International Institute of Information Technology, Hyderabad
School of Multi-disciplinary Computing

M. Tech in Product Design and Management

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1. Vision and Mission for the School of Multi-disciplinary Computing

Vision

To be recognized as a globally reputed school by offering innovative academic programs and specializations in core computing, computing technologies, and computing in association with multiple disciplines, at all levels (UG, PG, Ph.D.) with state-of-the-art curricula, by promoting quality research in thrust areas, and blending research outcomes into teaching programs.

Mission Statements

MS1: To produce competent next-generation technology leaders, who can apply the science and engineering of computing to add immense value to their profession.

MS2: To implement a state-of-the-art curriculum in all the academic programs in line with the multidisciplinary societal and technological needs and encourage students to imbibe creativity, research, problem-solving skills, professional ethics, and human values.

MS3: To design and execute innovative multidisciplinary academic programs, specializations, and courses that combine computing and other domains organically, by involving all the stakeholders such as students, teachers, research scholars, experts from industry, academia, and alumni.

MS4: To conduct quality research in fundamental, applied, multidisciplinary, and futuristic domains and become a key player in the educational ecosystem within the country and abroad.

MS5: To create and sustain a strong suite of academic outreach programs catering to varied segments such as industry professionals, external students, and early career researchers.

MS6: To collaborate with other reputed institutions in India and abroad and implement best practices to achieve excellence.
2. PEOs, POs, and PSOs for the M.Tech Program in Product Design and Management

After completing the M. Tech in Product Design and Management successfully, the graduates will be able to:

PEO 1: Demonstrate problem-solving abilities to handle real-world problems from a customer centric perspective by transforming theoretical knowledge to design practice.

PEO2: Demonstrate the requisite breadth and depth of knowledge in advanced areas of product design and management and to excel in digital product industry.

PEO3: Exhibit inter-personal skills required to function effectively in varied, dynamic, and inter-disciplinary teams.

PEO4: Develop an aptitude for self-learning and life-long learning so as to keep abreast with rapidly evolving technologies.

PEO5: Practice ethics and human values in their profession.

Program Outcomes (POs)

PO1: Product Engineering Knowledge: Demonstrate competency in the process of conceptualizing, defining, designing, and delivering technology products for markets.

PO2: Design/Development of solutions: Synthesize products or solutions for complex engineering that meet the specified market needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO3: Market Research & Development: Apply existing knowledge base and self-learning skills towards quantitative human, cultural and technological research to identify and develop appropriate product design and market strategies.

PO4: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern product management, development engineering and IT tools to become effective product managers and/or entrepreneurs.

PO5: Design & Creativity: Demonstrate an understanding of markets, and design solutions that connect and impress the customers, being aware of contemporary global, societal, ethical, and professional issues in the practice of product design and product engineering.

PO6: Product & Project management: Apply the principles of project management with focus on issues such as the life cycle, scoping, costing, and development of a product.
**PO7: Business fundamentals:** Demonstrate a solid foundation in business knowledge, skills and competencies while comprehending relevant topics in the areas of accounting, business communications, finance, human resources, introduction to business management, marketing, and supply chain management.

**PO8: Effective Communication:** Comprehend and write product proposals, business plans design documentation, effective reports and be able to make effective presentations.

**PO9: Ethics:** Practice principles of professional ethics and make informed decisions after a due impact analysis.

**PO10: Individual and team-work:** Work efficiently as an individual and provide leadership in team-oriented projects of varying sizes, cultural milieu, professional accomplishments, and technological backgrounds.

**PO11: Self-Learning and Life-long Learning:** Exhibit the aptitude for independent, continuous, and life-long learning required to meet professional and career goals.

**PSOs**

**PSO1:** Demonstrate competence in core areas of Product Design and Management, including design thinking, user research, business fundamentals and business finance.

**PSO2:** Exhibit specialized knowledge in any one or more of the sub-areas of product design and management such as interaction design, wearable systems design, game design, product market fit, technology entrepreneurship, organizational operations.

**PSO3:** Demonstrate solutioning skills to conceptualize, analyse, design, build, and scale technology products.

**PSO4:** Possess the requisite breadth, depth, and skills needed to excel in technology product-driven environments.

### Mapping between PEOs and Mission Statements

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Mapping between POs, PSOs and PEOs

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Curriculum

About the Programme

M. Tech in Product Design and Management (PDM) is a program that converges technology trends in software, design thinking, user centric design, products & markets, business models around technology products. The program is being supported in-part by Ministry of Electronics and Information Technology, Government of India. It is a 2-year Masters programme.

An applicant to this programme is required to have a Bachelor’s degree in Engineering/Technology/Design/Science or Equivalent (4 year programme after 10+2) or Masters degree in Science/Computer Applications (2 year programme after 10+2+3) with a minimum of 60% or equivalent grade. The course shall focus on ICT technology-oriented product design and management. Hence candidates who apply are expected to have at least 1 yr experience in product development (especially ICT related products). Some exposure to design is preferred (engineering design or hardware design or industrial design) but not necessary.

The program intake shall be 25-30 students. Scholarship amount shall be paid to some of the students to cover living expenses as per MeitY project rules. The candidate must be enrolled under full-time M.Tech PDM programme to be eligible for stipend. The two-year program contains a mix of Technology, Entrepreneurship and Design courses.

Key Objectives

The aim of M. Tech in Product Design and Management program is to create market and design aware technologists that are equipped with knowledge needed to be able to conceptualize, define, design technology products and connect them with markets. The curriculum shall create graduates that understand the convergence of technology, design, markets and the business of products. The program shall enable creation of new products, new startups, groom early career IT professions to become technology product managers for technology companies specifically around information technologies.

The semester wise distribution of courses is given below.

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<thead>
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<th>Semester</th>
<th>Code</th>
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<td>1</td>
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<td>Design Thinking - Research to Define</td>
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<td>Design Thinking - Ideate to Evaluate</td>
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<td>PD9.404 PDM Project - 4</td>
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<td><strong>Sem4 Total Credits</strong></td>
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<td><strong>Total Credits</strong></td>
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**Product Design Electives**

- PD1.501 - Human Computer Interaction (HCI)
- PD1.502 - Design of Wearable systems
- PD1.411 - Product Design Workshop
- CS9.438 - Game Design and Engineering

**Business/Entrepreneurship Electives**

- PD2.431 & PD2.432 - Technology Product Entrepreneurship
- PD2.423 - Organizational Operations
- PD2.501 - Product Marketing

**Bridge/Technology Electives (representative set – other courses may be included)**

- CS6.302 - Software Systems Development (SSD)
- CS6.401 - Software Engineering (SE)
• CS9.431 - ICTs for Development course
• EC4.402 - Introduction To UAV Design
• CS9.435 - Computational Social Science.
• CE9.609 - IoT Workshop
• CS8.402 - Information Security Audit and Assurance
• CS9.426 - Intro to Cognitive Science
• CS9.421 - Behavioural Research & Experimental Design
• CS7.403 - Statistical Methods in AI

M.Tech PDM - Academic Regulations (Highlights)

Credit Requirements:

• Minimum credits required for graduation is 66. Students are expected to register for the credits every semester as per the specified sequence.
• Every student must complete the Design and Entrepreneurship courses in the 1st year.
• Every student must register for two 3-credit product design courses in the 2nd semester.
• Some students who do not have the requisite background shall be asked to take the “Software Systems Development” bridge course.
• Every student must register for 8 credits of technology/systems/open electives, which include any 400+ level CSE or ECE elective offered in the institute. Electives outside of CSE and ECE program require the approval of the program head.

Project Work:

• The product development project will be an integrated effort to create a market connected product or solution. May lead to a startup or a product that can create some social impact. For tech professionals from industry, the project may lead to a very relevant product that can be used in government or social sectors. And for startup aspirants, the thesis may lead towards the first market MVP of their startup idea.

• Product Development project completed in Third & Fourth semesters with 12 credits each will follow Satisfactory(S)/Unsatisfactory(X) grading scheme without grade points.

Academic Performance:

• A student should complete the requirements with a minimum CGPA of 6.00 to receive the M.Tech degree.

Residency Requirements:

• **Full-time students:** Students will have minimum of 4 semesters and maximum of 6 semesters to complete the graduate requirements, failing which they will be terminated from the program.
• **Industry Students (Part time mode):** M.Tech program may be pursued concurrently with your work. Currently, this option is available for Industry / Self sponsored candidates & Startups.

**Choice Based Credit System:**

The curriculum aims to continue the implementation of Choice Based Credit System with a minimal core program followed by electives from across disciplines including mathematics, sciences, human sciences, engineering electives, and so on. The curriculum set aside close to 17% of the credits necessarily from courses outside of the program so as to allow scope for students to credit courses from the sciences, mathematics, human sciences, and engineering sciences. A total of 12% credits are set aside as open electives – student can use these credits to either go deeper in the program or to opt for courses outside of the program and broaden their outlook by opting for multi-disciplinary courses too.

All courses use a continuous evaluation model with a combination of homework assignments, quiz exams, mid-term, and final examinations. Students are required to stay clear of plagiarism in any of their work submitted for evaluation. Most elective courses include a course project or a term paper additionally. These course projects often require students to practice team-work, enhance their self-learning and communication skills, and impart essential project management skills. Some courses include a laboratory component with a scheduled laboratory session.

For the highly motivates students, the present curriculum continues to provide the Honors option which requires students to do additional credits including projects and advanced electives and work under the supervision of a faculty member.
Course descriptions for core and elective courses

Design Thinking 101 – Research to Define
Prof. Raman Saxena

Course Code: PD1.301

L-T-P: 3 -1-0- 2

(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1. Prerequisite Course / Knowledge:
No prerequisites are required

Semester, Year : 1st Sem – Year 1 (Monsoon, 2022)
(Ex: Spring, 2022)

2. Course Objectives & Outcomes (COs)

The overall goal of design thinking course is to help design better solutions, products, services, systems, processes, strategies, and experiences. This course is aimed at guiding through the Design Thinking Process and will help developing a solid understanding of the overall process, phases and methods in design thinking. Introduce the concept of Human-centred approach, empathy, collaboration, co-creation and product-user & product-market fit. It will provide the theory and operational skills to follow Human (User)-Centred approach and how to implement this knowledge in professional work life.

After completion of this course successfully, the students will be able to…

CO-1 Understand the Human-Centered (HCD) led Empathy (end user advocacy) & Creative Thinking based approach for Problem solving and designing/delivering new products, solutions and services

CO-2 Demonstrate good understanding of various methods and tools used to understand the user’s socio-cultural-economic context during the research/empathies and define stages of the Design Thinking Process.

CO-3 Apply hands-on skills, methods and tools for user research including User Research, Empathy, Contextual Inquiries, Shadowing, User Personas, Use and User Journey mapping, etc.

CO-4 Create, document and present the various deliverables and communications including Stakeholder Mapping, User Personas, Use Case Scenarios, User Journey Maps, Empathy Maps etc. related to the Design Thinking process and deliverables.

CO-5 Demonstrate the ability to collaborate and co-create the design solution and integrate the DT process within the overall product development and management life-cycle.
3. Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

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Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write ‘3’ in the box for ‘High-level’ mapping, 2 for ‘Medium-level’ mapping, 1 for ‘Low’-level’ mapping

3. Detailed Syllabus:

UNIT 1. UNLEARNING (Week 1 - Lecture 1 & 2)

Initial part of the course will emphasize on unlearning and to cultivate a knack for design thinking, and creative problem solving among the students that will work as a good foundation before introducing them to detailed process, methods and tools of DESIGN THINKING.

UNIT 2. UNDERSTANDING DESIGN AND DESIGN DOMAIN (Week 2 - Lecture 3 & 4)

- Understanding Design
- Role & Functions of design and designers.
- Design Elements – (Function, Ergonomics & Aesthetics) + Desirability, Feasibility & Viability

UNIT 3. INTRODUCTION TO DESIGN THINKING (Week 3 - Lecture 5 & 6)

- What is Design Thinking?
- Why Design Thinking?
- Design Thinking approach in new product development & innovative solutions

UNIT 4. DESIGN THINKING PROCESS (Week 4 - Lecture 7 & 8)

- Design Thinking Process – human-focused, empathy, research, ideation and prototype-driven, innovative design approach.
- Introduce/Initiate Design Thinking Pilot Project which is built into course structure and will run parallel to the course content in the DT-Part1 and will conclude in DT-Part 2.
UNIT 5. DISCOVERY PHASE (Week 5 - Lecture 9 & 10)

- What is Discovery and Validation phase and why?
- Understanding User Context? – Why & How to Empathies?
- Understanding the User Needs and Goals through empathy by observing their behaviour and drawing conclusions based on qualitative information
- Understanding Business Goals
- Tools and Methods and Deliverables

UNIT 6. DEFINE PHASE (Week 6 - Lecture 11 & 12)

- Analysis and Synthesis of Data and Information.
- Driving Insights (both user and business) and solution directions
- Tools and Deliverables of the Define phase

UNIT 7. DRIVING ACTIONABLE BRIEF (Week 7 - Lecture 13 & 14)

- Through the process of analysis and synthesis, identifying user-business insights, arriving at an actional brief in form of HMW statement.
- Debriefing and briefing on upcoming course “Design Thinking 101 – Research to Define”

Reference Books:

1. Case1: Design Thinking and Innovation at Apple, Stefan T. & Barbara F. (HBS 9-609-066)
2. Case2: Defining Innovative Mobile Strategies: How Design Thinking Offers an Effective Way to Address the “Wicked Problem” of Enterprise Mobility by SAP
3. Case3: Good Kitchen- Public service delivery Innovation
5. Book: Design Thinking for Strategic Innovation by Idris Mootee
8. Book: 101 Design Methods: A structured approach for driving innovation in your organisation by Vijay Kumar

4. Teaching-Learning Strategies in brief (4 to 5 sentences):

- The Course will be divided into lectures (around 12 nos.) and hands-on work including assignments, classroom exercises and homework.
- The course will also include fieldwork, hand on activities, learning by doing, to practice the learning from the lectures.
- I will also introduce and discuss a couple of case studies including cases related to the new product development and ICT domain.
- It is supported by the design thinking and research approaches of various design, technology and business schools including Stanford, NID, IIM Bangalore etc. and also prestigious design consulting’s including IDEO, FROG Design, Nokia Research, Nokia Design and Siemens etc. to bring both academic and industrial flavor in the content and learning.
- Other than attending lectures and doing classroom exercises & assignments, students need to spend 4 to 6 hours per week on home/field assignments.
5. Assessment methods and weightages in brief (4 to 5 sentences):

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<th></th>
<th>Classroom/Home activities &amp; assignments</th>
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<tr>
<td>2.</td>
<td>Project Individual/Group</td>
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<td>Final Exam</td>
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**Design Thinking 101 – Idea to Evaluate/Implement**

Prof. Raman Saxena

Course Code: PD1.201

L-T-P: 3-1-0- 2

(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1. Prerequisite Course / Knowledge:

Design Thinking 101 – Research to Define Course

Semester, Year : 1st Sem – Year 1 (Monsoon, 2022)
(Ex: Spring, 2022)

2. Course Objectives & Outcomes (COs)

This course is the extension of the earlier course “Design Thinking 101- Research to Define” and will introduce the knowledge and skills required for the second diamond of the overall design thinking process. This course is aimed at guiding the students to work through the Ideation & Prototyping (Diversion) and Test/Evaluate (Convergence) phases of the second diamond of the overall Design Thinking Process. This course will help the student appreciating the criticality and value of generating lots of ideas, early prototyping and user testing/validation of the ideas at the early stage of design development for delivering solution which has higher fit between the products and the user needs and business model.

This course is core knowledge/skill and will also serves as a foundation for further learning for any student irrespective of their specific domain such as product design, product management, user experience design, service design, software & IT, technology design and business.

After completion of this course successfully, the students will be able to…
CO-1 Understand the Human-Centered (HCD led Empathy (end user advocacy) & Creative Thinking based approach for Problem solving and designing/delivering new products, solutions and services

CO-2 Demonstrate good understanding of various methods and tools used to understand the user’s socio-cultural-economic context during the research/empathies and define stages of the Design Thinking Process.

CO-3 Apply hands-on skills, methods and tools for user research including User Research, Empathy, Contextual Inquiries, Shadowing, User Personas, Use and User Journey mapping, etc.

CO-4 Create, document and present the various deliverables and communications including Stakeholder Mapping, User Personas, Use Case Scenarios, User Journey Maps, Empathy Maps etc. related to the Design Thinking process and deliverables.

CO-5 Demonstrate the ability to collaborate and co-create the design solution and integrate the DT process within the overall product development and management life cycle.

3. Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

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Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write ‘3’ in the box for ‘High-level’ mapping, 2 for ‘Medium-level’ mapping, 1 for ‘Low’-level’ mapping

3. Detailed Syllabus:

UNIT 1. REVIST THE PREVIOUS LEARNINGS AND ACTIONABLE BRIEF (Week 1 - Lecture 1 & 2)

- Revise the understandings and learnings of the earlier course.
- Revisit and deliberate on the actionable brief and tweak the same if needed.
• The process of divergence and convergence.

UNIT 2. IDEATION (DIVERGENCE) PHASE (Week 2 - Lecture 3 & 4)

• Power and Value of Ideation process
• Process and techniques of Ideation to generate many ideas.
• Case study- Mainframe- Design for next generation.
• Project continue from H1

UNIT 3. PROTOTYPING (DIVERGENCE) PHASE (Week 3 - Lecture 5 & 6)

• Why prototyping?
• Types of Prototypes – Low fidelity & high fidelity
• Creation of prototypes.
• Case study of Embrace – The Baby Warmer and deliberation/discussion.
• Project continue from H1

UNIT 4. USER TESTING AND VALIDATION (Week 4 - Lecture 7 & 8)

• Why Test?
• Types of user testing and evaluation.
• Process of user testing/validation using prototypes.
• Use case of user testing/validation
• Project continue from H1

UNIT 5. PROJECT WORK- IDEA GENERATION FOR THE PROJECT WORK (Week 5 - Idea Generation and design)

This week will be dedicated to a generation of ideas against the actionable brief. The students will require working on generating more and more ideas and lecture hours will be used for work in progress presentation by the students, discussions and feedback.

UNIT 6. PROJECT WORK - PROTOTYPE CREATION AND TESTING (Week 6- Hands-on Prototyping & testing)

Students will be required to develop several prototypes based on the ideas generated during the ideation phase and validate the ideas for shortlisting.

UNIT 7. PROJECT WORK – TWEAKING IDEAS AND FINALISING THE SOLUTION (Week 7- Project Completion)

• Tweaking the ideas and further development of the same.
• Final presentation of the work.

Reference Books:

• Case1: Design Thinking and Innovation at Apple, Stefan T. & Barbara F. (HBS 9-609-066)
• Case2: Embrace- A Baby Warmer, Project by Stanford University.
• Case3: TALA- Democratising the Credit delivery
• Book: HBR's 10 Must Reads on Design Thinking, by Harvard Business Review
• Book: Design Thinking for Strategic Innovation by Idris Mootee
• Book: Change by Design by Tim Brown
• Book: Design Thinking: A Culture of Innovation by Sean Koh
• Book: Design Thinking, by Nigel Cross
1. Book: The Design of Everyday Things by Donald A. Norman

4. Teaching-Learning Strategies in brief (4 to 5 sentences):

- The Course will be divided into lectures (around 12 nos.) and hands-on work including assignments, classroom exercises and homework.
- The course will also include fieldwork, hand on activities, learning by doing, to practice the learning from the lectures.
- I will also introduce and discuss a couple of case studies including cases related to the new product development and ICT domain.
- It is supported by the design thinking and research approaches of various design, technology and business schools including Stanford, NID, IIM Bangalore etc. and also prestigious design consulting’s including IDEO, FROG Design, Nokia Research, Nokia Design and Siemens etc. to bring both academic and industrial flavor in the content and learning.
- Other than attending lectures and doing classroom exercises & assignments, students need to spend 4t to 6 hours per week on home/field assignments.

5. Assessment methods and weightages in brief (4 to 5 sentences):

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<tr>
<th></th>
<th>Classroom/Home activities &amp; assignments</th>
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<tr>
<td>2</td>
<td>Project Individual/Group</td>
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User Research Methods
Prof. Priyanka Srivastava

Name of the Program : M.Tech - Product Design and Management (PDM)

Course Code: CS9.501
L-T-P: 3-1-0
Credits: 2
( L= Lecture hours, T=Tutorial hours, P=Practical hours)

Prerequisite Course / Knowledge:
No prerequisite

Semester, Year : I Sem – Year 1 (Monsoon, 2022)
(Ex: Spring, 2022)

Course Outcomes :

After completion of this course successfully, the students will be able to..

CO-1: Apply basic qualitative and quantitative research methods, using 3-dimensional framework using attitudinal and behavioural, and context of use

CO-2: Design and develop field and lab studies, by employing various research methods like interviews, comparative analyses etc.

CO-3: Evaluate the users’ need and pain points
Identify and recognize the problem and gaps, generate possible solutions to user problems

CO-4: Analyze the ethics of conducting study and observations

CO-5: Synthesize the user research data and summary

Course Topics :

Unit 1: Understanding User
Unit 2: Lab and Field, Quantitative and Qualitative methods
Unit 3: Ethics in User Research
Unit 4: Statistics – How to present User Research Results

Units are not equally distributed in classes but highlights the topic that will be covered under each unit.

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<th>Unit 1</th>
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<tr>
<td>Understanding User</td>
<td>Observation Techniques</td>
<td>Ethics</td>
<td>Data Visualization and Presentation</td>
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<td>Introduction and Qualitative Research Overview – foundation of user experience, key terms, highlight the hall of shame, why user-centric design and control is important; attitudinal and behavioural dimension</td>
<td>Conducting studies in usability lab, Lab studies – eye-tracking, behavioural observations, control design observations</td>
<td>Code of conduct; Participants Rights, Privacy -data safety, Respect – individual rights, time and effort, Sensitive and Empathetic; Risk analysis; Informed Consent</td>
<td>Qualitative Analysis – Thematic, values, product quality etc. organize and summarise data</td>
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<td>User need assessments, Qualitative research method, Interview protocols followed up with activities. Know your user – age, gender, cognitive / psychological perspectives, people with disability or accessibility,</td>
<td>Field study, site visits, naturalistic observations, controlled field experiment, individual and group survey and focused interviews, customer satisfaction, remote testing</td>
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<td>Quantitative Analysis – count, accuracy, response time or time taken to complete the task or speed analysis, visualization, learning curve,</td>
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How to conduct interview, make observations, and extract data from interview, ethics and consent, user research protocols, survey-based observations

| Industry practice - A/B and Multivariate testing, card sorting or tree testing, qualitative and quantitative method, How to deliver user research results |
| Affinity Wall and Analysis – Qualitative and quantitative analysis, survey and questionnaire analyses and affinity diagram to cluster and bundle ideas/ facts/ experience together |

**Preferred Text Books**


**Reference Books**

**E-book Links**

**Grading Plan**

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**Mapping of Course Outcomes to Program Objectives:** (1 – Lowest, 2—Medium, 3 – Highest, or a ‘-’ dash mark if not at all relevant). Program outcomes are posted at

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Teaching-Learning Strategies in brief (4-5 sentences):

• The course will offer primarily lecture and activity-based learning course.
• Students will be required to participate in activities and discuss the observations with their peers in class and will be asked to present their observations.
• Students will be encouraged to take assignments inspired from their everyday experiences and will be asked to evaluate the event/phenomenon/ processes critically and scientifically using user research methods.
• These activities will be performed either as individual or as a team, where they will be asked to demonstrate the individual contribution to the team activities.

Product Management 101
Ramesh Swaminathan & Avneesh Bhatnagar

Name of the Program : M Tech Product Design & Management
Course Code : PD2.401
L-T-P : 3-1-0 (L= Lecture hours, T=Tutorial hours, P=Practical hours)
Credits : 2
Semester, Year : II Sem – Year 1 (Monsoon, 2022).
(Ex: Spring, 2022)
Pre-Requisites : No prerequisite
Course Outcomes :
CO1 : Understand the key role of a product manager in ideating & developing technical products for the Digital World
CO2 : Create a Product Strategy by using various market research techniques
CO3 : Develop a product mindset to create innovative product & solutions that solve complex technical problems that is required by the Market
CO4 : Execute product strategy through Roadmaps & Release Plans
CO5 : Learn various product development methodologies that can be applied to enable faster Go to Market
Course Topics :
Module 1: Introduction to Product Management – the Art & Science of Product Management
1. What is product management
2. Types of Product Management
3. Product life cycle

Module 2: Product Strategy

1. Market Research
2. Product Value Proposition
3. Product Strategy
   a. Market Needs
   b. Key Differentiators
   c. Business Goals

Module 3: Product Ideation & Market fit

1. Product Ideation
2. Product Feasibility
3. Product market Fit
4. User Journeys

Module 4: Adopting a Product Mindset

1. Prioritization
2. People
3. Process
4. Progress

Module 5: Product Roadmap

1. Top Down Product Strategy
2. Feature less Roadmaps to feature roadmaps
3. Roadmaps to Release plans

Module 6: Product release execution

1. Product Prototyping & Market Validation
2. Product Development Process
   a. Agile development process
   b. Lean product development
3. Product release to market

Reference Books:
1. Inspired: How to create Tech Products Customers Love by Marty Cagan
2. The Lean Product Playbook by Dan Olsen

Grading Plan:
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<tr>
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Mini Project | 40%
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Other Evaluation (Product Workshop) | 20%

**Mapping of Course Outcomes to Program Objectives:** (1 – Lowest, 2—Medium, 3 – Highest, or a ‘-’ dash mark if not at all relevant). Program outcomes are posted at

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**Teaching-Learning Strategies in brief (4-5 sentences):**

This Course will be taught through a Hands-on train model wherein the students will learn by doing. Theory will be taught through Power Point presentation and will be followed up by Assignments. The Assignments will conclude in a mini project that needs to be submitted at the end of semester. A Role play driven workshop at the end of the Semester will be a major evaluation factor for this Semester.

**Back-Sem1**

**Business Fundamentals - 1**

Prof.Himanshu Warudkar

Name of the Program : M.Tech – Product Design and Management

Course Code : PD2.321

Credits : 2
Course Objectives:
Much of 21st century economy has depended on organizational ability to identify needs of customers and to quickly create products that meet these needs and can be produced at low cost. Achieving these goals is not solely a marketing problem, nor is it solely a design problem or a manufacturing problem; it is a product development and management problem involving all these functions. This course on Business Fundamentals provides a collection of tools and techniques intended to enhance the abilities of cross-functional teams to work together to develop great products. A product is something sold by an enterprise to its customers. Product development and management is the set of activities beginning with the perception of a market opportunity and ending in the production, sale, and delivery of a product. At the end of the Business Fundamentals 1 course, students will be well equipped with a knowledge of key competencies required to be successful in product management roles.

Course Outcomes:

CO1: Demonstrate sound understanding of key concepts of modern management

CO2: Demonstrate ability to distinguish between a good and bad strategy and be able to analyze the industry they are operating in using models such as Porter’s 5 Forces

CO3: Develop competencies for sound decision making in a world of uncertainty. This would be based on concepts of Decision Making Under Uncertainty, Bounded Rationality, Prospect Theory

CO4: Develop an understanding of various leadership theories and practical usage of the same. Students will be able to analyze for themselves, types of leadership, their pros / cons.

CO5: Demonstrate competency in the process of conceptualizing, defining, designing, and delivering technology products for markets. Synthesize products or solutions for complex engineering that meet the specified market needs

Course Topics:

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<th>Learning Objective</th>
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| 3. | Decision Making in Organizations | - Key concepts around Decision Making  
- Decision Making Under Uncertainty, Bounded Rationality, Prospect Theory  
- Developing knowledge of various decision-making techniques and traps  
- Introduction Behavioral Economics  
| 4. | Leadership for a VUCA World | - Leadership Theories and Practical Usage  
- Types of leadership and their pros / cons  
- Analysis of leadership styles for students  
| 5. | Product Engineering Knowledge – Mahesh Natarajan, Thermo-Fischer | - Demonstrate competency in the process of conceptualizing, defining, designing, and delivering technology products for markets. | *Usha to facilitate as Mahesh is based in Hyderabad* |
| 6. | Design / Development of solutions — Mahesh Natarajan, Thermo-Fischer | - Synthesize products or solutions for complex engineering that meet the specified market needs  
- Consideration for public health and safety, and the cultural, societal, and environmental considerations | *Usha to facilitate as Mahesh is based in Hyderabad* |
| 7. | Product Value Co-Creation | - Understanding customer’s needs  
- Concepts of value co-creation | [https://servicedesigntools.org/tools/personas](https://servicedesigntools.org/tools/personas)  
[https://xd.adobe.com/ideas/process/user-research/ux-research-process-product-design/](https://xd.adobe.com/ideas/process/user-research/ux-research-process-product-design/) |
| 8. Managing Teams | - Building and managing diverse teams  
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<td><strong>11.</strong> Timing the Market</td>
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<td>Case Study – Healthcare startup</td>
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<td><strong>12.</strong> Delivering for Quality</td>
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<td>Key concepts in developing quality products</td>
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<td>Measuring quality of services</td>
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<td>Total Quality Management</td>
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<td><strong>13.</strong> Innovation &amp; Creativity</td>
<td>-</td>
<td>Theories of innovation</td>
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<td>Open innovation paradigms</td>
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<td><strong>14.</strong> Product Innovation and Market Leadership</td>
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<td>Case Study - Zerodha: Sustaining a Leadership Position in India</td>
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**Teaching-Learning Strategies in brief (4-5 sentences):**

This course may be taught based on presentations covering key topics for each session, discussion on mini and / full length case studies requiring students to critically analyze various real-life situations. Students will be required to identify a topic of their interest and analyze a new product idea, existing product and prepare a write-up on the same. Learning will also be enhanced through a variety of domain-based case studies, guest lectures.

**Back-Sem1**

**Business Fundamentals - 2**

Prof. Himanshu Warudkar

Name of the Program : M.Tech – Product Design and Management
Course Code : PD2.421
Credits : 2
L - T - P : 3- 1- 0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Monsoon 2022
Pre-Requisites : Business Fundamentals - 1

Course Objectives: This course is a continuation of Business Fundamentals – 1 course and provides further insights into advanced topics around creating, running a product company, and / or performing a product owner / manager role. Whilst Business Fundamentals – 1 course provided basics of Management, Decision Making, Leadership, Value Co-Creation, Managing Teams etc. Business Fundamentals – 2 course is aimed at covering application of the concepts learnt in Business Fundamentals – 1. Participants will be introduced with topics such as Platforms (moving from Product to Platforms), identifying Societal Grand Challenges to be solved using Product Mindset, Introduction to Finance, Sales / Marketing and Market Research. Participants will be exposed to products in a variety of domains through case studies. At the end of the Business Fundamentals 2 course, participants should be well equipped with applied knowledge of for identifying both problem space and solution space around product management.

Course Outcomes:

CO1: Develop ability to transition from a services mindset to a product mindset

CO2: Develop awareness of key competencies in HRM for product ventures

CO3: Develop knowledge of key concepts in financial management in product management roles

CO4: Develop awareness of sales / marketing and competencies for execution of turnkey projects

CO5: Develop capability to start own product venture or step into a product owner / manager role

Course Topics :

<table>
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<tr>
<th>#</th>
<th>Session Name</th>
<th>Learning Objective</th>
<th>References</th>
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<td>16</td>
<td>Assessing Business Performance</td>
<td>- Understanding and overcoming challenges in launching a product in a nascent but crowded market</td>
<td>Philips India: Launch of New Air Purifiers – HBSP Case Study</td>
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<td>The CEO's guide to corporate finance – McKinsey</td>
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20. Assessing Business Performance VP Thomson Reuters

- Measures of corporate performance – financial and social


21. Quiz

22. Creating Business Cases

- Understanding how to write business cases and get buy-in


23. Market Research & Development - Mahesh Natarajan, Thermo-Fischer

- Market research tools and techniques


24. Modern tool usage - Mahesh Natarajan, Thermo-Fischer

- Use of various product management tools

25. Turnkey Project Executions - Telecom Case Study

- Competencies for turnkey project executions

26. Selling your Product - Case Study on Cloud and VM

- Case study of selling a product

27. Services to Product Mindset - Case Study of Byrny.io &

- Transitioning from a services mindset to a product mindset

28. Summing it All Together - Product Management for the 21st Century

- Takeaways from BF1 & BF2

**Preferred Textbooks**: Cooper, R. G. - *Winning at new products* Addison-Wesley.


**Grading Plan**: 
(The table is only indicative)

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Teaching-Learning Strategies in brief (4-5 sentences):

This course may be taught based on presentations covering key topics for each session, discussion on mini and / full length case studies requiring students to critically analyze various real-life situations. Students will be required to identify a topic of their interest and analyze a new product idea, existing product and prepare a write-up on the same. Learning will also be enhanced through a variety of domain-based case studies, guest lectures.

Back-Sem1

Year 1 -II Sem
List of the PDM courses Sem – II:

- Business Finance
- Human Computer Interaction
- Organizational Operations
- Design of wearable systems
- Product Design Workshop
- Technology Product Entrepreneurship 1
- Technology Product Entrepreneurship 2

**Business Finance**

Prof. Mayank Mathur

Name of the Program: M. Tech in Product Design and Management program

Course Code : PD2.422

Credits : 2

L - T - P : 3 - 1 - 0

(L - Lecture hours, T-Tutorial hours, P - Practical hours)

Semester, Year : II Sem – Year 1 (Monsoon, 2022)
(Ex: Spring, 2022)

Pre-Requisites : None

Course Objective :
As a part of the Business Finance course, we go over the fundamentals of business finance in the contemporary world. We discuss some basic definitions and concepts of business finance regarding organizations required to understand their financial health concerning the markets. The managers need to know, understand and analyze the three main arms of the organization's financial health. The course will cover the financial statements in detail. The course also covers aspects of assets, liabilities, debits, credits, profit, loss, earning, lending, and a detailed dive into financial ratios. The other main modules we cover are as follows:

- Working capital decision-making,
- forecasting,
- Startup Valuation, and
- Time Value of Money (TVM)

CO-1 Demonstrate a good understanding of an organization's financial health and position through the study of financial statements.
CO-2 Demonstrate a good understanding of various Financial Ratios and parameters derived out of the monetary positions of an organization.

CO-3 Demonstrate the ability to understand and analyze the working capital decision-making based on the above parameters and hands-on skills in applying allocation of the working capital.

CO-4 Demonstrate the ability to understand and analyze the valuation exercise as an entrepreneur of one's startup organization and make decisions on the decision making again related to the Use Case Scenarios.

CO-5 Demonstrate the ability to determine, analyze and make decisions as per the Time Value of Money (TVM) of the assets owned in running own businesses.

Course Topics:

Basics of Business Finance/ Corporate Finance, two sessions:
- **Business Finance Basics**: Profit Loss, Debit Credit, etc.: Supported by both theoretical and some practical numerical hands-on examples around the concepts.

Financial Statements: Balance Sheets: Supported by both theoretical and some practical numerical hands-on examples and case studies. Focus on the importance of these concepts and statements in the entrepreneurial journey.

Adjustments: the practical examples of adjustments.

Financial Statements: Profit and Loss Statement/Cash Flow Statement. Tutorials, Numerical Questions: Supported by both theoretical and some practical numerical hands-on examples. Focus on the importance of these concepts and statements in the entrepreneurial journey.

Financial Ratios: Derivations and Definitions, Supported by both theoretical and some practical numerical hands-on examples. Focus on the importance of these ratios in the entrepreneurial journey.

Case Studies and Numericals
Startup Valuation and entrepreneur's view
Forecasting

Decision Making: Forecasting:
- a. Meaning of a Forecast
- b. Future Income and Future Expenses
- c. Qualitative Financial Forecasting Methods
- d. Quantitative Financial Forecasting Methods
Valuation:
a. The Basics of Business Valuation
b. Special Considerations: Methods of Valuation
c. Accreditation in Business Valuation
Supported by both theoretical and some practical numerical hands-on examples and case studies.

Time Value of Money (TVM):
Formula description, related Concepts, definitions, solved examples about the application of the TVM. Supported by both theoretical and some practical numerical hands-on examples around the concepts.

Preferred Text Books:
Fundamentals of Financial Management,
Author(s): Eugene F. Brigham | Joel F. Houston

Reference Books:
- Finance: The Basics by Erik Banks. Author: Erik Banks Publisher: Routledge.
- Finance Sense: Corporate Finance For Non-Finance Executives by Chandra Author: Prasanna Chandra

Grading Plan:
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Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs) – Course Articulation Matrix
Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write ‘3’ in the box for ‘High-level’ mapping, 2 for ‘Medium-level’ mapping, 1 for ‘Low’-level’ mapping.

Teaching-Learning Strategies in brief (4-5 sentences):

I believe in inclusive teaching with involvement from the class as much as possible. I tend to keep the teaching and learning hand in hand and ensure we teach, learn and evaluate as we go. This helps students to pace the subject well and also makes them accustomed to the subject in a better way. I keep quizzes and assignments to include them in the classes as much as possible. We keep the Case studies and hands-on culture intact.

Course Objectives & Outcomes (COs)

Human-Computer Interaction

Prof. Raman Saxena

Course Code: PD1.201

L-T-P: 3-1-0-2

(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1. Prerequisite Course / Knowledge:

No prerequisites are required

Semester, Year: II Sem – Year 1 (Monsoon, 2022)
This course provides knowledge about the interaction between human (user), computer (machine) and environment. The course will examine the HCI from the science, technology and human-centered design perspective.

Lecture topics are aimed at guiding the students through analysing and discussing the interaction between products and people based on cognitive, physical and emotional factors. It will introduce fundamentals of interaction design such as mental models, human action cycles and difference between User Experience, User Interface and Interaction Design. It will look at the various types of human-computer interaction and how it affects the people intended goals and objectives. How a good HCI design delivers higher perceive usefulness, usability or ease of use leading to positive and delightful user experience. It will build understanding the factors that influence the interaction between people and products in a desired direction. The course will explain the process of User-centered software design and development and the deliverables within the same such as user cases, user stories, workflow, task analysis, information architecture, wireframes, storyboards and low fidelity and high-fidelity prototypes. The course will also introduce the concept and practice of usability testing and evaluation. The course will also investigate the technology trends such as AI, Chatbots, etc. and their influence on the interactions between human and computers. The course will also cover User Experience, The Course will divide into lectures including classroom exercises, quizzes, a short project and home assignments.

The students of this course will be able to apply the knowledge/learning’s from this course to their own professional work as HCI Designer, Interaction designer, UX Designer and design interaction layer of the software/IT products including Mobility, Healthcare, Learning, E-commerce and Utility etc. The course will include a short project to offer opportunity to the students to experience the full HCI cycle.

After completion of this course successfully, the students will be able to…

CO-1 Demonstrate good understanding of Human-Computer Interaction and How it influences the User Experience of digital products, systems, solutions and services.

CO-2 Demonstrate good understanding of methods and tools used to understand the HCI from the perspectives of technology, human-centered design and human/social sciences such as cognitive, and digital anthropology perspective.

CO-3 Demonstrate good understanding of incorporating human-centered approach in HCI to deliver useful and easy to use software and IT products including Mobility, Healthcare, Learning, E-commerce and Utility etc.

CO-4 Demonstrate the ability to create, document and present the various deliverables and communications related to HCI, UX and UI Design including Human-Action Cycle, Personas, Use Cases, Task Flow and Analysis, Information Architecture diagram, Wireframes, UI Design, and Usability Testing etc.

CO-5 Demonstrate the ability to collaborate and co-create the design solution and integrate the DT process within the overall product development and management life cycle.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix
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**Detailed Syllabus:**

**UNIT 1. Introduction to Human-Computer Interaction** (Week 1 - Lecture 1)
- Introduction to HCI?
- History of HCI
- How Human interact with outside world?
- Human Conceptual/Mental models
- Conflict between Mental Models and Design Models.

**UNIT 2. UNDERSTANDING Human-Machine System** (Week 2 - Lecture 2)
- Understanding Human-Machine System
- Human-Action Cycle (HAC)
- 7 stages of Human-action cycle.
- Classroom exercise on HAC
- User Experience

**UNIT 3. Art and Science of User Experience and UI Design** (Week 2 Lecture 3 & Week 3 - Lecture 4)
- Attention and Memory
- Gestalt theory and principles
- UI Elements including color and interaction model
- Information and Interaction Design principles

UNIT 4. **User-Centered approach to software Design** (Week 3 - Lecture 5 & Week 4 - Lecture 6)
- Introducing HCI Project
- Perceived Usefulness and Perceived Ease of Use
- Understanding User Persona
- Why user person is important
- Use cases, User stories
- Task Flows & Task Analysis
- Human-centered software Design Workflow.

UNIT 5. **Usability Engineering and Testing** (Week 4 - Lecture 7 & Week 5 - Lecture 8)
- HCI Project Continue
- Information Architecture
- Wireframes and Storyboards
- Low and High-Fidelity prototypes

UNIT 6. **HCI PROJECT WORK – UX Design** (Week 5 - Lecture 9 & Week 6 - Lecture 10)
- HCI Project Discussions and Feedback
- Design Documentation

UNIT 7. **HCI PROJECT WORK – UX Design** (Week 6 - Lecture 11 & Week 7 - Lecture 12)
- HCI Project Discussions and Feedback
- Rapid Prototyping
- Testing and Final Presentation
- Documentation and presentation

**Reference Books & Cases:**
- Book: Human-Computer Interaction in the New Millennium, by Carroll, John
- Book: Learn Human-Computer interaction: Solve human problems and focus on rapid prototyping and validating solutions through user testing., by Christopher Reid Becker
- Book: Lean UX: Designing Great Products with Agile Teams, by Jeff Gothelf & Josh Seiden
- Book: Designing with Mind in Mind: Simple guide to understanding User Interface Guidelines, by Jeff Johnson
- Book: Sketching User Experiences: Getting the Design Right and the Right Design, by Bill Buxton
- Book: Human-Computer Interaction: Solve human problems and focus on rapid prototyping and validating solutions through user testing, by Christopher Reid Becker
• Book: Interaction Design: Beyond Human-Computer Interaction, By Helen Sharp, Jennifer Preece & Yvonne Rogers
• Book: Designing User Interfaces: Exploring User Interfaces, UI Elements, Design Prototypes and the Figma UI Design Tool, Dario Calonaki
• Book: Designing Interfaces: Patterns for Effective Interaction Design, By Jennifer Tidwell, Charles Brewer and Aynee Valencia
• Book: UX for XR: User Experience Design and Strategies for Immersive Technologies (Design Thinking), by Cornel Hillmann
• Book: Information Visualization: Design for Interaction, by Prof. Robert Spence
• Book: Moderating Usability Test: Principles and Practices for Interacting, by Dumas, Joseph
• Case1: Design of Mainframe User Experience
• Case2: Design of a Conversational UI’s.

**Teaching-Learning Strategies in brief (4 to 5 sentences):**

- The Course will be divided into lectures (around 12 nos.) and hands-on work including assignments, classroom exercises and homework.
- The course will also include fieldwork, hands on activities, learning by doing, to practice the learning from the lectures.
- I will also introduce and discuss a couple of case studies including cases related to the new product development and ICT domain.
- It will introduce and discuss a couple of case studies including cases related to HCI, User Experience and UI Design of software products.
- A HCI project to practice HCI, UX, UI and Usability learnings.
- Other than attending lectures and doing classroom exercises & assignments, students need to spend 4 hours per week on home/field assignments.

**Assessment methods and weightages in brief (4 to 5 sentences):**

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**Organizational Operations**

Prof. Mayank Mathur

**Name of the Program:** M. Tech in Product Design and Management program
Course Code : PD2.423

Credits : 2 Credits

L - T - P : 3 -1-0

(L - Lecture hours, T-Tutorial hours, P - Practical hours)

Semester, Year : II Sem – Year 1 (Monsoon, 2022)
(Ex: Spring, 2022)

Pre-Requisites : None

Course Objective :
Operations are the work of managing the inner workings of your business so it runs as efficiently as possible. Whether you make products, sell products, or provide services, every small business owner has to oversee the design and management of behind-the-scenes work. Organizational operations management involves converting input into efficient outputs to achieve desired results for an entrepreneur. The course contains various operations models, tools, and techniques for supply chain management, quality control systems, and streamlining workflows. You will learn how to innovate business operations to improve productivity and capacity with the resources. You will develop skills that will empower you to configure business processes to channel operations and reduce bottlenecks.

Course Outcomes :

CO-1 Understand key functional areas of operations with the type of decisions they are typically involved in to run a business efficiently.

CO-2 Identify key differences between service and manufacturing organizations and the business operations in the two sectors of the businesses.

CO-3 Understand and map each process phase to formulate an organizational strategy with actions typically performed at that phase.

CO-4 Identify and categorize different transformation characteristics of manufacturing and service operations strategies.

CO-5 Understand the concept of organizational strategy, the four-phase process for formulating this strategy, and how the strategy should be aligned with operations strategy in the manufacturing and services context.

Course Topics :

Operations Management: Basics of production systems, Planning, Scheduling, Sequencing, Workplace Layouts, Locational problems of warehouses. Four sessions
**Basics of Lean Operations**: Classification of wastes, 5S, Kaizen, Jidoka, Kanban, Kaizen, Value Stream Mapping, Total Productive Maintenance. **Three sessions**

**Service Operations** - Service strategy, service enterprise design, service operations, service blueprint, Capacity planning, queueing models, forecasting demand, and managing service inventory. **Three sessions**

**Supply Chain Management** - Measuring supply chain performance, drivers and metrics, planning and managing inventories in the supply chain, managing economies of scale, uncertainty, optimal product availability, sourcing decisions. **Three sessions**

**Basics of Information Systems and Impact on Operations** - Basics of Business Analytics and Business Intelligence, Enterprise Management Systems, necessity, functions of ERP systems **Four sessions**

**Modern Technology interventions** - Impact of technology interventions like IoT, Blockchain, Artificial Intelligence, and Robotics on Manufacturing and service applications of the future **Four sessions**

**Preferred Text Books** :

**Reference Books** :
- Operations Management: Processes and Supply Chains 11th Edition, by Lee Krajewski (Author), Manoj Malhotra (Author), Larry Ritzman (Author)
- Operations Management (11thEdition) by Heizer, Jay, Render, Barry

**Grading Plan** :
(The table is only indicative)

<table>
<thead>
<tr>
<th>Type of Evaluation</th>
<th>Weightage (in %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quiz-1</td>
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</tr>
<tr>
<td>Mid SemExam</td>
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<tr>
<td>Quiz-2</td>
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</tr>
<tr>
<td>End Sem Exam</td>
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</tbody>
</table>
Assignments | 20

Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
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<td>CO1</td>
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</table>

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write ‘3’ in the box for ‘High-level’ mapping, 2 for ‘Medium-level’ mapping, 1 for ‘Low’-level’ mapping

Teaching-Learning Strategies in brief (4-5 sentences):

I believe in inclusive teaching with involvement from the class as much as possible. I tend to keep the teaching and learning hand in hand and ensure we teach, learn and evaluate as we go. This helps students to pace the subject well and also makes them accustomed to the subject in a better way. I keep quizzes and assignments to include them in the classes as much as possible. We keep the Case studies and hands-on culture intact.

Back-Sem2

**Design of Wearable Systems**

Prof. Raghu Reddy

**Name of the Academic Program:** Master of Technology in Product Design and Management

**Course Code:** PD1.502
L-T-P: 3-0-0  Credits: 2  (Half Course)

( L= Lecture hours, T=Tutorial hours, P=Practical hours)

Prerequisite Course / Knowledge:

Students must have knowledge of basic electronics or seek permission from instructor.

Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):

After completion of this course successfully, the students will be able to…

CO1: Understand the design and construction of a bare-minimum wearable system
CO2: Demonstrate the ability to explore and identify feature requirements for building a wearable system
CO3: Apply engineering principles and practices from existing use-cases of wearable systems
CO4: Demonstrate use of tools required to design and prototype a wearable system
CO5: Practice social ethics and human values while building wearable system for the targeted audience
CO6: Exhibit aptitude for working in teams and deliver task outcomes effectively

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

<table>
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Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write ‘3’ in the box for ‘High-level’ mapping, 2 for ‘Medium-level’ mapping, 1 for ‘Low’-level’ mapping

Detailed Syllabus:
UNIT 1:
- Wearable systems Fundamentals – Attributes, challenges and opportunities.
- Applications of wearable device technology such as Healthcare, Sports, Fitness, Entertainment, Connected cars, etc.
- Wearable systems design and architecture

UNIT 2:
- User Experience of Wearable Technology
- Social Aspects of Wearable Technology

UNIT 3
- Technology of Connected Devices – Energy Considerations
- Recommend appropriate process steps for a device based on size, cost, operating conditions, and capabilities.

UNIT 4
- Analyze performance; including sensitivity, noise, bandwidth, and dynamic range for common wearable and implantable systems a variety of applications.
- Evaluate the methods, results, and conclusions from case studies and extract relevant details for a performance comparison.
- Describe design tradeoffs in selecting, developing or redesigning wearable and implantable solutions.

Reference Books:

Teaching-Learning Strategies in brief (4 to 5 sentences):

The course is delivered using a combination of project based and case based learning methodology. Design and architecture of wearable systems from different domain is reinforced through various case studies. The lectures emphasize on the fundamentals as well as applications of wearable systems. Focus is on
understanding and analyzing various attributes like performance, bandwidth, noise, energy consumption, latency, etc. to build a wearable system by the end of the class.

Assessment methods and weightages in brief (4 to 5 sentences):

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Weightage</th>
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</thead>
<tbody>
<tr>
<td>Course Project</td>
<td>40%</td>
</tr>
<tr>
<td>Case study presentation</td>
<td>10%</td>
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<tr>
<td>Case study report</td>
<td>15%</td>
</tr>
<tr>
<td>Assignments</td>
<td>25%</td>
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<tr>
<td>Other In-class Activities</td>
<td>10%</td>
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</tbody>
</table>

**Product Design Workshop**
Prof. Prakash Yalla

**Name of the Program:** M. Tech in Product Design and Management program

**Course Code:** PD1.411

**Credits:** 2 Credits

**L - T - P:** 1.5 - 0 - 3

(L - Lecture hours, T-Tutorial hours, P - Practical hours)

**Semester, Year:** 2nd Sem – Year 1 (Monsoon, 2022)
(Ex: Spring, 2022)

**Pre-Requisites:** Basic principles of, Software programming, Design thinking and Product design. Basics of workshop tools and equipment operations (lathe, cnc, 3d printing, laser cutter & pcb maker. Else tutorials need to be taken). Basics of rapid prototyping CAD software for mechanical and electronics design (else tutorial to be taken)

**Course Objective & Overview:**

This course module intends to equip students with tools and techniques to rapid prototype a physical product that solve real life problems. Some of the most impactful systems interact with physical world.
All of these have software driven intelligence. The objective of this learning module is to empower students with tools and techniques and to design real world physical systems.

**Mode:** Hands on workshop and project-based delivery. The course will involve a series of micro level projects that add up-to a larger project leading to a physical system (s).

**Course Outcomes (COs)**

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

- CO-1. Apply Product design & rapid prototyping tools in development of physical systems/products.
- CO-2: Re-engineer/Design products based on end user needs
- CO-3. Integrate and create an end to end physical system ( SW, Mechanicals and Electronics).
- CO-4. Deploy in live setting and capture usable information from physical world.

**Detailed Syllabus:**

<table>
<thead>
<tr>
<th>#</th>
<th>Topics</th>
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<tbody>
<tr>
<td>1</td>
<td>Rapid Prototyping Techniques &amp; Tools</td>
</tr>
<tr>
<td>2</td>
<td>Shapes, Cuts and Joints : Usage and realise using RPT tools</td>
</tr>
<tr>
<td>3</td>
<td>Materials and selection depend upon their applications.</td>
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<tr>
<td>4</td>
<td>Product aesthetics : Materials Texture, Feel, and colour.</td>
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<tr>
<td>5</td>
<td>Embedded Intelligence</td>
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<tr>
<td>6</td>
<td>System Integration &amp; Live deployment</td>
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</tbody>
</table>

The course has four parts to it with each part naturally dove tailing into the other

**Part 1: Understanding Physical Objects & Rapid Prototyping:**

In this module students get introduced to basics of rapid prototyping and usage of equipment like 3d printers, laser cutters, CNC machines etc. The students replicate everyday objects as is using these tools (builds an understanding on the right tool for right job).

**Part 2: Problem Solving – understanding user need, usage scenario and re-imagining:**

In this module students are given design problems that makes one re-imagine know systems based on user needs e.g. How could the everyday object manifest in the context of say r a Parkinson’s patient.

**Part 3: Embedding Intelligence:**

In this module students are taught how to capture physical world information and how to embed smarts in a seamless manner into the physical system. This module brings into focus the behavior of software systems while engaging with real world parameters.

**Part 4: Putting it all Together: Final project**
This part of the course assembles all the learning in the form of an end to end system/object that students showcase. The end semester exam for this is an end use feedback: the usability, the aesthetics, the functionality, the smarts etc.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix**

<table>
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<tr>
<th>CO1</th>
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</table>

‘3’ in the box denotes ‘High-level’ mapping, 2 for ‘Medium-level’ mapping, 1 for ‘Low’-level’ mapping

**Teaching-Learning Strategies in brief:**

The course is experiential in nature. It is workshops and discussions-based methodology to discover solutions to problems and projects that enables students to see their designs work in real world.

Lectures by integrating ICT into classroom teaching, weekly tutorials involving problem solving and active learning by students and Project-based Learning by doing 4 mini-projects & one major project in laboratory by the students

**Assessment methods and weightages in brief :**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Weightage</th>
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<tbody>
<tr>
<td>In-class activities and Quizzes</td>
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</tr>
<tr>
<td>Weekly Lab assignments</td>
<td>30%</td>
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<tr>
<td>Main Project</td>
<td>40%</td>
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<tr>
<td>End Semester Exam</td>
<td>10%</td>
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</tbody>
</table>

**Technology Product Entrepreneurship1- Tools & Techniques**

Ramesh Loganathan, Prakash Yalla

Name of the Program: Technology product entrepreneurship- Tools and techniques
Course Code : PD2.431
Credits : 2
L - T - P : 3-1-0
(L - Lecture hours, T - Tutorial hours, P - Practical hours)

Semester, Year : II Sem 1st Year
(Ex: Spring, 2022)

Pre-Requisites : No prerequisites

Course Outcomes:
This course introduces the fundamentals of technology product entrepreneurship. You will learn the process of building a technology enterprise in a workshop format. Starting from a technology idea, mapping the idea to a high-potential commercial opportunity, defining/designing/validating the product, figuring out the market avenues & how to sell the product, and planning/managing rapid growth.

The class will apply the learning to their tech product ideas and create a venture able product & plan; in a workshop mode thru extensive hands-on assignments concurrent with course modules.

CO1-Understand how to evaluate product ideas and assess the market opportunity in real-time, along with learning from current scenarios.

CO2-Connect products with markets and identify market & customer segments with the help of frameworks and business models.

CO3-Assess competition and evolve Value proposition for the product in cognizance of the current market trends and ever-evolving customer needs.

CO4-Be able to put a complete business plan for a technology product, after analysing the markets and building a GTM strategy.

Course Topics:

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Topics</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction</td>
</tr>
<tr>
<td></td>
<td>Technology Product innovation.</td>
</tr>
<tr>
<td>2</td>
<td>Successful product cases review</td>
</tr>
<tr>
<td>2</td>
<td>Creativity &amp; Innovation</td>
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<tr>
<td>2</td>
<td>Stretch the idea. Idea Hexagon framework applied</td>
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<tr>
<td>Frameworks &amp; Models</td>
<td>Product &amp; Market first</td>
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<tr>
<td>Vision first (Vision/Strategy/Execution)</td>
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<td>Large opportunity (Big untapped market/ Much better product/ Much better team)</td>
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<td>Lean Startup models</td>
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<td>Crossing the chasm”</td>
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<td>Design Thinking</td>
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<td>Design thinking process: understand, observe, define, ideate, prototype, test</td>
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<td>Customer Discovery/Opportunity mapping</td>
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<td>LEAN Startup methodology</td>
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<td>Business Model canvass Tool</td>
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<tr>
<td>Customer Development</td>
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<tr>
<td>Models: through trial and error, hiring and firing, successful startups all invent a new, parallel process to product development for sales, marketing and business development</td>
<td></td>
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<tr>
<td>Market &amp; Competitive Positioning</td>
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</table>

**Preferred Text Books:**

High Tech Start Up, Revised and Updated: The Complete Handbook For Creating Successful New High Tech Companies by John L. Nesheim

The Lean Startup: How Today’s Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses by Eric Ries
**Reference Books:**
Technology Entrepreneurship: Overview, Definition, and Distinctive Aspects

2. Toward a General Modular Systems Theory and Its Application to Interfirm Product Modularity
3. [http://amr.aom.org/content/25/2/312.abstract](http://amr.aom.org/content/25/2/312.abstract)
4. Harvard: Why Lean Startup Changes everything

**E-book Links:**
The Art of the Start by Guy Kawasaki

1. Demand: Creating What People Love Before They Know They Want It by Adrian J. Slywotzky with Karl Weber
2. The Innovator’s Dilemma: The Revolutionary Book That Will Change the Way You Do Business by Clayton M. Christensen
3. Running Lean: Iterate From Plan A to a Plan That Works by Ash Maurya
4. Positioning: The Battle for Your Mind by Al Ries and Jack Trout
5. Venture Deals by Brad Feld and Jason Mendelson
6. Lean Analytics by Alistair Croll and Benjamin Yoskovitz
7. Crossing the Chasm by Geoffrey A. Moore

**Grading Plan:**

<table>
<thead>
<tr>
<th>Type of Evaluation</th>
<th>Weightage (in %)</th>
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<tbody>
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<td>Quiz-1</td>
<td>20%</td>
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<td>Labs</td>
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<tr>
<td>Tech Product Quiz-2</td>
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<tr>
<td>Demo and Presentation</td>
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<tr>
<td>Final submission</td>
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</table>
Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a ‘-’ dash mark if not at all relevant). Program outcomes are posted at

<table>
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Teaching-Learning Strategies in brief (4-5 sentences):

- **Introduction:** Assignment: Create startup website; Vision: Basic Positioning statement.
- **Creativity & Innovation:** Assignment: Based on team’s tech idea considered, list 3 product possibilities, applying Idea hexagon framework.
- **Frameworks & Models:** Assignment: Assess opportunity for the ideas. And pick the “venturable business.”
- **Customer Discovery/Opportunity mapping:** Assignment: Apply Lean Startup Methodology, and Validate customer interest, need & … ; Assignment: First cut of Business Model Canvas filled in
- **Design Thinking:** Assignment: Rapidly create and refine the product functionality for the teams product using design thinking process
- **Customer Development:** Assignment: Competitive Positioning; Assignment: Update Product functionality capturing the competitive proposition
- **Sales & Market Strategy:** Assignment: Evolve the GTM plans
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- **Technical Architecture considerations:** Assignment: Study 2 similar solutions in market and compare/contrast tech architecture used by your product
- **Corporate Technology Innovation:** TBD
- **Tech Product Pitch/Plan presentations**
Technology Product Entrepreneurship2- Tools & Techniques
Ramesh Loganathan, Prakash Yalla

Name of the Program: Technology product entrepreneurship- Tools and techniques

Course Code : PD2.432
Credits : 2
L - T - P : 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)

Semester, Year : II Sem 1st Year
(Ex: Spring, 2022)

Pre-Requisites : No prerequisites

Course Outcomes:
This course introduces the fundamentals of technology product entrepreneurship. You will learn the process of building a technology enterprise in a workshop format. Starting from a technology idea, mapping the idea to a high-potential commercial opportunity, defining/designing/validating the product, figuring out the market avenues & how to sell the product, and planning/managing rapid growth.

The class will apply the learning to their tech product ideas and create a venture able product & plan; in a workshop mode thru extensive hands-on assignments concurrent with course modules.

CO1-Understand the sales and strategy of a startup while having a clear understanding of markets.

CO2- Creating, developing, and evaluating the Technology Product’s “concept of a business” while using real-time frameworks.

CO3-Assess technology frameworks and leverage existing technology.

CO4-Be able to put a complete business plan for a technology product, after analysing the markets and building a GTM strategy.

Course Topics:

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<th>Sl No</th>
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<tr>
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<th>Sales &amp; Market Strategy</th>
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<td>Go to Market avenues, and projections</td>
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<td>GTM Planning</td>
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<td>2</td>
<td>Business Plans</td>
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<td>Creating, developing and evaluating the Technology Product’s “concept of a business”</td>
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<td>innovation? Is it a business or a product or both? Sizing the market? The technology, market and competitive risks? Competitive proposition</td>
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<td>3</td>
<td>Technical Architecture considerations</td>
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<td>Leveraging Mobile and Cloud</td>
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<td>Corporate Technology Innovation</td>
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<td>Applying research technology in corporate environments</td>
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<td>5</td>
<td>Tech Product Pitch/Plan presentations</td>
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<td>6</td>
<td>Final Demo and presentations</td>
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**Preferred Text Books:**
High Tech Start Up, Revised and Updated: The Complete Handbook For Creating Successful New High Tech Companies by John L. Nesheim

The Lean Startup: How Today’s Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses by Eric Ries

**Reference Books:**
Technology Entrepreneurship: Overview, Definition, and Distinctive Aspects

2. Toward a General Modular Systems Theory and Its Application to Interfirm Product Modularity
3. [http://amr.aom.org/content/25/2/312.abstract](http://amr.aom.org/content/25/2/312.abstract)
4. Harvard: Why Lean Startup Changes everything

E-book Links:
The Art of the Start by Guy Kawasaki
1. Demand: Creating What People Love Before They Know They Want It by Adrian J. Slywotzky with Karl Weber
2. The Innovator’s Dilemma: The Revolutionary Book That Will Change the Way You Do Business by Clayton M. Christensen
3. Running Lean: Iterate From Plan A to a Plan That Works by Ash Maurya
4. Positioning: The Battle for Your Mind by Al Ries and Jack Trout
5. Venture Deals by Brad Feld and Jason Mendelson
6. Lean Analytics by Alistair Croll and Benjamin Yoskovitz
7. Crossing the Chasm by Geoffrey A. Moore

Grading Plan:

<table>
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<tr>
<th>Type of Evaluation</th>
<th>Weightage (in %)</th>
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<tbody>
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<td>Quiz-1</td>
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<tr>
<td>Labs</td>
<td>20%</td>
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<tr>
<td>Tech Product Quiz-2</td>
<td>20%</td>
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<tr>
<td>Demo and Presentation</td>
<td>10%</td>
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<tr>
<td>Final submission</td>
<td>30%</td>
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</table>

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a ‘-’ dash mark if not at all relevant). Program outcomes are posted at
CO1
CO2
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CO4

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Teaching-Learning Strategies in brief (4-5 sentences):

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- **Corporate Technology Innovation**: TBD
- **Tech Product Pitch/Plan presentations**
List of the Electives for the PDM Courses:

- Software Engineering (SE)
- Software Systems and Development (SSD)
- Intro to Cognitive Science
- Behavioural Research & Experimental Design
- Introduction To UAV Design
- ICTs for Development course
- Computational Social Science
- Statistical methods in AI
- IoT Workshop
- Game Design and Engineering
Software Engineering

Name of the Academic Program: Bachelor of Technology in Computer Science and Engineering

Course Code: CSE461

L-T-P: 3-0-1

Credits: 4

( L= Lecture hours, T=Tutorial hours, P=Practical hours)

Prerequisite Course / Knowledge:

Students must have taken Intro to Software Systems, Design and Analysis of Software Systems or Equivalent courses

Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):

After completion of this course successfully, the students will be able to…

CO-1: Demonstrate familiarity with various process models, design patterns, architecture patterns and the characteristics of good software architectures

CO-2: Apply principles of user interface design, sub-system design and analyze the designs for good Software Engineering principles

CO-3: Demonstrate the use of tools to quantitatively measure and refactor existing software systems

CO-4: Compare design trade-offs between different patterns and/or different implementations of the same pattern

CO-5: Design the major components and user interface for a small-scale software system using modeling approaches such as UML class diagrams, and sequence diagrams

CO-6: Critique the quality of a software design and use product quality metrics to assess the quality of delivered software
Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

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Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write ‘3’ in the box for ‘High-level’ mapping, 2 for ‘Medium-level’ mapping, 1 for ‘Low-level’ mapping.

Detailed Syllabus:

Unit 1: Software Development Lifecycle and importance of architecture and design in the lifecycle; Process models; Modeling using UML.

Unit 2: Anti-patterns; Metrics and Measurement; Reverse Engineering and Refactoring.

Unit 3: Design Principles and Classification of Patterns
   - Structural patterns: Adapter, Composite, Façade, Proxy, Decorator
   - Behavioral patterns: Iterator, Observer, Mediator, Command, Memento, State, Strategy, Chain of Responsibility
   - Creational patterns: Abstract Factory, Builder, Singleton, Factory Method

Unit 4: Software architecture and Architectural business cycle; Quality attributes and Tactics for achieving attributes; Architectural styles and Techniques; Designing Architectures, Case studies.

Reference Books:


**Teaching-Learning Strategies in brief (4 to 5 sentences):**

The course is delivered using project based learning methodology. Topics like software subsystems modeling, design analysis, design trade-offs, language agnostic designs and component-based software development are taught and reinforced via unit level projects. The lectures emphasize the study and development of software sub-systems, comprehension and analysis of design quality attributes. The focus is on application of these concepts to concrete design problems through in-class design exercises and analysis of existing designs of currently implemented software systems. Entire class is run in a studio mode to facilitate discussion between student teams and discuss design trade-offs among students within student teams. Students present their designs and implementations to other students who are expected critique the designs.

**Assessment methods and weightages in brief (4 to 5 sentences):**

<table>
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<tr>
<th>Assessment</th>
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<td>Final Exam</td>
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<td>Mid-term Quiz</td>
<td>12 %</td>
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<tr>
<td>Unit Questions</td>
<td>12 %</td>
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<tr>
<td>3 Unit Projects (2 * 17) + (1 * 10)</td>
<td>44 %</td>
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<tr>
<td>Other In-class Activities</td>
<td>10 %</td>
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Software Systems Development

Charu Sharma

Name of the Program : PG Program (M.Tech I year I Semester - CSE & CSIS)
Course Code : CS6.302
Credits : 4
L - T - P : 3-0-2  
(L - Lecture hours, T-Tutorial hours, P - Practical hours)

Semester, Year : Monsoon 2022  
(Ex: Spring, 2022)

Pre-Requisites : No

Course Outcomes : The aim of this course is to provide a working knowledge of tools and technologies to build software systems. At the end of this course, students are expected to be

- Comfortable enough to work with various Unix-like computing environments.
- Able to write simple to complex scripts/programs.
- In a position to build small to medium sized software applications using various tools and technologies to automate tasks/solve problems.

Course Topics : Linux and Shell Scripting, HTML, CSS, Javascript and related libraries, Python, Basics of SDLC, Simple Queries, Networking and Security concepts.

1. Shell Programming - Linux basic commands, script writing, swiss-army- knife tools (vi, grep, awk, sed ..)

2. Web Programming - Intro to basic concepts of the World Wide Web (WWW) and tools used to develop web apps. -Client-side & server-side scripting (HTML, XHTML, CSS, Java script, Python,... )

3. Database Programming, Networking and Security

Reference Books :

- Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bashscripting, and Shell programming, by Mokhtar Ebrahim, Andrew Mallett
- Learning Python: Powerful Object-Oriented Programming, by Mark Lutz
- JavaScript: The Definitive Guide, by David Flanagan

E-book Links :

Grading Plan :

<table>
<thead>
<tr>
<th>Type of Evaluation</th>
<th>Weightage (in %)</th>
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<td>Quiz-2</td>
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<td>End Sem Exam</td>
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<td>Assignments</td>
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<td>Project</td>
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<tr>
<td>Other Evaluation (Lab activities + Class activities)</td>
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</table>
Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a ‘-’ dash mark if not at all relevant). Program outcomes are posted at

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Teaching-Learning Strategies in brief (4-5 sentences):

The plan is to use the prepared slides/documents in general to explain the problem and methods. This would include the handwritten/typed notes or using board to describe the topics. The outline has quite a few topics from different domains of computer science and would be taught in detail. Coding sessions would be conducted through labs and tutorials to make the topics easier to understand.

Back to Electives List

Intro to Cognitive Science

Course Code: CS9.426

Course Information
Course Description: Cognitive Science is a highly interdisciplinary field of study that seeks to understand how the mind works. In this course, we will discuss a diverse range of perspectives from philosophy, linguistics, psychology, neuroscience, and computer science, on how to unravel the mysteries of human cognition.

Credits: 4

L-T-P: 3-1-0 (L = lecture hours, T = tutorial hours, P = practical hours)

Prerequisite: None
Textbook & Course Materials:

Recommended Texts & Other Readings: Lecture slides and supplementary readings will be posted to Moodle.

Course Technology Requirements
You will need access to the following tools to participate in this course.
- Laptop/desktop computer
- webcam
- microphone
- a stable internet connection (don't rely on cellular)

Course Structure:
This course will be delivered fully in-person in a physical classroom unless COVID restrictions make us move online (Microsoft Teams).

Student Expectations
In this course you will be expected to complete the following types of tasks.
- communicate via email
- complete basic internet searches
- download and upload documents to the course site on Moodle
- read documents online
- view online videos
- participate in online discussions
- complete quizzes/tests online
- upload documents to a Dropbox/Moodle
- participate in synchronous online discussions

Course Outcomes (COs)
After successful completion of this course, students will be able to:
- CO-1: demonstrate familiarity with seminal research findings in cognitive science.
- CO-2: read, interpret, critique, and evaluate research in cognitive science.
- CO-3: critically think about the relationship between diverse fields such as AI, philosophy, neuroscience, and cognitive science.
- CO-4: identify flaws in how scientific results are communicated and critique scientific work
  in terms of confounds, experimental design, etc.
- CO-5: appreciate the nature of scientific debate in cognitive science and be able to generate well-informed perspectives on these debates.

You will meet the outcomes listed above through a combination of the following activities in this course:
- Attend lectures and participate in class discussions (CO-1, CO-2, CO-3, CO-4, CO-5)
- Debate sessions (CO-1, CO-2, CO-3, CO-5)
- Quiz 1, Quiz 2, and end-semester exam (CO-1, CO-2, CO-3, CO-5)
- Complete a term paper/debate reaction paper (CO-1, CO-2, CO-3, CO-5)

List of topics and activities
Introduction
Evolution of Cognitive Science
A free-form discussion on consciousness
Empirical approaches in cognitive science
Brain: Organization; Intro to sensation and perception
Sensory systems
Perception and Perceptual Learning, Cross-modal interactions
Vision
Attention
Learning
Development
Memory
Language and Cognition
Knowledge Representation
Special topics: e.g. Music, mind, and technology
Several debate sessions with student debate teams

Grading Policies

Graded Course Activities
Description Percentage
Quiz 1 (10 marks) 10%
Quiz 2 (10 marks) 10%
Debate reaction paper or debate team participation (20 marks) 20%
Mid-Sem exam (20 marks) 20%
End semester exam (40 marks) 40%
Total (100 marks) 100

Behavioral Research & Experimental Design

Course Code: CS9.421

Credits: 4

L-T-P: 3-1-0 (L = lecture hours, T = tutorial hours, P = practical hours)

Prerequisite: None

OBJECTIVE : The primary objective of these courses is to acquaint students with
fundamentals of experimental design, related research methods, data analyses approaches and techniques. Specifically, the course in Monsoon aims at introducing them to the basic concepts used in research and to scientific research methods and their approach. It includes discussions on sampling techniques, research designs and techniques of analysis. Some other objectives of the course are:

- To develop understanding of the basic framework of behavioral research process.
- To identify various sources of information for literature review for operationalization and data collection.
- To develop an understanding of various experimental designs and techniques.
- To develop an understanding of the ethical dimensions of conducting applied research.
- Appreciate the components of scholarly writing and evaluate its quality.

**COURSE TOPICS:**

1. Introduction to Research Methods: Qualitative and Quantitative Approaches; Conducting Behavioral Research; Ethics in Research; Institute Review Board (IRB) Process.

2. Starting on Research, Experimental Design: Hypothesis Testing, Type I and II errors, Hypothesis-based vs Exploratory Research, Operationalizing Research, Literature Review; Sampling, Types of variables and levels of Measurements, Designing an Experiment; Validity, Reliability and Cross-validation in Research

3. Types of Experimental design: Non-Experimental Designs, Pilot Testing; 4. Data Collection: Surveys Questionnaires; Data Representation: Levels of Measurement, Human Annotation, Different types of design: Simple randomized design, Factorial designs, Simple repeated measures design, Randomized blocks design, Latin square type designs, Between-subject and within-subject factors in an experiment; Scaling Behavioral Experiments: web and mobile experiments, crowdsourcing, big data, large-scale experiments, citizen science, online data collection (PsiTurk, Mechanical Turk, etc).

4. Data Visualization and Analysis: Descriptive Statistics, Tests of Normality and Data Transformation, Outliers, Collinearity in Data, Data Summarization vs Data Reduction Techniques: Exploratory Factor Analysis, Principal Component Analysis, Discriminant Factor Analysis

5. Introduction to Statistical Analysis: Inferential Statistics-Tests of Difference and Tests of Association: Multi-level tests (ANOVA): nonparametric and parametric tests of difference – chisquare test, Mann Whitney U test, Binomial Sign test, Wilcoxon’s T test, Related and Unrelated tests: nonparametric and parametric tests of association – correlation, regression; Significance testing [NOTE: While this course emphasizes basic descriptive and inferential statistical analysis, the Second part of the course to be offered in Spring would cover Statistical Analysis of Behavioral and Neuroimaging data in more detail].
6. Communicating and Assessing Research: Writing, Poster and general Presentations (formatting of the research paper using APA and IEEE journal/conference formats)

PREREQUISITES: Interest in conducting behavioral experiments is desirable. Open only for DD, MS, and PhD students. BTech and MTech students can be admitted based on specific requirements and instructor permission.

Introduction to UAV Design

Course Code: EC4.402

L-T-P: 3-1-0, Credits: 4

(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1. Prerequisite Course / Knowledge:
Basics of Linear Algebra, Laplace transform and Vector calculus.

2. Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):

After completion of this course successfully, the students will be able to..

CO-1 Determine the design specifications of the Unmanned Aerial Vehicle (UAV) used for a particular application.

CO-2 Explain the various design phases involved in the UAV design.

CO-3 Perform the conceptual design and preliminary design for multi-rotor, fixed-wing and hybrid UAVs.

CO-4 Perform the stability and flight performance analysis for the designed UAV.

CO-5 Able to manufacture a prototype UAV.

CO-6 Perform the flight simulation and flight testing of the prototype UAV and verify its stability and performance characteristics.
### 3. Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

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Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs.

[Back to Electives List]

### ICTs for Development

**Course Code:** CSE 595

Credits: 4

L-T-P: 4-0-0

(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Prerequisite Course / Knowledge: UG3 and above – no other prerequisite knowledge

**2. Course Outcomes (COs)** - After completion of this course successfully, the students will be able to dop the following”

CO-1. Develop a holistic definition and the role of information and communication technology [ICTS] in socio-economic development

CO-2. Learn critical theoretical theories of development and ICTD from a global perspective
CO-3: Grasping context aware concepts and application of ICTD in India

CO-4. Deep analysis of ICTD case studies in India and the global South

CO-5. Develop a research project applying foundational learnings from the course

3. Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

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‘3’ in the box denotes ‘High-level’ mapping, 2 for ‘Medium-level’ mapping, 1 for ‘Low’-level’ mapping

Course Structure in Detail

Overview of Course

OBJECTIVES

To introduce the idea of channeling the potential of Information and Communication Technology [ICTs] for socio-economic development to students of Engineering and Computational Humanities

To debate the notion of development as a sociological concept, with a particular focus on India, and discuss impacts of the development process on society as a multi-faceted phenomenon

To focus upon and formulate the idea of social media, as a component of ICTs, and the role they play in shaping the contours of social and everyday life

COURSE TOPICS/CONTENT/OUTLINE

Information and Communications Technology for Development is a growing area of research and community of scholars studying the role of technology in international development. Students in this course will study contemporary debates, issues and field projects that engage with information and communication technologies [ICTs] in the service of socio-economic progress and human development. This means a range
of things: it could refer to the scope of technology in alleviating poverty, in impacting low-resource settings, in designing and engineering relevant technologies to close digital literacy gaps in specific populations.

Topics that will be covered as part of the course are the following. These are broad umbrella categories which contain sub-topics

Introduction to the idea of Development:

Studying development is essentially a multidisciplinary exercise rooted in a range of technical and social-science research. By combining a variety of subject areas, the course will engage deeply with some of the complex problems associated with developing economies especially unstable infrastructures, scarce resources, and social disadvantages. We will discuss A Sen, K Galbraith among others

Globalization and Development

The course will specifically look at globalization as a socio-economic disruptor having far-fetched implications for not only wealth generation for a country but also bringing cultural transformations. We will discuss several historical trajectories of globalization in specific country contexts. We will include works of J Sachs, W Easterly

Technology and Development

The course will introduce a variety of social environments across resource and economic constraints that are targets for socio-economic development either through a top down model of deploying ICTs or through a more market driven and organic social processes. These can range from building low-cost technologies to studying user-driven innovations of ICTs to fit contexts of use. We will cover certain domain areas, using relevant theoretical models and practical outcomes, within ICTs and Development, like, education, healthcare, livelihoods, entertainment, and governance. Students will develop a critical lens to evaluate the processes and impacts and gain a well-rounded and practical perspective on issues of assessment and successes of development projects

Introducing Information and communication technologies as harbingers of social change

Under this topic we will debate and discuss the nature and contours of new channels of information, social networking the rise of social media and online content generation. Questions posed by these digital artifacts evaluate the inherently democratizing, process of owning, using, and networking with new media technologies. With the help of case studies, with a focus on India, we will articulate the implications of new and digital media in everyday life. We will focus on the sociology of new media technologies, with a specific aim to anchor them within select theoretical debates and in specific geographic contexts.

Social Media as a Developmental tool

Research had pointed to the rich field of utilization of new media tools for leisure and social networking as well as the unique affordances they spawn in the arena of self-expression and acquiring socio-digital identities. For example, the pre-pay mobile internet made web surfing an affordable and engaging activity even in the down markets and resource poor social ecologies of urban India. The course will critically evaluate the impacts of media technologies in the development discourse of a nation. The topic will include case-studies from the global North and South centering on social segments in resource-poor and emerging market settings
This class has no pre-requisite requirements and open to students from any background.

Students will be continuously evaluated with periodic quizzes/short tests and a course end assignment that will gauge student ability in engaging with and comprehending the course readings and classroom discussions.

**PREFERRED TEXT BOOKS:**

**REFERENCE BOOKS:**

**GRADING PLAN:**

<table>
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<th>Type of Evaluation</th>
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<td>End Sem Quiz</td>
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OUTCOME:

Students will be able to identify and apply a developmental lens in a variety of and diverse socio-economic contexts. The course will provide a strong grounding in developing a sociological perspective of digital media and their impact in the evolution of a digital society as a part of parcel of socio-economic development. One of the critical question the course will attempt to unpack is how technology seeks to address the needs and aspirations of people who increasingly consuming technologies and services despite are living in low resourced eco systems.

Computational Social Science

Ponnurangam Kumaraguru

Name of the Program : Applicable to all Programs on campus including, CSE, CLD,CHD, CND, both at UG & Masters level.

Course Code : CS9.435

Credits 4

L - T - P : 3-0-1
(L - Lecture hours, T-Tutorial hours, P - Practical hours)

Semester, Year : Spring, 2022
(Ex: Spring, 2022)

Pre-Requisites : Any UG3, UG4, M.Tech., MS, and Ph.D. student should be able to take it

Course Outcomes :

□ C0-1: Students will describe the opportunities and challenges that the
digital age creates for social sciences research.

☐ C0-2: Students will evaluate modern social research from the perspectives of both social science and data science.

☐ C0-3: Students will create research proposals that blend ideas from social science and data science.

☐ C0-4: Students will be able to summarize and critique research papers in Computational Social Science.

☐ C0-5: Students will conduct, develop, and practice the techniques needed to conduct their proposed research, through course project.

Course Topics:

(please list the order in which they will be covered, and preferably arrange these as five to six modules.)

Module 1: Social Research

☐ Computational Social Science 101
  ☐ What is Computational Social Science?
  ☐ Is Computational Social Science = or Computer Science + Social Science?
  ☐ Why study Computational Social Science?
  ☐ Challenges with only Computer Science or Social Science
  ☐ Does Social Media data == Computational Social Science? Class debate.

☐ Social Science vs. Data Science

☐ Prediction vs. Causality

Read / Listen / Watch:

☐ Hanna Wallach. 2018. Computational social science ≠ computer science + social data. Commun. ACM 61, 3 (March 2018), 42–44. DOI:https://doi.org/10.1145/3132698


☐ Coded Bias
  ☐ Trailer https://youtu.be/jZl55PsfZJQ
  ☐ Full documentary https://www.netflix.com/title/81328723

Module 2: Modeling & Causal Inference

☐ Linear Regression, Model building, Hypothesis testing

☐ Causal Inference

☐ Running Experiments – Lab, Real-world

☐ Read / Listen / Watch:
  ☐ Blumenstock et al. 2015. Predicting Poverty and Wealth from Mobile PhoneMetadata. Science. https://www.unhcr.org/innovation/wp-
Module 3: Mass Collaborations

Human Computation

- Galaxy Zoo

- Crowd-coding of political manifestos

Open Calls

- Netflix Prize

- Foldit: Protein-folding game

Distributed Data collection

- eBird: Bird data from birders
  - Kelling, Steve, Daniel Fink, Frank A. La Sorte, Alison Johnston, Nicholas

- Photocity

- How to develop our own (including around course project) Mass Collaborations?
  - Opportunities
  - Methods
  - Challenges

Module 4: Ethics
- Studies of concern
  - Experiment on 700,000 Facebook users

- Tastes, Ties, and Time study on Facebook users

- Web Censorship


Crime prediction using Social data, Tracking immigrants through their phone apps

Institutional Review Board / Ethics Committee – Expectations, Why is it necessary?

Informed consent, Privacy, Risk

Module 5: Biases in CSS Research

Biases & inaccuracies at the source of the data

Biases & inaccuracies during processing

Biases in social data

Inferences from biased data

Read / Listen / Watch:


Preferred Text Books:


E-book Links:

Grading Plan

(The table is only indicative)

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Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a ‘-’ dash mark if not at all relevant).

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Teaching-Learning Strategies in brief (4-5 sentences):

Learning

☐ Lectures
☐ Reading research papers  
☐ Class participation: questions, discussions  
☐ Online discussion:  
  Teams Learning by doing  
  ☐ Course project  
  ☐ Real world issues  
  ☐ Interdisciplinary approach  
  ☐ Real world implementation

POTENTIAL GUEST LECTURES:  
  1. Prof. Mathew Salganik, Princeton University  
  2. (Soon to be Dr.) Ashwin Rajadesingan, University of Michigan  
  3. Dr. Hemank Lamba, Dataminr

Statistical Methods in AI

Course Code: CS7.403

Credits: 4

L-T-P: 3-1-0 (L = lecture hours, T = tutorial hours, P = practical hours)

Prerequisite: None

COURSE TOPICS:  
  . Introduction, Feature Representation  
  . Nearest Neighbor Classification  
  . Random Variables, Probability Densities, Multivariate Densities  
  . Bayesian Decision Theory  
  . Naive Bayes Classifier  
  . Maximum Likelihood Estimation (MLE)  
  . Linear Discriminant Functions  
  . Perceptron Learning  
  . Minimum Squared Error Procedures  
  . Logistic Regression  
  . Neural Networks, Backpropagation, Training Methods  
  . Principal Component Analysis and Eigen Faces  
  . Linear Discriminant Analysis and Fischer Faces  
  . Max-Margin Classification (SVM), SVM variants, Kernelization  
  . Data Clustering, K means (EM) and variants, Hierarchical Clustering  
  . Decision Trees  
  . Graphical Models, Bayesian Belief Networks
Combining Classifiers, Boosting

REFERENCE BOOKS:
* Pattern Classification by Duda, Hart & Stork
* Machine Learning – A probabilistic Perspective by Kevin Murphy (free eBook Available online), * Neural Networks- A Comprehensive Foundation by Simon Haykin
If any changes in the Grading Scheme, faculty will announce in the first class.

GRADING Scheme:
* Assignments: 20% (1 Mini-project + 2 Assignments)
* Homeworks: 30% (2-4 problems given after each lecture; Top 80% counted)
* Two Mid Sems: 30%
* Final Exam: 20%

OUTCOME:
This course will enable students to understand pattern recognition techniques namely, Classification and clustering in detail including both theoretical and practical aspects.

IoT Workshop

Course Code: CE9.609

Credits: 4

L-T-P: 2-0-3 (L = lecture hours, T = tutorial hours, P = practical hours)

Prerequisite: Introduction to IoT

OBJECTIVE: This is a hands-on course on embedded systems based on learning by doing method. Students must choose a real-life problem related to structural engineering such as health monitoring of a structural component. They should design, develop and deploy a basic proof of concept prototype. The main emphasis in this course is on considerations of practical issues that come in the field while deploying. The project in this course is team activity, which will also develop interpersonal skills.

COURSE TOPICS:
1. Basic properties of electricity and electrical circuits –
a. DC, Voltage, Current, Power, Energy, Resistance, Ohm’s Law, Circuit Diagrams
b. Kirchoff’s voltage and current laws, series and parallel resistance, Voltage and Current divider
c. Online Simulations using TinkerCAD
d. Basic Circuits, Mesh analysis, Node analysis.
3. Arduino Environment, C Programming, Arduino programming and debugging, URAT Protocol
4. Sensing/Actuators and Interfacing
   a. Sensor/Actuator selection (using data sheets)
   b. Physics of sensors and actuators related to projects
   c. Interfacing: Serial interfaces, Analog out, SPI, UART, I2C, “propriety" such as DHT22
5. Controller, Embedded Systems and Peripherals -
   a. Platform selection – ATMEL328, ESP32, STM8 Architecture; timers, interrupts, AVR, SAMR architectures
   b. Embedded Systems: power management, interrupts, memory managements, leaks, OTA firmware update, reliability, onboard debugging
   c. Peripherals: RTC, ADC channels, resolution, onboard memory, power, external/internal watchdog
6. Communications, Networking and IoT Architecture
   a. Different IoT communication protocols: Comparison of Zigbee/WiFi/BLE/4G/5G/eSim/LoRaWAN
   b. Data Protocols: MQTT/HTTPS/CoAP
7. Data Storage and Computation
   a. Cloud storage and computing
   b. Data retrieval optimization
   c. IoT standards for interoperability: Implementation using oneM2M
8. PCB and Enclosure Design
9. Data privacy and security
10. Dashboard and Visualization
    a. Software/Approaches: UI/UX and Time Series Data Visualization; Front-end and back-end technologies
11. Documentation
    a. User document and developer’s documentation
    b. Best practices for writing the two documents
    c. Referring style manual. For example, Microsoft/Chicago manual of style

PREFERRED TEXTBOOKS:
• P. Lea, Internet of Things for Architects, Packt, 2018
• A. Kurniawan, Internet of Things Projects with ESP32, Packt, 2019

*REFERENCE BOOKS:
• A. Bahga and V. Madisetti, Internet of Things, University Press, 2016
• Raj Kamal, Internet of Things, McGraw Hill, 2018

*ONLINE COURSES:
1. Linear Circuits 1: DC Analysis by Georgia Institute of Technology
   URL: https://www.coursera.org/learn/linear-circuits-dcanalysis/home/info
Week 1 - Full week, 5 lessons; except Module 1 - Extra problems
Week 2 - Full week, 6 lessons; except Module 2 - Extra problems
Week 3 - Full week, 4 lessons; except Module 3 - Extra problems

2. Introduction to the Internet of Things and Embedded Systems by University of California, Irvine
URL: https://www.coursera.org/learn/iot/home/welcome

3. The Arduino Platform and C Programming
URL: https://www.coursera.org/learn/arduino-platform?specialization=iot


GRADING PLAN:

<table>
<thead>
<tr>
<th>Type of Evaluation</th>
<th>Weightage (in %)</th>
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<tbody>
<tr>
<td>Mid 1</td>
<td>10</td>
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<td>Mid 2</td>
<td>10</td>
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<tr>
<td>EndSem</td>
<td>20</td>
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<tr>
<td>Lab</td>
<td>10</td>
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OUTCOME:
After completion of this course, a student will be able to Evaluate different solutions for a real-life application and choose the solution, which is practical in given conditions. Design, develop and deploy a proof-of-concept solution. Test, debug, and redesign the solution based on field experiences.

Game Design and Engineering

Course Code: CS9.438

Credits: 4

L-T-P: 3-1-0 (L = lecture hours, T = tutorial hours, P = practical hours)

Prerequisite: None

OBJECTIVE: The course introduces aspects fundamental to game design, genres, technology analysis and development for market. The course gives equal emphasis to digital, board and
physical games.

**COURSE TOPICS:**
This course is designed to introduce the critical aspects of games design and development. Students will go through a structured process involving theory and practical classes to understand game development. Equal emphasis is given to non-virtual or digital games including board games, electronic games like rhythm mat and/or games that require physical devices. The main goal is to get create patentable ideas. The theory classes will cover aspects like theme, narrative, technology (single player versus multiplayer, managing data, rendering etc.), game play, player experience, material analysis in the case of physical games, marketing and animation. In gameplay, basics like game engine (digital) and game logic models will also covered. Experts from industry will cover animation and certain topics in marketing. In the lab class, the teams will huddle to conceptualize the idea, structure the game design documents, present their ideas and finalize technology issues. The secondary or even primary goal in some cases is to use of CAD/CAM like tools to come up with schematics of any physical implement required for the game and actually solder, ut, fabricate and paint….

**Syllabus (theory classes)**
1. What is a game?
   - Games Overview -ATheory of Fun; History of Games.
   - History of Computer Games
2. What are the elements of a game?
   In this part, we cover the elements of a game,
   With emphasis on the four major ones. Case studies of games in which one or more of these elements have made the game will be analysed.
   - Mechanics: rules & procedures of the game.
   - Story: events that bind the game together.
   - Aesthetics: game’s look, feel and sounds.
   - Technology: high-technology to materials (paper, sensors, wood etc.,)
3. Principles of Game Design:
   - Layers of Game Design
   - Design Issues
   - Preproduction and Documentation
   - Design Trade Offs
   - Poor Design
   End of this part, the Game Design Document is prepared.
4. Who is the player?
   - Game Genre and player
   - Cutting through the noise from player (likes, dislikes...)
5. What is player's experience?
   - measuring player’s experience
   - Cognitive behaviour measurement techniques
   Understanding and measuring player’s experiences during game play is an Important test for optimal game designs. Player’s experiences are recorded by many techniques. This part will analyze each of the technique and the value addition of each. Some experimental work will be required using tools like simple EEG, ECG/GSR and eye tracking.
6. How to design game mechanics?
   - Decision-making, types of decisions
   - Flow theory.
   - Special dynamics: feedback loops, emergence, and intentionality
6. What’s game interface?
- User Interface design.
- Differences between digital and non-digital UI.
- User Interface iteration
7. How to create a game script/story?
- Linear & Nonlinear storytelling
8. Building a game with technologies
- Analysis of game engines (Unity, XNA)
- AI versus HI in game development.
- Computer graphics & animation
- Physics engine – collision detection
9. Testing a game.
- Solo testing.
- Critical analysis
- Designer testing.
- Player testing
10. Marketing the game
11. Ethics, Culture, Violence in Games and Responsibilities

PREFERRED TEXT BOOKS:
2. Challenges for Game Designers, Brenda Brathwaite

*REFERENCE BOOKS:
2. Game Design and Development: Introduction to the Game Industry.
   Moore, Michael. Reference papers on serious games, board games, swarm/biological behaviour, cognition and games etc.,

*PROJECT:
Each team of 3 will conceptualize, design, prototype and test 2 unique games. Number of Project: 2
P1: Design and prototype a board game that explains a concept. This can be trading, friendship, education, jobs, global trade, social media etc., think on the lines of games like monopoly, go, chess etc., Use readily available material to make the prototype. Game play, rules and player demographics will make up your report.
P2: Design and develop/engineer a game virtual or live-action game that can be used for physical therapy. Virtual game – for carpal tunnel syndrome (look up the web for this occupational hazard). Live action game: which can help people exercise their lower back (a major issue with people who sit for long hours)? Materials for the virtual game can include Kinnector joysticks. Interfaces need be assembled. For the live-action, raw materials which are readily available need to be used and fabrication like injection moulding should be avoided. Sensors can be used if electronic games are selected.

*If any changes in the assessment method, faculty will announce in the first class.

Course Assessment Plan (Monsoon 2020)
Assignments - 20%
Project - 55%
Term Paper - 15%
Quiz
OUTCOME:- 10%
At least couple of design patents. Selected games ideas to the annual Game Developer
Conference, transfer/license and most importantly connecting theory to
practice/real product

REMARKS: The course requires a lot of lab type of work. Considering that animation experts and
animators are not available, some creativity is encouraged to create avatars, characters for the
digital games and layouts for the physical games. Half of the class hours will be in a lab room
workspace. This space will be kept open throughout the semester for students to work at any time.