University of Mumbai

वेबसाईट – mu.ac.in
ईमेल - आयडी - dr.aams@fort.mu.ac.in
aams3@mu.ac.in

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 अमंलबजावणीच्या 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)
कुलसचिव

Copy forwarded for information and necessary action to :-	
1	The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Dept)(AEM), dr@eligi.mu.ac.in
2	The Deputy Registrar, Result unit, Vidyanagari drresults@exam.mu.ac.in
3	The Deputy Registrar, Marks and Certificate Unit,. Vidyanagari dr.verification@mu.ac.in
4	The Deputy Registrar, Appointment Unit, Vidyanagari dr.appointment@exam.mu.ac.in
5	The Deputy Registrar, CAP Unit, Vidyanagari cap.exam@mu.ac.in
6	The Deputy Registrar, College Affiliations & Development Department (CAD), deputyregistrar.uni@gmail.com
7	The Deputy Registrar, PRO, Fort, (Publication Section), Pro@mu.ac.in
8	The Deputy Registrar, Executive Authorities Section (EA) eau120@fort.mu.ac.in He is requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to the above circular.
9	The Deputy Registrar, Research Administration & Promotion Cell (RAPC), rapc@mu.ac.in
10	The Deputy Registrar, Academic Appointments & Quality Assurance (AAQA) dy.registrar.tau.fort.mu.ac.in ar.tau@fort.mu.ac.in
11	The Deputy Registrar, College Teachers Approval Unit (CTA), concolsection@gmail.com
12	The Deputy Registrars, Finance & Accounts Section, fort draccounts@fort.mu.ac.in
13	The Deputy Registrar, Election Section, Fort drelection@election.mu.ac.in
14	The Assistant Registrar, Administrative Sub-Campus Thane, thanesubcampus@mu.ac.in
15	The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan, ar.seask@mu.ac.in
16	The Assistant Registrar, Ratnagiri Sub-centre, Ratnagiri, ratnagirisubcentar@gmail.com
17	The Director, Centre for Distance and Online Education (CDOE), Vidyanagari, director@idol.mu.ac.in
18	Director, Innovation, Incubation and Linkages, Dr. Sachin Laddha pinkumanno@gmail.com
19	Director, Department of Lifelong Learning and Extension (DLLE), dlleuniversityofmumbai@gmail.com

Copy for information :-	
1	P.A to Hon'ble Vice-Chancellor, vice-chancellor@mu.ac.in
2	P.A to Pro-Vice-Chancellor pvc@fort.mu.ac.in
3	P.A to Registrar, registrar@fort.mu.ac.in
4	P.A to all Deans of all Faculties
5	P.A to Finance & Account Officers, (F & A.O), camu@accounts.mu.ac.in

To,

1	The Chairman, Board of Deans pvc@fort.mu.ac.in
2	**Faculty of Humanities,** **Offg. Dean** 1. Prof.Anil Singh Dranilsingh129@gmail.com **Offg. Associate Dean** 2. Prof.Manisha Karne mkarne@economics.mu.ac.in 3. Dr.Suchitra Naik Naiksuchitra27@gmail.com
	Faculty of Commerce & Management, **Offg. Dean,** 1 Prin.Ravindra Bambardekar principal@model-college.edu.in **Offg. Associate Dean** 2. Dr.Kavita Laghate kavitalaghate@jbims.mu.ac.in 3. Dr.Ravikant Balkrishna Sangurde Ravikant.s.@somaiya.edu 4. Prin.Kishori Bhagat kishoribhagat@rediffmail.com

	Faculty of Science & Technology **Offg. Dean** 1. Prof. Shivram Garje ssgarje@chem.mu.ac.in **Offg. Associate Dean** 2. Dr. Madhav R. Rajwade Madhavr64@gmail.com 3. Prin. Deven Shah sir.deven@gmail.com
	Faculty of Inter-Disciplinary Studies, **Offg. Dean** 1.Dr. Anil K. Singh aksingh@trcl.org.in **Offg. Associate Dean** 2.Prin.Chadrashekhar Ashok Chakradeo cachakradeo@gmail.com 3. Dr. Kunal Ingle drkunalingle@gmail.com
3	Chairman, Board of Studies,
4	The Director, Board of Examinations and Evaluation, dboee@exam.mu.ac.in
5	The Director, Board of Students Development, dsd@mu.ac.in DSW direcotr@dsw.mu.ac.in
6	The Director, Department of Information & Communication Technology, director.dict@mu.ac.in

AC – 20/5/2025
Item No. – 6.35 (N)

As Per NEP 2020

University of Mumbai

Syllabus for Major Vertical – 1, 4, 5 & 6		
Name of the Programme – B.E. (Mechanical Engineering)		
Faculty of Engineering		
Board of Studies in Mechanical Engineering		
U.G. Second Year Programme	**Exit Degree**	**U.G. Diploma in Mechanical Engineering.**
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. (Mechanical Engineering)**
2	**Exit Degree**	**U.G. Diploma in Mechanical Engineering.**
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-580C** **R. TEU-580D**	**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/-	**Sd/-**	**Sd/-**
Dr. S. M. Khot	**Dr. Deven Shah**	**Prof. Shivram S. Garje**
BoS-Chairman-Mechanical Engineering	**Associate Dean**	**Dean**
Faculty of Technology	**Faculty of Science & Technology**	**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 Information Technology Branch of 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 Information Technology in 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 Information Technology 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 First 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 2054-26. Subsequently, this system will be carried forward for Third Year and Final Year Engineering in the academic years 2026-27, and 2027-28, respectively.

Sd/-	**Sd/-**	**Sd/-**
Dr. S. M. Khot **BoS-Chairman-Mechanical Engineering** **Faculty of Technology**	**Dr. Deven Shah** **Associate Dean** **Faculty of Science & Technology**	**Prof. Shivram S. Garje** **Dean** **Faculty of Science & Technology**

Under Graduate Diploma in Engineering- Mechanical Engineering.

Credit Structure (Sem. III & IV)

	R. TEU-580C								
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	2403111 2403112 2403113 2403114 2403115 2403116	--	--	OE:2	--	VEC: 2 HSL: 2	CEP: 2	22	**UG Diploma 45**
	R. TEU-580D									
	IV	2404111 2404112 2404113 2404114 2404115	--	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. Mech. Scheme

Program Structure for Second Year of Mechanical 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
2404111	**Finite Element Analysis**	3	--	--	2	1	–	3
2404112	**Manufacturing Processes**	3	–	--	3	–	–	3
2404113	**Theory of Machines**	3	--	--	3	–	–	3
2404211	Multidisciplinary minor	3	–	--	3	–	–	3
2404311	To be taken from the bucket provided by the University from other Faculty	2	–	--	2	–	–	2
2404114	**Manufacturing Processes Lab**	–	2	–	–	–	1	1
2404115	**Theory of Machines Lab**	–	2	–	–	–	1	1
2404212	Multidisciplinary minor	–	2	–	–	–	1	1
2404411	**CAD Modeling**	–	4	–	–	–	2	2
2404511	**Business Model Development** (Syllabus common to all Branches).	–	2*+2	–	–	–	2	2
2404512	**Design Thinking** (Syllabus common to all Branch).	–	2*+2	–	–	–	2	2
Total		**14**	**18**	**--**	**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

Institute shall offer a 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)					
2404111	**Finite Element Analysis**	20	20	40	60	2	25	--	125
2404112	**Manufacturing Processes**	20	20	40	60	2	--	--	100
2404113	**Theory of Machines**	20	20	40	60	2	--	--	100
2404211	Multidisciplinary minor	20	20	40	60	2	--	--	100
2404311	To be taken from the bucket provided by the University from other Faculty	20	20	40	60	2	--	--	100
2404114	**Manufacturing Processes Lab**	--	--	--	--	--	25	25	50
2404115	**Theory of Machines Lab**	--	--	--	--	--	25	25	50
2404212	Multidisciplinary minor	--	--	--	--	--	25	--	25
2404411	**CAD Modeling**	--	--	--	--	--	50	25	75
2404511	**Business Model Development** (Syllabus common to all Branches).	--	--	--	--	--	50	--	50
2404512	**Design Thinking** (Syllabus common to all Branch).	--	--	--	--	--	50	--	50
Total		**100**	**100**	**200**	**300**	**10**	**250**	**125**	**825**

Semester – IV

Vertical –1

Major

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2404111	Finite Element Analysis	3	-	-	3	-	-	3

Course Code		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2404111	Finite Element Analysis	20	20	40	60	2	25	--	125

Rationale :

Most of the engineering branches are being off-spring of…….

Course Objectives: Six Course Objectives

1. To study the concept of FEM and various methods in it
2. To understand the knowledge of application of Matrix Algebra & Gaussian Elimination.
3. To study the finite element modeling approaches and understands the concept of boundary conditions.
4. To study 2D problems for Constant strain triangle, temperature effects, problem modeling and boundary conditions.
5. To study the concept of heat transfer and fluid flow.
6. It provides a bridge between hand calculations based on mechanics of materials and machine design and numerical solutions for more complex geometries and loading states

Course Outcomes: Six Course outcomes (Based on Blooms Taxonomy)

1. Apply the knowledge of principal of FEA, its types, governing equation, fundamental concept of solid mechanics.
2. Remember the mathematical understanding required for FEA and finite difference techniques.
3. Understand the knowledge of application of FEA such as related to stress on beams, three dimensional frames, and heat transfer.
4. Apply the knowledge of FEA in project work
5. Derive and use 1-D and 2-D element stiffness matrices and load vectors from various methods to solve for displacements and stresses.
6. Apply mechanics of materials and machine design topics to provide preliminary results used for testing the reasonableness of finite element results.

Prerequisite:

1. Mechanics of materials
2. DME I and DME II (Static and dynamic failure theories)
3. Engineering Graphics

DETAILED SYLLABUS: total six module for each subject (13 Weeks)

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Mechanics of materials, DME I and DME II (Static and dynamic failure theories), Engineering Graphics.		
I	**Introduction** :	Brief History of FEM, Finite Element Terminology (nodes, elements, domain, continuum, Degrees of freedom, loads & constraints). Application, Advantages, Steps of FEM, Stress and Equilibrium, Boundary conditions, Strain Displacement Relations, Stress-strain Relations, Von mises stress, Temperature effect, Potential Energy & Equilibrium, Gelerkin's Method, stiffness (Displacement) Method. **Home Exercise 1:** Introduction to Ansys Tools(Pre-Processing, Processing and Post-Processing)	**07**	**CO1**
II	**Matrix Algebra & Gausian Elimination:**	Matrix Multiplication, Transposition, Diagonal Matrix, Symetric Matrix, Upper Triangular Matrix, Determinant of Matrix, Matrix Inversion Eligen values & Elgen vectors, Gaussian elimination. **Home Exercise 2:** Finite Element Analysis (element selection, assigning properties, meshing, assigning loads, and boundary conditions, analysis and result interpretation).	**06**	**CO2**
III	**1D ELEMENT:**	Types of 1D element: Displacement function, Global and local coordinate systems, Order of element, primary and secondary variables, shape functions and its properties. Formulation of elemental stiffness matrix and load vector for spring, bar, beam, truss and Plane frame. Transformation matrix for truss and plane frame, Assembly of global stiffness matrix and load vector, Properties of stiffness matrix, half bandwidth, Boundary conditions elimination method and penalty approach, Symmetric boundary conditions, Stress calculations. Home Exercise 3: Any two problems using bar element	**07**	**CO3**

IV	**1D Steady State Heat Transfer Problems :**	Introduction, Governing differential equation, steady-state heat transfer formulation of 1D element for conduction and convection problem, boundary conditions and solving for temperature distribution. **Home Exercise 4:** Any one problem on steady state heat conduction	**06**	**CO4**
V	**Dynamic Analysis:**	Types of dynamic analysis, General dynamic equation of motion, point and distributed mass, lumped and Consistent mass, Mass matrices formulation of bar and beam element. Undamped-free vibration- Eigen value problem, Evaluation of eigen values and eigenvectors (natural frequencies and mode shapes). **Home Exercise 5:** Any one problem of free vibration analysis using bar element	**06**	**CO5**
VI	**2D ELEMENTS:**	Second Order 2D Equations involving Scalar Variable Functions — Variation formulation –Finite Element formulation — Triangular elements — Shape functions and element matrices and vectors. Application to Field Problems —Torsion of Non circular shafts – Quadrilateral elements. Stress analysis of CST. **Home Exercise 6:** Any two problems using CST element	**07**	**CO6**

Text Books:

1. Introduction to Finite Element Engineering – T.R.Chandrupatla,Belegunda; PHI
2. A First course in Finite Element Method- Darya Logon, ThompsonLearning (TL Publisher)
3. Concepts and Applications of Finite Element Analysis, R. D. Cook, et al. Wiley, India

References:

1. Seshu P., ―Text book of Finite Element Analysis‖, PHI Learning Private Ltd. New Delhi, 2010.
2. Bathe K. J., ―Finite Element Procedures‖, Prentice-Hall of India (P) Ltd., New Delhi.
3. Fagan M. J., ―Finite Element Analysis, Theory and Practice‖, Pearson Education Limited.
4. Kwon Y. W., Bang H., ―Finite Element Method using MATLAB‖, CRC Press, 1997
5. S. Moaveni, ―Finite element analysis, theory and application with Ansys‖,
6. Fundamental of Finite Element Analysis, David V. Hutton, Tata McGraw-Hill
7. TheFiniteElement Method in Engineering- S.S.Rao, Elsveir Pub.
8. An Introduction to FiniteElement Method-J.N.Reddy, Tata Mc-graw Hil

Online References:

Sr. No.	**Website Name** (NPTEL/SWAYAM Courses)
1.	https://nptel.ac.in/courses/112/104/112104193/
2.	https://nptel.ac.in/courses/105/106/105106051/
3.	https://nptel.ac.in/courses/112/104/112104115/
4.	https://nptel.ac.in/courses/112/103/112103295/
5.	https://nptel.ac.in/courses/112/106/112106135/
6.	https://nptel.ac.in/courses/112/106/112106130/
7.	https://nptel.ac.in/courses/105/105/105105041/
8.	https://nptel.ac.in/courses/112/104/112104116/

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 20 marksQ.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

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2404112	Manufacturing Processes	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2404112	Manufacturing Processes	20	20	40	60	2	--	--	100

Course Objectives:

1. To prepare the students understand basic manufacturing processes and Metal Casting used in industries.
2) To familiarize with joining manufacturing fundamentals
3) To make the students understand various hot and cold working processes and sheet metal forming methods and its applications.
4) Topreparethestudentsunderstandvariousmachinetoolsandbasicmachiningprocessesas well as understand the fundamentals of metal cutting.
5) 5.To familiarize with principle and working of non-traditional manufacturing
6) 6.To introduce to them the intelligent manufacturing in the context of Industry 4.0

Course Outcomes: Learnerwillbeableto

1.Demonstrate an understanding of casting process

2.Demonstrate applications of various types of welding processes.

3. Illustrate principles of forming processes.

4.Differentiate chip forming processes such as turning, milling, drilling, etc.

5.Illustrate principles and working of non-traditional manufacturing

6 Illustrate the concept of producing polymer components and ceramic components.

7.Understand the manufacturing technologies enabling Industry 4.0

Prerequisite: Required Knowledge of Engineering Workshop-I &II ,Engineering Materials and Metallurgy

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Required Knowledge of Engineering Workshop-I&II, Engineering Materials and Metallurgy.		–
I	Introduction to Manufacturing processand Metal Casting	Classification of Manufacturing Processes and applications areas Pattern making materials, Types of pattern and allowances. Sand molding and Machine molding Gating system: Types of riser, types of gates, solidification **Special casting processes:** CO2 and shell molding, Investment casting, Die casting, Vacuum casting, Inspection & casting defects and remedies.	06	CO1
II	Joining Processes	Classification of various joining processes; Applicability, advantages and limitations of Adhesive bonding, Mechanical Fastening; Welding and allied processes, Hybrid joining processes. Classification and Working of various welding methods: Gas, Arc, Chemical, Radiant, Solid State etc. Welding Joints, Welding Positions, Welding defects and their remedies.	07	C02
III	Metal Forming Process and Sheetmetalworkingprocesses	**3.1 Metal Forming Process** Introduction and classification of metal working processes, hot and cold working processes Introduction,classificationandanalysisofforgingandrollingoperations, Defects in rolled and forged components, Extrusion process, Classification and analysis of wire and tube drawing processes. **Sheet metal working processes** Classification of Sheet metal operations, types of Presses use din sheet metal operations, types of dies.	06	C03
IV	MachineTools, Machining Process	**4.1MachineToolsandMachiningProcesses** Lathe Machines, Milling Machines, Drilling Machines, and Grinding Machines and selection of grinding wheel, Broaching machines, Lapping/Honing machines (Super Finishing Operations) and shaping/slotting/planning Machines. Gear Manufacturing Gear milling, standard cutters and limitations, Gear Hobbing, GearShaping, Gear Shaving and Gear Grinding processes Theory of Metal cutting:Geometry and nomenclature of single point cutting tool, Speed, feed, depth of cut, Concept of chip formation and types of chips.	**10**	**CO4**

V	Non Traditional Machining Processes:	Electro-chemicalmachining(ECM) Electric-dischargemachining(EDM) Ultrasonicmachining(USM) LaserBeamMachining(LBM)	**04**	**CO5**
VI	Polymer Processing , Powder Metallurgy: and Intelligent manufacturing in the context of Industry 4.0,	**6.1 Polymer Processing:** Polymer Molding Techniquesfor thermoplastic andthermosetting plastics. Applications of Plastics in engineering field**.** **6.2 PowderMetallurgy:** Introduction to Powder Metallurgy PM, Powder making processes, Steps in PM. Compaction and Sintering processes. Secondary and finishing operations in PM**.** **6.3 Intelligent manufacturing in the context of Industry4.0,** Cyber-physicalsystems(CPS) Internet of Things(IoT)enabled manufacturing Cloud Manufacturing	**06**	**CO6**

Text Books:

1. FoundrytechnologybyOPKhanna
2. Principle of Metal Casting- Heine, Loper and Rosenthal, Tata McGraw Hill.
3. WeldingtechnologybyOPKhanna
4. Manufacturing Technology (Foundation Forming & Welding)- P.N. Rao, Tata McGraw Hill.
5. Basic Manufacturing Process- D. Mishra IndiaTech Publisher, New Delh
6. Elementsof workshop technology.Vol. 1& IIbyS K HajraChoudhury
7. ManufacturingSciencebyGhoshand Malik
8. ProductionTechnologybyWAJ ChapmanVolI,II,III
9. Production TechnologybyP CSharma.
10. Production TechnologybyRaghuvanshi.

References

1. Manufacturing Engineering and Technology, 4th Edition- S.Kalpakjian and S.R. Scsimid, Pearson Education

2 Industry4.0:The IndustrialInternetof ThingsbyAlasdairGilchrist,2016,Apress.

3 Cyber-PhysicalSystems: FromTheorytoPracticebyDandaB.Rawat,JoelRodrigues,Ivan Stojmenovic, 2015, C.R.C. Press.

4. Optimization of Manufacturing Systems using Internet of Things by Yingfeng Zhang, Fei Tao, 2017, Academic Press (AP), Elsevier.

Online References:

Sr. No.	Links for online NPTEL/SWAYAM courses:
1	https://nptel.ac.in/courses/112/107/112107219/
2	https://nptel.ac.in/courses/112/107/112107215/
3	https://nptel.ac.in/courses/112/107/112107084/
4	https://nptel.ac.in/courses/112/107/112107144/
5	https://nptel.ac.in/courses/112/107/112107078/
6	https://nptel.ac.in/courses/112/107/112107239/
7	https://nptel.ac.in/courses/112/104/112104195/
8	https://nptel.ac.in/courses/112/107/112107219/
9	https://nptel.ac.in/courses/112/107/112107144/
10	https://nptel.ac.in/courses/112/107/112107213/
11	https://nptel.ac.in/courses/112/107/112107090/
12	https://nptel.ac.in/courses/113/106/113106087/
13	https://nptel.ac.in/courses/112/103/112103263/
14	https://nptel.ac.in/courses/112/107/112107239/
15	https://nptel.ac.in/courses/112/106/112106153/
16	https://nptel.ac.in/courses/112/107/112107250/
17	https://nptel.ac.in/courses/112/107/112107144/
18	https://nptel.ac.in/courses/112/107/112107239/
19	https://nptel.ac.in/courses/112/107/112107219/

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:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- Questionpaperwillcompriseoftotalsixquestions,**eachcarrying20marks**
  Question1 will be **compulsory** and should **cover maximum contents of the curriculum**
- **Remainingquestions**willbe**mixedinnature**(forexampleifQ.2haspart(a)frommodule3the n part (b) will be from any module other than module 3)
- A total of **Three question** need to be answered.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2404113	Theory of Machines	3	2	-	3	2	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2404113	Theory of Machines	20	20	40	60	2	--	--	100

Rationale :

Course Objectives: Six Course Objectives

1. To acquaint with basic concept of kinematics of machine elements
2. To familiarize with basic and special mechanisms
3. To study the functioning of motion transmission machine elements
4. To study the functioning of power transmission machine elements
5. To acquaint with working principles and applications of Governors
6. To acquaint with working principles and applications of Gyroscope

Course Outcomes: Six Course outcomes (Based on Blooms Taxonomy)

1) Identify various components of mechanisms and develop mechanisms to provide specific motion
2) Draw and analyze velocity and acceleration diagrams for various mechanisms
3) Draw a cam profile for the specific follower motion
4) Predict conditions for maximum power transmission in the case of a belt drive
5) Illustrate requirements for an interference-free gear pair
6) Demonstrate working Principles of different types of governors and Gyroscopic effects on the mechanical systems

Prerequisite:

DETAILED SYLLABUS: total six module for each subject (13 Weeks)

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I		Basic Kinematics Kinematic link & its types, Kinematic pairs, Types of Kinematic pairs, Kinematic chains, Types of constrained motions, Mechanism, Machine, Structure, Types of joints, Degree of freedom (mobility), Kutzbach mobility criterion, Grűbler's criterion & its limitations. Four bar chain and its inversions, Slider crank chain and its inversions, Double slider crank chain and its inversions. 1.2 Hooks Joint (Single and double)	06	1
II	Velocity and Acceleration Analysis	Velocity Analysis of Mechanisms (mechanisms up to 6 links) 2.1 Velocity analysis by relative velocity method (Graphical approach) 2.2 Acceleration Analysis of Mechanisms (mechanisms up to 6 links) Acceleration analysis by relative method (Graphical approach). (No Numerical on Coriolis Component)	08	2
III	Cam and Follower Mechanism	3.1 Cam and follower; Classification Cam and follower terminology; 3.2 Motions of the follower: Uniform Velocity, SHM, Constant acceleration and deceleration (parabolic), Cycloidal. (Displacement, Velocity and acceleration Plots)	06	3
IV	Power Transmission	**Power Transmission Belts, Chains**: 4.1 Belts: Introduction, Types, Dynamic analysis –belt tensions, condition of maximum power transmission 4.2 Chains: Introduction to Chain Drives, Classification of chains, length of chain. Types of brakes Introduction and Classification.(No Numerical)	06	5
V	Gears	5.1 Gears: Law of gearing, Forms of tooth, Details of gear terminology, Path of contact, Arc of contact, Contact ratio, Interference in involutes gears, Minimum number of teeth for interference free motion	06	5
VI	Governors and Gyroscopes	6.1 Governors: Introduction to Centrifugal and Inertia governors, Study and Force analysis of Porter and Hartnell governors. 6.2 Gyroscope: Introduction, Gyroscopic couple and its effect on spinning bodies, naval ship during steering, pitching, rolling and their stabilization.	08	6

Text Books:

1.1. S.S. Ratan, “Theory of Machines”, Tata McGraw Hill
2. Ghosh and A.K. Mallik, “Theory of Mechanisms and Machines”, East-West Press
3 Theory of Machines by Jagdish Lal Metropolitan Book New Delhi, Company, Daryaganj, Delhi

References:

1.1. J.J. Uicker, G.R. Pennock, and J.E. Shigley, “Theory of Machines and Mechanism”, Oxford Higher Education
P.L. Ballaney, “Theory of Machines”, Khanna Publishers
3. M.A. Mostafa, “Mechanics of Machinery”, CRC Press
4. R.L. Norton, “Kinematics and Dynamics of Machinery”, McGraw Hill
5. A.G. Erdman, G.N. Sander, and S. Kota, “Mechanism Design: Analysis and Synthesis Vol I”, Pearson
6 Theory of Machines Thomas Bevan CSB Publishers & Distributors

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/112/105/112105268/
2.	https://www.youtube.com/playlist?list=PLYRGB44zNZWVibVLmWANp-7obQzOhJLRt
3.	http://www.nptelvideos.in/2012/12/kinematics-of-machines.html

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:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

- Questionpaperwillcompriseoftotalsixquestions,**eachcarrying20marks**
  Question1 will be **compulsory** and should **cover maximum contents of the curriculum**
- **Remainingquestions**willbe**mixedinnature**(forexampleifQ.2haspart(a)frommodule3the n part (b) will be from any module other than module 3)
- A total of **Three question** need to be answered.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2404115	Theory of Machines Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test	Test 2	Avg. of 2 Tests				
2404115	Theory of Machines Lab	--	--	--	--	25	25	50

Lab Objectives: Six Lab Objectives

1. To familiarize with various mechanisms and inversions
2. To acquaint with basics of power transmission systems
3 To acquaint velocity and acceleration of mechanisms
4 To acquaint motion and power transmission
5 To acquaint with working principles and applications of governors
6 To acquaint with working principles and applications of gyroscope

Lab Outcomes: Six Lab outcomes (Based on Blooms Taxonomy)

1) Develop and build mechanisms to provide specific motion.
2) Find velocity of a mechanism by using Relative method.
3) Analyse velocity and acceleration of a specific link of a slider crank mechanism using graphical approach by Relative method. (Including Problems of Coriolis components of acceleration)
4) Plot displacement-time, velocity-time, and acceleration-time diagrams of follower motion and Draw cam profile for the specific follower motion.
5) Plot and analyze governor characteristics
6) Analyze principle of gyroscopic on laboratory model

Part (A)

List of Experiments

Sr No	List of Experiments	Hrs
01	Using Virtual lab any one experiment on mechanism	**2**
02	Analysis of velocity of mechanisms by Relative Velocity method – 3 to 5 problems	**4**
03	Analysis of acceleration of mechanism by Relative method including pairs involving Coriolis acceleration – 3 to 5 problems	**4**
04	Motion analysis and plotting of displacement–time, velocity-time and acceleration-time, jerk-time, and layout of cam profiles - 2 to 3 problems	**2**
05	Experiments on Governors- Porter Governor, Hartnell Governor	**2**
06	Experiments on Gyroscope	**2**

Part (B)

Sr No	List of Assignments / Tutorials	Hrs
01	Belts and Chains	2
02	Gears	2

Part (C)

Course project on design and fabrication of any one mechanism for a group of maximum 4 students

Assessment :

Term Work: Term Work shall consist part (a) + (b) +(c)

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Course Project) + + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical 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
2404114	**Manufacturing Processes Lab**	**-**	**2**	**-**	**-**	**1**	**-**	**1**

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of 2 Tests				
2404114	**Manufacturing Processes Lab**	**--**	**--**	**--**	**--**	**25**	**25**	**50**

Lab Objectives:

1 To familiarize with the various safety measures and the operational procedures of various machines on the shop floor.

2. To familiarize with the pattern making process.

3. To introduce to the learner various machine tools used for manufacturing.

4. To understand the tool geometry of a single point cutting tool.

5. To familiarize various machining operations in industry.

6. To understand the principle and working of non-traditional manufacturing

Lab Outcomes:

1. Know the specifications, controls and safety measures related to machines and machining perations.
2. To make a pattern for moulding operation.
3. Perform various machining operations for making various engineering jobs.
4. To know Tool nomenclature and grinding operations.
5. To observe the application of various machine tools in actual industrial setup.
6. To observe the application of various non-conventional machining operations in industry.

Prerequisite:

Required Knowledge of Engineering Workshop-I &II

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Required Knowledge of Engineering Workshop-I &II		
1	Safety Measures	Study of safety precautions in machine shop practices	02	LO1
2	Foundry	Various types of patterns, pattern allowances, pattern materials.	08	LO2
3	Machine Tools and Machining Processes:	Study of various Machining Processes on Lathe Machines, Milling Machines, shaping and Drilling Machines.	12	LO3
4	Demonstration of Tool Grinding	Study of Grinding Machines and selection of grinding wheel and To single point tool Nomenclature	02	LO4
5	Industrial Visit	Visit to a manufacturing industry to observe various Machining Operations.	-	LO5
6	Industrial visit	Visit to a non-conventional Machining facility.	-	LO6

Text Books:

1. Foundry technology by O P Khanna
2. Elements of workshop technology. Vol. 1 & II by S K Hajra Choudhury
3 Production Technology by WAJ Chapman Vol I, II, III

References:

1. Principles of manufacturing materials and processes- J.S.Campbell, Tata McGraw Hill.
2. Manufacturing Engineering and Technology, 4th Edition- S.Kalpakjian and S.R. Scsimid, Pearson Education.
3. Materials and processes in manufacturing- DeGarmo, Black and Kohser, Prentice Hall of India.
4. Principle of Metal Casting- Heine, Loper and Rosenthal, Tata McGraw Hill.

List of Experiments:-

Sr No	List of Experiments	Hrs
01	Pattern making 1 job with wood, wax or any other material.	4
02	One composite job consisting of minimum three components covering taper turning and threading, shaping and milling operations.	16
03	Demonstration of single point cutting tool grinding.	2
04	Visit to a manufacturing industry to observe various machining operations.	2
05	Visit to a non-conventional machining facility	2

Term Work:

Term Work shall consist of 5 Practical's based on the above list. Complete Work-Shop Book giving details of drawing of the job and timesheet.

Term Work Marks:

25 Marks (Total marks) = 20 Marks (Experiment) + 5 Marks (Attendance)

Practical & Oral Exam: 25 Marks (Total marks)

An Oral exam will be held based on the above syllabus and the Practical examination will be based on the lathe operations.

Vertical – 4

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2404411	CAD Modelling	-	4	-	-	2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test	Test 2	Avg. of 2 Tests				
2404411	CAD Modelling	--	--	--	--	50	25	75

Lab Objectives: Six Lab Objectives

1. To familiarize geometric modelling techniques
2. To impart 2D sketching skills using CAD software
3. To impart the 3D Solid Modelling skills for the development of 3D models of engineering components.
4. To impart the 3D surface modelling skills for development of 3D models of basic engineering components.
5. To impart the 3D modelling skills for assembling different parts made in 3D modelling software.
6. To introduce Product data exchange among CAD systems.

Lab Outcomes: Six Lab outcomes (Based on Blooms Taxonomy)
Learner will be able to…

1. Use appropriate technique for geometric modelling.
2. Apply 2D sketching tools to prepare sketch of a given object using 3D CAD software.
3. Create solid model of the object using 3D CAD software.
4. Develop the surface model of a given object using 3D CAD software.
5. Generate assembly of given objects using assembly tools of a 3D CAD software
6. Use product data exchange formats to perform product data exchange among CAD systems.

Prerequisite:
1. ESL201: Engineering Graphics laboratory
2. PLC 303: Working Drawing – GD & T laboratory

DETAILED SYLLABUS: Syllabus related Lab experiment must be considered and mapped with Blooms Taxonomy.
total six module for each subject lab (13 weeks) to be distributed among six modules.

Sr. No.	Module	Detailed Content	Hours	LO (Lab Outcomes) Mapping
0	Prerequisite	**Comment** (Prerequisite syllabus should not be considered for paper setting)	02	
I	**Introduction to CAD**	Different modelling techniques (solid modelling, surface modelling, parametric modelling, feature based modelling) for creation of CAD models, creation of CAD models from different perspectives.	02	**LO1**
II	**Sketching using 2D sketch tools**	Setting the sketch environment, creating sketch from a geometry using the sketching commands like- line, circle, arc, etc., modification in sketches using commands like- move, trim, rotate, etc.), use of viewing commands like- pan, zoom, rotate, etc., use of sketch constraints.	08	**LO2**
III	**Solid Modelling**	Settings environment for part modeling, creating machine/engineering parts/components using features like – extrude, revolve, mirror, threading, fillet, hole, bend, rib, patterns (rectangular, circular, etc.), etc.	12	**LO3**
IV	**Surface Modeling**	Generation of surfaces from open profiles using create tools like extrude, sweep, loft, trim, etc., path & guide surface option commands like – extend, trim, shell, patch, etc., mesh of curves, free form surfaces	10	**LO4**
V	**Assembly**	Constraints, exploded views, interference check, drafting (layouts, standard & sectional views, detailing & plotting), use of transformations and manipulation commands (translate, rotate, scale, etc.) to modify and assemble the created CAD models.	16	**LO5**
VI	**Data Exchange**	CAD data exchange formats Like IGES, PDES, PARASOLID, DXF and STL along with their comparison and applicability.	02	**LO6**

Textbooks:

1. A textbook of Machine Drawing by Laxminarayan and M.L.Mathur, Jain brothers Delhi 3. Machine Drawing by Kamat and Rao

2. A text book of Machine Drawing by R.B.Gupta, Satyaprakashan, Tech. Publication

References:

1. Machine Drawing by N.D. Bhatt.

2. Machine Drawing by K.I. Narayana, P. Kannaiah, K.Venkata Reddy

List of Experiments.

Sr No	List of Exercises	Hrs
01	3D modeling of basic Engineering components like - Nuts, Bolts, Keys, cotter, Screws, Springs etc. **(Note: Any two out of above)**	2
02	3D modeling of basic machine components like - Clapper block, Single tool post, Lathe and Milling tail stock, Shaper tool head slide, jigs and fixtures Cotter, Knuckle joint, Couplings: simple, muff, flanged Protected flange coupling, Oldham's coupling, Universal coupling, element of engine system and Miscellaneous parts. **(Note: Any two out of above)**	2
03	Generation of surface model of **any two** objects like - hull of a ship, aeroplane wing, etc. using various surface creation tools in CAD software.	2
04	1) Generation of an assembly model (minimum five child parts) along with working (production) drawing of the system, creation of 3D models with assembly constraints, interference check, exploded view, GD&T, tolerance table and fit table, bill of material. 2) Reverse Engineering of a physical model: disassembling of physical model having not less than five parts, measuring the required dimensions of each component, sketch the minimum views required for each component, convert these sketches into 3-D model and create an assembly drawing with actual dimensions **(Note: Any one out of above)**	2

Using the knowledge and skills acquired through six modules, students should complete minimum seven assignments/experiments from the given sets of assignments using standard CAD modeler like – SolidWorks/ PTC Creo/CATIA /UG /any other suitable software.

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals based on the above list. Also, Term work Journal must include at least 7 exercises (prints) as mentioned above.

Term Work Marks: 25 Marks (Total marks) = 20 Marks (Experiment/Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above 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)			
		Test1	Test 2	Avg. of 2 Tests					
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-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	**04**	**L1, L2**
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
3.	Entrepreneurship by Prof. C Bhaktavatsala Rao https://onlinecourses.nptel.ac.in/noc20_mg35/preview
4.	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)			
		Test1	Test 2	Avg. of 2 Tests					
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-topics/external-links/design-thinking-case-study-index	**05**	**L1, L2**

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
5.	Design Thinking and Innovation by Ravi Poovaiah https://onlinecourses.swayam2.ac.in/aic23_ge17/preview
6.	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 wireframes of the user interface for their product or service. Use tools like Balsamiq or paper and pen for low-fidelity wireframes.	2
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

Sd/-

Dr. Vaishali D. Khairnar
BoS-Chairman-Information Technology
Faculty of Technology

Sd/-

Dr. Deven Shah
Associate Dean
Faculty of Science & Technology

Sd/-

Prof. Shivram S. Garje
Dean
Faculty of Science & Technology