

University of Mumbai

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विद्याविषयक प्राधिकरणे
सभा आणि सेवा विभाग (ए.ए.एम.एस)
रूम नं. १२८ एम.जी.रोड, फोर्ट,
मुंबई - ४०० ०३२
टेलिफोन नं - ०२२ - ६८३२००३३

(नॅक पुनर्मूल्यांकनाद्वारे ३.६५ (सी.जी.पी.ए.) सह अ++ श्रेणी
विद्यापीठ अनुदान आयोगाद्वारे श्रेणी १ विद्यापीठ दर्जा)

क्र.वि.प्रा.स.से./आयसीडी/२०२५-२६/३७

दिनांक : २७ मे, २०२५

परिपत्रक:-

सर्व प्राचार्य/संचालक, संलग्नित महाविद्यालये/संस्था, विद्यापीठ शैक्षणिक विभागांचे संचालक/ विभाग प्रमुख यांना कळविण्यात येते की, राष्ट्रीय शैक्षणिक धोरण २०२० च्या अमलबजावणीच्या अनुषंगाने शैक्षणिक वर्ष २०२५-२६ पासून पदवी व पदव्युत्तर अभ्यासक्रम विद्यापरिषदेच्या दिनांक २८ मार्च २०२५ व २० मे, २०२५ च्या बैठकीमध्ये मंजूर झालेले सर्व अभ्यासक्रम मुंबई विद्यापीठाच्या www.mu.ac.in या संकेत स्थळावर NEP २०२० या टॅब वर उपलब्ध करण्यात आलेले आहेत.

मुंबई - ४०० ०३२
२७ मे, २०२५


(डॉ. प्रसाद कारंडे)
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As Per NEP 2020

University of Mumbai



Syllabus for Major Vertical – 1 , 4, 5 & 6

Name of the Programme – B.E. (Civil and Infrastructure Engineering)

Faculty of Engineering

Board of Studies in Civil & Infrastructure Engineering

U.G. Second Year Programme	Exit Degree	U.G. Diploma in <u>Civil and Infrastructure Engineering.</u>
Semester	IV	
From the Academic Year	2025-26	

University of Mumbai



(As per NEP 2020)

Sr. No	Heading	Particulars
1	Title of program O: _____	B.E. (<u>Civil and Infrastructure Engineering</u>)
2	Exit Degree	U.G. Diploma in <u>Civil and Infrastructure Engineering.</u>
3	Scheme of Examination R: _____	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination
4	Standards of Passing R: _____	40%
5	Credit Structure R. TEU-655C R. TEU-655D	Attached herewith
6	Semesters	Sem. IV
7	Program Academic Level	5.00
8	Pattern	Semester
9	Status	New
10	To be implemented from Academic Year	2025-26

Sd/-
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Faculty of Technology

Sd/-
Dr. Deven Shah
Associate Dean
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Sd/-
Prof. Shivram S. Garje
Dean
Faculty of Science & Technology

Preamble

To meet the challenge of ensuring excellence and NEP 2020 policy in engineering education, the issue of quality needs to be addressed, debated, and taken forward systematically. Accreditation is the principal means of quality assurance in higher education. The major emphasis of the accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Science and Technology (in particular Engineering) of the University of Mumbai has taken the lead in incorporating the philosophy of NEP 2020 education in the process of curriculum development.

The second-year engineering course is a core training program to impart scientific and logical thinking training to learners in general, with a choice of course selection from the program core course, multidisciplinary minor, and vocational skill-enhanced course. Simultaneously, the objectives of NEP 2020 demand nurturing the core program and skills required for the Civil & Infrastructure engineering in the learner. Keeping this in view, a pool of courses is offered in Core Courses covering fundamentals required to understand core and modern engineering practices and emerging trends in technology. Considering the shift in pedagogy and the convenience of a stress-free learning process, a choice-based subject pool is offered in the coursework under the heads of Civil & Infrastructure Engineering for open electives and multidisciplinary minor courses in the third and fourth semesters. Essentially, to give a glimpse of trends in the industry under vocational and enhanced skill practices, the pool is offered to nurture and develop creative skills in contemporary industrial practices. Criteria met in the structure is the opportunity for learners to choose the course of their interest in all disciplines.

Program Core Course Cover Civil & Infrastructure Engineering core courses. Also, OE and MDM where a pool of subjects are given for selection. Considering the present scenario, diverse choices need to be made available to fulfill the expectation of a learner to aspire for a career in the field of current trends of Technology and interdisciplinary research. Ability enhancement can be achieved in Undergraduate training by giving an objective viewpoint to the learning process and transitioning a learner from a rote learner to a creative professional. For the purpose Design Thinking is introduced in the Fourth Semester to orient a journey learner to become a skilled professional. Considering the NEP-2020 structure of award of Certificate & Diploma at multiple exit-point pools of Vocational skills is arranged for giving exposure to the current Industry practices.

The faculty resolved that course objectives and course outcomes are to be clearly defined for every course so that all faculty members in affiliated higher education institutes understand the depth and approach of the course to be taught, which will enhance the learner's learning process. NEP 2020 grading system enables a much-required shift in focus from teacher-centric to continuous-based learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation, which will enhance the quality of education. Credit assignment for courses is based on a 15-week teaching-learning process for NEP 2020, however, the content of courses is to be taught in 12-13 weeks, and the remaining 2-3 weeks are to be utilized for revision, tutorial, guest lectures, coverage of content beyond the syllabus, etc.

There was a concern that in the present system, the second-year syllabus must not be heavily loaded to the learner and it is of utmost importance that the learner entering into the second year of an engineering course should feel at ease by lowering the burden of syllabus and credits. This is necessary for a learner to get accustomed to the new environment of a college and to create a bond between the teacher and the learner. The present curriculum will be implemented for the Second Year of Engineering from the academic year 2025-26. Subsequently, this system will be carried forward for Third Year and Final Year Engineering in the academic years 2026-27, and 2027-28, respectively.

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Under Graduate Diploma in Engineering- Civil & Infrastructure Engineering.

Credit Structure (Sem. III & IV)

	R. TEU-655C									
Level	Semester	Major		Minor	OE	VSC, SEC (VSEC)	AEC , VEC ,IKS	OJT, FP, CEP, CC, RP	Cum. Cr. / Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
5.0	III	PCC301:3 PCC302:3 PCC303:3 PCC304:3 PCL301: 1 PCL302:1	--	--	OE:2	--	VEC: 2 HSL: 2	CEP: 2	22	UG Diploma 45
	R. TEU-655D									
	IV	PCC401:3 PCC402:3 PCC403:3 PCL401:1 PCL402:1	--	MDM: 4	OE:2	VSEC:2	VEC: 2 EEM:2	--	23	
	Cum Cr.	25	--	4	4	2	2+2+2+2	2	45	

Exit option: Award of UG Diploma in Major and MDM with 90 credits and additional 4 credits core **one** theory subject with 3 credits and **one** lab with 1 credit from one third year from where they want to take Exit degree. Along with theory and practical course student must compulsory do internship for **one month or 160 hours** which internship is equal to 4 credits.

[Abbreviation - OE – Open Electives, VSC – Vocation Skill Course, SEC – Skill Enhancement Course, (VSEC), AEC – Ability Enhancement Course, VEC – Value Education Course, IKS – Indian Knowledge System, OJT – on Job Training, FP – Field Project, CEP – Continuing Education Program, CC – Co-Curricular, RP – Research Project]

S.E. Civil & Infrastructure Engineering Scheme

Program Structure for Second Year of Civil & Infrastructure Engineering

UNIVERSITY OF MUMBAI (With Effect from 2025-2026)

SEMESTER IV

Course Code	Course Description	Teaching Scheme (Contact Hours)			Credit Assigned			
		Theory	Practical	Tutorial	Theory	Tutorial	Practical	Total Credits
2084111	Applied Mathematics for Civil Engineering-II	2	–	1	2	1	–	3
2084112	Modern Surveying	3	–	–	3	–	–	3
2084113	Structural Analysis	3	–	–	3	–	–	3
2084211	Multidisciplinary minor (form Other Engineering Branch/Science/Commerce /Management)	3	–	–	3	–	–	3
2084311	Open Elective (From other boards Science/Commerce/Manag ement stream)	2#	–	–	2	–	–	2
2084114	Modern Surveying Lab	–	2	–	–	–	1	1
2084115	Structural Analysis Lab	–	2	–	–	–	1	1
2084212	Multidisciplinary minor (form Other Engineering Branch/Science/Commerce /Management)	–	2	–	–	–	1	1
2084411	Computer Aided Architectural Planning & Design Lab	–	4	–	–	–	2	2
2994511	Business Model Development	–	2*+2	–	–	–	2	2
2994512	Design Thinking	–	2*+2	–	–	–	2	2
Total		13	18	01	13	01	09	23

* Two hours of practical class to be conducted for full class as demo/discussion.

Theory / Tutorial 1 credit for 1 hour and Practical 1 credit for 2 hours

Students must select course for Open Elective from Science/Commerce/Management stream bucket provided by the University of Mumbai.

#Institute shall offer a course for MDM from other Engineering Boards.

Course Code	Course Description	Examination scheme							
		Internal Assessment Test (IAT)			End Sem. Exam Marks	End Sem. Exam Duration (Hrs.)	Term Work (Tw)	Oral & Pract.	Total
		IAT-I	IAT-II	Total (IAT-I) + IAT-II)					
2084111	Applied Mathematics for Civil Engineering-II	20	20	40	60	2	25	–	125
2084112	Modern Surveying	20	20	40	60	2	–	–	100
2084113	Structural Analysis	20	20	40	60	2	–	–	100
2084211	Multidisciplinary minor (form Other Engineering Branch/Science/Commerce/Management)	20	20	40	60	2	–	–	100
2084311	Open Elective (From other boards Science/Commerce/Management stream)	20	20	40	60	2	–	–	100
2084114	Modern Surveying Lab	–	–	–	–	–	25	25	50
2084115	Structural Analysis Lab	–	–	–	–	–	25	25	50
2084212	Multidisciplinary minor (form Other Engineering Branch/Science/Commerce/Management)	–	–	–	–	–	25	–	25
2084411	Computer Aided Architectural Planning & Design Lab	–	–	–	–	–	50	25	75
2994511	Business Model Development	–	–	–	–	–	50	–	50
2994512	Design Thinking	–	–	–	–	–	50	–	50
Total		100	100	200	300	10	250	75	825

SEMESTER IV

Vertical – 1 Major

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2084111	Applied Mathematics for Civil Engineering - II	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT -I	IAT -II	Total					
2084111	Applied Mathematics for Civil Engineering -II	20	20	40	60	2	--	--	100

Pre-requisite:

- Applied Mathematics-I,
- Applied Mathematics-II,
- Applied Mathematics for Civil Engineering II

Objectives:

- 1) To study the concept of Vector calculus & its applications in engineering.
- 2) To study Line and Contour integrals and expansion of complex valued function in a power series.
- 3) To familiarize with the concepts of statistics for data analysis.
- 4) To acquaint with the concepts of probability, random variables with their distributions and expectations.
- 5) To familiarize with the concepts of probability distributions and sampling theory with its applications.

Outcomes:

Learner will be able to,

- 1) Apply the concept of Vector calculus to evaluate line integrals, surface integrals using Green's theorem, Stokes theorem & Gauss Divergence theorem.
- 2) Use the concepts of Complex Integration for evaluating integrals, computing residues & evaluate various contour integrals.
- 3) Apply the concept of Correlation, Regression and curve fitting to the engineering problems in data science.
- 4) Illustrate understanding of the concepts of probability and expectation for getting

the spread of the data and distribution of probabilities.

- 5) Apply the concept of probability distribution to engineering problems & Testing hypothesis of small samples using sampling theory
- 6) Apply the concepts of parametric and nonparametric tests for analyzing practical problems.

DETAILED SYLLABUS:

Module	Detailed Contents	Hrs.	CO Mapping
I	Module : Vector Calculus 1.1 Solenoidal and irrotational (conservative) vector fields. 1.2 Line integrals – definition and problems. 1.3 Green's theorem (without proof) in a plane, Stokes' theorem (without Proof) only evaluation problems, Gauss' Divergence theorem (without proof) and problems (only evaluation). Self- Learning Topics: Identities connecting Gradient, Divergence and Curl, Angle between surfaces. Verifications of Green's theorem, Stoke's theorem & Gauss- Divergence theorem, related identities & deductions.	05	CO1
II	Module: Complex Integration 2.1 Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof). 2.2 Taylor's and Laurent's series (without proof). 2.3 Definition of Singularity, Zeroes, poles of $f(z)$, Residues, Cauchy's Residue Theorem (without proof) Self-learning Topics: Application of Residue Theorem to evaluate real integrations.	05	CO2
III	Module: Statistical Techniques 3.1 Karl Pearson's Coefficient of correlation (r) and related concepts with problems 3.2 Spearman's Rank correlation coefficient (R) (Repeated & non repeated ranks problems) 3.3 Lines of regression. Self-learning Topics: Covariance, fitting of exponential curve, Fitting of first and second degree curves.	04	CO3
IV	Module: Probability Theory: 4.1 Discrete and Continuous random variables, Probability mass and density function, Probability distribution for random variables, 4.2 Expectation, Variance, Co-variance. 4.3 Moments, Moment generating functions, (Four moments about the origin & about the mean). Self- learning Topics: Conditional probability, Total Probability and Baye's Theorem. Properties variance and covariance.	04	CO4
V	Module: Probability Distribution and Sampling Theory-I 5.1 Probability Distribution: Poisson and Normal distribution 5.2 Sampling distribution, Test of Hypothesis, Level of Significance, Critical region, One-tailed, and two-tailed test, Degree of freedom. 5.3 Student's t-distribution (Small sample). Test the significance of single sample mean and two independent sample means and paired t- test) Self-learning Topics: Test of significance of large samples, Proportion test, Survey based project.	05	CO5

VI	Module: Sampling theory-II 6.1 Chi-square test: Test of goodness of fit and independence of attributes (Contingency table). 6.2 Analysis of variance: F-test (significant difference between variances of two samples) Self- learning Topics: ANOVA: One way classification, Two-way classification (short- cut method), Yate's Correction.	04	CO6
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Term Work:

General Instructions:

- 1) Batch wise tutorials are to be conducted. The number of students per batch should be as per University pattern for practical.
- 2) Students must be encouraged to write at least 6 class tutorials on entire syllabus.
- 3) A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Applied Mathematics for Civil Engineering-I. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1	Attendance (Theory and Tutorial)	05 marks
2	Class Tutorials on entire syllabus	10 marks
3	Mini project	10 marks

Assessment:

Internal Assessment (IA) for 20 marks:

IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test Duration of each test shall be one hour.

End Semester Theory Examination:

Question paper format

- Question Paper will comprise of a total of Six **questions each carrying 15 marks**
Q.1 will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **Four questions** needs to be answered.

References:

1. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication
 University of Mumbai

2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited,
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication,
4. Vector Analysis, Murray R. Spiegel, Schaum Series
5. Complex Variables and Applications, Brown and Churchill, McGraw-Hilleducation
6. Probability Statistics and Random Processes, T. Veerarajan, Mc. GrawHilleducation.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2084112	Modern Surveying	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT -I	IAT -II	Total					
2084112	Modern Surveying	20	20	40	60	2	--	--	100

Rationale:

Surveying is the scientific technique to determine the position of points and angles & distances between them. The process of surveying is necessary to accomplish all civil engineering works or projects successfully like highways, railways, bridges, airports, harbours, canals, dams, reservoirs, sand waste water disposal.

In this core subject, students will learn about the principles and methods in surveying. They will study various conventional instruments which are used in the field for surveying.

For all infrastructures projects, very precise measurements are needed. Thus, the use of modern equipment and methods has become standard. It allows the gathering of much more accurate data in a time-efficient manner and aids in creating the best design possible. Students will learn about the Modern Surveying Instruments and methods, their suitability and applications.

Course Objectives:

The students will be able to learn:

1. Understand appropriate principles and methods of surveying based on accuracy and precision required as per the availability of resources, economics and duration of the project.
2. Learn to apply the technique for measurement of distances in a vertical plane using surveying instruments.
3. Compare direct and indirect methods of measurement and decide the suitable method.
4. Acquire the knowledge of different curves and estimate the quantities.
5. Understand the Modern Surveying Instruments and methods and their suitability.
6. Demonstrate applications of modern instruments and techniques to real problems.

Course Outcomes:

Upon completion of the course, students shall have ability to:

1. Apply the principles and methods of surveying for project works.
2. Measure distances in vertical plane accurately.
3. Suggest solutions to the surveying field problems.
4. Apply the geometric principles for computing data and preparation of drawings.
5. Highlight the improvements in modern surveying instruments/techniques.
6. Use modern surveying tools to solve day to day surveying field problems

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content		Hours	CO Mapping
I	Introduction	1.1	Definition, principles, objectives, fundamental Classification-plane and geodetic.	06	CO1
		1.2	Chaining, Ranging and offsetting: Definitions, Principles, Instruments required, Obstacles, conventional signs and symbols.		
		1.3	Bearings – Different types, compass – prismatic, surveyor, dip, declination and local attraction, compass traversing.		
		1.4	Plane Table Surveying- principle, accessories and method.		
II	Levelling and Contouring.	2.1	Basic terms, principal axes of dumpy level, temporary and permanent adjustments.	05	CO2
		2.2	Booking and reduction of levels.		
		2.3	Contouring: terms, contour, contouring, contour interval, horizontal equivalent, characteristics of contour lines.		
III	Theodolite Surveying	3.1	Various parts and axes of transit, technical terms, measurement of horizontal and vertical angles.	08	CO3
		3.2	Theodolite traverse, Latitudes and departures, traverse adjustments by Bowditch's and transit rule, Gales traverse table.		
		3.3	Tacheometry - Principle, Objective, Suitability and different methods of tacheometry, Stadia formula.		
IV	Curves	4.1	Horizontal Curves - Definitions of different terms, necessity and types of curves. Methods of setting out Simple circular curves- linear methods and Angular methods (Numericals on imple circular curves only).	06	CO4
		4.2	Vertical curves – Definitions, geometry and types. Tangent correction and chord gradient methods.		

V	Introduction to Modern Surveying Instruments Techniques	5.1	EDM	08	CO5
		5.2	Electronic Theodolite		
		5.3	Total Station		
		5.4	Smart Station		
		5.5	GPS		
		5.6	GIS		
		5.7	Remote Sensing		
VI	Application of Modern Surveying Techniques	6.1	Application of Total Station, GIS, GPS, Remote Sensing, LIDAR, Drones.	06	CO6
		6.2	Introduction to GRAM++, Q-GIS.		

Text Books:

1. Surveying and Levelling: R. Agor, Vol. -I, 11th Edition, Khanna Publishers (ISBN8174092358).
2. Surveying and Levelling: Kanetkar and Kulkarni, Vol.-I, 24th Edition, PuneVidyarthiGriha, Pune. (ISBN 8185825114).
3. Surveying and Levelling: Dr. B.C. Punmia, Vol.-I, 16th Edition, Vol. -II 4th Edition, Laxmi Publications (ISBN9788170088530).
4. Surveying and Levelling: N N Basak, 2nd Edition, Tata McGraw Hill, New Delhi. (ISBN9789332901537)
5. Remote Sensing and GIS: B Bhatia, Oxford University Press, New Delhi.
6. Remote Sensing and Geographical Information Systems: M. Anji Reddy, B.S.Publications, Hyderabad, 2001.
7. Concepts and Techniques of Geographic Information Systems: Lo, C.P. & Yeung A.K.W., Prentice Hall of India, New Delhi, 2002.

References:

1. Surveying: Volume - I: Dr K.R. Arora, Standard Book House.
2. Surveying and Levelling (2nd Edition): R. Subramanian; Oxford Higher Education.
3. Surveying and Levelling (Vol.-I): S.K. Duggal, Tata McGraw Hill.
4. Textbook of Surveying: C Venkatramaiah, University Press, Hyderabad, Latest Edition.
5. Fundamentals of Surveying: S.K. Roy, Prentice Hall India, New Delhi.
6. Surveying for Engineers: John Uraire and Bill Price, Palgrave Macmillan.
7. Surveying: Theory and Practice, James Anderson, Edward M. Mikhail, Tata McGraw Hill.
8. GIS, Spatial Analysis, and Modeling: Maguire, D., M. Batty, and M. Goodchild 2005. ESRI Press (070.212.05842005).
9. Global Positioning System: Signals, Measurements, and Performance, Pratap Misra and Per Enge (2nd Ed.), 2006.
10. Remote Sensing Principles and Interpretation: Floyd, F. Sabins, Jr., Freeman and Co., San Francisco, 1978.
11. Geographic Information System and Science: Longley, Paul A., Michael F. Goodchild, David J. Maguire, David W. Rhind, John Wiley and Sons, New York (2nd Ed.), 2005.

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/105/107/105107121/

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

□ Question paper format

- Question Paper will comprise of a total of **six questions each carrying 15 marks. Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **Three questions** need to be answered from Q .2 to Q.6

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2084113	Structural Analysis	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
2084113	Structural Analysis	20	20	40	60	2	--	--	100

Rationale:

Civil & Infrastructure engineering structures are made using various engineering materials such as steel, concrete, timber, other metals or their composites. They are subjected to force systems resulting in to axial forces, bending moments, shear forces, torsion and their combinations. Different materials respond differently to these by getting deformed and having induced stresses. Determination of stress, strain, and deflection suffered by structural elements when subjected to diverse loads is prerequisite for an economical and safe design. In this course, learners will understand the behavior; determine the internal forces and analyses the stresses of various structural elements under action of different type of force systems. The knowledge of Mechanics of Solids will be foundation of essential theoretical background for the subjects of Structural Analysis and Structural Design. Different components of Civil & Infrastructure engineering structures are subjected to various force systems and their combinations. For designing the components, these are analyzed for their response. The structural systems are determinate or indeterminate in nature and so there are different analysis methods. These will be learnt in this course. Subject knowledge of Engineering Mechanics and Mechanics of solids is the prerequisite of this course. Their application on solids and mechanisms, the action of force systems is studied and further extended in this subject. Learner will learn to apply these to the analysis of various members of structural systems such as beams, trusses, portal frames and arches. These analyses will further be used while designing of Steel and RCC structures.

Course Objectives:

The students will be able to learn:

1. To analyze for axial force in the Coplanar, perfect trusses and analysis of statically determinate truss for finding deflection at joints using unit load and strain energy method.
2. To interpret the concept of Influence Line Diagrams for Reactions, SF and BM in Beams and axial forces in trusses and their application for rolling load systems.
3. To compute static and kinematic indeterminacy (degrees of freedom) of the structures

such as beams, rigid jointed and pin jointed frames.

4. To analyze the indeterminate structures using Flexibility method.
5. To analyze the indeterminate structures such as beams & simple rigid jointed frames using slope deflection, moment distribution and direct stiffness method
6. To articulate the concept of plastic hinge, plastic moment carrying capacity, shape factor and collapse load for single and multiple span beams

Course Outcomes:

Upon completion of the course, students shall have ability to:

1. Calculate axial forces in the Coplanar trusses by using Method of joints and calculate the deflection of truss joints using Unit load method and strain energy method.
2. Draw Influence Line Diagrams for axial forces in trusses, Reactions, SF and B M in beams and find their values when rolling loads are passing over them.
3. Evaluate rotation and displacement at a joint in frames with the understanding of static and kinematic indeterminacy of structure.
4. Analyze the indeterminate structures such as beams & simple rigid jointed frames using force method (Flexibility) to analyze the indeterminate structures.
5. Analyze the indeterminate structures such as beams & simple rigid jointed frames using displacement method like slope deflection, moment distribution and direct stiffness method.
6. Understand the behavior of various statically indeterminate beams under plastic state.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content		Hours	CO Mapping
I	Analysis of truss and deflection of truss joints	1.1	Trusses: Analysis of Perfect Coplanar Trusses by Method of Joints.	06	CO1
		1.2	Deflection of truss joints: Application of Unit Load Method and Strain Energy method for calculating deflection of a point on Pinjointed truss.		
II	Influence line diagrams and rolling loads	2.1	Influence lines for Reactions, shear force and bending moment at a section of cantilever, simply supported, overhanging beams without internal hinges.	07	CO2
		2.2	Determination of S,F and B.M at a section , criteria for maximum shear force and bending moment, Absolute maximum shear force and bending moment under Rolling loads rolling loads (UDL and series of point loads) for simply supported girder.		
III	Determinate and Indeterminate structures	3.1	Static and kinematic indeterminacies: Types of structures occurring in practice, their classification, linear and non-linear behavior of materials, geometric non-linearity.	05	CO3

		3.2	Static and kinematic determinacy and indeterminacy of structure.		
IV	Analysis of indeterminate structures by Force method	4.1	Flexibility coefficients and their use in formulation of compatibility equations.	04	CO4
		4.2	Application of flexibility method to propped cantilevers, fixed beams & continuous beams, Simple Rigid jointed frames		
V	Analysis of indeterminate structures by displacement methods	5.1	Slope Deflection method: Application to indeterminate beams & Simple rigid jointed frames having up to three degrees of freedom Including the effect of support settlement.	12	CO5
		5.2	Moment distribution method: Application to indeterminate beams & simple rigid jointed frames having up to three degrees of Freedom including the effect of support settlement.		
		5.3	Direct stiffness method: Stiffness coefficients for prismatic members and their use for formulation of equilibrium equations. Application of Direct stiffness method to indeterminate beams & Simple rigid jointed frames.		
VI	Plastic analysis of structures	6.1	Introduction to plastic analysis, concept of plastic hinge, plastic moment carrying capacity, shape factor. Determination of collapse load for single and Multiple span beams.	05	CO6
		6.2	Static and Kinematic method of plastic analysis. Determination of collapse load for single and multiple span beams.		

Text Books:

1. Basic Structural Analysis: C. S. Reddy, Tata McGraw Hill New Delhi.
2. Mechanics of Structures: Vol-I: S. B. Junnarkar and H.J. Shah, Charotar Publishers, Anand.
3. Analysis of Structures: Vol. I and II, Vazirani and Ratwani.
4. Strength of Materials: S. Ramamrutham, Dhanpatrai and Publishers, Delhi
5. Theory of Structures: S. Ramamrutham, Dhanpatrai and Sons, Delhi
6. Structural Analysis- I: Hemant Patil, Yogesh Patil, Jignesh Patel, Synergy Knowledge, Mumbai.
7. Strength of Materials: Rajput, S. Chand Publications, Delhi
8. Structural Analysis: Bhavikatti, Vikas publisher house Pvt, Ltd.
9. Structural Analysis: Devdas Menon, Narosa Publishing House.
10. Basic Structural Analysis: K.U. Muthu, et.al., I.K. International Publishing House Pvt. Ltd.
11. Elementary Structural Analysis: Jindal
12. Structural Analysis: L.S. Negi and R. S. Jangid, Tata McGraw Hill India.
13. Structural Analysis: T.S. Thandavamoorthy, Oxford University Press.
14. Structural Analysis: Manmohan Das, Bharghab Mohan Pentice Hall International.

References:

1. Structural Analysis: Hibbler, Prentice Hall International.
2. Structural Analysis: Chajes, EIBS London.
3. Theory of Structures: Timoshenko and Young, Tata Mc Graw Hill NewDelhi.
4. Structural Analysis: Kassimali, TWS Publications.
5. Element of Structural Analysis: Norris and Wilbur, McGraw Hill.
6. Structural Analysis: Laursen H.I, McGraw Hill Publishing Co.
7. Structural theorem and their application :B.G.Neal, Pergaman Press.
8. Elementary theory of Structures: Hsieh, Prentice Hall

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test.

Question paper format

- Question Paper will comprise of a total of **six questions each carrying 15 marks. Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **three questions** need to be answered from Q .2 to Q.6.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2084114	Modern Surveying Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	IAT-II	Total				
2084114	Modern Surveying Lab	-	-	-	-	25	25	50

Lab Objectives:

The students will be able to learn:

1. Study various surveying instruments, their least counts, various parts and suitable uses.
2. Apply methods of measurements in the field.
3. Demonstrate skills for collecting, recording and analyzing the field data.
4. Learn advanced instruments/techniques.
5. Acquire first hand practical experience by receiving field exposure to collect site specific data.
6. Exhibit setting out techniques.

Lab Outcomes:

Upon completion of the course, students shall have ability to:

1. Operate and use the surveying instruments.
2. Measure linear and angular dimensions in horizontal and vertical planes.
3. Collect records and analyze the field data systematically.
4. Compare advanced instruments/ techniques with the conventional ones.
5. Prepare the drawings from the collected data in the form of plans, sections and contours.
6. Set out curves and foundation plans.

Prerequisite:

Basic concepts of surveying.

DETAILED SYLLABUS

List of Experiments.

(Any 6 experiments to be performed)

Sr. No.	List of Experiments	Hours	LO Mapping
1	Chain and compass surveying.	02	LO1
2	Simple and compound leveling practices	02	LO1
3	Measurement of horizontal angles and vertical angles using a Theodolite.	02	LO2
4	Measurement of distances, bearings and area using total station.	02	LO2
5	Plane Table Surveying by intersection method.	02	LO3
6	Find constants, heights and distances using Tacheometry.	02	LO3
7	Setting out a simple circular curve.	02	LO5
8	Setting out a simple foundation plan.	02	LO6
9	Determination of co -ordinates and lengths of a profile using GPS.	02	LO4
10	Analysis of survey projects conducted using various softwares.	02	LO4

Projects

A survey camp of three days is to be arranged to execute the following projects for undergoing the students through practical instructions in civil engineer's career with the actual field exposure at an ideal site location.

1	Project I: Road project using Auto level for a minimum length of 500 m including fixing of alignment, profile leveling, cross-sectioning at 20 m interval, plotting of 'L' section and 'C' section. (Two full imperial sheets, the first sheet with key plan and section and the second sheet covering any three typical Cross-sections)
2	Project II: Block Contouring project using Auto level for minimum 60 m × 60 m Area and generating contours by MS Excel. (Take contour interval as 0.2 meter)
3	Project III: Tacheometric contouring project on a hilly area with at least two instrument stations about 60 m to 100 m apart and generating contours by taking Contour intervals as 1 meter.

References:

1. Surveying and Levelling : R. Agor, Vol-I, 11th Edition, Khanna Publishers (ISBN 8174092358).
2. Surveying and Leveling: Kanetkar and Kulkarni, Vol-I, 24th Edition, Pune Vidyarthi Griha, Pune. (ISBN 8185825114).
3. Surveying and Levelling : Dr. B.C. Punmia, Vol.-I, 16th Edition, Vol -II 4 th Edition, Laxmi Publications (ISBN9788170088530).
4. Surveying and Levelling: N N Basak, 2nd Edition, Tata McGraw Hill, New Delhi. (ISBN 9789332901537).
5. Surveying: Vol-I: Dr K.R. Arora, Standard Book House.
6. Surveying and Levelling (2nd Edition): R. Subramanian; Oxford Higher Education.
7. Surveying and Levelling (Vol.-I): S.K. Duggal, Tata Mc-Graw Hill.
8. Global Positioning System: Signals, Measurements, and Performance, Pratap Misra (2nd Ed.), 2006.
9. Imaging Radar for Resource Survey: Remote Sensing Applications: W. Travelt, Chapman and Hall.
10. A Remote Sensing Perspective: Introductory Digital Image Processing: John, R. Jensen, Prentice Hall.

11. Remote sensing and Image interpretation, T.M Lilles, R.W Kiefer and J.W Chipman, 5th edition, John Wiley and Sons India.

Online Resources:

Sr. No.	Website Name
1.	https://youtu.be/TKzEBJ1qkz8?feature=shared
2.	https://youtu.be/Mb2jbdqMJHA?feature=shared
3.	https://youtu.be/z0wV0VsXdX0?feature=shared

Assessment:

Term Work: Term Work shall consist of at least 06 practicals based on the experiment list. Also, Including above practical work, projects and assignments, distribution of marks for Term Work shall be as follows:

Practical Work	: 05 marks
Assignments	: 05 marks
Project	: 15 marks
Total	: 25 marks

End Semester Practical/ Oral Examination

Practical Examination : 10 Marks

Oral Examination : 15 Marks.

Oral examination will be conducted after conduction of practical examination & it will be based on term work & Practical examination.

Practical & Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2084115	Structural Analysis Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-I	IAT-II	Total				
2084115	Structural Analysis Lab	-	-	-	-	25	25	50

Lab Objectives:

The students will be able to learn:

1. To analyze for axial force in the Coplanar, perfect trusses and evaluate deflection in trusses using energy methods.
2. To study the concept of Influence Line Diagrams and rolling loads.
3. To understand to differentiate determinate and indeterminate structures.
4. To learn methods for evaluating rotation and displacement of frames and trusses.
5. To analyze the indeterminate structures using Flexibility methods and Stiffness method.
6. To understand Plastic analysis including plastic hinge and plastic moment capacity.

Lab Outcomes:

On completion of this course, the students will be able to:

1. Calculate axial forces in the Coplanar trusses by using Method of joints and method of sections and also calculate deflection in truss at various joints using energy methods.
2. Draw Influence Line Diagrams for axial forces in trusses, Reactions, SF and B M in beams and find their values when rolling loads are passing over them.
3. To compute static and kinematic indeterminacy (degrees of freedom) of the structures such as beams & rigid and pin jointed frames.
4. Evaluate rotation and displacement at a joint of frames and deflection at any joint of truss and will be able to compute static and kinematic indeterminacy of structure.
5. Analyze the indeterminate structures such as beams & simple rigid jointed frames using Flexibility methods and direct stiffness method.
6. Evaluate the behavior of various statically indeterminate beams under plastic state.

DETAILED SYLLABUS

List of Experiments.

Sr No	List of Experiments	Hrs	LO Mapping
1	Analysis of Trusses. (Numericals based on this Module will be solved in tutorial room.)	2	LO1
2	1) Analysis of Trusses 2) Solve set of questions given by the course instructor (or) 3) Write a report on use of arches in civil engineering (or) 4) Difference in behaviour of trusses and arches if used in bridges (or) 5) Write a report on limitations of trusses /arches (or) 6) Report Famous Truss structures / arch structures in world (or) 7) Write a report on use of trusses in Civil Engineering	2	LO2
3.	Influence line diagrams and rolling loads (Numericals based on this Module will be solved in tutorial room.)	2	LO2
4	Influence line diagrams and rolling loads 1) Solve set of questions given by the course instructor (or) 2) Write a report on use of arches in civil engineering (or) 3) Design an experiment for ILD of reactions of beam. (or) 4) Design an experiment for ILD of axial forces of a multi-bay truss (or) 5) write a report on IRC and classes of rolling loads	2	LO3
5	Determinate and Indeterminate structure (Numericals based on this Module will be solved in tutorial room.)	2	LO4
6	Determinate and Indeterminate structure 1) Solve set of questions given by the course instructor (or) 2) Prepare a chart explaining static and kinematic indeterminacy (or) 3) Write a computer program in C++ or MS-excel or similar for ILD of reactions. (or) 4) Write a computer program in C++ or MS-excel or similar for ILD for axial forces in Truss members.	2	LO5
7	Analysis of indeterminate structures by Flexibility method (Numerical based on this Module will be solved in tutorial room.)	2	LO6
8	Analysis of indeterminate structures by Flexibility method 1) Solve set of questions given by the course instructor (or) 2) Prepare a poster on Flexibility and Stiffness approach (or) 3) Solve a set of 4-5 questions given by the course instructor on Flexibility methods and validate the same using relevant Structural Analysis or design software.	2	LO5
9	Analysis of indeterminate structures by Direct stiffness method (Numericals based on this Module will be solved in tutorial room).	2	LO6
10	Analysis of indeterminate structures by slope and deflection method 1) Solve set of questions given by the course instructor (or) 2) Write a report on Stiffness methods in civil engineering (or) 3) Prepare a poster on Clapeyron's theorem for continuous beam. (or)	2	LO6

	4) Solve a set of 4-5 questions given by the course instructor on direct stiffness method and validate the same using relevant Structural Analysis or design software.		
11	Moment distribution method, Plastic analysis of structures (Numerical based on this Module will be solved in tutorial room.)	2	LO5
12	Moment distribution method, Plastic analysis of structures 1. Solve set of questions given by the course instructor (or) 2. Write a report on Plastic analysis of structures (or) 3. Solve a set of 4-5 questions given by the course instructor on Moment distribution method and validate the same using relevant Structural Analysis or design software.	2	LO6

Sr. No.	List of Assignments / Tutorials	CO Mapping
1	Analysis of truss and deflection of truss joints	CO1
2	Influence line diagrams and rolling loads	CO2
3	Determinate and Indeterminate structures	CO3
4	Analysis of indeterminate structures by Force method	CO4
5	Analysis of indeterminate structures by displacement methods	CO5
6	Plastic analysis of structures	CO6

Text Books:

1. Basic Structural Analysis: C. S. Reddy, Tata McGraw Hill NewDelhi.
2. Mechanics of Structures: Vol-I: S. B. Junnarkar and H.J.Shah, Charotar Publishers, Anand.
3. Analysis of Structures: Vol.I and II, Vazirani and Ratwani.
4. Strength of Materials: S. Ramamrutham, Dhanpatrai and Publishers, Delhi
5. Theory of Structures: S. Ramamrutham, Dhanpatrai and Sons, Delhi
6. Structural AnalysisI: Hemant Patil, Yogesh Patil, Jignesh Patel, Synergy knowledge Mumbai.
7. Elementary Structural Analysis: Jindal
8. Structural Analysis: L.S. Negi and R. S. Jangid, TataMc-Graw Hill India
9. Structural Analysis: T.S. Thandavamoorthy, Oxford University Press.
10. Structural Analysis: Manmohan Das, BharghabMohan Pentice Hall International.

References:

1. Structural Analysis: Hibbler, Pentice Hall International.
2. Structural Analysis: Chajes, ElBS London.
3. Theory of Structures: Timoshenko and Young, Tata Mc Graw Hill New Delhi.
4. Structural Analysis: Kassimali, TWS Publications.
5. Element of Structural Analysis: Norrisand Wilbur, McGraw Hill.
6. Structural Analysis: Laursen H.I, McGraw Hill Publishing Co.
7. Structural theorem and their application :B.G.Neal, PergamanPress.

Assessment:**Term Work:**

Term work will include Tutorial work and Assignments both, Distribution of marks for Term Work shall be as follows:

Tutorial work- : 10 Marks

Assignments- : 10 Marks

Attendance : 05 Marks

Total Term work: 25 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted
75% - 80%: 03 Marks; 81% - 90%: 04 Marks; 91% onwards: 05 Marks.

Oral Exam: An Oral exam will be held based on the above syllabus.

Vertical – 4

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2084411	Computer Aided Architectural Design Lab Course-1	-	4	-	-	2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical / Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-I	IAT-II	Total				
2084411	Computer Aided Architectural Design Lab Course-1	-	-	-	-	50	25	75

Lab Objectives:

The students will be able to learn:

1. To remember and recall the intricate details of building design and drawing.
2. To gain an understanding of the basic concepts of building design and drawing.
3. To learn how to apply professional ethics and act responsibly pertaining to the norms of building design and drawing practices.
4. To identify, analyze, research literature and solve complex building design and drawing problems.
5. To have new solutions for complex building design and drawing problems.
6. To effectively communicate ideas, related to building design and drawing, both orally as well as in written format like reports & drawings.

Lab Outcomes:

Upon completion of the course, students shall have ability to:

- 1) Design and drawing of floor plan, elevation, section plan site plan, foundation plan, roof plan, schedule of opening of building.
- 2) Design and drawing of site plan, foundation plan, roof plan, schedule of opening of building.
- 3) Draw one-point perspective views of various building.
- 4) Prepare various working and detailed drawing of the buildings in CAD software.
- 5) Draw two point perspectives drawing of various building.
- 6) Prepare service plan of a building.

DETAILED SYLLABUS

List of Experiments

Sr No.	List of Drawings	Hrs.	LO Mapping
1	Ground floor plan, first floor plan, elevation, section passing through at least one sanitary unit & staircase, of a residential building(bungalow or apartment) to be constructed as a (G+1) R.C.C framed structure (only manual drawing)	06	LO1
2	Site plan, foundation plan and details of one footing, roof plan, schedule of opening and construction notes of a residential building(bungalow or apartment) to be constructed as a (G+1) R.C.C. framed structure (only manual drawing)	04	LO2
3	One-point perspective drawing for any residential structure (only manual drawing)	04	LO3
4	Ground floor plan, first floor plan, elevation, section passing through at least one sanitary unit & staircase, schedule of opening and construction notes of a public building(education/health related) be constructed as a (G+1) R.C.C. framed structure (only CAD drawing Sheet)	06	LO4,LO1,LO2
5	Two-Point perspective drawing for any one public building (only CAD drawing Sheet)	04	LO5,LO4,LO2
6	Service plan of any one building project in CAD software (Residential/public)	02	LO6,LO4

Project Work :

Students should visit any Residential building/Public building physically and take Measurements inside of all rooms & over all outside of the building & can submit a small drawing sheet with the help of CAD.

Recommended Books:

1. Building Drawing with an Integrated Approach to Built Environment by M. G. Shah, C. M. Kale, S.Y. Patki (Tata McGraw-Hill Education)
2. Civil Engineering Drawing (including Architectural aspect) by M. Chakraborti (MonojitChakraborti Publications, Kolkata)
3. Planning and Designing Buildings by Y. S. Sane (Modern Publication House, Pune)
4. Building Drawing and Detailing by B.T.S. Prabhu, K.V. Paul and C. V. Vijayan (SPADES Publication, Calicut)
5. Building Planning by Gurucharan Singh (Standard Publishers & Distributors, New Delhi)

References:

1. IS 962: 1989 – Code of Practice for Architectural and Building Drawings.
2. National Building Code of India – 2005 (NBC 2005)
3. Development Control Regulations for Mumbai Metropolitan Region for 2016 – 2036 (<https://mmrda.maharashtra.gov.in>)
4. Development Control Regulations for Navi Mumbai Municipal Corporation – 1994 (<https://www.nmmmc.gov.in/development-control-regulations>)
5. Development Plan and Control Regulation KDMC, <https://mmrda.maharashtra.gov.in>

Reference Codes:

1. National Building Code of India, 2005
2. IS 779-1978 Specification for water meter
3. IS 909-1975 Specification for fire hydrant • IS 1172-1983 Code of basic requirement for water supply ,drainage & sanitation
4. IS 1742-1983 code of practice for building drainage

The term work shall consist of:**Drawings -**

1. Ground floor plan, first floor plan, elevation, section passing through at least one sanitary unit & staircase, Site plan, Foundation Plan and details of one FOOTING, Roof Plan ,schedule of opening and construction notes of a residential building(bungalow or apartment) to be constructed as a (G+1) R.C.C. framed structure (only Manual Drawing)
2. One-Point Perspective drawing for any Residential structure (only Manual drawing)
3. Ground floor plan, first floor plan, elevation, section passing through at least one sanitary unit & staircase, schedule of opening and construction notes of a public building(Education/Health related) be constructed as a (G+1) R.C.C. framed structure (only CAD drawing Sheet)
4. Two-Point perspective drawing for any one public building (only CAD drawing Sheet)

Distribution of the Term Work Marks:

The marks of term-work shall be judiciously awarded depending upon the quality of the term work. The final certification acceptance of term-work warrants the satisfactorily the appropriate completion of the required quality & quantity of work for the minimum passing marks to be obtained by the students. Broadly, the split of the marks for term work shall be as given below. However, there can be further bifurcation in the marks under any of the heads to account for any sub-head therein.

Drawing Sheet (Manual)	:	15 Marks
Drawing Sheet (CAD Based)		15 Marks
Project Work	:	15 Marks
Attendance	:	5 Marks
Total	:	50 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to. 75% 80%: 03 Marks; 81% 90%: 04 Marks 91% onwards: 05 Marks (Consider Practical attendance

Practical Examination (Oral & sketching) –

Practical Examination will consist of sketching & oral examination based on the entire syllabus.

Vertical – 5

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract .	Tut.	Total
2994511	Business Model Development	-	2*+2	-	-	2*+2	-	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
2994511	Business Model Development	-	-	-	-	-	50	-	50

Note: * Two hours of practical class to be conducted for full class as demo/discussion/theory.

Lab Objectives:

1. To introduce a learner to entrepreneurship and its role in economic development.
2. To familiarize a learner with the start-up ecosystem and government initiatives in India.
3. To explain the process of starting a business.
4. To familiarize a learner with the building blocks of a business.
5. To teach a learner to plan their own business with the help of Business Model Canvas.
6. To teach a learner to have financial plan for a business model.

Lab Outcomes:

The learner will be able to:

1. Discuss the role of entrepreneurship in the economic development of a nation and describe the process of starting a business.
2. Describe start-up ecosystems in Indian and global context.
3. Identify different types of business models.
4. Identify customer segments, channels and customer relationship components for a particular business.
5. Identify key activities, key partners and key resources for a particular business.
6. Develop a financial plan for a business with the help of cost structure and revenue model.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Basic Design Thinking principles	01	-
I	Introduction to Entrepreneurship	Introduction to Entrepreneurship: Definition, the role of entrepreneurship in the economic development, the entrepreneurial process, Women entrepreneurs, Corporate entrepreneurship, Entrepreneurial mindset Self-learning Topics: Case studies: Henry Ford https://www.thehenryford.org/docs/default-	04	L1, L2

		source/default-document-library/default-document-library/henryfordandinnovation.pdf?sfvrsn=0 The Tatas: How a Family Built a Business and a Nation by Girish Kuber, April 2019, Harper Business		
II	Entrepreneurship Development	Entrepreneurship Development: Types of business ownerships: Proprietorship, Public and Private Companies, Co-operative businesses, Micro, Small and Medium Enterprises (MSME): Definition and role of MSMEs in economic development	05	L2, L3, L4
III	Start-up financing	Start-up financing: Cost and revenue models, Sources of start-up fundings: Angel investors, Venture capitalists, Crowd funding, Government schemes for start-up funding Self-learning Topics: Successful business pitching	04	L2, L3, L4, L5
IV	Intellectual Property Rights (IPR)	Intellectual Property Rights (IPR): Types of IPR: Patents, trademarks and copyrights, Patent search and analysis, Strategies for IPR protection, Ethics in technology and innovation	04	L2, L3, L4
V	Business Model Development	Business Model Development: Types of business models, Value proposition, Customer segments, Customer relationships, Channels, Key partners, Key activities, Key resources, Prototyping and MVP Self-learning Topics: The Art of the Start 2.0: The Time-Tested, Battle-Hardened Guide for Anyone Starting Anything by Guy Kawasaki	04	L3, L4, L5, L6
VI	Digital Business Management	Digital Business Management: Digital Business models (Subscription, Freemium etc), Digital marketing: Search Engine Optimization (SEO), Search Engine Marketing (SEM), Social media and influencer marketing, Disruption and innovation in digital business Self-learning Topics: Case study: Airbnb https://www.prismetric.com/airbnb-business-m	04	L2, L3

Textbooks:

1. Entrepreneurship: David A. Kirby, McGraw Hill, 2002
2. Harvard Business Review: Entrepreneurs Handbook, HBR Press, 2018
3. Business Model Generation; Alexander Ostlewalder and Yves Pigneur, Strategyzer, 2010
4. E- Business & E- Commerce Management: Strategy, Implementation, Practice – Dave Chaffey, Pearson Education

Reference books:

1. Entrepreneurship: New venture creation by David Holt, Prentice Hall of India Pvt. Ltd.
2. E- Business & E- Commerce Management: Strategy, Implementation, Practice – Dave Chaffey, Pearson Education

Online Resources:

Sr. No.	Website Name
1	Entrepreneurship by Prof. C Bhaktavatsala Rao https://onlinecourses.nptel.ac.in/noc20_mg35/preview
2	Innovation, Business Models and Entrepreneurship by Prof. Rajat Agrawal, Prof. Vinay Sharma https://onlinecourses.nptel.ac.in/noc21_mg63/preview
3	Sarasvathy's principles for effectuation https://innovationenglish.sites.ku.dk/model/sarasvathy-effectuation/

List of Experiments.

The lab activities are to be conducted in a group. One group can be formed with 4-5 students. A group has to develop a Business Model Canvas and a digital prototype (Web App/ mobile app). Weekly activities are to be conducted as follows:

Sr. No.	Lab activities	Hrs.
01	Problem identification (Pain points, Market survey)	2
02	Design a digital solution for the problem (Ideation techniques)	2
03	Preparing a business model canvas: Value proposition, Key partners, Key resources, Key activities	2
04	Preparing a business model canvas: Customer segment, Customer relationships and channels	2
05	Preparing a business model canvas: Cost and Revenue structure	2
06	Prototype development: Low fidelity	2
07	Prototype development: Customer feedback	2
08	Prototype development: High fidelity	2
09	Presentation of high-fidelity prototype	2

Sr. No.	List of Assignments / Tutorials	Hrs.
01	Presentation on case study of a failed business model	2
02	Presentation on case study of a woman entrepreneur	2

Assessment:

Term Work: Term Work shall consist of 09 lab activities based on the above list. Also, Term work journal must include any 2 assignments from the above list.

Term Work Marks: 50 Marks (Total marks) = 25 Marks (Experiment) + 10 Marks (Assignments) + 5 Marks (Attendance)+10 Marks (Report).

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2994512	Design Thinking	-	2*+2	-	-	2*+2	-	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
2994512	Design Thinking	-	-	-	-	-	50	-	50

Note: * Two hours of practical class to be conducted for full class as demo/discussion/theory.

Lab Objectives:

1. To introduce a learner to the principles of Design Thinking.
2. To familiarize a learner with the process (stages) of Design Thinking.
3. To introduce various design thinking tools.
4. Study of the techniques for generation of solutions for a problem.
5. To expose a learner to various case studies of Design Thinking.
6. Create and test a prototype.

Lab Outcomes:

Students will be able to ...

1. Compare traditional approach to problem solving with the Design Thinking approach and discuss the principles of Design Thinking
2. Define a user persona using empathy techniques
3. Frame a problem statement using various Design Thinking tools
4. Use ideation techniques to generate a pool of solutions for a problem
5. Create prototypes using different techniques
6. Test the prototypes and gather feedback for refining the prototype

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	No perquisites	-	-
I	Introduction to Design Thinking	Introduction to Design Thinking: Definition, Comparison of Design Thinking and traditional problem-solving approach, Need for Design Thinking approach, Key tenets of Design Thinking, 5 stages of Design Thinking (Empathize, Define, Ideate, Prototype, Test) Self-learning Topics: Design thinking case studies from various domains https://www.design-thinking-association.org/explore-design-thinking-	05	L1, L2

		topics/external-links/design-thinking-case-study-index		
II	Empathy	Empathy: Foundation of empathy, Purpose of empathy, Observation for empathy, User observation technique, Creation of empathy map Self-learning Topics: Creation of empathy maps https://www.interaction-design.org/literature/topics/empathy-mapping	05	L2, L3
III	Define	Define: Significance of defining a problem, Rules of prioritizing problem solving, Conditions for robust problem framing, Problem statement and POV Self-learning Topics: Creating a Persona – A step-by-step guide with tips and examples https://uxpressia.com/blog/how-to-create-persona-guide-examples	05	L2, L3
IV	Ideate	Ideate: What is ideation? Need for ideation, Ideation techniques, Guidelines for ideation: Multi-disciplinary approach, Imitating with grace, Breaking patterns, Challenging assumptions, Looking across value chain, Looking beyond recommendation, Techniques for ideation: Brainstorming, Mind mapping Self-learning Topics: How To Run an Effective Ideation Workshop: A Step-By-Step Guide https://uxplanet.org/how-to-run-an-effective-ideation-workshop-a-step-by-step-guide-d520e41b1b96	05	L3
V	Prototype	Prototype: Low and high-fidelity prototypes, Paper prototype, Story board prototype, Scenario prototype	03	L6
VI	Test	Test: 5 guidelines of conducting test, The end goals of test: Desirability, Feasibility and Viability, Usability testing	03	L4, L5

Textbooks:

1. Design Your Thinking: The Mindsets, Toolsets, and Skill Sets for Creative Problem-solving, Pavan Soni, Penguin Random House India Private Limited
2. Design Thinking: Methodology Book, Emrah Yayichi, 2016
3. Handbook of Design Thinking: Christian Mueller-Roterberg, 2018

Reference books:

1. Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School, Idris Mootee, Wiley, 2013
2. Change by Design, Tim Brown, Harper Business, 2009

Online Resources:

Sr. No.	Website Name
1.	Design Thinking and Innovation by Ravi Poovaiah https://onlinecourses.swayam2.ac.in/aic23_ge17/preview
2.	Introduction to Design Thinking by Dr. Rajeshwari Patil, Dr. Manisha Shukla, Dr. Deepali Raheja, Dr. Mansi Kapoor https://onlinecourses.swayam2.ac.in/imb24_mg37/preview
3.	Usability Testing https://www.interaction-design.org/literature/topics/usability-testing

List of Experiments :-

The experiments are to be performed in groups. A practical batch may be divided into groups of 4-5 students.

Sr. No.	List of Experiments	Hrs.
01	Customer Journey Mapping: Visualize the steps users take to interact with a product or service. Map out the customer journey from discovering a product to making a purchase and using the product. Identify pain points and opportunities for improvement.	2
02	Stakeholder mapping: Identify all relevant stakeholders in a project. Create a stakeholder map, categorizing stakeholders based on their influence and interest. Include management of relationships with key stakeholders.	2
03	"How Might We" Problem Framing: Transform user insights into actionable problem statements. After empathizing with users, turn challenges into "How Might We" statements that define the problem without prescribing a solution.	2
04	Brainstorming Session: Generate a pool of ideas in a creative, non-judgmental environment. Using ideation techniques like mind mapping and brainwriting, students brainstorm as many solutions as possible to their "How Might We" problem statements.	2
05	Affinity Diagramming: Organize group ideas to find patterns and insights. After brainstorming, students will categorize their ideas into themes by placing sticky notes on a wall and moving them into groups based on similarities.	2
06	Rapid Prototyping: Create quick, low-fidelity versions of solutions. Use materials like paper, cardboard, and markers to build a prototype of their solution within 30 minutes. The focus is on speed and functionality, not aesthetics.	2
07	Wireframing: Create a visual guide for digital interfaces for mobile app / web app for the problems identified in earlier lab sessions. Students will sketch	2

	wireframes of the user interface for their product or service. Use tools like Balsamiq or paper and pen for low-fidelity wireframes.	
08	Role-Playing: Walk through a prototype from the user's perspective. Students act as both users and designers, role-playing scenarios where they interact with their prototype (Developed in earlier lab sessions). Gather feedback from participants on how to improve the experience.	2
09	Usability Testing: Evaluation of the effectiveness and user-friendliness of a prototype (developed in earlier lab sessions). Students will have peers or target users test their prototypes, observe how they interact with it, and collect feedback on any issues or improvements needed.	2
10	Feedback Loop and Iteration: Refine solutions based on user feedback. After usability testing, students will refine their prototypes. Document changes made based on feedback and discuss how continuous iteration improves the design.	2

Sr No	List of Assignments (Any two)	Hrs.
01	Create an empathy map for a target user group. Break them into four sections: Says, Thinks, Feels, and Does. Interview users or research their experiences to fill in the map.	3
02	Based on research, students will create user personas including demographic details, motivations, pain points, and goals. Each group will present their persona to the class.	3
03	Consider 3 examples of real-life products which have good design and bad design. Write down reasons why do you think they are good or bad designs. May take user survey to support your work.	3
04	Study any open-source design thinking tool and write a brief report about it.	3

Assessment:

Term Work: Term Work shall consist of 08 to 10 lab activities based on the above list. Also, Term work journal must include any 2 to 4 assignments from the above list.

Term Work Marks: 50 Marks (Total marks) = 25 Marks (Experiment) + 10 Marks (Assignments) + 5 Marks (Attendance)+ 10 Marks (Report).

Letter Grades and Grade Points:

Semester GPA/ Programme CGPA Semester/ Programme	% of Marks	Alpha-Sign/ Letter Grade Result	Grading Point
9.00 - 10.00	90.0 – 100	O (Outstanding)	10
8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)	9
7.00 - < 8.00	70.0 - < 80.0	A (Very Good)	8
6.00 - < 7.00	60.0 - < 70.0	B+ (Good)	7
5.50 - < 6.00	55.0 - < 60.0	B (Above Average)	6
5.00 - < 5.50	50.0 - < 55.0	C (Average)	5
4.00 - < 5.00	40.0 - < 50.0	P (Pass)	4
Below 4.00	Below 40.0	F (Fail)	0
Ab (Absent)	-	Ab (Absent)	0

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