Course number	: CS515
Course name	: Advanced Computer Science Practicum
Credits	: 2-0-2-3
Prerequisites	: UG level courses on Computer Networks, Operating Systems, Databases, Computer Organization and Compilers
Intended for	: MTech (CSE), MS, PhD
Distribution	: Discipline Core for MTech CSE, Elective for others

1. Preamble

The CSE MTech program envisions to train students in the skill-set required to work on large problems. Though courses such as operating systems, databases, networks, computer architecture and compilers are typically a part of all BTech CSE curriculums, students joining IIT Mandi after clearing GATE may have differing backgrounds when the practical experience with these courses is concerned. The objective of this course is to fill this gap and bring all MTech CSE students on the same page with respect to hands-on experience with some of the standard tools and techniques in designing computer systems, with a hope that this will help them perform well in all other practicum-based courses in future.

2. Course modules

1. Databases: Assignment on implementing an end-to-end system involving database backend, front-end web-based visualization and using database queries, joins, procedures, triggers, views, cursors, and transactions. Possible problems include:

[8 hours]

- Create a backend database application with a front-end web-based visualization that plots dependent variables of interest.
- Create a front-end website with the ability to register and authenticate users with respect to usernames and passwords; write a trigger on a table in a database that allows us to back-up the deleted entries in the table; write other complex queries involving joins on multiple tables.

2. Operating Systems: Assignments on understanding practical aspects of synchronization and implementing kernel modules in Linux. Modules allow extending the function of the kernel without rebooting the system. This assignment will introduce the students to implementing simple modules, their compilation and also tools for debugging kernels.

[8 hours]

Proposal for a New Course

3. Computer Networks: Assignments that involve socket programming, and protocol analysis by using network simulators. [8 hours]

4. Compilers and Architecture: Assignments that involve understanding the mapping of a high-level program down to a machine. The idea would be to familiarize students with the nuances of the connection between translating a high-level program and the machine on which it is executed. The assignments could be a subset of:
[16 hours]
- Writing a translator for converting programs written in a small programming language to an intermediate representation.
- Writing an interpreter for evaluating expressions/statements in a (small) programming language.
- Writing a register allocator for a given reference architecture.
- Writing an assembler that translates programs in an intermediate representation to the assembly for a given architecture.

5. Mini-project on designing scalable systems for different applications. This project will follow software engineering principles of project management, will emphasize scalable design principles, and involve performance analysis. [16 hours]

4. Reference books

1) Linux Device Drivers, Third Edition by Jonathan Corbet, Alessandro Rubini, and Greg Kroah-Hartman, O'Reilly Media, 2005.
2) Operating Systems: Three Easy Pieces by Remzi H. Arpaci-Dusseau and Andrea C. Arpaci-Dusseau, Arpaci-Dusseau Books, August, 2018 (Version 1.00).
3) Computer Networking: A Top-Down Approach,by Kurose and Ross, (6th edition), Pearson 2013.
4) Modern Compiler Implementation in Java, Second Edition, by Andrew W. Appel and Jens Palsberg, Cambridge University Press, 2002.
5) Elmasri, R., & Navathe, S. B. (2015). Fundamentals of Database Systems (7th edition). London, UK: Pearson Education, UK.

5. Similarity content declaration with existing courses:

Course Code	Course Name	Common Topic(s)	Overlap (%)
CS 207	Applied Database Practicum	Database queries, cursors, triggers, and stored procedures	20%
CS309	System Practicum	Scalable system design	20%
CS 310	Introduction to Communicating Distributed Processes	Certain concepts in operating systems and networking	15%
CS502	Compiler Design	IR generation, register allocation	10%

Proposal for a New Course

6. Justification of new course proposal if cumulative similarity content is >30%:

This course is proposed as a core course for MTech (CSE) and BTech students will not be allowed to credit the same. The overlapping contents are essentially with various BTech core courses, and thus the intended audience is completely different.