25 Se- Annexure 2

Minor program

A minor of 16 credits provides students with an opportunity to diversify their academic portfolio and gain expertise in an additional field of study. This complementary coursework enhances their skill set, making them more versatile and competitive. By exploring interdisciplinary courses, students can broaden their knowledge base, foster innovative thinking, and open up new career pathways. Overall, a minor enriches the educational experience and equips graduates with a well-rounded perspective.

Types of Minor:

1. Discipline Minor
2. Interdisciplinary Minor

Eligibility and entry to the Minor programs:

- A student of IIIT Dharwad B.Tech program may enroll in a Minor program starting from 3rd semester up to starting of 5th semester.
- Minimum CPI required to get admission to Minor is 6.00 at the time of Minor enrollment.

1. Discipline Minor program structure:

For Discipline Minor program structure a student has to complete 16 credits from core course basket, elective course basket, and project.

Credit Structure for Discipline Minor is as follows:

Sl. No.	Category	Course List and minimum credits to be earned
1	Core Courses	• Basket of Discipline core courses • Minimum core course credits required to be earned: 4
2	Elective Courses	• Basket of elective courses • Minimum elective course credits required to be earned: 4
3	Project	• Minimum credits to be earned: 4 • Maximum credits to be earned: 8
	Total Credit	16

2. Interdisciplinary Minor program structure

- Total credits requirement for the award of minor is 16
- A student enrolled for the minor program shall earn maximum of 4 credits in a semester
- Attendance policy as specified for the B.Tech program
- Any course cannot be considered for dual credit in B.Tech program as well as Minor

Every Minor program shall offer core courses, elective courses and project as described in the following table:

Sl. No.	Category	Course List and minimum credits to be earned
1	Core Courses	● Basket of core courses ● Minimum core course credits required to be earned: 4
2	Elective Courses	● Basket of elective courses ● Minimum elective course credits required to be earned: 4
3	Project	● Minimum credits to be earned: 4 ● Maximum credits to be earned: 8
	Total Credit	16

Exit Options:

1. A student can choose to exit the Minor program at any time during their course of study.
2. If a student decides to drop the Minor program, then these courses are listed in the transcript as additional courses done by the student and are not considered for the BTech credit requirements and CPI calculation.

Minor in Entrepreneurship (Interdisciplinary)

This minor in Entrepreneurship empowers the students to think creatively and innovatively, equipping them with essential knowledge, tools, and frameworks to succeed in various careers.
Through hands-on experience, develop entrepreneurial skills to:
- Launch your own venture
- Thrive in startups or innovative corporations
- Drive social and environmental change
-Contribute to entrepreneurial ecosystems as a consultant, venture funder, accountant, law practitioner, or policymaker

25 Se- Annexure 2.1 (Minor in Entrepreneurship)

Minor in Generative AI

Background:

To establish a structured approach to Generative AI activities at IIIT Dharwad, a committee was formed with the objective of creating programs that reflect the institute's culture. The focus is on enhancing industry-academia partnerships, internships, placements, and projects across all existing disciplines. The GenAI committee includes

1. Dr. Deepak K T, Department of ECE, IIIT Dharwad
2. Dr. Nataraj K, Department of ECE, IIIT Dharwad
3. Dr. Chinmayananda A, Department of ECE, IIIT Dharwad
4. Dr. Krishnendu Ghosh, Department of CSE, IIIT Dharwad
5. Dr. Siddharth R, Department of DSAI, IIIT Dharwad
6. Dr. Sunil Saumya, Department of DSAI, IIIT Dharwad
7. Prof. S. R. Mahadeva Prasanna, Dept. of DSIS, IIIT Dharwad
8. Prof. Nixon Patel, Department of DSAI, Professor of Practice, IIIT Dharwad

The committee proposed a Minor degree program in the domain of Generative AI for undergraduates.

Sl. No.	**Category**	**Course List**
1	Core Courses	1. Foundations of Machine Learning and Generative AI 2. Generative AI Applications: From Concept to Implementation
2	Elective Basket	1. Text and Speech Generation with Advanced Models 2. Visual Creativity with Generative AI 3. Advanced Techniques in Prompt Engineering 4. Operationalizing LLMs: Tools and Techniques 5. Small Language Models
3	Project	Capstone Project in Generative AI

Note: List of courses is only indicative and may be upgraded as and when required.

Course Syllabus

Course Name: Foundations of Machine Learning and Generative AI

Course Code:

Name of the Faculty: **Credit: 3-0-2-0-4**

Required knowledge exposure	Basic programming concepts Introduction to data structures and algorithms Fundamentals of probability and statistics
Course objective	Provide a comprehensive introduction to the foundational concepts of machine learning and generative AI. Explain the AI/ML process and workflow from data collection to model deployment. Discuss different data types and state-of-the-art models in AI and ML. Highlight the distinctions and applications of Generative AI, including text generation and image/video diffusion. Examine the advantages and limitations of Generative AI.
Course Learning outcome	LO1: Understand the AI/ML process and workflow. LO2: Differentiate between various data types and their applications in AI/ML. LO3: Recognize the key concepts and models in generative AI. LO4: Evaluate the advantages and limitations of generative AI.

Course Syllabus	*Unit I: Introduction to AI and ML* History, Definitions, and Applications, AI/ML Process and Workflow: From Data Collection to Model Deployment, Types of Data: Text, Image, Audio, Video, Tabular, Time Series *Unit II: State-of-the-Art Models in AI and ML* Overview of Classical Machine Learning Models, Introduction to Deep Learning Models, State-of-the-Art Models in AI and ML *Unit III: Generative AI Concepts and Applications* Generative AI: Concepts and Distinctions from Traditional AI, Applications of Generative AI: Text Generation, Image and Video Diffusion, Small Language Models: Implementation and Use Cases *Unit IV: Ethical and Practical Considerations* Impact, Ethics, Trust, and Vulnerabilities with Generative AI, Transformation of Businesses and Careers with Generative AI, Advantages and Limitations of Generative AI
Assessment components	Quiz 1: 10% Mid Term: 25% Lab Exam: 30% End Term: 35%
Attendance policy	85%
Text Books	1. Foster, David. Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play. Singapore, O'Reilly Media, 2019. 2. Dhamani, Numa. Introduction to Generative AI. United States, Manning, 2024. 3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, 2016. 4. Bishop, C. M. Pattern Recognition and Machine Learning. Springer, 2006.

Minor in VLSI

Background:

A committee was constituted to prepare a Road Map of activities related to Semiconductor at IIIT Dharwad. The desire was to have programs in the semiconductor area that suits IIIT culture. The programs are expected to be translation research in nature so that it brings a lot of industry-academia linkages, internships, placements and projects for all the existing discipline programs offered at the Institute. The committee constituted the following members.

1. Prof. Madhu M, Dept of CSE, IIT Madras, Chairman
2. Prof. Sujay Deb, Prof. ECE & CSE, IIIT Delhi, Member
3. Dr. Srinivas C. Gupta, CTO, Smartsoc, Member
4. Dr. Neel Gala, CTO, InCore Semiconductors, Member
5. Dr. Jagadish D. N., Asst. Professor, IIIT Dharwad, Member Convenor

The committee proposed a Minor degree program in the domain of VLSI for undergraduates. Students from any discipline (CSE/ECE/DSAI) can opt for the Minor degree program in VLSI. For a student to be eligible to receive a Minor degree in VLSI a total of minimum of 20 credits needs to be earned in addition to credits of major degree program. Students may enroll for the said Minor degree program at the 3rd semester of his/her regular degree and may complete the credit requirement before completion of the major degree. Students will register for the courses under the guidance of the program coordinator of the Minor degree program. Table shown below summarizes the proposed credits allocation for Minor degree in VLSI.

Sl. No.	Category	Credits	Course list
1	Core courses (from basket of courses)	8 (Min 4)	1. Verilog Hardware Description Language 2. CAD for VLSI
2	Electives (from basket of courses)	8 (Min 4)	1. RTL-to-GDS 2. RISC V 3. System-on-Chip 4. VLSI Verification and Testing
3	Project	4 (Max 8)	1. Industry tie-up/ relevant project(s)
	Total credits	20	

The credits and course structure of the curriculum are now being placed before the senate for discussion and consideration.

Minor Degree Program VLSI Curriculum - Courses and Credits				
Sl no.	Type/Code	**Course**	**Credit**	**(L-T-P-S-C)**
SEM 3				
1	Core	Course from VLSI Core basket	4	3-0-2-0-4
		Total	**4**	
SEM 4				
2	Core	Course from VLSI Core basket	4	3-0-2-0-4
		Total	**4**	
SEM 5				
3	Elective	Course from VLSI Electives basket	4	3-0-2-0-4
		Total	**4**	
SEM 6				
4	Elective	Course from VLSI Electives basket	4	3-0-2-0-4
		Total	**4**	
SEM 7				
5	Project	VLSI Project	4	0-0-0-16-4
		Total	**4**	

Course Syllabus

Course Name: Verilog Hardware Description Language

Course Code: **Credit: 3L-0T-2P-0S-4C**

Prepared by Faculty:

Required knowledge exposure	Basic concepts in digital circuit design.
Course objective	• Discuss how to implement a hardware solution through software. • Explain how to implement and test complex combinational logic, sequential logic, arithmetic circuit, and memory. • Describe a solution to complex logic design problems and implement a test solution using Verilog. • Identify, debug and find a solution to an existing hardware problem.
Course Learning outcome	• LO1: Be able to synthesize hardware through programming. • LO2: Be able to verify complex logic designs.

Course Syllabus	**Unit-I: Basic Verilog:** Overview of Digital Design with Verilog HDL, Hierarchical Modeling Concepts, Basic Concepts, Modules and Ports, Gate-Level Modeling, Dataflow Modeling, Behavioral Modeling, Tasks and Functions, Useful Modeling Techniques **Unit-II: Advanced Verilog:** Timing and Delays, Switch-Level Modeling, User-Defined Primitives, Programming Language Interface, Logic Synthesis with Verilog HDL
Text books	1. Samir Palnitkar. Verilog HDL: A Guide to Digital Design and Synthesis. Pearson India, 2nd Ed, 2003.
Assessment components	Mid Exam: 20%; End Exam: 30%, Viva/Assignment: 10%, Lab Component: 40% (flexibility with the Instructor)
Attendance policy	85%

Course Syllabus

Course Name: CAD for VLSI

Course Code: **Credit: 3L-0T-2P-0S-4C**

Prepared by Faculty:

Required knowledge exposure	Knowledge of Hardware Description Languages
Course objective	● The role of CAD tools in the VLSI design process. ● Working of CAD tools. ● Algorithmic and heuristic approaches used in CAD flow.
Course Learning outcome	● LO1: Be able to model circuits and hardware. ● LO2: Be able to write algorithms to synthesize and optimize hardware.
Course Syllabus	**Unit-I: Architectural (High-Level) Synthesis:** Scheduling, resource sharing and binding. **Unit-II: Logic Synthesis:** 2-level, multi-level, sequential, and technology mapping. **Unit-III: Physical Synthesis:** Partitioning, floorplanning, placement, and routing.

Text books	1. G. Micheli. Synthesis and optimization of digital circuits. 2. G.D. Hachtel and F. Somenzi. Logic Synthesis and Verification Algorithms.
Assessment components	Mid Exam: 20%; End Exam: 30%, Viva/Assignment: 10%, Lab Component: 40% (flexibility with the Instructor)
Attendance policy	85%

Course Syllabus

Course Name: RISC V

Course Code: **Credit: 3L-0T-2P-0S-4C**

Prepared by Faculty:

Required knowledge exposure	Basic concepts in digital circuit design.
Course objective	● To make students know a wider variety of issues, including factors such as power, reliability, cost of ownership, and scalability. ● To give the students good knowledge about "instruction set architecture" (ISA) ● To make students to understand RISC-V ISA ● To make students understand how processors exploit implicit parallelism, Datapath and constructs a simple processor to implement an instruction set like RISC-V.
Course Learning outcome	● Students will broaden their knowledge of computer architectures. ● Students will increase their proficiency in Instruction Set Architecture (ISA). ● Students will get an idea of implementing an Instruction Set like RISC-V. ● Students will know the design principles of contemporary computers. ● Students will acquire the knowledge about Arithmetic for Computer, Pipelining and parallelism.

Course Syllabus	**Unit-I: Computer Abstractions and Technology:** Introduction, Eight Great Ideas in Computer Architecture, Technologies for building processors and Memory, Performance, The Power Wall, The Switching from uniprocessor to Multiprocessor, Benchmarking Intel i7, Fallacies and Pitfalls, Concluding Remarks. Instructions: The Language of Computer: Introduction, Operations of Computer hardware, Operands of Computer hardware. **Unit-II: Instructions: The Language of Computer:** Signed and Unsigned numbers, Representing Instruction in Computer, Logical operations, Instructions for making decisions, supporting procedures in Computer hardware. RISC-V Addressing for wide immediate and addresses, Parallelism and Instructions: Synchronization, Translating and Starting Programs (Excluding DLL). **Unit-III: Instructions: The Language of Computer::** A C Sort Example to put it All together , Arrays versus Pointers, Advanced Material: Compiling C, The Rest of RISC-V Instructions Arithmetic for Computer: Introduction, addition and Subtraction, Multiplication, Division, Floating Point, Parallelism and Computer Arithmetic. **Unit IV: RISC-V Interrupts and extension:** Overview of RISC-V Interrupt, Introduction to the RISC-V Vector Extension, The Processor: Introduction, Logic Design Conventions, building a Datapath, A Simple Implementation Scheme, an overview of pipelining, Pipelined Datapath and Control, Data Hazards, Exceptions, Parallelism via Instructions.
Text books	1. Computer Organization and Design- The Hardware/Software Interface: RISC-V Edition, David A. Patterson, John L. Hennessy, 2nd Edition. 2. Digital Design and Computer Architecture, RISC-V Edition by Sarah Harris, David Harris.
Assessment components	Mid Exam: 20%; End Exam: 30%, Viva/Assignment: 10%, Lab Component: 40% (flexibility with the Instructor)
Attendance policy	85%

Minor in Undergraduate Research Experience

Background:

A committee was constituted to prepare a Road Map of activities related to Research at IIIT Dharwad. The desire was to have a program dedicated to Research that suits IIIT culture. The program is expected to foster interdisciplinary skill development**,** give impetus to innovation, creativity, and adaptability in a changing job market. The committee is constituted of the following members.

1. Prof. S.R. Mahadeva Prasanna, Director, IIIT Dharwad, Chairman.
2. Dr. K.T. Deepak, Asst. Professor, ECE Dept., Member.
3. Dr. Sunil C. K., Asst. Professor, CSE Dept., Member.
4. Dr. Manjunath K. Vanahalli, Asst. Professor, DSAI Dept., Member.
5. Dr. Chinmayananda A., Asst. Professor, ECE Dept., Member Convenor.

The committee proposed a Minor degree program in Research for undergraduates. Students from any discipline (CSE/ECE/DSAI) can opt for this Minor degree program. For a student to be eligible to receive a Minor degree in Research a total of minimum of 20 credits needs to be earned in addition to credits of major degree program. Students may enroll for the said Minor degree program at the 3rd semester of his/her regular degree and may complete the credit requirement before completion of the major degree. Students will register for the courses under the guidance of the program coordinator of the Minor degree program. Table shown below summarizes the proposed credits allocation for this Minor degree in Research.

Sl. No.	**Category**	**Credits**	**Course list**
1	Core	8 (min 4)	1. Research Methodology 2. Literature Survey and State of the Art Seminar 3. Any core course suggested by the supervising faculty and relevant to research
2	Elective	8 (min 4)	Elective course(s) suggested by the supervising faculty and relevant to research.
3	Research Project	8	1. A research project under the guidance of any faculty.
	Total credits	**20**	

The credits and course structure of the curriculum are now being placed before the senate for discussion and consideration.

Minor Degree Program in Research Curriculum - Courses and Credits				
Sl no.	Type/Code	**Course**	**Credit**	**(L-T-P-S-C)**
SEM 3				
1	Core	Suggested Core Course	4	3-0-2-0-4
		Total	**4**	
SEM 4				
2	Elective	Suggested Elective Course	4	3-0-2-0-4
		Total	**4**	
SEM 5				
3	Core	Research Methodology	2	2-0-2-0-2
4	Core	Literature Survey and State of the Art Seminar	2	0-0-0-8-2
		Total	**4**	
SEM 6				
5	Project	Research Project I	4	0-0-0-16-4
		Total	**4**	
SEM 7				
6	Project	Research Project II	4	0-0-0-16-4
		Total	**4**	

Course Syllabus

Course Name: Research Methodology

Course Code: **Credit: 2L-0T-2P-0S-2C**

Prepared by Faculty:

Required knowledge exposure	Basic mathematics.
Course objective	• Understanding Research Fundamentals, Research Design and Strategy. • Inculcate Critical Thinking and Problem Solving skills while doing Literature Review. • Understand Data Collection Methods and Data Analysis. • Appreciate Scientific Writing and Presentation.
Course Learning outcomes	• Demonstrate the capability to formulate clear and concise research questions, hypotheses, and objectives. • Design robust and coherent research strategies tailored to specific research problems.

	• Critically assess and select appropriate research designs, identifying key themes, trends, and gaps in the existing research. • Develop well-founded arguments and solutions based on the critical analysis of existing research.
Course Syllabus	**Unit I:** Meaning of Research, Objectives of Research, Motivation, Research Approaches, Research and Scientific method, Selecting the Problem, Necessity of Defining the Problem, Techniques involved in Defining a Problem and an Illustration. **Unit 2:** Features of a Good Research Design, Basic Principles of Experimental Designs, Sample Design, Sampling and Non-sampling Errors, Sample Survey Vs. Census Survey, Types of Sampling Designs. **Unit 3:** Quantitative and Qualitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement, Scaling, Scale Classification Bases, Scaling Techniques, Multidimensional Scaling, Deciding the Scale. **Unit 4:** Techniques of Interpretation, Precautions in Interpretation, Significance of Report Writing, Different steps in writing report, Layout of the Research Report, Oral Presentation, Mechanics of writing a Research Report, Precaution for writing Research Reports.
Text books and References	1. Business Research Methods- Donald Cooper & Pamela Schindler, TMGH, 9th Edition. 2. Business Research Methods- Alan Bryman & Emma Bell, Oxford University Press. 3. Research Methodology- C. R. Kothari 4. Select references from the Internet - a. https://www.isical.ac.in/~palash/research-methodology.html b.https://documents.uow.edu.au/content/groups/public/@web/@commerce/documents/doc/uow012042.pdf
Assessment components	Mid Exam: 15%; End Exam: 15%, Viva: 20%, Assignments : 50%
Attendance policy	85%

Minor in Cybersecurity

The global cybersecurity market was valued at around $181 billion in 2023 and is expected to grow at a compound annual growth rate (CAGR) of 10.56% from 2024 to 2028, reaching a market volume of $273.60 billion by 2028. The field of cybersecurity offers a wide range of career paths, including roles such as security analyst, penetration tester, security architect, and chief information security officer (CISO).

A Minor in Cybersecurity equips students with critical skills and knowledge to protect digital assets in an increasingly interconnected world. This program provides a comprehensive understanding of fundamental cybersecurity principles, threat identification, and mitigation strategies. Students gain hands-on experience with industry-standard tools and techniques, including cryptographic methods, network security protocols, and secure coding practices. By completing this minor, students enhance their technical proficiency and become valuable assets in safeguarding organizations against cyber threats.

Committee:

1. Dr. Dattatraya Kulkarni, VP, McAfee Fellow
2. Prof. S.R.M. Pasanna, Director, IIIT Dharwad.
3. Dr. Srinivas Kulkarni, Professor in Practice, Dept. of CSE, IIIT Dharwad
4. Dr. Rajendra Hegadi, Associate Professor, Dept. of DSAI, IIIT Dharwad
5. Dr. Pavan Kumar C, Assistant Professor, Dept. of CSE, IIIT Dharwad
6. Dr. Malay Kumar, Assistant Professor, Dept. of CSE, IIIT Dharwad
7. Dr. Suvadip Hazra, Assistant Professor, Dept. of CSE, IIIT Dharwad
8. Dr. Sunil Saumya, HOD, Dept. of DSAI, IIIT Dharwad
9. Dr.Siddharth R, Assistant Professor, Dept. of DSAI, IIIT Dharwad

Total credits required for award of Minor: 20

Sl. No.	**Category**	**Course Basket**
1	Basket of Core Courses Min (4 C)	1. Introduction to Cybersecurity (2C) 2. Principles of Security Engineering (4C) 3. Network Security Essentials (2C) 4. Security Operations - Governance Risk & Compliance (4C) 5. Computer Networks Basics and Operating Systems (2C) 6. Software Engineering (2C)
2	Basket of Elective	1. Web, Mobile and DevOps Security (4C) 2. Network and Cloud Security (4C)

	courses Min (4C)	3. Hardware Security/Asset Security (4C) 4. Cyber Environment and Trustworthiness (4C) 5. Cryptography (4C) 6. AI for cybersecurity (4C)
3	Project Min (4C) Max (8C)	Capstone Project (s) on cybersecurity (4C/8C)

Course Syllabus

Course Name: Introduction to Cybersecurity

Course Code: Credit: 2-0-0–0-2

Required knowledge/exposure	Basic Computer skills
Course Objective	
Course Learning Outcome	● Students will learn the history and evolution of Cybersecurity starting from Physical information threats Digital Information Threats and beyond ● Students will understand the impact of Cybersecurity in at least 4 different industries ● Students will learn on how various strategies are adopted based on industry or threat landscapes ● Students should be able to interpret and explain the difference between Confidentiality, Integrity & availability
Course Syllabus	Unit - I: Introduction to Cybersecurity - History of Cybersecurity & evolution, Impact of Cybersecurity in Industry & daily lives, Strategy & Operating Model (Roles), Confidentiality, Integrity & Availability, Introduction and Definition Unit - II: Identity & Access Management - User & Digital Identities, Authentication & Authorization, Provisioning, Privilege Access Management, Multi-Factor Authentication Unit - III: Asset Security - Application Security, Hardware Security, Type of Cloud & Security, Data Security (Cryptography), Network Security

	Unit - IV: Security Operations - Security Incident Response, Digital Forensics, Vulnerability Assessment, Compliance Reporting, Risk Management Unit - V: Standards & Regulations - ISO 27001, NIST Family, PCI, DSS, CIS Controls, Global Regulations – GDPR, PIPEDA, IT Act 2000, CMMC, PDPA etc. Cyber Ethics & Principles Unit - VI: Governance Risk & Compliance - Security Governance Management, Various roles and required skill sets, Compliance Reporting, Security Policy Management, KPI & Performance Reporting
Textbooks	
Assessment Components	Quizzes - 20% Mid Exam - 30% End Exam - 50%
Attendance Policy	85%

Minor in Quantum Information Science and Technology

Background:

A committee was constituted to prepare a Road Map of activities related to Quantum Information Science and Technology at IIIT Dharwad. The desire was to have programs in the Quantum Information Science and Technology area. The programs are expected to be translation research in nature so that it brings a lot of industry-academia linkages, internships, placements and projects for all the existing discipline programs offered at the Institute. The committee constituted the following members.

1. Prof. Ravishankar V. (IIT Delhi Retired Professor), Chairman
2. Prof. Nixon Patel, Technology Innovator, Member
3. Dr. Anindita Banerjee (QKD), Expert from CDAC Pune, Member
4. Dr. L. Venkata Subramaniam, IBM Quantum India Leader, Member
5. Dr. Manish Modani, Expert from NVIDIA, India, Member
6. Dr. Debajyoti Bera, HEI Expert from IIIT Delhi, Member
5. Dr. Aswath Babu H., IIIT Dharwad, Member Convener

The committee proposed a Minor degree program in the domain of Quantum Information Science and Technology for undergraduates. Students from any discipline (CSE/ECE/DSAI) can opt for the Minor degree program in Quantum Information Science and Technology. For a student to be eligible to receive a Minor degree in Quantum Information Science and Technology a total of minimum of 20 credits needs to be earned in addition to credits of major degree program. Students may enroll for the said Minor degree program in the 3rd semester of his/her regular degree and may complete the credit requirement before completion of the major degree. Students will register for the courses under the guidance of the program coordinator of the Minor degree program. The table shown below summarizes the proposed credit allocation for a Minor degree in Quantum Information Science and Technology.

Sl. No.	Category	Credits	Course list
1	Core courses	4	1. Introduction to Quantum Information Science and Technology
2	Electives (from a basket of courses)	8 (Min 4)	1. Quantum Communication and Security/ Quantum Communication and Networking 2. Applications of Quantum Computing and Technology 3. Quantum Natural Language Processing
3	Project	8	1. Research Project with Quantum Computing Platforms (Qiskit, Cirq, Cuda-Q)

			2. Research Project with Quantum Computing Platforms (Xanadu's Pennylane & Strawberry Fields)
	Total credits	20	

The credits and course structure of the curriculum are now being placed before the Senate for discussion and consideration.

Minor Degree Program QIST Curriculum - Courses and Credits				
Sl no.	Type/Code	**Course**	**Credit**	**(L-T-P-S-C)**
SEM 3				
1	Core	Course	4	2-1-2-0-4
		Total	**4**	
SEM 4				
2	Elective	Course from Electives basket	4	2-1-2-0-4
		Total	**4**	
SEM 5				
3	Elective	Course from Electives basket	4	2-1-2-0-4
		Total	**4**	
SEM 6				
4	Project	Research Project	4	0-0-0-16-4
		Total	**4**	
SEM 7				
5	Project	Research Project	4	0-0-0-16-4
		Total	**4**	

Minor courses would provide students with a comprehensive understanding of Quantum Principles and their applications across various domains, and on other hand Minor Projects prepare the students in perceiving career in research by contributing to development and innovation in the area of Quantum Computing.

Overall, B.Tech. in Minor in Quantum Technology would provide students with a unique blend of theoretical knowledge and practical skills to contribute to the rapidly advancing field of Quantum Technology, which has the potential to revolutionize computing, communication, and sensing in the coming decades.

Potential Minor Project Areas

There are numerous areas students can explore, which are listed below:

1. Quantum Algorithms Development

Quantum Search Algorithms: Implement Grover's algorithm for database search and compare its performance with classical search algorithms.

Quantum Fourier Transform: Explore the Quantum Fourier Transform and its applications, such as in solving the Hidden Subgroup Problem.

Quantum Simulation: Simulate physical systems using quantum algorithms, such as the time evolution of quantum states.

2. Quantum Cryptography

Quantum Key Distribution (QKD): Implement and simulate the BB84 protocol for secure communication.

Quantum-Safe Cryptography: Explore post-quantum cryptographic algorithms that are resistant to quantum attacks, such as lattice-based cryptography.

3. Quantum Machine Learning

Quantum Support Vector Machine: Implement a quantum version of SVM and compare its performance with classical SVM.

Quantum Neural Networks: Develop simple quantum neural network models and explore their learning capabilities on small datasets.

4. Quantum Error Correction

Error Correction Codes: Implement and test quantum error correction codes like the Shor code or the Steane code.

Noise Simulation: Simulate the effects of different types of quantum noise (e.g., bit-flip, phase-flip) and apply error correction techniques.

5. Quantum Hardware Simulation

Qubit Simulation: Develop a software simulator for different types of qubits (e.g., superconducting qubits, trapped ions) and their interactions.

Quantum Gates Simulation: Simulate the operation of basic quantum gates (e.g., CNOT, Hadamard) and their effects on qubits.

6. Quantum Circuit Design

Circuit Optimization: Design and optimize quantum circuits for specific tasks, minimizing the number of gates and depth.

Quantum Circuit Compilation: Implement techniques for compiling high-level quantum algorithms into low-level quantum circuits.

7. Quantum Chemistry

Molecular Simulation: Use quantum algorithms to simulate the behavior of small molecules and chemical reactions.

Variational Quantum Eigensolver (VQE): Implement VQE to find the ground state energy of simple molecules.

8. Quantum Annealing

Optimization Problems: Use D-Wave's quantum annealers to solve optimization problems like the Traveling Salesman Problem or graph coloring.

Benchmarking: Compare the performance of quantum annealers with classical optimization techniques.

9. Quantum Communication

Entanglement Distribution: Simulate protocols for distributing entanglement between distant nodes in a quantum network.

Quantum Teleportation: Implement and simulate the quantum teleportation protocol.

10. Quantum Software Development

Quantum Programming Languages: Develop small projects using quantum programming languages such as Qiskit, Cirq, or Q#.

Quantum Cloud Services: Utilize cloud-based quantum computing platforms (e.g., IBM Quantum Experience, Amazon Braket) to run quantum algorithms and analyze results.

Tools and Resources

IBM Qiskit: Python-based open-source framework for working with quantum computers.

Google Cirq: Framework for designing, simulating, and running quantum circuits on Google's quantum processors.

Microsoft Q#: Quantum programming language integrated with Visual Studio and Azure Quantum.

Amazon Braket: Provides access to quantum hardware and simulators via the AWS cloud.

PennyLane: Software library for quantum machine learning and quantum computing with integrations for TensorFlow and PyTorch.

NVIDIA Cuda Quantum

Steps for a Successful Project

1. **Literature Review**: Start with a thorough review of existing literature to understand the state-of-the-art in your chosen area.

2. **Define Objectives**: Clearly define the objectives and scope of your project.
3. **Select Tools**: Choose the appropriate tools and frameworks based on your project requirements.
4. **Implementation**: Implement your project, ensuring to document your process and code.
5. **Testing and Validation**: Test your implementations and validate the results against known benchmarks or theoretical predictions.
6. **Reporting**: Prepare a detailed report documenting your methodology, results, and conclusions.

By selecting a focused and manageable project area from above potential areas, students can delve into the fascinating world of Quantum Computing and contribute to its growing body of knowledge.

Course Syllabus

Course Name: **Introduction to Quantum Information Science and Technology**

Course Code: New Credit: 2L-1T-2P-0S-4C

Required knowledge/exposure	Exposure to Fundamental Physics (Newtonian Mechanics, Modern Physics, Electrostatics, Quantum Physics)
Course Objective	To develop knowledge in Quantum Computational Theory among the students, in turn they could able to understand how Quantum Physics works, which would allow them to model, analyze and code such computing problems using Quantum Hardware.
Course Learning Outcome	With completion of the course student will be able to LO 1. Use Quantum Physics background to develop Quantum Computing skills. LO 2. Implement coding in Quantum Computing using Quantum Circuits. LO 3. Use Computational tools Qiskit and Cuba-Quantum to realize Quantum Algorithms. LO 4. Implement models to realize Quantum Hardware
Course Syllabus	Relevant background: Models for classical computation; Turing machines, Circuits. The analysis of computational problems; How to quantify computational resources, Computational complexity, Decision problems and the complexity classes P and NP, A plethora of complexity classes, Energy and computation, Perspectives on computer science. Information coding; Coding numbers, Coding language, The Morse code, Mean code length and coding efficiency, Optimizing coding efficiency, Shannon's source-coding theorem. Reversible computation; Maxwell's demon and Landauer's principle. From computer architecture to logic gates, Reversible logic gates and computation. Introduction and overview of Quantum Computing: Global perspectives, Deutsch thesis, basics of quantum computation and quantum, information, Quantum bits, Multiple

	qubits, Quantum computation, Single qubit gates, Non-classical correlations and violation of Bayes' theorem, Multiple qubit gates, Measurements in bases other than the computational basis, Quantum circuits, No-cloning Theorem, Example: Bell states, Example: quantum teleportation, Super Dense Coding, Quantum algorithms, Classical computations on a quantum computer, Quantum parallelism, Oracle algorithms-The Deutsch and The Deutsch–Jozsa algorithm. Practical realization of Quantum gates. Quantum computers-physical realization: Guiding principles, Conditions for quantum computation. Preparation of fiducial initial states, Measurement of output state. Physical example including Optical Photons, Josephson Junctions, Ion trap, Quantum dots. Limitations and Challenges.
Textbooks/References	1. Quantum Computation and Quantum Information by Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press, 2010 (10th Anniversary Edition) 2. Classical and Quantum Information Theory: An Introduction for the Telecom Scientist, Emmanuel Desurvire, Cambridge University Press, 2009 3. Lecture Notes for Physics 229: Quantum Information and Computation by John Preskill, Caltech (Freely available online), 1998 (with updates in subsequent years) 4. Quantum Computer Science: An Introduction by N. David Mermin, Cambridge University Press, 2007.
Assessment Components	1. One quiz:25% 2. End Semester Exam: 60% 3. Assignments+Attendance (above 85 percent): 15%
Attendance Policy	As per the institute's norm

Course Syllabus

Course Name: **Quantum Communication and Security**

Course Code: New Credit: 2L-1T-2P-0S-4C

Required knowledge/exposure	Introduction Quantum Information Science and Technology Course
Course Objective	To develop knowledge in Quantum noise and quantum processing even secure manner.
Course Learning Outcome	With completion of the course student will be able to LO 1. Use Quantum error correction protocols to noiseless communication. LO 2. Implement Quantum Key Distribution protocol. LO 3. Use various Quantum Cryptography for Quantum Communication network. LO 4. Use Quantum Cryptography beyond classical cryptography.
Course Syllabus	**Quantum noise and quantum operations:** **Quantum error-correction:** **Quantum Information Theory:**
Textbooks/References	1. Quantum Computation and Quantum Information by Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press, 2010 (10th Anniversary Edition) 2. Classical and Quantum Information Theory: An Introduction for the Telecom Scientist, Emmanuel Desurvire, Cambridge University Press, 2009 3. Lecture Notes for Physics 229: Quantum Information and Computation by John Preskill, Caltech (Freely available online), 1998 (with updates in subsequent years) 4. Quantum Computer Science: An Introduction by N. David Mermin, Cambridge University Press, 2007.
Assessment Components	1. One quiz:25% 2. End Semester Exam: 60% 3. Assignments+Attendance (above 85 percent): 15%

Attendance Policy	As per the institute's norm

Course Syllabus

Course Name: **Introduction of Quantum communication & Quantum Network**

Course Code: New Credit: 2L-1T-2P-0S-4C

Required knowledge/exposure	Content Introduction Quantum Information Science and Technology Course
Course Objective	To introduce the concepts of quantum communication including the [illegible] with quantum communication protocols. Work hands on experience
Course Learning Outcome	With completion of the course student will be able to LO 1. Use Quantum Network Simulators LO 2. Implement Quantum Key Distribution protocol. LO 3. Use various Quantum Cryptography for Quantum Communication network. LO 4. Use Quantum Cryptography beyond classical cryptography.
Course Syllabus	**Week-1** Basics of Quantum Networks & Internet 1) Basics of Linear algebra 2) Basics of Density matrix formalism 3) Qubit - a) Local (Superconducting) qubit & local operations b) Non-local (Photonic) qubit & non-local operations 4) Superdense Coding 5) Quantum Entanglement 6) Bell-state Measurement 7) Teleportation 8) No-Cloning Theorem 9) Entanglement Swapping **Week-2** Structure of Quantum Network 1. Quantum Network Architecture a. All Photonic quantum networks b. Quantum networks with memories c. Quantum networks with processing nodes 2. Hardware a. Optical channels b. Detectors c. Entangled photon sources i. Non-linear crystals ii. SPDC d. Matter Nodes e. Repeaters 3. Software a. Application Layer i) Multiple application of Quantum Network Simulator b) Transport Layer c) Network Layer i) Topology of the network (1) Service node (2) End node d) Link Layer i) Link layer protocols, generation, purification & Swapping

	e) Physical Layer **Week-3 & Week- 4** Network Protocols 1. Classical Network Protocols a. Layers of Abstraction (7-layer OSI Model) b. Physical Layer c. Data Link Layer d. Network Layer e. Transport Layer f. Session Layer g. Presentation Layer h. Application Layer 2. Quantum Network Protocols a. Physical Layer (Hardware) b. Entanglement Management i. Entanglement Generation a. Local entanglement generation b. SPDC 1) Non-local entanglement generation i) DLCZ Protocol ii) Barret-Kok Entanglement generation Protocol 2) Entanglement Purification a) BBPSSW Protocols b) Other protocols 3) Entanglement Swapping a) Local b) Nonlocal protocol 4) Routing Protocol a) Best effort b) NoN protocol c) Others 5) Benchmarking of quantum Network a) Parameters for transport layer i) Congestions in the network b) Parameters for Network layer i) Throughput ii) Latency iii) Robustness iv) Average fidelity **Week-4 Role of classical communication in Quantum networks** Classical network Classical massage passing in the quantum teleportation protocols Classical massage as heralding signal of the Bell-state measurement Classical passing techniques in the Routing Algorithms. Week-5 Components of Quantum Network Single Photon Source Entangled Photon Source Quantum Memory

	Quantum Random No. Generator Quantum Repeater & BSM Quantum Router & Switch Quantum Channel (QNS) **Week-6 Introduction with QuSense Quantum network Simulator** Motivation Working of Quantum network Simulator Challenges Limitations Instructions for how to install QQNS Locally Instruction for installing on the cloud Tutorial User guide Examples Week-7 Basics of Quantum Optics & Quantum Memories 1) Quantization of EM field 2) Two-level System 3) Three-level System Quantum Memory and Quantum Storage protocols Electromagnetically Induced transparency (EIT) Atomic Frequency Comb (AFC) Gradient Echo Memory (GEM) Control reversible inhomogeneous broadening (CRIB) Week-8 Application of Quantum Internet 1) Long distance quantum Communication 2) End-to-End Entanglement generation 3) Entanglement based Quantum communication a) E91 protocol b) BBM92 4) Time Synchronization Note: Students are expected to do the simulations on QQNS and prepare a detailed report on the quantum network. The presentation and demonstration should be presented and that will be review and graded.
Textbooks/References	1. Quantum Computation and Quantum Information by Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press, 2010 (10th Anniversary Edition). 2. Classical and Quantum Information Theory: An Introduction for the Telecom Scientist, Emmanuel Desurvire, Cambridge University Press, 2009. 3. Lecture Notes for Physics 229: Quantum Information and Computation (with updates in subsequent years), freely available online), 1998 by John Preskill, California Institute of Technology. 4. Quantum Computer Science: An Introduction by N. David Mermin, Cambridge University Press, 2007.
Assessment Components	1. One quiz:25% 2. End Semester Exam: 60% 3. Assignments+Attendance (above 85 percent): 15%
Attendance Policy	As per the institute's norm

Course Syllabus

Course Name: **Applications of Quantum Information Science and Technology**

Course Code: New Credit: 2L-1T-2P-0S-4C

Required knowledge/exposure	Introduction Quantum Information Science and Technology Course
Course Objective	To develop knowledge in Quantum Computing applications along with development of skills to implement quantum algorithms and code for real world problems.
Course Learning Outcome	With completion of the course student will be able to LO 1. Use Quantum Fourier Transform applications. LO 2. Implement Quantum search algorithms. LO 3. Use QML and QAI over conventional methods. LO 4. Use Quantum Computing for real world applications.
Content	Introduction to Quantum Computing, applications, quantum algorithms, analyze

Course Syllabus	**The quantum Fourier transform and its applications:** The quantum Fourier transform. Phase estimation. Performance and applications. Applications of phase estimation. Period finding. Discrete logarithms. The hidden subgroup problem. Other quantum algorithms. Lower bounds. The **Quantum search algorithms:** The quantum search algorithm. The oracle. The procedure. Optimality of the search algorithm. Black box algorithms. Database **Quantum Machine Learning and Artificial Intelligence :** Representing Data on a Quantum Computer. Encoding Binary Inputs Quantum cognition and related approaches. Cognitive architectures **Quantum Computing for real world applications:** Material Science: simulation of molecular systems for understanding Machine learning. Applications of
Textbooks/References	1. Quantum Computation and Quantum Information (2010) by Isaac Chuang and Michael Nielsen. 2. Machine Learning with Quantum Computers (2021, Springer) by Maria Schuld and Francesco Petruccione. 3. Quantum Machine Learning: What Quantum Computing Means to Data Mining (2014, Elsevier - Ai, Academic Press) by Peter Wittek. 4. Principles of Quantum Artificial Intelligence (2014) by Andreas
Assessment Components	1. One quiz:25% 2. End Semester Exam: 60% 3. Assignments+Attendance (above 85 percent): 15%
Attendance Policy	As per the institute's norm

Course Syllabus

Course Name: **Quantum Natural Language Processing**

Course Code: New Credit: 2L-1T-2P-0S-4C

Required knowledge/exposure	Introduction Quantum Information Science and Technology and Quantum Communication and Security Courses Content
Course Objective	To get the basics of Diagrammatic Quantum Theory (QT). Explore [illegible] applications of QNLP and its future research directions. [illegible]
Course Learning Outcome	With completion of the course student will be able to LO 1. Use Quantum Fourier Transform applications. LO 2. Implement Quantum search algorithms. LO 3. Use QML and QAI over conventional methods. LO 4. Use Quantum Computing for real world applications.
Course Syllabus	**Processes as Diagrams:** [illegible] Processes, Sets, Functions, Relations, Functions versus Relations. [illegible] **String Diagrams and Quantum Computing:** [illegible] Gates as ZX-Diagrams, [illegible] **Foundations for Near-Term Quantum Natural Language Processing:** A quantum model for natural language [illegible] learning parts from the whole, [illegible] variational quantum circuits, [illegible] **lambeq: An Efficient High-Level Python Library for Quantum NLP:** String diagrams [illegible]
Textbooks/References	1. Bob Coecke, "Foundations for Near-Term Quantum Natural Language Processing", https://arxiv.org/abs/2012.03755 2. Bob Coecke, Aleks Kissinger, "Picturing Quantum Processes", Cambridge University Press, 2017 3. Joachim Lambek, "From Word to Sentence: A Computational Algebraic Approach to Grammar", Polimetrica s.a.s., 2008 4. Bob Coecke, Giovanni de Felice, Konstantinos Meichanetzidis, [illegible] Language Processing", 2020
Assessment Components	1. One quiz:25% 2. End Semester Exam: 60% 3. Assignments+Attendance (above 85 percent): 15%

Attendance Policy	As per the institute's norm

25 Se- Annexure 2.1

Curriculum Brief: Unlock Your Inner Entrepreneur: Minor in Entrepreneurship

No startup idea? No problem! This minor empowers you to think creatively and innovatively, equipping you with essential knowledge, tools, and frameworks to succeed in various careers.

Through hands-on experience, you'll develop entrepreneurial skills to:
- Launch your own venture
- Thrive in startups or innovative corporations
- Drive social and environmental change
- Contribute to entrepreneurial ecosystems as a consultant, venture funder, accountant, law practitioner, or policymaker

The entrepreneurship minor prepares you for dynamic careers, including:
- New business creation and capitalization
- Startup and innovation management
- Social and environmental entrepreneurship
- Entrepreneurial consulting and support services

Program Structure

- Total credits requirement for the award of minor is 16
- Attendance policy as specified for the B.Tech program
- Any course cannot be considered for dual credit in B.Tech program as well as Minor

The minor will have the following courses:

Core, Elective, and Project categorization:

Category	Course Name (Credits)
Core (Minimum 4 Credits)	• Innovation, Entrepreneurship and Technology (2) • Introduction to Sales and Marketing (2) • Business Plan Development (2)
Electives (Minimum 4 Credits)	• Financial Engineering (2) • Market Research (2) • Consumer Psychology and Decision Making (2) • Managerial Economics (2) • Game Theory for Startups (2) • International Business (2) • Strategic Management (2) • Introduction to Finance for Engineers (2)
Capstone Project (Minimum 4 credits and maximum 8 credits)	• Launch Your Startup: A Hands-on Learning Experience

In each of the above courses, we will go in-depth by teaching important concepts to the students and then make them practice these ideas through actual ideation and practice that are current to the industry by involving industry practitioners.

Building Entrepreneurs:

- Real student ideas, where found eligible for relevant grants from various Government and Industry bodies co-ordinated by IIIT Dharwad Research Park (IDRP), shall be provided with the same to help accelerate the prototyping. IDRP shall provide mentoring and industry access support to the student entrepreneurs.

- In-case the student converts the idea into a viable prototype satisfying commercialization criteria that IDRP will set-out, such ideas shall become eligible for further funding and mentorship under IDRP's Early Stage Incubation Programme.

Exit Option:

- A student can choose to exit the Minor program at any time during their course of study.
- If a student decides to drop the Minor program, then these courses are listed in the transcript as additional courses done by the student and are not considered for the B.Tech credit requirements and CPI calculation.

Course Title: Innovation, Entrepreneurship and Technology

Credits: 2 (28 Hours)

Course Description: Students will learn about the entrepreneurial mindset, technology trends, how to generate and develop innovative ideas, and how to develop a tech-enabled business model.

Target Audience: Undergraduate students interested in entrepreneurship within engineering streams, business, or management.

Prerequisites: None

Course Outline:

Week 1: Introduction to Innovation and Entrepreneurship
- Defining innovation and entrepreneurship
- Entrepreneurial mindset and skills
- Overview of the startup ecosystem

Week 2: Idea Generation and Validation
- Techniques for generating innovative ideas
- Validating ideas through market research and feedback

Week 3: Business Model Canvas
- Introduction to the Business Model Canvas
- Creating a business model for your innovative idea

Week 4: Technology and Entrepreneurship
- Overview of key technologies for entrepreneurship (e.g., AI, blockchain, IoT)
- Leveraging technology to scale your venture

Week 5: Pitching and Storytelling
- Crafting a compelling pitch for your venture
- Storytelling techniques for entrepreneurs

Week 6: Entrepreneurial Finance
- Overview of funding options for startups (e.g., venture capital, crowdfunding)
- Creating a financial plan for your venture

Week 7: Launching and Growing Your Venture
- Strategies for launching and growing a successful startup
- Scaling your venture through partnerships and collaborations

Week 8: Final Project Presentations
- Students will present their final projects, which can be a business plan, pitch deck, or prototype.

Assessment:
- Class participation and engagement (20%)
- Weekly assignments and quizzes (40%)
- Group project and presentation (30%)
- Final exam (10%)

Teaching Methods:
- Lectures
- Case studies
- Group projects and presentations
- Hands-on data analysis and interpretation

Learning Outcomes:
- Understand market research principles and methodologies

- Design and implement market research studies
- Analyze and interpret market data
- Develop market segmentation and targeting strategies
- Apply competitive intelligence tools and techniques

Textbook:

- "The Lean Startup" by Eric Ries
- "Business Model Generation" by Alexander Osterwalder and Yves Pigneur
- Online resources and articles, including TED talks and startup blogs.

Course Title: Market Research

Credits: 2 (28 Hours)

Course Description: This course introduces market research principles, methods, and applications, focusing on data-driven decision-making in business. Preparing students for corporate careers in marketing, business, and research.

Target Audience: Undergraduate students interested in entrepreneurship within engineering streams, business, or management.

Prerequisites: None

Course Outline:

Week 1: Introduction to Market Research
- Definition and importance of market research
- Research process and ethics

Week 2: Research Design and Methodology
- Qualitative and quantitative methods
- Survey design and questionnaire development

Week 3: Data Collection Methods
- Primary and secondary data collection
- Online and offline data collection methods

Week 4: Data Analysis and Interpretation
- Descriptive statistics and data visualization
- Inferential statistics and hypothesis testing
- Univariate and Multivariate Data Analysis

Week 5: Market Segmentation and Targeting
- Segmenting and targeting markets
- Positioning and branding strategies

Week 6: Competitive Analysis and Intelligence
- Analyzing competitors and market trends
- Competitive intelligence tools and techniques

Week 7: Product Testing and Launch
- Product testing methods (concept testing, usability testing)
- Launch strategies and metrics

Week 8: Case Studies and Group Project Presentations

Assessment:
- Class participation and engagement (20%)
- Weekly assignments and quizzes (40%)
- Group project and presentation (30%)
- Final exam (10%)

Teaching Methods:
- Lectures
- Case studies
- Group projects and presentations
- Hands-on data analysis and interpretation

Learning Outcomes:
- Understand market research principles and methodologies

- Design and implement market research studies
- Analyze and interpret market data
- Develop market segmentation and targeting strategies
- Apply competitive intelligence tools and techniques

Textbook:

- "Market Research: The Process and Application" by David L. Luck and Tina M. Lowrey

Additional Resources:

- Market research databases (IBISWorld, Statista)
- Online survey tools (SurveyMonkey, Qualtrics)
- Data analysis software (SPSS, R Studio)
- Market research reports and case studies

Course Title: Consumer Psychology and Decision Making

Credits: 2 (28 Hours)

Course Description: This course provides a comprehensive introduction to consumer psychology and decision-making, preparing students for careers in marketing, advertising, and consumer research. It explores the psychological factors influencing consumer behaviour, decision-making, and marketing strategies.

Target Audience: Undergraduate students interested in entrepreneurship within engineering streams, business, or management.

Prerequisites: None

Course Outline:

Week 1: Introduction to Consumer Psychology
- Definition and scope of consumer psychology
- Historical development and key concepts

Week 2: Perception and Attention
- Sensory perception and processing
- Attention and cognitive processing

Week 3: Memory and Learning
- Types of memory (short-term, long-term)
- Learning theories (classical conditioning, operant conditioning)

Week 4: Motivation and Emotions
- Theories of motivation (Maslow, McClelland)
- Emotional influences on decision-making

Week 5: Attitudes and Persuasion
- Attitude formation and change
- Persuasion techniques (foot-in-the-door, door-in-the-face)

Week 6: Decision-Making Processes
- Rational and intuitive decision-making
- Heuristics and biases (availability, confirmation)

Week 7: Social Influence and Group Dynamics
- Social norms and conformity
- Group decision-making and leadership

Week 8: Case Studies and Group Project Presentations

Assessment:
- Class participation and engagement (20%)
- Weekly assignments and quizzes (40%)
- Group project and presentation (30%)
- Final exam (10%)

Teaching Methods:
- Lectures
- Case studies
- Group projects and presentations
- Interactive experiments and simulations

Learning Outcomes:
- Understand consumer psychology principles and theories
- Analyse factors influencing consumer decision-making

- Apply marketing strategies based on consumer psychology
- Develop critical thinking and problem-solving skills
- Evaluate ethical implications of consumer psychology

Textbook:

- "Consumer Behavior" by Leon G. Schiffman and Leslie Lazar Kanuk

Additional Resources:

- Consumer psychology journals (Journal of Consumer Research)
- Marketing and advertising databases (AdAge, Advertising Age)
- Online consumer behaviour resources (Consumer Reports)

Course Title: Financial Engineering

Credits: 2 (28 Hours)

Course Description: This course provides a comprehensive introduction to financial engineering, covering key foundational concepts, financial markets, instruments, and quantitative methods.

Target Audience: Undergraduate students interested in entrepreneurship within engineering streams, or building career in investment banking.

Prerequisites: None

Course Outline:

Week 1: Introduction to Financial Engineering
- Overview of financial engineering
- Financial markets and instruments

Week 2: Time Value of Money
- Present value and future value
- Net present value (NPV) and internal rate of return (IRR)

Week 3: Financial Markets and Instruments
- Stocks, bonds, and derivatives
- Risk and return

Week 4: Quantitative Methods
- Basic statistical concepts (mean, variance, correlation)
- Introduction to Excel for financial analysis

Week 5: Financial Modelling
- Building financial models
- Scenario analysis and sensitivity analysis

Week 6: Options and Futures
- Introduction to options and futures
- Pricing and hedging

Week 7: Risk Management
- Identifying and managing financial risk
- Introduction to Value-at-Risk (VaR)

Week 8: Case Studies and Group Project Presentations

Assessment:
- Class participation and engagement (20%)
- Weekly assignments and quizzes (40%)
- Group project and presentation (30%)
- Final exam (10%)

Teaching Methods:
- Lectures
- Case studies
- Group projects and presentations
- Excel-based assignments and quizzes

Learning Outcomes:
- Understand foundational concepts in financial engineering
- Analyse financial markets and instruments
- Apply quantitative methods for financial analysis
- Build financial models and manage risk

Textbook:

- "Financial Engineering: A Complete Guide to Financial Innovation" by Robert L. McDonald

Additional Resources:

- Excel software
- Financial databases (e.g., Bloomberg, Country specific financial markets websites)

Course Title: Managerial Economics

Credits: 2 (28 Hours)

Course Description: This course applies economic principles to managerial decision-making, covering optimization, market analysis, and strategic planning.

Target Audience: Undergraduate students interested in entrepreneurship within engineering streams, business, or economics.

Prerequisites: None

Course Outline:

Week 1: Introduction to Managerial Economics
- Overview of managerial economics
- Basic economic concepts (scarcity, opportunity cost)

Week 2: Optimization Techniques
- Marginal analysis
- Cost-benefit analysis
- Break-even analysis

Week 3: Market Analysis
- Market structures (perfect competition, monopoly)
- Demand and supply analysis
- Price elasticity

Week 4: Consumer Behaviour
- Consumer preferences
- Demand curves
- Market segmentation

Week 5: Production and Cost
- Production functions
- Cost functions (fixed, variable, marginal)
- Economies of scale

Week 6: Pricing Strategies
- Price discrimination
- Price differentiation
- Bundling and tie-in sales

Week 7: Strategic Decision-Making
- Game theory basics
- Oligopoly and competitive strategy
- Entry and exit decisions

Week 8: Case Studies and Group Project Presentations

Assessment:
- Class participation and engagement (20%)
- Weekly assignments and quizzes (40%)
- Group project and presentation (30%)
- Final exam (10%)

Teaching Methods:
- Lectures
- Case studies
- Group projects and presentations
- Interactive games and simulations

Learning Outcomes:

- Apply economic principles to managerial decision-making
- Analyse market structures and consumer behavior
- Develop critical thinking and problem-solving skills
- Understand strategic planning and pricing strategies

Textbook:

- "Managerial Economics" by Christopher R. Thomas and S. Charles Maurice

Additional Resources:

- Online economic simulations (e.g., EconPort)
- Business case studies (e.g., Harvard Business Review)

Course Title: Introduction to Sales and Marketing

Credits: 2 (28 Hours)

Course Description: This course introduces sales and marketing principles, focusing on customer engagement, relationship-building, and revenue growth..

Target Audience: Undergraduate students interested in entrepreneurship within engineering streams, business, or economics.

Prerequisites: None

Course Outline:

Week 1: Introduction to Sales and Marketing
- Definition and importance of sales and marketing
- Sales and marketing process

Week 2: Understanding Customer Needs
- Customer analysis and segmentation
- Buyer behaviour and decision-making

Week 3: Sales Strategies and Techniques
- Consultative selling
- Needs-based selling
- Handling objections

Week 4: Marketing Mix and Planning
- 4Ps (product, price, promotion, place)
- Marketing research and analytics

Week 5: Digital Marketing and Social Media
- Online marketing channels (email, search engine optimization)
- Social media marketing (Facebook, Twitter, Instagram)

Week 6: Branding and Positioning
- Brand identity and image
- Unique selling proposition (USP)

Week 7: Sales and Marketing Metrics
- Sales performance metrics (conversion rates, sales funnel)
- Marketing metrics (ROI, customer acquisition cost)

Week 8: Case Studies and Group Project Presentations

Assessment:
- Class participation and engagement (20%)
- Weekly assignments and quizzes (40%)
- Group project and presentation (30%)
- Final exam (10%)

Teaching Methods:
- Lectures
- Case studies
- Group projects and presentations
- Role-playing and sales simulations

Learning Outcomes:
- Understand sales and marketing principles
- Analyse customer needs and behaviour

- Develop sales strategies and techniques
- Apply marketing mix and planning
- Evaluate sales and marketing metrics

Textbook:

- "Sales and Marketing for Dummies" by Barbara Findlay Schenck

Additional Resources:

- Sales and marketing databases (HubSpot, Salesforce)
- Online marketing resources (Moz, Social Media Examiner)
- Sales and marketing case studies (Harvard Business Review)

Course Title: International Business

Credits: 2 (28 Hours)

Course Description: This course introduces the principles and practices of international business, exploring global market opportunities, cultural diversity, and cross-border transactions. Prepares students for careers in global markets.

Target Audience: Undergraduate students interested in entrepreneurship within engineering streams, business, or management.

Prerequisites: None

Course Outline:

Week 1: Introduction to International Business
- Globalization and international trade
- Benefits and risks of international business

Week 2: Global Market Environment
- Cultural differences and business etiquette
- Economic systems and political environments

Week 3: International Trade and Finance
- Trade theories and agreements (WTO, NAFTA)
- International payment methods and currency exchange

Week 4: Global Marketing Strategies
- Market research and segmentation
- Product adaptation and branding

Week 5: International Human Resource Management
- Cross-cultural management
- Global staffing and talent management

Week 6: International Logistics and Supply Chain
- Global sourcing and procurement
- Transportation and inventory management

Week 7: Global Business Ethics and Sustainability
- Corporate social responsibility
- Environmental and social sustainability

Week 8: Case Studies and Group Project Presentations

Assessment:
- Class participation and engagement (20%)
- Weekly assignments and quizzes (40%)
- Group project and presentation (30%)
- Final exam (10%)

Teaching Methods:
- Lectures
- Case studies
- Group projects and presentations
- Guest lectures from international business experts
- Interactive simulations and games

Learning Outcomes:
- Understand international business concepts and terminology
- Analyse global market environments and cultural differences

- Develop global marketing and HRM strategies
- Understand international trade and finance
- Apply ethical and sustainable business practices

Textbook:

- "International Business: The Challenges of Globalization" by John J. Wild and Kenneth L. Wild

Additional Resources:

- International business databases (IBISWorld, Statista)
- Global market research reports (Euromonitor, USAWorld, MECentre)
- Cultural intelligence resources (Cultural Intelligence Center)

Course Title: Strategic Management

Credits: 2 (28 Hours)

Course Description: This course introduces strategic management principles, focusing on business strategy, competitive analysis, and organizational performance.

Target Audience: Undergraduate students interested in entrepreneurship within engineering streams, business, or management.

Prerequisites: None

Course Outline:

Week 1: Introduction to Strategic Management
- Definition and importance of strategy
- Strategic management process

Week 2: External Analysis
- Industry analysis (5 Forces)
- Market analysis (STEEPLE)

Week 3: Internal Analysis
- Resource-based view (RBV)
- VRIO framework

Week 4: Business-Level Strategy
- Cost leadership
- Differentiation
- Focus strategy

Week 5: Corporate-Level Strategy
- Diversification
- Vertical integration
- Mergers and acquisitions

Week 6: Competitive Analysis
- Competitive dynamics
- Game theory

Week 7: Strategy Implementation
- Organizational design
- Change management

Week 8: Case Studies and Group Project Presentations

Assessment:
- Class participation and engagement (20%)
- Weekly assignments and quizzes (40%)
- Group project and presentation (30%)
- Final exam (10%)

Teaching Methods:
- Lectures
- Case studies
- Group projects and presentations
- Interactive simulations and games

Learning Outcomes:
- Understand strategic management principles
- Analyse external and internal environments

- Develop business and corporate-level strategies
- Evaluate competitive dynamics
- Implement strategic plans

Textbook:

- "Strategic Management: An Integrated Approach" by Charles W.L. Hill and Gareth R. Jones

Additional Resources:

- Strategic management databases (IBISWorld, Statista)
- Business case studies (Harvard Business Review)
- Strategy simulation tools (StrategyLab)

Course Title: Game Theory for Startups

Credits: 2 (28 Hours)

Course Description: This course provides a practical introduction to game theory for startup strategy, decision-making, and innovation.

Target Audience: Undergraduate students interested in entrepreneurship within engineering streams, business, economics, or computer science.

Prerequisites: None

Course Outline:

Week 1: Introduction to Game Theory
- Basic concepts: rationality, strategy, payoff
- Types of games: cooperative, non-cooperative, zero-sum

Week 2: Strategic Decision-Making
- Nash Equilibrium
- Prisoner's Dilemma
- Startup examples: competition, partnerships

Week 3: Competitive Strategy
- Game trees
- First-mover advantage
- Startup examples: market entry, pricing

Week 4: Cooperation and Network Effects
- Cooperative games
- Network effects
- Startup examples: partnerships, platforms

Week 5: Auctions and Bargaining
- Auction theory
- Bargaining games
- Startup examples: fundraising, acquisitions

Week 6: Information and Uncertainty
- Imperfect information
- Signaling
- Startup examples: marketing, fundraising

Week 7: Innovation and Disruption
- Game-changing strategies
- Disruptive innovation
- Startup examples: Uber, Airbnb

Week 8: Case Studies and Group Project Presentations

Assessment:
- Class participation and engagement (20%)
- Weekly assignments and quizzes (40%)
- Group project and presentation (30%)
- Final exam (10%)

Teaching Methods:
- Lectures
- Case studies
- Group projects and presentations
- Interactive games and simulations

Learning Outcomes:

- Apply game theory to startup strategy and decision-making
- Analyse competitive and cooperative scenarios
- Develop critical thinking and problem-solving skills
- Understand network effects and innovation strategies

Textbook:

- "Game Theory for Applied Economists" by Robert Gibbons

Additional Resources:

- Online game theory simulations (e.g., Game Theory Simulator)
- Startup case studies (e.g., Harvard Business Review)
- Guest lectures from startup founders and industry experts

Course Title: Business Plan Development

Credits: 2 (28 Hours)

Course Description: This course empowers students to develop well-structured business plans, preparing them for entrepreneurial ventures or intrapreneurial roles once they join corporate. The planning focuses on market analysis, financial projections, marketing strategies, and entrepreneurial leadership. It includes a live project.

Target Audience: Undergraduate students interested in entrepreneurship within engineering streams, business, or management.

Prerequisites: None

Course Outline:

Week 1: Introduction to Business Planning
- Overview of business planning process
- Entrepreneurial mindset

Week 2: Market Analysis
- Market research methods
- Target market identification
- Competitive analysis

Week 3: Company Description and Structure
- Business model canvas
- Organizational structure
- Management team

Week 4: Products/Services and Marketing Strategy
- Product/service development
- Marketing mix (4Ps)
- Sales strategy

Week 5: Financial Projections
- Revenue models
- Break-even analysis
- Cash flow statements

Week 6: Funding and Financing Options
- Bootstrapping vs. funding
- Venture capital, angel investors, crowdfunding
- Pitch deck development

Week 7: Operations and Management
- Supply chain management
- Human resources planning
- Risk management

Week 8: Final Business Plan Presentations and Feedback

Assessment:
- Class participation and engagement (20%)
- Weekly assignments and quizzes (40%)
- Business plan draft and final presentation (30%)
- Peer review and feedback (10%)

Teaching Methods:
- Lectures

- Case studies
- Group projects and presentations
- Business plan workshops and feedback sessions

Learning Outcomes:

- Develop comprehensive business plans
- Conduct market analysis and competitive research
- Create financial projections and funding strategies
- Design effective marketing and sales strategies
- Understand entrepreneurial leadership and operations management

Textbook:

- "Business Model Generation" by Alexander Osterwalder and Yves Pigneur
- "Entrepreneurship: Successfully Launching New Ventures" by Bruce R. Barringer and R. Duane Ireland

Additional Resources:

- Business planning templates (LivePlan, BizPlanBuilder)
- Market research databases (IBISWorld, Statista)
- Entrepreneurial resources (Small Business Administration, Entrepreneur Magazine)

Course Title: Introduction to Finance for Engineers

Credits: 2 (28 Hours)

Course Description: This course introduces engineering students to financial concepts, tools, and techniques to make informed decisions in engineering projects and management.

Target Audience: Undergraduate students interested in entrepreneurship within engineering streams, business, or management.

Prerequisites: None

Course Outline:

Week 1: Introduction to Finance
- Overview of finance
- Time value of money

Week 2: Financial Statements and Analysis
- Balance sheet, income statement, cash flow statement
- Ratio analysis and financial metrics

Week 3: Cost-Benefit Analysis and Break-Even
- Cost estimation and classification
- Break-even analysis and sensitivity

Week 4: Discounted Cash Flow and NPV
- Discounted cash flow (DCF) analysis
- Net present value (NPV) and internal rate of return (IRR)

Week 5: Risk and Return
- Risk assessment and mitigation
- Expected return and portfolio management

Week 6: Capital Budgeting
- Capital budgeting process
- Project evaluation and selection

Week 7: Engineering Economics
- Cost of capital and funding
- Life-cycle costing and maintenance

Week 8: Case Studies and Group Project Presentations

Assessment:
- Class participation and engagement (20%)
- Weekly assignments and quizzes (40%)
- Group project and presentation (30%)
- Final exam (10%)

Teaching Methods:
- Lectures
- Case studies
- Group projects and presentations
- Excel-based assignments and simulations

Learning Outcomes:
- Understand financial concepts and terminology
- Analyse financial statements and data
- Apply cost-benefit analysis and DCF
- Evaluate risk and return

- Develop capital budgeting skills

Textbook:

- "Engineering Economics" by Leland T. Blank and Anthony J. Tarquin

Additional Resources:

- Financial databases (Market finance sites, Bloomberg)
- Engineering economics resources (NSPE, ASME)
- Excel templates and financial models

Course Title: Launch Your Startup: A Hands-on Learning Experience (Capstone Project)

Credits: 8

- **Prerequisites:** None

Realizing your startup idea through *Launch Your Startup* is an immersive performance learning course where students turn their entrepreneurial aspirations into reality. Working in teams, students create and grow their own companies under the guidance of expert instructors and renowned mentors from the startup and venture capital ecosystem.

Through this experiential course, students bridge the gap between theory and practice, applying business and entrepreneurship concepts to real-world challenges. The focus is on launching viable companies that generate economic impact, create employment opportunities, and foster deep learning.

Key Features of the course:

- Team-based startup creation and growth
- Expert instructors and high-profile mentors
- Experiential learning in business and entrepreneurship
- Real-world application of theoretical concepts
- Potential for economic impact and employment generation

IDRP Aids:
- If student is unable to ideate and come up with a problem statement, but is interested to turn Entrepreneur, IDRP shall help with few industry problem statements for the student to choose from.
- Capstone project will go through the entire process: Ideation to Market Research to Market Validation to Prototype Build to Business Planning to Pitch Deck Preparation
- Students will have to achieve clearly defined milestones to be able to earn **proportionate credits**.
- Students shall work in groups (max of 3 members).

