security*, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, *Information Systems Security,* Wiley India, New Delhi
6. Kennetch J. Knapp, *Cyber Security &Global Information Assurance* Information Science Publishing.
7. William Stallings*, Cryptography and Network Security,* Pearson Publication
8. Websites for more information is available on : The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
9. Website for more information , A Compliance Primer for IT professional : https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

Subject Code	Subject Name	Credits
MILO 1017	**Disaster Management and Mitigation Measures**	**03**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	**--**	**--**	03	--	**--**	03

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	-	--	--	100

Course Objectives

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster
5. To understand application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

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Detail Syllabus

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Module	Contents
I.	**Introduction** 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. **(03)**
II.	**Natural Disaster and Manmade disasters:** **Natural Disaster:** Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion **Manmade Disasters:** Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters. **(09)**
III.	**Disaster Management, Policy and Administration** Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process. **(06)**
IV.	**Institutional Framework for Disaster Management in India:** 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. **(06)**
V.	**Financing Relief Measures:** 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. **(09)**
VI.	**Preventive and Mitigation Measures:** 6.1 Pre-disaster, during disaster and post-disaster measures in some events in general 6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication 6.3 Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 6.4 Do's and don'ts in case of disasters and effective implementation of relief aids. **(06)**

Contributions to Outcomes

On successful completion of the course work, the learner will be able to:

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

Internal Assessment:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper - Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks

3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Recommended Books:

1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elseveir Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by RajdeepDasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.
8. (N.B. Learners are also expected to refer reports published at national and International level and updated information available on authentic web sites)

Subject Code	Subject Name	Credits
MILO 1018	**Energy Audit and Management**	**03**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	**--**	**--**	03	--	**--**	03

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	-	--	--	100

Course Objectives

1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Detail Syllabus

Module	Detailed Contents
I.	**Energy Scenario:** Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy

	Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance **(04)**
II.	**Energy Audit Principles:** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach- understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR) **(08)**
III.	**Energy Management and Energy Conservation in Electrical System:** Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. **Energy efficiency measures in lighting system, Lighting control:** Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives. **(10)**
IV.	**Energy Management and Energy Conservation in Thermal Systems:** Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities. **(10)**
V.	**Energy Performance Assessment:** On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis. **(04)**
VI.	**Energy conservation in Buildings:** Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources **(03)**

Contributions to Outcomes

On successful completion of the course work, the learner will be able to:

1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
5. To analyze the data collected during performance evaluation and recommend energy saving measures

Internal Assessment:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Recommended Books:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons

4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).

5. Energy Management Principles, C.B.Smith, Pergamon Press

6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press

7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press

8. www.energymanagertraining.com

9. www.bee-india.nic.in

Subject Code	Subject Name	Credits
MDLO 1011	**DESIGN OF BRIDGE STRUCTURES** (Departmental Elective)	**04**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	**--**	**--**	04	--	**--**	04

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	-	--	--	100

Course Objectives

1. To study the loads, forces on bridges, selection of suitable type of bridge according to the site condition, IRC loadings, load distribution and railway loading.
2. To understand the design of bridge superstructure and substructures.
3. To study different types of bridge foundations and design thereof.
4. To study the erection of bridge super structures.

Module	Content
I.	Introduction to bridge engineering, classification and components of bridges, layout, planning, Investigation for bridges. Choice of the types of bridges, Conceptual bridge design.
II.	Structural forms of bridge decks, beam and slab decks, cellular decks. Standard specification for bridges, IRC loadings for road bridges, IRS loading standards for railway bridges. Bridge appurtenances.
III.	Design of slab culvert, box culvert and skew bridge.
IV.	Behaviour, analysis and design of RC and PSC box girder bridge decks.
V.	Introduction to Courbon's method, Henry-Jaegar method and Guyon-Massonet method. Design of T-beam PC bridges using Courbon's method.
VI.	Introduction to Structural classification of Rigid Frame bridge, analysis and design of Rigid Frame bridge.
VII.	Classification and design of bearings. Expansion joints. Forces acting on abutments and piers, analysis and design, types and design of wing walls.
VIII.	Bridge foundations: Shallow and deep foundation – design and construction aspects including open well, pile and caisson foundation.
IX.	Seismic design philosophy for bridges, sate of art of modelling of bridges, seismic design of substructure, Capacity design of substructures and ductile detailing, seismic design of well and pile foundation.
X.	Pre-stressed Concrete Bridge: Types of Pre-stressed concrete bridge, types of pre-stressing, principles of design, design of pre-tensioned pre-stressed concrete slab deck and T-beam deck slab, design of bridge girder subjected to IRC loading

<div style="border:1px solid black; text-align:center; font-weight:bold;">Contributions to Outcomes</div>

On successful completion of the course, the student shall be able to:

1. Select the suitable type of bridges according to the site condition.
2. Understand IRC loads, distribution of these loads among longitudinal beams of a bridge.
3. Undertake the design of balanced cantilever concrete bridge, prestressed concrete bridge, Railway Bridge, RC arch bridges and box girder bridges.
4. Undertake the design different types of foundations, piers and abutments, their methods of construction,
5. Understand various types of bearings and their suitability, erection of bridge superstructure.
6. Understand the Seismic design philosophy for bridges.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester . The students shall be asked to appear for the either tests. However, at least one test is mandatory and the students may be asked to undertake the completion of assignment on live problems or course project solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
3. The students will have to attempt any **four** questions out of **total six** questions
4. The questions can be of **mixed nature** irrespective of modules

Recommended Books:

1. Victor, J. : 'Essentials of Bridge Engineering',*Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi (Fifth Edition)*
2. *Jagadeesh, T.R. andJayaram, M.A.: 'Design of Bridge Structures', Prentice-Hall of India Pvt. Ltd.*
3. *Krishna Raju, N.:'Design of Bridges',Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.*
4. Lee, David:'Bridge Bearings and Expansion Joints', *E and FN Spon.*

5. Raina, V.K.:'Concrete Bridge Practice Analysis, Design and Economics', *Tata McGraw Hill.*

6. Relevant IRC Codes – IRC: 5, IRC: 6, IRC: 18, IRC: 27, IRC: 45, IRC: 78, IRC: 83.

7. Chen, W. F. and Dual, L. ' Bridge Engineering Handbook', *CRC Press, 1999.*

8. Bowles, J. E.: 'Foundation Analysis and Design', *McGraw-Hill International Edition.*

9. Ponnuswamy, S.:'Bridge Engineering', *Tata McGraw Hill.*

10. Kurian, N. P.: 'Design of Foundation Systems', *Narosa Publishing House.*

11. SaranSwamy: 'Analysis and Design of Substructures',*Oxford & IBH Publishing Co. Pvt.Ltd., New Delhi.*

Subject Code	Subject Name	Credits
MDLO 1012	**ANALYSIS AND DESIGN OF TRANSPORTATION STRUCTURES** (Departmental Elective)	**04**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	**--**	**--**	04	--	**--**	04

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	-	--	--	100

Course Objectives

1. To study the classical methods of structural analysis and its application to the elements of different transportation structures.

2. To extend the application of Slope Deflection Method, Moment Distribution Method and Kani's Method for the analysis of the elements, i.e., prismatic and non-prismatic members, of different transportation structures.

3. To understand the analysis of the fixed arches, two hinged stiffening girder, beams curved in plan.

4. To understand the analysis of beams resting on elastic foundation with respect to various boundary conditions.
5. To study the Analysis and design of slab and box culverts.
6. To study the structural behaviour of the concrete pavements (highways and airfields) subjected to different loads.
7. To study the various types of structural responses (stresses and deformations) inducing the pavements due to wheel load and other climatic variations.
8. To study the methods of designing of highway concrete pavement using IRC method and its subsequent application along with the design of joint.
9. To study the various methods for the analysis and design of Airfields

Detail Syllabus

Module	Content
I.	**Introduction to classical methods of Structural Analysis:** Flexibility and Stiffness method (joint and member approach) and its application to beam, frame and truss element (Bridge and Hanger) under axial bending. Slope Deflection and moment distribution method and its application for prismatic and non-prismatic members such as beam, simple portal frame and grid. Kani's method for beam and single storey frame
II.	**Arches and Girder** Analysis of fixed arches, Two hinged stiffening girder
III.	Analysis of beam curved in plan and beams resting on elastic foundation
IV.	**Analysis and Design of Culverts:** Slab culvert and Box culvert
VI.	**Analysis and Design of Concrete Pavement (Highways):** Different types of stresses to be induced in pavements, Analysis of Pavement for different loadings, Stress Distribution, Design Principles, Overview of the methods of pavement design as per various IRC codes (IRC: 58); Design of concrete pavement using latest IRC code (IRC: 58-2015); Design of Joints.
VII.	**Analysis and Design of Concrete Pavement (Airfields):** Study Various methods such as: U.S. Corp's Engineers method, FAA and ICAO Methods; Its application for designing the airfield pavements.

On successful completion of the course, the students shall be able to:

- Able to analyze different transportation structures or members/ components thereof.
- Able to design the simple bridge structures such as culverts.
- Able to analyze and design the highway and airfield pavaments.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester . The students shall be asked to appear for the either tests. However, at least one test is mandatory and the students may be asked to undertake the completion of assignment on live problems or course project solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
3. The students will have to attempt any **four** questions out of **total six** questions.
4. The questions can be of **mixed nature** irrespective of modules.

Recommended Books:

1. Principles and Practice of Highway Engineering: *L.R.Kadiyali*, Khanna publications.
2. Highway Engineering: *Khanna S.K. and Justo* C.E.G. Nem Chand (Revised 10th Edition, 2014)
3. Principles, Practice and Design of Highway Engineering (Including Airport Pavements): *Sharma, S.K*., S. Chand Technical Publications (3rd Revised Edition, 2013)
4. Pavement Analysis and Design: *Yang H. Huang*, Prentice Hall, New Jersey, 1993
5. Pavement Design: *Yoder* and*Witzech*, McGraw-Hill, 1982.
6. The Design and Performance of Road Pavements: *Croney, David et al*, McGraw Hill.
7. S.P Gupta, G.S. Pandit and R. Gupta: 'Theory of Structures'Vol-II, *Tata Mc Graw-Hill.*
8. P. K. Sing: 'Matrix Analysis of Structures', *Cengage Learning.*

9. M. L. Gambhir: 'Fundamentals of Structural Mechanics and Analysis',*PHI Publication.*

10. R. Vaidyanathan, P. Perumal 'Comprehensive Structural Analysis', Vol-II, *Laxmi Publication.*

11. T. S. Thandavamoorthy:'Structural Analysis', *Oxford University Press.*

12. L. S. Negi and R. S. Jangid: 'Structural Analysis' *Tata Mc Graw-Hill.*

13. S. Ramamrutham: 'Design of Reinforced Concrete Structures', *Dhanpat Rai Publication.*

Subject Code	Subject Name	Credits
MDLO 1013	**ANALYSIS OF COMPOSITE STRUCTURES** (Departmental Elective)	**04**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	**--**	**--**	04	--	**--**	04

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	-	--	--	100

Course Objectives

1. To develop an understanding of the behaviour of the composite structures.
2. To design the steel concrete composite elements and structures.

Detail Syllabus

Module	Contents
I.	Introduction to composite construction, basic concepts, types of composite constructions
II.	Steel concrete composite sections

III.	Analysis and of composite beams, Composite floors.
IV.	shear connectors: functions & types
V.	Steel concrete composite columns, columns subjected to axial loads and moments.
VI.	Encased composite construction of beams and columns, concepts and design.
VII.	Study of IS: 11384, IRC-22 and their applications

Contributions to Outcomes

On successful completion of the course, the students shall be able to:

1. Understand design composite beams, columns, including the related connections.
2. Understand the need, advantages and limitations of composite material.
3. Apply basic mechanical principles in analysis of composite structures likebeams, columns, floors, shear connectors, etc.
4. Understand various codal provisions as per Indian standards for the design of structural components using composite materials and its subsequent application.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester . The students shall be asked to appear for the either tests. However, at least one test is mandatory and the students may be asked to undertake the completion of assignment on live problems or course project solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
3. The students will have to attempt any **four** questions out of **total six** questions.
4. The questions can be of **mixed nature** irrespective of modules

Recommended Books:

1. Jones, R.M.: 'Mechanics of Composite Materials'; *Mc Graw Hill,Tokyo*.
2. Christensen, R.M.: 'Mechanics of Composite Materials'; *John Wiley and Sons,New York.*

3. Agarwal, B.D. and Broutman, L.J.: Analysis andPerformance of Fibres Composite; *John Wiley and Sons, New York.*

4. Calcote, L.R.:'The Analysis of Laminated Composite Structures';*Van Nostrand Reinhold Co., New York.*

5. Holmes, M and Just, D.J.: 'GRP in Structural Engineering';*Applied Science Publishers, London.*

6. Gibson R.F.; 'Principles of Composite Material Mechanics'.

7. Reddy J.N.:'Analysis of Composite Laminated Plates', *Mc Graw Hill.*

8. Johnson, R.P. "Composite Structures of Steel and Concrete", Vol-I, Granado Publishing Ltd., London, 1994.

Semester I

Subject Code	Subject Name	Credits
MDLO 1014	**NUMERICAL METHOD** (Departmental Elective)	**04**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	**--**	**--**	04	--	**--**	04

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	-	--	--	100

Course Objectives

1. To familiarize the students in the field of numerical methods.
2. To expose the students to the applications of such methods for solving the problems associated with structural engineering applications.

Detailed Syllabus

Module	Content
I.	**Introduction:** Roots of a non-linear equation and Roots of a polynomial of nth degree [Incremental search method; Method of successive approximations; Newton's method; Bisection method; Secant method; Müller's method; Synthetic division; Bairstow's method]

	and convergence study.
II.	**Solution of (non-homogeneous) linear algebraic equations**: Review of matrix algebra; Gauss elimination method; Cholesky's decomposition method; Householder method; Gauss-Seidal iterative method.
III.	**Solution of non-linear algebraic equations**: Method of successive approximation; Newton's method; Modified Newton – Raphson method; Secant method.
IV.	**Eigen values and Eigen vectors:** Reduction of generalized Eigen value problem to the standard Eigen value problem; methods for obtaining Eigen values and Eigen vectors [Polynomial method; Vector iteration method; Mises power method; Jacobi method].
V.	**Time marching schemes for solution of problems in time domain:** Numerical integration (2 – D) [Newton – Cotes method; Gauss –Legendre method].
VI.	**Solution of differential equations:** Ordinary and partial differential equations, Taylor series, Euler's method; Runge – Kutta method; Simple applications in structural mechanics such as critical loads of struts, beam columns, Solution of transcendental equation, applications of buckling of simple portal frames
VII.	**Finite difference method**: Simple applications to problems of beam and plates , Laplacian equation, consolidation equation, laterally loaded piles etc.
VII.	**Regression Analysis:** Least square method, Polynomial function curve fitting Interpolation-Polynomial approximation, Lagranges method, Spline interpolation

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Contributions to Outcomes

On successful completion of the course, the learner shall be able to use the various methods studied in this course in solving the structural engineering and allied problems.

Internal Assessment:
The internal assessment consists of two tests, i.e., mid-semester and end semester . The students shall be asked to appear for the either tests. However, at least one test is mandatory and the students may be asked to undertake the completion of assignment on live problems or course project solely at the discretion of the course instructor.

Theory Examination:
1. Question paper will comprise of **six** questions; each carrying 20 marks.

2. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
3. The students will have to attempt any **four** questions out of **total six** questions.
4. The questions can be of **mixed nature** irrespective of modules

Recommended Books:

1. Chapra, S. C. and Canale R. P.: 'Numerical Methods for Engineering', *Tata McGraw Hill.*
2. Carnahan, B., Luther, H. A. and Wilkes, J. O.:'Applied Numerical Methods', *John Wiley.*
3. Heath, M. T.: 'Scientific Computing: An Introductory Survey', *McGraw Hill.*
4. Douglas Faires, J. and Richard Burden: 'Numerical Methods', *Thomson.*
5. Rajasekaran, S.:'Numerical Methods in Science and Engineering',*S. Chand.*
6. E. Balguruswamy:'Numerical Methods', *TMH Publications.*
7. Pallab Ghosh: 'Numerical Methods with Computer Programming in C++', *PHI Pvt. Ltd.*
8. John F.Flemming:'Computer Analysis of Structural Systems', *Mc Graw Hill International Edition.*
9. Atkinson, K.E.:'An Introduction to Numerical Analysis', *J. Wiley and Sons.*
10. Wilkinson, J.H.:'The Algebric Eigen Value Problems', *Oxford University Press.*

Subject Code	Subject Name	Credits
MDLO 1015	**ADVANCE CONCRETE TECHNOLOGY**	**04**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	**--**	**--**	04	--	**--**	04

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	-	--	--	100

Course Objectives

To study the properties of concrete making materials, tests , mix design, special concretes and various methods of making concrete in the context of advances in the field of concrete technology.

Detailed Syllabus

Module	Content
I.	Concrete: properties of concrete, w/c ratio, w/b ratio, gel space ratio, maturity concept, and aggregate cement bond strength.
	Use of Fly Ash, Silica Fumes, Metakaolinand GGBS in concrete; Rheological behavior of concrete, requirements of workability of concrete; Durability andeffect of environmental

	conditions, Strength and maturity of hardened concrete; Impact, dynamic and fatigue behavior of concrete;Shrinkage and creep of concrete, behavior of concrete under fire. Behavior of concrete under aggressive environmental conditions including temperature.
II.	Light weight concrete, ultra-light weight concrete, waste material based concrete, sulphur concrete and sulphur infiltrated concrete, jet cement concrete (ultra-rapid hardening), gap graded concrete; Fibre reinforced concrete, no fines concrete; Polymer Concrete – High performance concrete; High performance fiber reinforced concrete, Geo Polymer concrete; under water concreting; Fracture mechanics of concrete,repairs and rehabilitation of old concrete.
III.	MIX DESIGN: Proportioning of concrete mixes by various methods – fineness modulus, trial and error, mix density, ISI code methods ; factors in the choice of mix proportions – Durability of concrete –quality control of concrete – Statistical methods, design of high strength concrete mixes, design of light weight aggregate concrete mixes, design of fly ash cement concrete mixes, design of high density concrete mixes non-destructive testing methods: probe penetration, pull out test, break off maturity method, stress wave propagation method, electrical/magnetic methods, nuclear methods and infrared thermography, core test.
IV.	Historical development of fibre reinforced concrete, properties of metallic fibre, polymeric fibres, carbon fibres, glass fibres and naturally occurring fibres. Interaction between fibres and matrix (uncracked and cracked matrix), basic concepts and mechanical properties: tension and bending.
V.	Properties of hardened FRC, 64ehaviours under compression, tension and flexure of steel fibres and polymeric fibres. GFRC, SFRC, SIFCON-development, constituent materials, casting, quality control tests and physical properties.
VII.	Ferrocement, analysis and design of prefabricated concrete structural elements, manufacturing process of industrial concrete elements, precast construction, errection and assembly techniques.

Contributions to Outcomes

On successful completion of the course, the learners shall have an in depth knowledge of the advanced concrete technology and its application in the diverse spectrums of the Civil Engineering.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester . The students shall be asked to appear for the either tests. However, at least one test is mandatory and the students may be asked to undertake the completion of assignment on live problems or course project solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
3. The students will have to attempt any **four** questions out of **total six** questions.
4. The questions can be of **mixed nature** irrespective of modules

Recommended Books:

1. Concrete Technology: Santhakumar,*Oxford University Press.*
2. Concrete Technology: A.M. Neville and Brooks
3. Properties of Concrete: Murdock.
4. Properties of Concrete: P.K.Mehta.
5. Concrete Technology: M.S.Shetty.
6. Fiber Reinforced Cement Composite: P.N.Balguru and P.N.Shah.
7. Concrete Technology:D.F.Orchard
8. Concrete Technology:Gambhir,*3rd edition, TataMc Graw Hill*

Subject Code	Subject Name	Credits
MDLO 1016	**ANALYSIS AND DESIGN OF MULTISTORIED BUILDINGS** (Departmental Elective)	**04**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	**--**	**--**	04	--	**--**	04

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03	-	--	--	100

Course Objectives

1. To understand the complete analysis and design of building frames using relevant IS codes.
2. Mathematical modelling of buildings with different structural systems with and without diaphragms.
3. To understand the complete Special aspects in Multi-storeyed buildings.
4. To impart knowledge on static and dynamic wind analysis, design of multi-storeyed buildings
5. To expose students to state-of-the-art multi-storeyed / high-rise buildings
6. To familiarize students with the Indian codes/Standards for static and dynamic wind analysis, design and design for Fire Resistant.

7. To inculcate the aptitude for mathematical modeling with and without diaphragms, infill wall etc.

8. To develop the students well versed with concepts of civil engineering techniques and ability to use it in practice.

Detailed Syllabus

Module	Content
I.	Building frames, frame-shear wall buildings; Braced Buildings, Mathematical modelling of buildings with different structural systems with and without diaphragms.
II.	Earthquake, wind and other (i.e. blast andsnow) load calculations along with dead load and live loads and their combinations.
III.	Special aspects in Multi-storeyed buildings: Effect of torsion, flexible first story, P-delta effect, soil-structure interaction on building response, drift limitation.
IV.	Analysis and Design of multi-storeyed buildings with masonry infills, Sequential analysis for multi-storeyed buildings.
V.	Design for Fire Resistant, Creep, Shrinkage and Thermal stresses.

Contributions to Outcomes

On successful completion of the course:

1. The present methods of static and dynamic wind analysis of multistoried buildings

2. The student shall be able to independently or as a member of the team design the structures using structural analysis and design knowledge for safety, serviceability and economy.

3. The student shall be able to design multi-storeyed buildings by relevant Indian codes/Standards for RCC and PSC structures.

4. To identify preliminary sizing for mathematical modeling of RC/steel structures, various shear wall analysis and design for Fire Resistant.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester . The students shall be asked to appear for the either tests. However, at least one test is mandatory and the students may be asked to undertake the completion of assignment on live problems or course project solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
3. The students will have to attempt any **four** questions out of **total six** questions.
4. The questions can be of **mixed nature** irrespective of modules

Recommended Books:

1. FarzadNaeim (2001):'Handbook on Seismic Analysis and Design of Structures', *Kluwer Academic Publisher*
2. Paulay, T. and Prestiley, M.J.N. (1999):'Seismic Design of R.C.C.and Masonry Buildings', *John Willey and Sons (2nd Edition)*
3. Booth, E. (1994):'Concrete Structures in Earthquake Regions', *Longman Higher Education*
4. Park, R. andPaulay, T. (1975):'Reinforced Concrete Structures', *John Willey and Sons (2ndEdition)*
5. Fintel, M. (1986):'Handbook of Concrete Engineering', *CBS Publishers, Delhi (2nd Edition)*

Subject Code	Subject Name	Credits
MSTR- L101	**Laboratory - I**	**01**

Detail Syllabus

List of experiments (Any Four)

1. Determination of flexural stress and deflection of cantilever beam (Equal Angle Section) under unsymmetrical bending

2. Shear centre location of thin open channel section

3. Deflection in simply supported beam using strain gauge

4. Measurement of strain by Electrical Resistance Strain Gauge

5. Deflection in Continuous beam and verification of Maxwell's Reciprocal Theorem

6. Buckling Test on steel rod specimen

7. Compression Test on Laminated Neoprene Pad

	Semester I	

Subject Code	Subject Name	Credits
MSTR-L102	**Design Studio-I**	**01**

Contents

The students shall be asked to undertake the analysis and design of some of the structures involved in various subjects and submit the comprehensive report thereof for evaluation.

In case of subjects where analysis and design of the structures are not involved, the students shall be given the assignments (Minimum two and maximum five).

Computer aided analysis and design (as the case may be) using standard software (SAP/ ANSYS/ ETABS/ STAAD Pro) is recommended.

Subject Code	Subject Name	Credits
MSTR- C201	**FINITE ELEMENT ANALYSIS**	04

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	--	--	04	--	--	04

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	25	--	--	125

Course Objectives

1. To understand the basics, advantages and significance of finite element analysis.
2. To study the various methods used in finite element formulation.
3. To compute stresses and strains in simple structural elements using finite element methods.
4. To understand geometric non-linearity, material non-linearity in two dimensional elements and general formulation of a physically non-linear problem.
5. To employ finite element analysis methods on selected real world problems.

Detail Syllabus	

Module	Contents
I.	**Introduction:** Review of Variation methods- Calculus of variation- Variational Principles of solid Mechanics. Principe of Minimum Potential Energy, Principal of Complementary Energy- Hamilton Principal, The Basic component- Concept of an element- Various Element Shapes- Displacement models- Formulation of Finite Element Method. Using principle of virtual Displacement- Derivation of Element Stiffness and loads for Pin Jointed Bar element, Beam element, Triangular Plate element (In-plane forces), Triangular and Rectangular Plate Element in Bending.**(08)**
II.	**Variational formulation of finite element methods:** Variational Formulation of Finite Element Method (FEM), Isoparametric element- Local vs. Natural Co-ordinates system, Line, Triangular, Quadrilateral and Tetrahedral Element- Interpolation Displacement Models Formulation of Isoparametric Finite element matrices in Local and Global Coordinate system. **(08)**
III.	**General steps involved in finite element analysis:** Implementation of FEM – Discretization of the Structure- Calculation of Element Stiffness, Mass and Equivalent Nodal loads, Assemblage of Structures Matrices, Boundary Conditions- Solutions of the overall problem. Calculations of Element Stresses, Computer Program Organization.**(08)**
IV.	**Non Linear analysis using finite element methods:** Introduction to Non Linear Analysis- Geometric Non-Linearity- Geometric Stiffness of an Axial Element, Stability of Bar Spring System. General Formulation of a Geometrically Non-linear problem. Geometric Stiffness of a Beam-Column of Triangular element. Non-linear material behavior. Non-linear spring- Elastic Plastic Analysis by FEM-Elasto-Plastic Analysis of Truss-Two Dimensional Element Formulations- General Formulation of a Physically Non-linear Problem.**(08)**

V.	**Dynamic analysis:**
	Introduction to Dynamic Analysis by FEM- Formulation of Inertial Properties- Lumped Mass vs. Consistent Mass matrices- Condensation and Assembly of Mass Matrices- Formulation of a Physically Non-linear Problems.**(08)**
VI.	**Application of finite element methods in structural mechanics:**
	Formulation and solution of Problems in Structural Mechanics using the above methods.**(08)**

Contributions to Outcomes

On successful completion of the course, the learner shall be able to:

1. Understand and appreciate the importance and capabilities of finite element analysis methods.
2. Understand the various kinds of non-linearity induced in a structure.
3. Understand and implement finite element methods in selected real world problems.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester . The students shall be asked to appear for the either tests. However, at least one test is mandatory and the students may be asked to undertake the completion of assignment on live problems or course project solely at the discretion of the course instructor.

Theory Examination:
1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
3. The students will have to attempt any **four** questions out of **total six** questions.
4. The questions can be of **mixed nature** irrespective of modules

Recommended Books:

1. Zienkiewicz O.C.: 'The Finite Element Method in Engineering Science', *McGraw Hill book Co.*
2. J.N. Reddy:'Finite Element Analysis', *McGraw hill book Co.*

3. Chandragupta T.R. & Belagundu A.D:'Introduction to Finite Elements in Engineering', *Prentice Hall of India Pvt. Ltd.*

4. Rajshekaran S,:'Finite Element Analysis', *Wheeler publishing*.

5. Krishnamoorthy C.S.:'Finite Element Analysis', *McGraw hill book Co*.

6. Cook R.D., Malkus D.S. and Plesha M.E.:'Concepts and Applications of Finite Element Analysis', *John Wiley & Sons (Asia) Pvt. Ltd*.

7. Bickford W.B.:'A First Course in Finite Element Method', *IRWIN, Homewood, IL 60430*

8. Rao S.S.:'The Finite Element Method in Engineering', *Pergamon Press*.

9. Weaver W and Johnston P.R.:'Finite Element for Structural Analysis', *Prentice Hall*.

Subject Code	Subject Name	Credits
MSTR-C202	**STRUCTURAL DYNAMICS**	**04**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	--	--	04	--	--	04

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	--	--	--	100

Course Objectives

- To expose the students to understand the basic theory of structural dynamics, structural behavior under vibratory load and the effect of damping.
- To study the difference between static load and different types of dynamic loads.
- To study the free vibration analysis of SDOF systems, concept of damping anddynamic analysis of SDOF system subjected to different dynamic loads.
- To study the dynamic degrees of freedom and calculation of the frequencies and mode shapes for lumped mass for discrete MDOF systems,
- To study the modal analysis of MDOF systems and analysis of systems with distributed mass for continuous system.
- To study the random vibrations, probabilistic theory, random process and related parameters.
- To study the stochastic response analysis of linear SDOF systems.

	Detail Syllabus

Module	Content
I.	**Introduction to structural Dynamics- Definition of Basic Problem in Dynamics**. Static vs. Dynamic loads. Different types of dynamics loads**(4)**
II.	**Introduction to single Degree of freedom (SDOF) Systems.** Undamped vibration of SDOF system natural frequency and period of vibration Damping in structures, viscous damping and Coulomb damping, effect of damping on frequency of vibration and amplitude of vibration, Logarithmic decrement Forced vibration, response to periodic loading, response to pulsating forces, dynamic load factor. Response of structure subjected to General dynamic load, Duhamel's Integral Numerical Evaluation of Dynamic Response of SDOF systems Response of structure in frequency domain subjected to general periodic and not periodic/impulsive force of short duration, use of complex frequency response function, use of Fourier series for Periodic Forces. Introduction to vibration isolation. Distributed mass system idealized as SDOF system, use of Rayleigh's method. Response of SDOF system subjected to ground motion **(14)**
III.	**Lumped mass multi-degree of freedom (MDOF) system, coupled and uncoupled system** Direct determination of frequencies of vibration and mod shape. Orthogonality principle. Vibration of MDOF systems with initial conditions Approximate method of determination of natural frequencies of vibration and mode shapes – Vector Integration Method Energy methods and use of Lagrange's method in writing equation of motions decoupling of equations of motion, modal equation of motion, concept of modal mass and modal stiffness. Forced vibration of MDOF system, Modal Analysis. Application to multi-storey rigid frames subjected to lateral dynamic loads. **(12)**
IV.	**Earthquake analysis – Introduction.** Seismicity of a region, causes of earthquake

	Intensity of earthquake, Richter Scale, Measurement of Earthquake ground motion, Seismogram, construction of seismograph
	Application of modal analysis concept to seismic disturbance, Response spectrum method.
	I.S code provisions for seismic analysis of buildings and water towers.
	Approximate method of earthquake analysis– Seismic co-efficient method and its limitation
	Introduction to history analysis **(12)**
V.	**Structure with distributed mass system, use of partial differential equation**.
	Free vibration analysis of single span beams with various boundary conditions, determination of frequencies of vibration and mode shapes
	Forced vibration of single span beams subjected to the action of specified dynamic loads. **(06)**

Contributions to Outcomes

The students are expected to understand the difference between static and dynamic loads and analysis. They are expected to evaluate the response of SDOF and MDOF systems to different types of dynamic loads including ground motions. They are also expected to understand the basics of random vibrations and the application of this concept to analyze Linear SDOF systems.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester . The students shall be asked to appear for the either tests. However, at least one test is mandatory and the students may be asked to undertake the completion of assignment on live problems or course project solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
3. The students will have to attempt any **four** questions out of **total six** questions.
4. The questions can be of **mixed nature** irrespective of modules

Recommended Books:-

1. Craig R.R.: 'Structural Dynamics-An Introduction to Computer Methods',*John Wiley and Sons.*
2. Anil K. Chopra: 'Dynamics of Structures', *Prentice Hall India Pvt. Ltd.*
3. CloguhandPenzein: 'Dynamics of Structures'*Tata Mc-Graw Hill Pvt. Ltd.*
4. John M. Biggs: 'Structural Dynamics',*Tata Mc-Graw Hill.*
5. Mario Paz: 'Structural Dynamics Theory and Computation', *CBS Publisher.*

Subject Code	Subject Name	Credits
MSTR-C203	**ADVANCED DESIGN OF CONCRETE STRUCTURES**	**04**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	--	--	04	--	--	04

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	04	--	--	--	100

Course Objectives

1. To understand the design philosophy of two way slab using ultimate load method.

2. To study the concept of the design of flat slab, flat plate slab.

3. To study the analysis of the beams curved in plan and extend its application for the design of such beams.

4. To understand the design concept for special foundations such as strip footing, raft foundations and pile foundations including pile cap along with that for storage structures such as bunkers and silos.

5. To understand the concept for the design of miscellaneous structures.

6. To get acquainted with the analysis and design of concrete pavements for highways using IRC: 58-2015 including the design of joints therein.

Module	Content
I.	Ultimate Load Analysis of RC slabs using Yield line theory (Virtual work and equilibrium method); Application for the analysis and design to orthotropically reinforced square/rectangular slabs with various boundary conditions under uniformly distributed loads.
II.	Design of flat plates and flat slabs, Behaviour of flat slab, Method of analysis (Direct design method, Equivalent frame method, Transfer of moments of column), Shear in flat plates and flat slabs, Design of flat plate and flat slab.
III.	Beams curved in plans loaded perpendicular to their plane, Fixed and continuous curved beams, Design of beams curved in plan.
IV.	Special Foundations: Design of Strip footing, Raft foundation, Pile foundation including pile cap.
V.	Silos and Bunkers: Lateral pressure as per Janssen's and Airy's theory, Design consideration for square, rectangular and circular shapes, Design of Hopper and Support structures.
VI.	Design of miscellaneous structures: Corbells, Deep beams, RC structural wall including introduction to shear walls; and design of nibs.
VII.	Analysis and design of concrete pavement (highways) and joints as per IRC method.

Contributions to Outcomes

On successful completion of the course, the learner will be able to design the various structural elements as contained in the syllabus including special foundations, storage structures and pavements along with the miscellaneous structures such as corbels, deep beams, structural walls, etc.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester . The students shall be asked to appear for the either tests. However, at least one test is mandatory and the students may be asked to undertake the completion of assignment on live problems or course project solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
3. The students will have to attempt any **four** questions out of **total six** questions.
4. The questions can be of **mixed nature** irrespective of modules

Recommended Books:

1. V. Ramakrishnan and P.D.Arthur.: 'Ultimate Strength design for structural concrete', *Wheeler Publishing Co.*
2. Karve S.R. and Shah V.C.:'Design of reinforced cement concrete structures using Limit State Approach', *Structures Publishers.*
3. G.S. Ramaswamy:'Design and construction of concrete shell roofs', *McGraw Book Co.*
4. Jain O.P and Jaikrishna:'Plain and reinforced concrete', *Vol-II, Nemchand and Bros.*
5. Ramamrutham S.:'Design of reinforced Concrete Structures',*Dhanpat Rai and Sons.*
6. P. C. Vargis.: 'Design of Reinforced concrete shells and folded Plates', *PHI Learning Pvt. Ltd.*
7. P. C. Varghese.:'Design of Reinforced concrete Foundation',*PHI Learning Pvt. Ltd.*
8. P. C. Varghese.: 'Advanced Reinforced Concrete Design', *PHI Learning Pvt. Ltd.*
9. Ramachandra: 'Design of Concrete Structures'*Vol. I & II. Standard Book House.*

Subject Code	Subject Name	Credits
MILO 2021	**Project Management**	**03**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	**--**	**--**	03	--	**--**	03

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	--	--	--	100

Course Objectives

1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.

2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Detail Syllabus

Module	Contents
I.	**Project Management Foundation:**
	Definition of a project, Project Vs Operations, Necessity of project management, Triple

	constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).**(5)**
II.	**Initiating Projects:** How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics. **(6)**
III.	**Project Planning and Scheduling:** Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS). **(8)**
IV.	**Planning Projects:** Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks **(6)**
V.	**5.1 Executing Projects:** Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings. **5.2 Monitoring and Controlling Projects:** Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit. **5.3 Project Contracting** Project procurement management, contracting and outsourcing, **(8)**
VI.	**6.1 Project Leadership and Ethics:** Introduction to project leadership, ethics in projects. Multicultural and virtual projects. **6.2 Closing the Project:**

	Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study. **(6)**

Contributions to Outcomes

Learner will be able to…

1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference

Internal Assessment:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Recommended Books:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India,

7thEd.

2. A Guide to the Project Management Body of Knowledge (PMBOK$^{®}$ Guide), 5th Ed, Project Management Institute PA, USA

3. Gido Clements, Project Management, Cengage Learning.

4. Gopalan, Project Management, , Wiley India

5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.

Subject Code	Subject Name	Credits
MILO 2022	**Finance Management**	**03**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	--	--	--	100

Course Objectives

1. Overview of Indian financial system, instruments and market
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
3. Knowledge about sources of finance, capital structure, dividend policy

Detail Syllabus

Module	Contents
I.	**Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System.

	Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. **Financial Markets:** Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market **Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges **(06)**
II.	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting. **(06)**
III.	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. **Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis. **(09)**
IV.	**Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) **Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities. **(10)**
V.	**Sources of Finance:** Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. **Capital Structure:** Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between

	Capital Structure and Corporate Value; Concept of Optimal Capital Structure **(05)**
VI.	**Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach **(03)**

Contributions to Outcomes

Learner will be able to…

1. Understand Indian finance system and corporate finance
2. Take investment, finance as well as dividend decisions

Internal Assessment:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Recommended Books:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.

4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Semester II

Subject Code	Subject Name	Credits
MILO 2023	**Enterpreneurship Development and Management**	**03**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	**--**	**--**	03	--	**--**	03

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	--	--	--	100

Course Objectives

1. To acquaint with entrepreneurship and management of business

2. Understand Indian environment for entrepreneurship

3. Idea of EDP, MSME

Detail Syllabus

Module	Contents
I.	**Overview Of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership. **(04)**

	Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship
II.	**Business Plans And Importance Of Capital To Entrepreneurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur **Entrepreneurship And Business Development:** Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations**(09)**
III.	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises**(05)**
IV.	**Indian Environment for Entrepreneurship:** key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc. **(08)**
V.	**Effective Management of Business:** Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing. **(08)**
VI.	**Achieving Success In The Small Business:** Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business**(05)**

Contributions to Outcomes

Learner will be able to…

1. Understand the concept of business plan and ownerships
2. Interpret key regulations and legal aspects of entrepreneurship in India
3. Understand government policies for entrepreneurs

Internal Assessment:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Recommended Books:

1. PoornimaCharantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. MaddhurimaLall, ShikahSahai, Entrepreneurship, Excel Books
7. RashmiBansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. LaghuUdyogSamachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Subject Code	Subject Name	Credits
MILO 2024	**Human Resource Management**	**03**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	--	--	--	100

Course Objectives

1. To introduce the students with basic concepts, techniques and practices of the human resource management.

2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations.

3. To familiarize the students about the latest developments, trends & different aspects of HRM.

4. To acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders and managers.

	Detail Syllabus

Module	Contents
I.	**Introduction to HR** Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues. **(05)**
II.	**Organizational Behavior (OB)** Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behavior. Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor); Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. Case study **(07)**
III.	**Organizational Structure &Design** Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies. **(06)**
IV.	**Human resource Planning** Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale. Performance Appraisal Systems: Traditional & modern methods, Performance Counseling,

	Career Planning. Training & Development: Identification of Training Needs, Training Methods**(05)**
V.	**Emerging Trends in HR** Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment Cross Cultural Leadership and Decision Making**:** Cross Cultural Communication and diversity at work**,** Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.**(06)**
VI.	**HR & MIS** Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries **Strategic HRM** Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals **Labor Laws & Industrial Relations** Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act**(10)**

Contributions to Outcomes

Learner will be able to…

1. Understand the concepts, aspects, techniques and practices of the human resource management.
2. Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioral skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Internal Assessment:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Recommended Books:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
5. P. SubbaRao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Subject Code	Subject Name	Credits
MILO 2025	**Professional Ethics and Corporat Social Responsibility (CSR)**	**03**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	**--**	**--**	03	--	**--**	03

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	--	--	--	100

Course Objectives

1. To understand professional ethics in business
2. To recognized corporate social responsibility

Detail Syllabus

Module	Contents
I.	**Professional Ethics and Business:** The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business**(04)**
II.	**Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition;

	Oligopolistic Competition; Oligopolies and Public Policy **Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources**(08)**
III.	**Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination:** Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.**(06)**
IV.	**Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India**(05)**
V.	**Corporate Social Responsibility:** Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India**(08)**
VI.	**Corporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.**(08)**

Contributions to Outcomes

Learner will be able to…

1. Understand rights and duties of business
2. Distinguish different aspects of corporate social responsibility
3. Demonstrate professional ethics
4. Understand legal aspects of corporate social responsibility

Internal Assessment:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Recommended Books:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by BidyutChakrabarty, Routledge, New Delhi.

Subject Code	Subject Name	Credits
MILO 2026	**Research Methodology**	**03**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03	--	--	--	100

Course Objectives

1. To understand Research and Research Process

2. To acquaint students with identifying problems for research and develop research strategies

3. To familiarize students with the techniques of data collection, analysis of data and interpretation

Detail Syllabus

Module	Detailed Contents
I.	**Introduction and Basic Research Concepts** **1.1** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle.Research methods vs Methodology **1.2** Need of Research in Business and Social Sciences (**09**)

	1.3 Objectives of Research
	1.4 Issues and Problems in Research
	1.5 Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical
II.	**Types of Research**
	2.1. Basic Research
	2.2. Applied Research
	2.3. Descriptive Research
	2.4. Analytical Research
	2.5. Empirical Research
	2.6 Qualitative and Quantitative Approaches**(07)**
III.	**Research Design and Sample Design**
	3.1 Research Design – Meaning, Types and Significance
	3.2 Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors**(07)**
IV.	**Research Methodology**
	4.1 Meaning of Research Methodology
	4.2. Stages in Scientific Research Process:
	a. Identification and Selection of Research Problem
	b. Formulation of Research Problem
	c. Review of Literature
	d. Formulation of Hypothesis
	e. Formulation of research Design
	f. Sample Design
	g. Data Collection
	h. Data Analysis
	i. Hypothesis testing and Interpretation of Data
	j. Preparation of Research Report**(08)**
V.	**Formulating Research Problem**
	5.1 Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis**(04)**
VI.	**Outcome of Research**
	6.1 Preparation of the report on conclusion reached**(04)**
	6.2 Validity Testing & Ethical Issues

	6.3 Suggestions and Recommendation

Contributions to Outcomes

Learner will be able to…

1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings

Internal Assessment:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignments on complete syllabus or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Recommended Books:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education

Subject Code	Subject Name	Credits
MILO 2027	**IPR and Patenting**	**03**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	--	--	--	100

Course Objectives

1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

Detail Syllabus

Module	Detailed Contents
I.	**Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc.

	Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development **(05)**
II.	**Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement **Indian Scenario of IPR:** Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc. **(07)**
III.	**Emerging Issues in IPR:** Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc. **(05)**
IV.	**Basics of Patents:** Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent **(07)**
V.	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.) **(08)**
VI.	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication etc, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases **(07)**

Contributions to Outcomes

Learner will be able to…

1. understand Intellectual Property assets
2. assist individuals and organizations in capacity building

3. work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Internal Assessment:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignment on complete syllabus or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Recommended Books:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph&Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. LousHarns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. PrabhuddhaGanguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohdIqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications

10. KompalBansal and PraishitBansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications

11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,

12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company

13. N S Rathore, S M Mathur, PritiMathur, AnshulRathi, IPR: Drafting,Interpretation of Patent Specifications and Claims, New India Publishing Agency

14. Vivien Irish, 2005, Intellectual Property Rights for Engineers, IET

15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Subject Code	Subject Name	Credits
MILO 2028	**Digital Business Management**	**03**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
03	--	--	03	--	--	03

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	--	--	--	100

Course Objectives

1. To familiarize with digital business concept
2. To acquaint with E-commerce
3. To give insights into E-business and its strategies

Detail Syllabus

Module	Content
I.	**Introduction to Digital Business-** Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy,

	Drivers of digital business- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,**(09)**
II.	**Overview of E-Commerce** **E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC**(06)**
III.	**Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system **Application Development:** Building Digital business Applications and Infrastructure**(06)**
IV.	**Managing E-Business**-Managing Knowledge, Management skills for e-business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications**(06)**
V.	**E-Business Strategy**-E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)**(04)**
VI.	**Materializing e-business: From Idea to Realization**-Business plan preparation Case Studies and presentations**(08)**

The learner will be able to …..

1. Identify drivers of digital business
2. Illustrate various approaches and techniques for E-business and management
3. Prepare E-business plan

Internal Assessment:

Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or at least 6 assignments on complete syllabus or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper- Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

Recommended Books:

1. A textbook on E-commerce**,** Er Arunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, VinocenzoMorabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance

9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5

10. Measuring Digital Economy-A new perspective -DOI:10.1787/9789264221796-en OECD Publishing

Subject Code	Subject Name	Credits
MDLO 2021	**THEORY OF PLATES AND SHELLS** (Departmental Elective)	**04**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	**--**	**--**	04	--	**--**	04

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	--	--	--	100

Course Objectives

1. To understand the behaviour of plates and shell under different boundary conditions/ loading conditions.
2. To study the evaluation of the response of such structures.

Detail Syllabus

Module	Content
I.	Introduction to theory of plates with small and large deflections: Distinction between Plate and Shell action.

II.	Pure bending of Thin Plates, Curvature at a point, Circle of curvature, Moment Curvature relationships, Relationships Between Twisting moment and Twist of Surface.
III.	Symmetrical bending of thin circular plates with small deflection under axi-symmetric transverse loads, Differential equation of equilibrium, Different support conditions, Plates with overhangs, Plates with co-axial circular opening.
IV.	Small deflection theory for lateral loaded thin rectangular plates, Various support conditions, Naviers and Levis solution for uniformly distributed and concentrated loads, Use of numerical technique for the solution of plates, Concept of Influence Surface, Study of simply supported plates with continuous edge moment.
V.	Introduction to Structural behaviour of thin shells, membrane and bending actions.
VI.	Mathematical representation of a shell surface, Principal curvatures, Gauss curvature, Classification of shells.
VII.	Membrane theory of thin shells, Stress resultant, Application to cylindrical shells under symmetrical loads and surfaces of revolution under axi-symmetric loads.
VIII.	Bending theory of open circular cylindrical shell with special emphasis on approximate theories of Finster walder and Shorer theories. Introduction to DJK, Flugg and other exact theories: Different boundary conditions for single and multiple shells.
IX.	Bending theory of closed circular cylindrical shell, stiffness coefficients at free edges along radial and rotational directions, Bending theory of spherical shells. Geckelers approximations, stiffness coefficients.

Contributions to Outcomes

On successful completion of the course, the learner will be able to analyze the plates and shells.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester . The students shall be asked to appear for the either tests. However, at least one test is mandatory and the students may be asked

to undertake the completion of assignment on live problems or course project solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
3. The students will have to attempt any **four** questions out of **total six** questions.
4. The questions can be of **mixed nature** irrespective of modules

Recommended Books:

1. Timoshenko: 'Theory of Plates and Shells', *McGraw Hill Book Co.*
2. Chandrashekhara:'Analysis of thin concrete shells', *McGraw Hill Book Co.*
3. Ramaswamy G.S:'Design and Construction of concrete shell Roofs', *McGraw Hill Book Co.*
4. Varadan T.K. and Bhaskar K: 'Analysis of plates Theory and Problems', *Narros Publishing House.*

Subject Code	Subject Name	Credits
MDLO 2022	**ANALYSIS AND DESIGN OF ENVIRONMENTAL AND HYDRAULICS STRUCTURES** (Departmental Elective)	**04**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	--	--	04	--	--	04

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	--	--	--	100

Course Objectives

- To expose the students to understand the basic principles used in design of environmental structures.
- To understand the behaviour of structural components of various environmental structures under standard loading conditions and design them as per codal provision
- To decide the section of Dams, Weirs and Barrages.
- To classify the Canals and design the Canals.
- To study spillways and energy dissipaters and canal regulation works.
- To study design details of surplus weir, barrages etc.

Detailed Syllabus

Module	Content
I.	Classification of R.C.C.pipes, Design principles, Reinforcements in pipes, Design of non-pressure, R.C.C.pipes for culverts, Structural design and laying – Hydrodynamic considerations.
II.	Design of underground water tanks, Design of water tanks resting on ground: circular & rectangular tanks; Elevated Storage Reservoir
III.	Jack well, Pump House, Settling tanks, Clari –floculators , Filter, aeration tanks
IV.	SpillwayNecessity, components and classification, Design consideration of overflow/ogee spillway, Design as per IS, Design of hydraulic jump type energy dissipaters-stilling basin as per IS.
V.	Types of aqueducts and syphon aqueducts, Design of aqueducts, Design of weirs and barrages over permeable foundations: causes of failure, Bligh's and Lane's creep theory, khosala's theory, Canal regulation works: alignment of off-taking channels, distributary head regulator, cross regulators and their design.

Contributions to Outcomes

On completion of this course the student shall be able to:

1. Understand the basic principles used in design of environmental structures like water tanks, pump house, water treatment units etc.
2. To understand the behaviour of structural components of various environmental structures under standard loading conditions and design them as per codal provision.
3. Understand the concepts of pipe network and design.
4. Perform analysis and design of various hydraulic structures.
5. Understand design principles of spillways, energy dissipation works and canal regulation works.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester . The students shall be asked to appear for the either tests. However, at least one test is mandatory and the students may be asked to undertake the completion of assignment on live problems or course project solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
3. The students will have to attempt any **four** questions out of **total six** questions.
4. The questions can be of **mixed nature** irrespective of modules

Recommended Books:

1. P.Dayaratnam, (2004): 'Reinforced Concrete', *Oxford Publishing Private Limited.*
2. Krishna Raju, (2004):'Prestressed Concrete', *Tata McGraw Hill Publishing Co, 2nd Edition.*
3. S.S.Bhavikatti (2014):'Advanced RCC Design',*(Vol. II) New Age International Publishers.*
4. S. Ramamrutham (2016):'Design of Reinforced Concrete Structures', *Dhanpatrai Publishing Co.*
5. N.C.Sinha& S.K.Roy, (2002):'Reinforced Concrete', *S.Chand and Co.*
6. Anchor, R.D.:'Design of liquid retaining concrete structure', *Edward Arnold, London,1992*
7. BIS, IS-3370, 'Indian standard code of Practice for Concrete Structure for the storage of Liquids', *Part-I to IV*
8. Ghali, A.:'Circular storage tanks and Silos', *E & F N Spon, London,1979.*
9. P.N. Modi: 'Irrigation Water Resources and Water Power Engineering',*Standard Book House, Delhi, ISBN 978-81-87401-29-0.*
10. S. K. Ukarande: 'Irrigation Engineering and Hydraulic Structures',*Ane's Books Pvt. Ltd. (Abridged Edition 2015)*, ISBN 9789383656899
11. B.C. Punmia, Pande, B.B. Lal, A.K Jain: 'Irrigation and Water Power Engineering',*Laxmi Publications Pvt, Ltd. New Delhi.*
12. S. K. Garg: 'Irrigation Engineering and Hydraulics Structures',*Khanna Publishers. Delhi.*
13. S. K. Sharma: 'Design of Irrigation Structures', *S. Chand and Co.*
14. R. S. Varshney and R, C. Gupta: 'Theory and Design of Irrigation Structures',*Nem Chand and Bros., Roorkee*

Subject Code	Subject Name	Credits
MDLO 2023	**DESIGN OF INDUSTRIAL STRUCTURE** (Departmental Elective)	**04**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	--	--	04	--	--	04

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	--	--	--	100

Course Objectives

1. To qualify the students to analyse and design of various types of industrial buildings.
2. To understand the design concept of lattice tower and steel chimney
3. To understand the design concept of trussed girder bridges and bearing
4. To develop clear understanding of the concepts and practical knowledge of modern Civil Engineering techniques for design of steel structures.
5. To understand the design concept of Cold–formed light gauges steel sections.
6. Use of various relevant IS codes for designing steel structures.

Module	Content
I.	Design of Trussed girder bridges and bearing. Deck type and through type bridges, bracing systems end bearing, mechanism and elastomeric bearings.
II.	Multistory steel buildings, load transfer mechanism, Internal load resisting systems, Design of moment resistant frames, concentrically braced frames, interacting moment resisting frames with shear walls for seismic/ wind effects structural systems, framed tube structures, braced tube structures , tube in tube structures.
III.	Cold–formed light gauges steel sections, special design considerations for compression elements, design of compression elements, stiffened compression elements, multistiffened elements, design of light gauge beams, behavior under repetitive loads and temperature effects.
IV.	Lattice Tower :Different configuration of lattice towers, loads acting on lattice towers, Analysis of lattice tower, design of lattice tower including welded or riveted connections for members by limit state method.
V.	Steel Chimney: Forces acting on chimney, design of self-supporting welded and bolted chimney and components including design of foundation.
VI.	Concrete –Steel composite sections, elastic behavior of composite beams, shear connectors, Behavior at ultimate load. Design of composite beams. Design of encased steel columns.

Contributions to Outcomes

1. Capable of design of industrial buildings with and without crane girders.
2. Capable enough to scrutinise the analysis and design of various industrial structures.
3. Capable of design of elements of steel construction.
4. Capable of providing the design of concrete –Steel composite sections.
5. On completion of this course, the students shall be able to understand the analysis and design of trussed girder bridges and bearing. They shall be able to analysis and design steel chimney, lattice tower. The students are expected to be able to independently design steel structures using relevant IS codes.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester . The students shall be asked to appear for the either tests. However, at least one test is mandatory and the students may be asked to undertake the completion of assignment on live problems or course project solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
3. The students will have to attempt any **four** questions out of **total six** questions.
4. The questions can be of **mixed nature** irrespective of modules

Recommended Books:

1. Ramchandran: 'Design of steel structures' Vol. *II, Standard book, house Delhi.*
2. A.S. Arya. J.L. Ajamani: 'Design of steel structures', *Nemchand and brothers.*
3. B. S.Tranath: 'Structural Analysis and Design of Tall Building', *McGrawhill.*
4. J.F. Bekar, M.R. Horne: 'Steel skeletal Plastic Behaviour and design',Vol. II *J.Heyman*
5. Neal B.G: 'Plastic methods of structural analysis', *Chapter and hall*.
6. S.P. – 6 (*BIS*)
7. 'Teaching Resource for Structural steel design', Vol.III by IIT Madras,Anna university Chennai SERC, Madras and Institute for steel Development and Growth
8. (INSDAG), Kolkatta.

Subject Code	Subject Name	Credits
MDLO 2024	**HEALTH MONITORING AND REHABILITATION OF STRUCTURES** (Departmental Elective)	**04**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	--	--	04	--	--	04

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	--	--	--	100

Course Objectives

- To get familiar with the causes of distress of concrete structures, seepage and leakage in concrete structures and the effect on steel corrosion.
- To study the condition survey, evaluation and assessment of damage through the visual inspection and various Non-Destructive Testing methods.
- To acquire the knowledge in connection with the special repair materials and crack repair methodologies to be applied in the field.
- To study the concrete protective materials, thermal protection coatings, etc.
- To implement the steel corrosion protection methods in the field.
- To know the various ways to maintain the reinforced concrete structures.

<table>
<tr><td colspan="2" align="center">**Detail Syllabus**</td></tr>
<tr><td align="center">**Module**</td><td align="center">**Content**</td></tr>
<tr><td align="center">I.</td><td>INTRODUCTION General Consideration – Distresses monitoring – Causes of distresses – Quality assurance – Defects due to climate, chemicals, wear and erosion – Inspection – Structural appraisal – Economic appraisal.</td></tr>
<tr><td align="center">II.</td><td>Structural Health, factors affecting health of structures, effect of leakage, age, creep, corrosion, fatigue on life of structure. Structural health monitoring. Various measures, regular maintenance, structural safety in alteration. Quality control & assurance of materials of structure, durability of concrete, Factors affecting durability of concrete, Corrosion in structures, Testing and prevention of corrosion, fire safety.</td></tr>
<tr><td align="center">III.</td><td>Structural Audit, Assessment of health of structure, study of structural drawings, nature of distress, visual observations, Collapse and investigation, limitations on investigator, tools for investigation, Various NDT Methods for assessing strength of distressed materials, investigation management, review of assimilated information, interviews and statements, evaluation and reporting, presentation of report, communication gap among client, architect, consulting engineer & contractor.</td></tr>
<tr><td align="center">IV.</td><td>Retrofitting of Structures, parameters for assessment for restoration strategies, selection of construction chemicals during restoration, Specification for important items of work in restoration, Structural detailing for restoration, and Various techniques of retrofitting.</td></tr>
<tr><td align="center">V.</td><td>Safety during construction, formwork and staging, material handling, Existing methods of formwork, Modular formwork, Structural aspects for formwork in buildings & bridges.</td></tr>
<tr><td align="center">VI.</td><td>Demolition of Structure, study of structural system and structural drawings, need and importance for demolition, outline of various demolition methods and their evaluation, partial and controlled demolition, role of safety measures, temporary support structures in demolition. Recycling of demolished materials, contracts.</td></tr>
<tr><td colspan="2" align="center">**Contributions to Outcomes**</td></tr>
</table>

On successful completion of the course, the students shall are expected to:

- Assess the structural health of the buildings and infrastructural works.
- Inspect and evaluate the damaged structures.

- Implement the techniques for repairing the concrete structures.
- Employ the methods of steel protection in the field.
- Maintain the concrete structures in the working and safe condition.
- Be able to take the decision of dismantling the structure, if it is deteriorated beyond the repairing.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester . The students shall be asked to appear for the either tests. However, at least one test is mandatory and the students may be asked to undertake the completion of assignment on live problems or course project solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
3. The students will have to attempt any **four** questions out of **total six** questions.
4. The questions can be of **mixed nature** irrespective of modules

Recommended Books:

1. Deananmmer: 'Handbook of Material Management',*McGrawHills.*
2. Gopalkrishnan: 'Fundamentals of Material Management'*Tata McGraw Hills*.
3. M Y Khan and Jain: 'Financial Management', *Tata McGraw Hills*
4. A M Neville: 'Properties of Concrete', *Longman*
5. R.N.Raikar: 'Durable Structures',*R & D Centre, (SDCPL), RaikarBhavan, Sector 17, Vashi, Navi Mumbai.*
6. R.N. Raikar, 'Learning from Failures', *R & D Centre, (SDCPL), RaikarBhavan, Sector 17, Vashi, Navi Mumbai.*
7. R.N. Raikar, 'Diagnosis and treatment of structures in Distress', *R & D Centre, (SDCPL), RaikarBhavan, Sector 17, Vashi, Navi Mumbai.*
8. Jayakumar J. Shah:'A Book – A Handy Guide to Repairs, Rehabilitation and Waterproofing of RCC Building (Structures)', *Third updated photo-copy set*.

9. Richardson.J.G: 'Formwork Construction and Practice'

10. Peurifoy. R.L., 'Formwork for Concrete Structures', *Tata McGraw-Hill Publishing Company Limited*

11. Austin. C. K : 'Formwork to Concrete', *Chapman and Hall*

12. Wynn.A.E: 'Design & Construction of Formwork for Concrete Structures', *Concrete Publishing Limited*

13. Y Kasai: 'Demolition and reuse of concrete', *Chapman and Hall*

14. 'Demolition by Colin Toplins', *Construction Press*

15. 'Demolition Techniques', *Construction Press*

16. Mr.GirishKulkarni 'Demolition of Structures', *Mumbai.*

17. Mr.UmeshDhargalkar 'Structural Audit', *Mumbai.*

18. Jayakumar J. Shah: 'An Article – House Keeping of RCC Buildings', *Published in April 2001 issue of the Housing Times, Vikas Premises, Fort Mumbai 400001.*

19. Jayakumar J. Shah: 'An Article – Repairs & Rehabilitation of RCC Buildings (Structures) – Materials and Techniques', *Published in March 2002 issue of New Building Materials and Construction World, New Delhi.*

20. Jayakumar J. Shah:'An Article – Repairs, Rehabilitation of Structurally Distressed RCC Members of Buildings', *Published in July 2000 issue of Construction World, ASAP Media, Mumbai.*

21. J. J. Shah: 'Point of View – Repair, Rehabilitation and Waterproofing of structures-Some View', *Published in April 1998 issue of The Indian Concrete Journal, Mumbai.*

22. Krautkramer, J and Krautkramer,H:'Ultrasonic Testing of Materials', *Springer-Verlag, Berlin, 1969.*

23. Mani, K and Srinivasan, P.:'An Article :Corrosion Damage and its Evaluation by Testing' in Advanced Testing and Evaluation of Structures and Components, Allied Publishres, Chennai, 2002 pp 14.01 – 14.33.

24. Ouyang, C., Landis, E., and Shah, S.P.:'An Article: Damage Assessment in Concrete using Acoustic Emission, in Non-destructive Testing of Concrete Elements and Structures', *ASCE, New York, 1992, pp 13-24.*

25. Popovics S, and Popovics J.S: 'An Article: A Critique of the Ultrasonic Pulse Velocity Method for Testing Concrete' in Nondestructive Testing of Concrete Elements and Structures', *ASCE, New York, 1992, pp 94-103.*

26. Sreenath H.G.: 'An Article: Safety Auditing of Concrete Structures. In Advanced Testing and Evaluation of Structures and Components' ,*Allied Publishers, Chennai, 2002 pp 9.01 – 9.19.*

27. Thandavamoorthy T.S. et al: 'Health Assessment of Concrete Structures by Ultrasonic pulse Velocity Technique an experimental Investigation in Building Materials', *RRL Bhopal, February 26-27, 2004, pp. 284-89.*

28. Websites for Formwork:

    a. http://www.dir.gld.gov.au/workplace/law/codes/formwork design

    b. www.peri-usa.com/,www.specialformwork.com/

29. Websites for Demolition of Structures:

    a. www.Howstuffworks.com

    b. www.Findarticles.com

    c. www.historylinks.org

    d. www.implosionworld.com

    e. www.home.earthlik.com

    f. www.seattlepi.com

    g. www.seattletimes.com

    h. www.phillyblast.com

    i. www.usgs.gov

Subject Code	Subject Name	Credits
MDLO 2025	**DESIGN OF GREEN BUILDING** (Departmental Elective)	**04**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	**--**	**--**	04	--	**--**	04

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	--	--	--	100

Course Objectives

1. To study the basic principle of sustainability and energy efficient building design.

2. Preparation for the LEED Green Associate.

3. Students will attain further knowledge of green building techniques, materials and practices.

4. Students will gain valuable project experience utilizing one or more national green rating systems to register, evaluate and document an actual green building project.

5. To study performance evaluation of smart buildings.

Detail Syllabus

Module	Content
I.	Principles of Sustainability, the fundamentals of sustainable and energy efficient building

	design, Energy Conservation and Water Conservation Introduction to Course, Major Environmental Challenges, Global Warming.
II.	Introduction to Green Buildings; LEED, Sustainable Urban Development. Green Construction Materials, Green building codes and standards, International Green Construction Code, Green Building Specifications. Materials and Resources - LEED Credits, Building Deconstruction, C&D Recycling, Indoor Environmental Quality – Basic, IEQ – LEED Credits,
III.	Building Commissioning, Materials selection strategies, International Green Construction Code, Carbon accounting
IV.	Building energy system strategies, Energy Conservation in Buildings, HVAC Systems(lighting, water supply, sewage, garbage disposal, recycling and composting) ,Clean & renewable energy in buildings Energy and Atmosphere - Building Rating systems (LEED, BREEAM, IGBC etc.), eQuest Energy Simulations, Conducting Energy Audit, Fossil Fuels vs. Renewable Energy. Water Conservation in Buildings, Storm, Water cycle strategies
V.	Rainwater harvesting Water and energy conservation Energy modelling and performance evaluation of Smart buildings (Sensing and control systems) Net Zero buildings.
VI.	HOUSING IN DISASTER PRONE ARES AS-Introduction – Earthquake - Damage to houses - Disaster prone areas - Type of Damages and Repairs of non-engineered buildings - Repair and restoration of earthquake Damaged non-engineered buildings recommendations for future constructions Requirement's of structural safety of thin precast roofing units against Earthquake forces Status of R& D in earthquake strengthening measures - Floods, cyclone, future safety

Contributions to Outcomes

Upon completion of this course, the student will be able to:

1. Identify and compare existing energy codes, green building codes and green rating systems.
2. Identify and compare cost and performance of building materials with recycled components, non-petroleum based materials, materials with low volatile organic compounds, materials with low embodied energy and salvaged materials and incorporate them into design.
3. Identify and use construction materials and methods that more easily allow for salvage and re-use of building materials.

4. Perform demolition in ways that allow for salvage of re-usable building materials.
5. Understand the techniques and benefits of building performance testing, monitoring and metering.
6. Identify and make use of techniques for weatherization and sustainable remodelling of existing structures.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester . The students shall be asked to appear for the either tests. However, at least one test is mandatory and the students may be asked to undertake the completion of assignment on live problems or course project solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
3. The students will have to attempt any **four** questions out of **total six** questions.
4. The questions can be of **mixed nature** irrespective of modules

Recommended Books:

1. Background material of green building training programme conducted by IGBC
2. C.J. Kibert (2008):'Sustainable Construction: Green Building Design andConnections, and Solutions', *14th Ed., Brooks Cole, Pacific Grove, California*
3. Energy Conservation Building Code (*ECBC*)
4. G.T. Miller Jr. (2004):'Living in the Environment: Principles',
5. A.K.Lal: 'Hand book of low cost housing', *Newage international publishers.*
6. Hindrichs, Dirk U., Plusminus: '20/40 Latitude: Sustainable Building Design in Tropical and Subtropical Regions'. *Axel Menges (October 2007)* ISBN 9783930698837
7. Hong, Wen et. al., Building Energy Efficiency - Why Green Buildings Are Key to Asia`s Future. The Asia Business Council (2007)
8. IGBC Green Factory Building Abridged Reference Guide
9. Indian Green Building Council: www.igbc.inIGBC Green Homes Abridged Reference Guide

10. Keeler, Marian and Burke, Bill - Fundamentals of Integrated Design for Sustainable Building. Wiley (May 2009) ISBN 9780472935

11. Kwok, Alison and Grondzik, Walter, The Green Studio Handbook: Environmental Strategies for Schematic Design, II edition. Architectural Press (April 2011) ISBN 9780080890524

12. LEED India NC Reference Guide / LEED India CS Reference Guide

13. Mazria, Edward, The Passive Solar Energy Book. Rodale Press (1980) ASIN B000VNM20C

14. McDonough, William and Braungart, Michael, Cradle to Cradle. Farrar, Straus & Giroux (April 2002) ISBN 9780865475878

15. McHarg, Ian L., Design with Nature, I edition. Wiley (February 1995) ISBN 9780471114604

16. Mendler, Sandra F., Odell, William, Lazarus, Mary Ann, The HOK Guidebook to Sustainable Design Second Edition. Wiley (November 2005) ISBN 97804716961314.

17. Modern trends in housing in developing countries – A.G. MadhavaRao, D.S.Ramachandra Murthy &G.Annamalai.

18. Shurcliff, William A., Thermal Shutters & Shades - Over 100 Schemes for Reducing Heat Loss through Windows, 1st edition. Brick House Publishing Co (April 1981) ISBN 9780931790140 \

19. Snell, Clarke and Callahan, Tim, Building Green: A Complete How-To Guide to Alternative Building Methods Earth Plaster, Straw Bale, Cordwood, Cob, Living Roofs. Lark Crafts(August 2009) ISBN 978-1600595349

20. Yudelson, Jerry, Green Building A to Z: Understanding the Language of Green Building. New Society Publishers (June 2007).

Semester II

Subject Code	Subject Name	Credits
MDLO 2026	**EARTHQUAKE ENGINEERING**	**04**

Teaching Scheme

Contact Hours			Credits assigned			
Theory	**Practical**	**Tutorial**	**Theory**	**Practical**	**Tutorials**	**Total**
04	--	--	04	--	--	04

Evaluation Scheme

Theory					Term work/Practical/Oral			Total
Internal Assessment			**End Sem Exam**	**Duration of End Sem Exam**	**TW**	**PR**	**OR**	
Test 1	**Test 2**	**Average**						
20	20	20	80	03	--	--	--	100

Course Objectives

- To study the importance of the earthquake engineering
- To study the different types of dynamic loads, concept of damping, and analysis of SDOF system subjected to different types of dynamic loads.
- To calculate frequency and mode shapes for the MDOF system, analysis of MDOF system subjected to different types of dynamic loads.
- To study the causes of earthquake, types of earthquakes, seismic waves, structure of earth, and measurement of earthquake magnitude and intensity.
- To study the concept of Response Spectrum, ground motion parameters, characteristics of response spectrum, and various methods to construct response spectrum.

- To analyze the structure subjected to ground motion as per codal provisions of IS:1893-2002 and calculation of earthquake loads/forces. Importance of ductility in earthquake resistant design of structure and codal provision of IS: 13920.
- To perform the basic experiments in structural dynamics on SDOF and MDOF system.

	Detail Syllabus

Module	Content
I.	Characteristics of Earthquakes: Earthquake terminology, Indian Earthquakes, Measurement of Earthquakes, Magnitude, Intensity, Frequency-magnitude relationship, Liquefaction.
II.	Earthquake response of linear SDOF systems: Response spectrum theory, Strong ground Motion, Accelerometers, Peak parameters, Concept of earthquake response spectrum, tripartite spectrum, Construction of design response spectrum.
III.	Earthquake response of linear MDOF systems: Modal Analysis, Participation factors, Modal contributions, multistoried buildings with symmetric and unsymmetrical plan, Torsional response.
IV.	Concept of Earthquake resistant design, Objectives, Ductility, Ductility reduction factors, Over strength, Response reduction factor, Design response spectrum, Lateral stiffness, Conceptual design, Building configuration.
V.	Lateral load analysis, Provisions of IS-1893 for buildings, Base Shear, Application to Multi-storey buildings, Load combinations.
VI.	Detailing of RCC and Masonry buildings, Provisions of IS- 13920, IS – 4326 Concepts of Structural control, Passive control, Base isolation, Tuned Mass Dampers, Vibration absorbers.

	Contributions to Outcomes

- The students are expected to understand the difference between static and dynamic analysis, types of dynamic loads, concept of damping.
- The students are expected to evaluate the response of the structures subjected to different types of dynamic loads.

- The students are expected to understand earthquake phenomenon, concept of response spectrum, application of structural dynamics in the evaluation of structural response to Earthquake excitation and their codal provisions.
- The students are expected to carry out Seismic analysis of structure.

Internal Assessment:

The internal assessment consists of two tests, i.e., mid-semester and end semester . The students shall be asked to appear for the either tests. However, at least one test is mandatory and the students may be asked to undertake the completion of assignment on live problems or course project solely at the discretion of the course instructor.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
3. The students will have to attempt any **four** questions out of **total six** questions.
4. The questions can be of **mixed nature** irrespective of modules

Recommended Books:

1. R. W. Clough and Joseph Penziene: 'Dynamics of Structures', *Mc- Graw HillPublication.*
2. A. K. Chopra: 'Dynamics of Structures Theory and Application to Earthquake Engineering', *Prentice- hall Publication.*
3. David Key: 'Earthquake Design Practice for Buildings', *Thomas Telford Pub.*
4. James M. Kelly: 'Earthquake Resistant Design with Rubber', *Springler-VerlagPublication.*
5. D. J. Dowrick: 'Earthquake Resistant Design for Engineers and Architects', *JohnnWiley and Sons.*
6. Robinson: 'Passive Vibration control', *T. T. Soong.*
7. Agrawal P. &Shrikhande M.: 'Earthquake Resistant Design of Structures', *Prentice hall India, New Delhi, 4th Edition, 2007.*
8. Duggal S.K:'Earthquake Resistant Design of Structures', *Oxford university press, New Delhi, 8th impression,2012.UK*

Semester II		

Subject Code	Subject Name	Credits
MSTR- L201	**Laboratory - II**	**01**

Contents

List of experiments: (any 4)

1. Dynamics of a three storeyed building frame subjected to harmonic base motion
2. Dynamics of a three storeyed building frame subjected to periodic (non-harmonic) motion
3. Dynamics of a single- storeyed building frame with planar asymmetry subjected to harmonic base motions
4. Dynamics of one-span and two-span beams
5. Dynamics of free-standing rigid bodies under base motions
6. Vibration isolation of a secondary system
7. Seismic wave amplification, liquefaction and soil-structure interactions
8. Dynamics of a four storied building frame with and without an open ground floor

	Semester II	

Subject Code	Subject Name	Credits
MSTR-L202	**Design Studio-II**	**01**

Contents

1. Development of finite element programming for analysis of beams, trusses, frames, plates and shells using standard software's
2. Analysis and design of multi storied framed building including foundation system using standard software's
3. Presentation and report submission of allotted topic from syllabus
4. Site visit of infra project and report submission (minimum one)

Semester III

Subject Code	Subject Name	Credits
MSTR S 301	**Seminar**	**03**

Contents

Guidelines for Seminar

- Seminar should be based on thrust areas in Structural Engineering including materials and allied subjects involving the knowledge of Structural Engineering (e.g. GeotechnicalEngineering, Transportation Engineering, Hydraulics Engineering with emphasis in the context soil- structure interaction, fluid- structure interaction, fluid-soil-structure interaction, pavement engineering, etc.)

- The objective behind seminar is to equip the student for carrying out literature survey, summarize the findings of the literature and formulate the problem or arrive upon the statement of the problem. Along similar lines, the student can work for their dissertation in the subsequent stages.

- The student in consultation with the Guide/ Supervisor shall settle or finalize / identify the topic of the seminar in the context of the specialization or allied theme. The students shall carry out literature survey pertaining to the topic, various sub-topics/ approaches/ methods falling within the purview of the topic. The student shall use multiple literatures and understand the topic, analyze the literature and summarize the findings. The report shall be compiled in a standard format. The student shall have to present the deliver the seminar/presentation in front of the board of examiners (refer note below)**.**

- The supervisor may ask the student to author a technical paper based on the seminar report and present it in a seminar or conference of national repute. Publication of paper in an International Conference shall be preferred. The paper could be a review paper.

- The assessment of the seminar shall be assessed in respect of the following points:
  1. Quality of Literature survey and Novelty in the topic
  2. Relevance to the specialization
  3. Understanding of the topic
  4. Quality of Written and Oral Presentation

5. Efforts made by the students to author a technical paper (preferably of review nature) and its subsequent publication either in the journal or in the conference proceedings and presentation in the conference.

IMPORTANT NOTE:

1. Assessment of Seminar will be carried out by a pair of Internal and External examiner. The external examiner should be selected from approved panel of examiners for Seminar by University of Mumbai, OR faculty from Premier Educational Institutions /Research Organizations such as IIT, NIT, BARC, TIFR, DRDO, etc. OR a person having minimum Post Graduate qualification with at least five years' experience in Industries.

2. Literature survey in case of seminar is based on the broader area of interest in recent developments and for dissertation it should be focused mainly on identified problem.

3. At least 4-5 hours of course on Research Methodology should be conducted which includes Literature Survey, Problems Identification, Analysis and Interpretation of Results and Technical Paper Writing in the beginning of 3rd Semester.

Semester III/ IV

Subject Code	Subject Name	Credits
MSTR-D301/ 401	**Dissertation (I and II)**	**12/15**

Contents

Guidelines for Dissertation

- Student should carry out the preliminary literature survey and subsequently, identify the problem in broad terms for Dissertation and finalize/ settle it in consultation with Guide/ Supervisor.

- Pursuant to this, the student shall refer multiple literatures pertaining to the theme of the problem and understand the problem and define the problem in the precise terms.

- Student should attempt solution to the problem by analytical/simulation/experimental methods. The solution shall be validated with proper justification. The students shall compile the reportin standard format.

- Student should publish at least one paper based on the work in reputed International / National Conference in which papers are blindly reviewed (desirably in Refereed Journal). More weightage shall be given for the journal publication.

- The work to be pursued as a part of the dissertation shall be divided broadly in two parts, namely-Dissertation Stage I and Dissertation Stage II.

- The topic of the Dissertation should be such that it is a value addition for the existing knowledge in the field and has some worthwhile research input.

Guidelines for Assessment of Dissertation I

- Dissertation I should be assessed based on following points
1. Quality of Literature survey and Novelty in the problem
2. Clarity of Problem definition and Feasibility of problem solution
3. Relevance to the specialization
4. Clarity of objective and scope

5. Methodology for carrying out the work defined as a Problem Statement (Formulation in respect of the analytical studies/ Experimental Work / Combination thereof depending upon the nature of the work involved)/ Data Collection, etc.

- Dissertation I should be assessed through a presentation by a panel of internal examiners appointed by the Head of the Department/Institute of respective Programme.

Guidelines for Assessment of Dissertation II

After completion of about 80% of the work (which shall be decided by the Guide/ Supervisor), proposed to be a part of the Dissertation, the student shall deliver a Pre-submission seminar based on the work pursued by him/ her during the second stage. It will be assessed by the panel of internalexaminers appointed by the Head of the Department/ Institute of the respective programme, as thecase may be.

The student shall take into account the suggestions made by the examiners/s during pre-submissionseminar in view of the work pursued by the students and shall try to incorporate it in the work, if the suggestions are worthwhile, consistent with the situation and provided they are such that those can be accommodated/ included in the work being pursued by the candidate at that point of time.

After the pre-submission seminar, the student shall compile the report in a standard format and written in the systematic manner and chapter wise.

The student shall adhere to the following scheme of chapterization while compiling the final report in general. The Guide/ Supervisor shall ensure the student has written the Dissertation Report inappropriate language (grammatically correct).

1. Introduction: The student shall give the introduction to the theme of the subject chosen as a Dissertation, give further current state of art related to the theme (i.e., brief review of literature), broad problem definition and scope of the work. The student shall also state at the end of this chapter the scheme of chapterization included in his/ her Dissertation.
2. Theoretical Aspects/ Review of Literature: The student is expected to highlight the various theoretical aspects pertaining to the topic chosen, literature (updated) available related to the various aspects of the topic chosen citing the research work carried out by the earlier researchers

and summarize the findings of the literature. The student may state the precise the problem definition.

3. Formulation/ Methodology/ Experimental Work: In this chapter, the student is expected to explain the methodology for pursuing his/ her work. In case of analytical work, student may give the Formulation along with validation for assessment of accuracy of the numerical procedure being used/ proposed by him/ her. In respect of experimental work, the student may outline the experimental set up/ procedure. In case of the work in which either approach is involved, the student may appropriately provide the methodology to cover either approach. This chapter may be supported by the Data Collection if the work involves the Collection of the Data and its subsequent processing.

4. Analysis/ Results and Discussion: The student is expected to present the results emerging from the analytical/ theoretical/ experimental study/ studies being pursued by the students. The results shall be discussed properly. The results may be compared with the results published by the earlier researchers if the work being pursued by the student warrants the same. The student may indicate the broad conclusions/ inferences at the end.

5. Summary and Conclusions: Based on the results discussed in the previous chapter, the student shall give in the systematic manner the conclusions/ inferences emerged from the study and summarize it properly. The student shall indicate the scope of the future work which can be extended by any other student/ researcher in the future. The student may point out the limitation/s left out in the work pursued by him/ her while carrying out the work contained in the Dissertation.

6. References: The student shall at the end give the list of the references in the appropriate manner. This part should not be treated as a Chapter. For referencing style, student may refer any standard journal of national and international repute.

7. Publication/s: The student shall give the list of the technical/ research papers published/ accepted for publication in the referred journal/ conference proceedings. This part should not be treated as a Chapter.

Dissertation II should be assessed based on following points:

1. Quality of Literature survey and Novelty in the problem
2. Clarity of Problem definition and Feasibility of problem solution
3. Relevance to the specialization or current Research / Industrial trends
4. Clarity of objective and scope

5. Methodology for carrying out the work defined as a Problem Statement (Formulation in respect of the analytical studies/ Experimental Work / Combination thereof depending upon the nature of the work involved)

6. Quality of work attempted Presentation of the results along with the validation of results or part thereof.

7. Quality of Written Report and Oral Presentation

8. Publication of the technical/ research paper by the student in a conference of National/ International repute. Publication of paper in a referred/ peer reviewed journal is highly preferred.

Dissertation II shall be assessed through a presentation jointly by the Internal Examiner

(Guide/ Supervisor) and External Examiner appointed by the University of Mumbai.