# 36TH MEETING OF THE SENATE
(9th October, 2013)
(6th November, 2013)

# MINUTES


**INTERNATIONAL INSTITUTE OF INFORMATIONTECHNOLOGY BANGALORE**
No. 26/C, Electronics City, Bangalore /Tele: +91 80 41407777 /Fax: 41407704

## 36.4 CONSIDERATION AND APPROVAL OF COURSE PROPOSAL

8 courses proposed were considered. It was informed that most of the courses being proposed were either taught as special topic courses or taught with similar contents under different title and being brought to the Senate for formal approvals. On consideration of the same following suggestions were made for consideration of the faculty:

a. As far as possible all the proposed courses may be decided before the announcement of the admission of the students in the academic year
b. Template of course proposal may contain the following columns:
    i. Any other faculty interested in teaching the proposed course
    ii. Level/s of the course
c. More details on the prerequisites may help the the students to make informed choices.

The proposed courses were approved as below:

| Course Proposed | Approval |
|---|---|
| 1. Cryptography- CS- Elective for M Tech- effective from Term II of 2013-14 by Prof. V N Muralidhara | Approved |
| 2. Design and Fabrication principles of Digital IC- NCE- Elective for M Tech- effective from Term II of 2013-14 by Prof. Madhav Rao | Approved |
| 3. Machine Learning- CS/DS- Elective for M Tech- effective from Term I of 2014-15 by Prof. G Srinivasaraghavan | Approved |
| 4. Theory of Computation-CS/DS- Elective for | Approved |

| | |
|---|---|
| M Tech- effective from Term II of 2013-14 by Prof. Meenakshi D' Souza and Prof. G Srinivasaraghavan | |
| 5. Introduction to Automated Formal Verification and Program Analysis- CS/SE-Elective for M Tech- effective from Term I of 2014-15 by Prof. Meenakshi D' Souza | Approved with the modification in the title. The New title would be "Automated Formal Verification" |
| 6. Data Analytics-DS- Elective for M Tech-effective from Term 1 of 2014-15 by Prof. Chandrashekar Ramanathan | Approved |
| 7. Introduction to Scientific Computation-CS-Elective for M Tech- effective from Term II of 2013-14 by Prof. Jaya Sreevalsan Nair | Approved and suggested to be offered as an Open Elective |
| 8. Wireless Sensor Networks – NCE- Elective for M Tech- effective from Term I of 2014-15 by Prof. Jyotsna Bapat | Approved |

## 36.5 CROSS LISTING OF EXISTING COURSES

Proposed cross listing of courses was approved.

## 36.6 ITEMS FOR REPORTING

Reported items were noted and following suggestions were made:-

a. Appropriate policy on internship of research students in Industrial Research unit or Government may be drafted and presented to the senate. (It was informed that the Committee on Research Degree Program Review committee would be considering this matter also.)

b. While deciding the internship in an Industrial and Government environment policy on IPR may be worked out to safeguard the interest of the institute.

c. Registration of Ms Sri Lakshmi Vadlamani, Student Enrolment No.PH2011005 may be terminated. The Senate noted that the

efforts of the the supervisor and the institute to persuade her to continue did not yield results.

**36.7 ANY OTHER ITEM WITH THE PERMISSION OF THE CHAIR.**

No other items were taken up

**36.8 SUPPLEMENTARY AGENDA ON COURSE PROPOSAL.**

The course proposal (Wireless Sensor Networks – NCE- Elective for M Tech- effective from Term I of 2014-15 by Prof. Jyotsna Bapat) submitted through the supplementary agenda was combined with Item no 36.3 and decided accordingly.

The meeting was concluded with thanks to the chair.

# 1 Course Proposal

| | |
|---|---|
| **Course Name** | ***Technology and Society: An introduction to the context of technology*** |
| Course Proposer Name(s) | Bidisha Chaudhuri |
| **Course Instructor** Name(s) | Bidisha Chaudhuri |
| **Course Type** *(Select one)*<br>*All course types except "Special Topics" go through the process for Academic Senate approval* | Regular Elective |
| Credits | 4 |
| Grading Scheme | 9-point scale (A,A-,B+,B,B-,C+,C,D,F) |
| Area of Specialization **(if applicable)** | Not Applicable (Offered in the stream of Social Sciences and Humanities) |
| **Semester** | Term: January 2014 |
| Pre-Requisites (**where** applicable, specify exact **course** names) | |
| NA | |

**Course Description**

Technology can be studied in its different dimension as it comprises of facts, artifacts, know-how, processes and last but not the least contexts. Understanding the context of technology turns our focus to the relationship between technology and society. The relationship between technology and society is an established field of studies within social sciences and humanities. There have been different disciplinary affiliations ranging from sociology of scientific knowledge to science and technology studies, from history of technology to philosophy of technology to analyze this relationship. All such scholastic approaches together touch upon wide-ranging and often complex facets of the relationship between technology and society. This introductory course, notwithstanding the depth and magnitude of this field of studies, provides a preliminary and cursory overview of all these approaches across three aspects of technology, such as production of technology, consumption/reception of technology and impact of technology. In analyzing these varied aspects of technology this course will serve a basic objective, that is, to demonstrate how the relationship between technology and society is mutually inclusive. Keeping its basic objective in mind this course is conceived to be covering three major

**37TH MEETING OF THE SENATE**
**(11th December, 2013)**

# MINUTES

**INTERNATIONAL INSTITUTE OF INFORMATIONTECHNOLOGY**
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**Annexure-I**

*(minutes of 37th Meeting of Senate)*

## 37.4 CONSIDERATION OF PROPOSAL ON THE MAXIMUM NUMBER OF RESEARCH STUDENTS TO BE ADMITTED

After detailed examination of the issue it was decided that the total area wise vacancy for the respective year shall be announced after assessing the maximum number of vacancy with each of the faculty in the institute. Further it was also decided to restrict the maximum number of Ph D students to be enrolled under the supervision of a faculty to 5 during a particular semester.

## 37.5 CONSIDERATION AND APPROVAL OF COURSE PROPOSAL

The proposed course was approved as below:

| Course Proposed | Approval |
|---|---|
| "Technology and Society: An introduction to the context of technology" to be offered to iMTech students from Term II of 2013-14 by Prof. Bidisha Chaudhuri | Approved as level 1 course. |

## 37.6 ITEMS FOR REPORTING

Reported items were noted and following suggestion were made:

(a) Late reporting by Mr Dibakar Das was concurred with as a special case. It was suggested that in future late registration in the semester should be avoided to the possible extent by deferring the registration to the subsequent semester.

(b) Grant of additional leave to Mr V Ranganathan, Student Enrolment No. PH2008903 up to July 2014 was approved on compassionate grounds.

# M.Tech. (SoC and EMS)
# Proposed Programme Curriculum

(Effective from academic year 2014-15)

International Institute of Information Technology
Bangalore – 560100
February 2014

The students will be given this information during the counseling done on joining the program and at the start of the program.

## 2 Overall M.Tech. Programme Structure

Tables 1 and 2 provide a summary of the credit distribution in the M.Tech. programme.

**Table 1: Overview of the curriculum**

| | |
|---|---|
| **Preparatory Term (3 weeks)** | **0 credits**<br>• C Programming<br>• Basic Electronics<br>• (PASS / FAIL mandatory courses) |
| **Semester 1 (15 weeks)** | **16 credits**<br>• 5 core courses<br>• (3 X 4 credits + 2 X 2 credits = 16 credits) |
| **Semester 2 (15 weeks)** | **18 credits**<br>• One SoC-EMS Theory Core and 4 Electives<br>• (1 X 2 credits + 4 X 4 credits = 18 credits) |
| **Summer (8 weeks)** | **9 credits**<br>• 2 Non-Technical Courses + *SoC-EMS Project + Seminar<br>• (2 X 3 credits + 1 X 2 credits + 1 X 1 credit= 9credits)<br>(*This is a SoC-EMS project with Industry Practices of 6 months duration – will start during 2nd semester and the final evaluation will be in summer semester) |
| **Semester 3 (15 weeks)** | **16 credits**<br>• 4 electives |
| **Semester 4 (26 weeks)** | **16 credits**<br>• Internship / Thesis |
| **Total** | **75 credits** |

**Table 2: Credit Distribution**

| Proposed | Credits | % |
|---|---|---|
| SoC-EMS Core Course Credits | 21 | 28 % |
| Non-Technical Core Course Credits | 6 | 8 % |
| Elective Course Credits | 32 | 43 % |
| Internship / Thesis Credits | 16 | 21 % |
| **Total credits requirement for M.Tech.** | **75** | |

## 3 Area of specializations

The proposed M.Tech. curriculum has two area of specializations:

- System on Chip (SoC)
- Embedded Systems (EMS)

## 4 Preparatory courses

Students entering the M.Tech in SoC and EMS. programme are expected to come with some prior knowledge of C programming and basic electronics. While we do not wish to conduct full-fledged C programming courses at the Masters level, we will provide an opportunity for the students to hone up their C programming skills in a structured way as part of the preparatory term. The preparatory term has one course in programming (covering C). The other course on basic electronics will provide an opportunity to get hands-on with circuits and simulation tools. The two courses will not carry any credit. However, they are mandatory courses with a PASS/FAIL grade. The Programming and Basic Electronics courses will be taught with emphasis on hands-on activities.

## 5 SoC and EMS Core courses

Core courses are those that all the students must take mandatorily. The complete list of core courses is provided in Table 1 below.

**Table 3: List of core SoC-EMS courses**

| Course | Credits | Semester |
|---|---|---|
| C Programming | 0 | Prep term |
| Basic Electronics | 0 | Prep term |
| Analysis and Design of Digital IC | 4 | Semester1 |
| Introduction to CMOS Fabrication and Analog CMOS VLSI Design | 4 | Semester 1 |
| MATHS for SoC and Embedded Systems | 4 | Semester 1 |
| Operating Systems | 2 | Semester 1 |
| Principles of Embedded systems | 2 | Semester 1 |
| SoC/EMS Engineering Practices (Theory) | 2 | Semester 2 |
| SoC/EMS Projects with Industry Practices (Project of 6 months) | 2 | Summer |
| Seminar | 1 | Summer |

Apart from courses in the Preparatory term, the core courses to be covered in the first regular semester are:

- Analysis and design of Digital IC (4 credits)
- Introduction to CMOS fabrication and Analog CMOS VLSI Design (4 credits)
- Mathematics for SoC and Embedded Systems (4 credits)
- Operating Systems (2 credits)
- Principles of Embedded Systems (2 credits)

The second semester will have one core course on the Theory of SoC and Embedded Systems Engineering Practices for two credits. This will be followed by a project course that lays emphasis on usage of industry-oriented software engineering practices for two credits. Details regarding objectives, syllabus and lecture hours for each course are provided in the Appendix-A. The elective courses are listed in Appendix B and C.

## 6 Summer Non-Technical Core courses

Table 2 below lists the courses to be offered in the summer semester. The total number of credits for non-technical summer courses is now 6.

**Table 4: List of Non-Technical Core courses**

| Course | Credits | Semester |
|---|---|---|
| Marketing and Strategy | 3 | Summer |
| Technical Communication | 3 | Summer |
| **Total Non-technical core credits** | **6** | |

## 7 Electives

The number of electives to be completed by each student is **eight**. Thus the total number of credits that can be accumulated through electives is now 32 credits. Each elective will be associated with one or more area of specializations with the exception of elective courses from the Information Technology and Society area of specialization, which will be offered as open electives. Each student is required to take at least **five** electives from his/her area of specialization. For example, for a student from the SoC area of specialization, all electives that are listed under EMS area of specialization (and not cross-listed under SoC) will be considered as open electives. The open electives also includes courses from IT-Society, Data-Science (DS), Software-Engineering (SE), Networking Communication and Embedded (NCE), Computer Science (CS) streams of our regular MTech in IT curriculum. The students from CS, DS, SE, and NCE can take these electives offered in this SoC and EMS MTech as open electives. Moreover, iMTech students can take these SoC and EMS MTech electives as their regular electives.

# Appendix-A Core courses

This section provides on the core courses in the curriculum. Each subsection below contains details regarding the various core courses. Elective courses topics will be given by the respective faculty member(s) and it will be processed through the Senate, before addition to the semester's elective.

## C Programming

Students come for M.Tech. from Electronics, Electrical and Instrumentation Engineering background. They all have varying levels of programming knowledge. Good programming skills are recognized as being a minimum pre-requisite for virtually all the courses (both core and elective). The goal of the preparatory term is to give a fast-track introduction to programming in C. The following table highlights some of the details of the course:

| | |
|---|---|
| **Course Name** | C Programming |
| **Term** | Preparatory Term |
| **Course Credits** | 0 |
| **Duration** | 3 weeks |
| **Session duration** | 3 hours per day |
| **Sessions per week** | 5 |
| **Total duration** | 45 hours (3 weeks) |

**Course Objectives:** At the end of the course, the students should have knowledge and competencies in the following areas:

- Preliminaries: Introduction to Unix, Introduction to case study
- Data types and expressions: Variables and data types, scope and lifetime of variables, type casting and data type conversion, expression evaluation
- Control flow: if statement, if-else statement, switch-case statement, for loop, while loop, do-while loop
- Functions: User-defined functions, parameters and return values, global variables, static variables, multi-file programming, introduction to built-in libraries (math.h, string.h, etc.).
- Recursion: Recursion for divide-and-conquer
- Arrays: 1-d array, 2-d array and n-d array
- Pointers: Pointers and addresses, pointers and function arguments,

pointers and arrays, address arithmetic, character pointers and functions

- More on pointers: Pointer arrays, pointers to pointers, pointers to functions
- Structures: Basics of structures, structures and functions, arrays of structures
- Advanced structures and unions: Pointers to structures, self-referential structures, unions, bit-fields
- File I/O: Text I/O sequential access, binary I/O sequential access, binary I/O random access

The course is divided into multiple **modules**. Each module is comprised of **lecture session**(s) and **lab session**(s). A session typically has a one hour lecture followed by a 2 hour lab every day.

## Basic Electronics

The goal of basic electronics preparatory course is to revise and clarify some of the basic concepts in electronics. This will help them to get more confidence in designing circuits and logics in regular semesters. Good electronic designing and trouble shooting skills are required throughout the MTech curriculum. The following table highlights some of the details of the course:

| | |
|---|---|
| **Course Name** | Basic Electronics |
| **Term** | Preparatory Term |
| **Course Credits** | 0 |
| **Duration** | 3 weeks |
| **Session duration** | 3 hours per day |
| **Sessions per week** | 5 |
| **Total duration** | 45 hours (3 weeks) |

**Course Objectives:** At the end of the course, the students should have knowledge and competencies in the following areas:

Kirchoffs law, electrical networks, linear circuits, thevenins and norton's theorm, phasor analysis, Design of RLC filter circuits, Rectifier circuits; Ebers-Moll model applied to basic transistor circuits, BJTs and MOSFETS amplifier circuits; FET switches. Feedback

and operational amplifiers and use of Opamps as amplifiers, peak detector, differentiators, integrator circuits, Schmitt Trigger and comparators. Active filters and Oscillators, TTL and CMOS, Digital gates using MOSFETs, Decoders, Multiplexers, Latch, Flip-Flops, Counters, Registers, Memories, Mealy and Moore machines, Finite State Machine, state equivalence and machine minimization; Algorithmic state machines, Analog/Digital Conversions, and Introduction to different microcontroller boards such as Arduino, Raspberry Pi, Galileo Development boards.

The course is divided into multiple **modules**. Each module is comprised of **lecture session**(s) and **lab session**(s). A session typically has a one hour lecture followed by a 2 hour lab every day.

## Mathematics for SoC-EMS

This course will cover aspects of mathematics relevant to the design and analysis of Embedded Systems, and Semiconductor devices. We will cover aspects of discrete mathematics relevant for the analysis of switching circuits such as Boolean Algebra, logics and predicate calculus needed for the analysis of real-time systems, graph theory that is relevant in the analysis of digital circuits and development of EDA tools, probability and statistics needed for reliability analysis, Monte-Carlo simulation, linear algebra and differential equations needed for circuit simulation, understanding CMOS technology and semiconductor physics. Computational geometry will also be included that is needed for robotics.

## SoC-EMS Practices

Knowledge of engineering principles is critical for any IT professional. Students can imbibe and internalize these principles only by applying in a systematic and structured manner. The SoC-EMS Engineering Practices course is designed with a greater emphasis on hands-on practices of well-known principles. The course is divided two components:

1. Lecture (about 25 hours) - January - April
2. Project (about 6 months duration) - January - June

While the lecture components will cover all essential concepts and principles, the project component will provide an opportunity for the students to actually put the principles into practice.

Assessments will be done based on about 70% weight given to the project and about 30% weight given to the lecture component, thus emphasizing the importance of practicing what is being taught.

The SoC-EMS Engineering Practices course is intended to be offered as a fifth course in the second semester because the value of the course is fully realized only when the project component happens in parallel. The following table highlights some of the details of the course:

| | |
|---|---|
| **Course Name** | SoC-EMS Engineering Practices |
| **Course Credits** | 4 |
| **Lectures hours per week** | 2 |
| **Total number of lecture hours (per semester)** | 25 |
| **Project Duration** | 6 Months |

**Course objectives:** At the end of the course, students should have knowledge and competencies in the following areas:

- Practical application of project management practices
- Awareness of practices for developing programs with emphasis on quality
- Defining project tasks with guidance from well-defined process models
- Effective management of source code and design
- Familiarity with basic terminology associated with process models and quality models.

**Lecture component (Theory part):** The lecture component will be conducted and completed with-in the second regular semester. The following modules are recommended to be covered as a part of the lectures to be taught in class:

- Process Models (3 hours): Waterfall model, spiral model, V model, iterative models, agile methods (Scrum, XP etc.)
- Project management principles (10 hours): Planning, estimation, monitoring, control, reporting
- Testing principles (6hours): Black box testing, white box testing, non-functional testing, testing metrics
- Configuration management (3 hours): Version control, project space and version space
- Software Quality (3 hours): Quality models (CMMi, Six Sigma, ISO), formal reviews, quality metrics (product quality and process quality)

Project Component: The course includes a mandatory project of "reasonable" complexity. The project is intended to be developed and delivered over a period of 6 months in a group of 4-6 students.

Students have to choose a project in one of the following areas:

- System on Chip (Analog, Digital, Process Simulation, Verification, Synthesis, etc)
- Embedded Systems (RTOS, Robotics, Integration of Multimodal Sensors, Prototype for various embedded systems applications such as safety, health, etc)

Every project necessarily needs a faculty member as a supervisor and mentor. Faculty members can announce and mentor projects one of the following two ways:

**Introduction to CMOS Fabrication and Analog CMOS VLSI Design (4 credits) (SBS/MR)**

**Prerequisites** : Kirchoff's Laws(KCL/KVL) in electrical networks, Linear circuits: Thevenin/Norton theorems, phasor analysis. Some exposure to diodes/transistors, biasing and small-signal analysis would be useful.

The course has two objectives :

(1) To introduce how CMOS VLSI chips are fabricated (VLSI Technology)
(2) To explain how robust Analog MOS circuits can be designed with a good understanding of VLSI Technology and MOS Device Physics.

The course will discuss how Analog circuits are designed in a VLSI chip environment starting from an understanding of VLSI technology and fabrication. The methodology adopted for teaching this course is to first provide a simple physical model of the MOSFET transistor that is capable of abstracting the essential electrical behavior of the device. Following this a related small-signal MOSFET model can be derived. The application of DC and small-signal analysis methods on MOSFET circuits can then follow.

The main aim of the course will be to learn how to analyze and build CMOS amplifiers that are the building blocks of almost all VLSI mixed-signal systems. At every stage of the course the students are expected to design, on paper as well as simulation, the circuits discussed in the class. An important aspect of the course will be a project in which the students are expected to design and simulate (using Spice simulator).

**Topics** : VLSI Technology, MOS device physics, Common-source, common-gate, common-drain, and cascode stages, Differential amplifiers, Current mirrors, Frequency response of amplifiers, One and two-stage operational amplifiers, Stability and frequency compensation, feedback networks, Memory design. The course will be useful for those interested in VLSI Design, mixed-signal embedded hardware and is a pre-requisite for RF Design.

**References:**

1. CMOS : Circuit Design, Layout and Simulation, R. Jacob Baker, IEEE Press/Wiley Student Edition.
2. Silicon VLSI Technology Fundamentals, Practice and Modeling, J. D. Plummer, M. D. Deal, and P. B. Griffin

**Analysis and design of CMOS Digital IC (4credit hours) (MR/SKR)**

**Topics :** The theory part includes CMOS logic, latches, flip-flops, CMOS layout, MOSFET Current and Capacitances, Non-ideal MOSFET Effects, CMOS Delay Estimation, Logical effort, Delay optimization and logical effort, Power estimation: Static and Dynamic, Low-Power design, Static Combinational CMOS Logic Styles, Dynamic Combination CMOS Logic styles, Static and Dynamic Sequential Circuit Design, Technology scaling, and VLSI design methodologies. The course will include a lab component of 1credit hour. This will require students to spend 2 hours per week in the lab. Lab component includes Schematic and layout of Digital circuits using Electric. HDL simulation, and synthesis using Mentographics/Xlinix/LASI digital design software tools. Digital prototyping on FPGA board is also included in this course.

**References:**

1. Neil H. E. Weste and David Harris, CMOS VLSI Design: A circuits and systems perspective, 4th edition, 2011.
2. Verilog HDL: A guide to digital design and synthesis, S. Palnikar, 1996.
3. J. Rabaey, A. Chandrakasan, and B. Nikolic, "Digital Integrated Circuits," 2nd Edition, Pearson Education, 2003.

## Operating Systems (2 credit hours) (PGP/SKR)

The following topics will be covered course in the first regular semester:

- System calls; user vs. super- user
- Processes and threads, process scheduling and management
- IPC (Inter Process Communication) and the dining philosophers problem
- Process synchronization using mutex locks, semaphores, monitors.
- Memory, virtual memory and memory management
- Message-passing vs. shared memory
- Kernel modules: changes and compilation

There will be no project component in this course.

**References:**

1. A. Silberschatz, P. Galvin, G. Gagne, Operating System Concepts, 9th Edition, John Wiley and Sons, 2012.

**Principles of Embedded Systems (2 Credits) (PGP) (Approved Elective)**

**Description :** Embedded systems are everywhere and most of the electronic systems have a computer inside to do smart things. Due to great demand a large number of embedded systems are available in the market from many companies. Purpose of this course is to help students understand existing architectures of embedded systems and also understand principles involved in designing such systems. In this course we will learn various issues involved in designing embedded systems meeting performance, cost, physical size and weight as well as power consumption requirements. Complex algorithms, user interface along with real time constraints make embedded computing more challenging than normal computing without any constraints on time. The course will start with Shannon's paper on switching circuits, simple microcontrollers and all the way up to distributed embedded computing. In order to understand the engineering aspects better each student or groups of students will study one of the existing platforms and share the knowledge with the class and also do some experiments on embedded systems. The course will involve more open discussions to discover principles and lab to get hands on experience in working with embedded systems.

**Topics :** Relay circuits, Boolean Algebra, Gates, Shift Registers, CPUs, Memories and Busses, Complex systems and Microprocessors, Embedded system design process and Formalisms for design, Instruction sets, CPU and Memory, I/O Devices and Component Interfacing, Program Design , Analysis and Optimization, Operating systems with real time constraints, Design Methodologies and Architecture design, Power management techniques for single and multi core systems, Multi core Embedded systems , Future Embedded systems, Neural computers and Quantum computers.

**References:**

1. Computers as Components, Principles of Embedded Computing System Design, Wayne Wolf, Princeton University, Morgan Kauffman Publishers, Academic Press, 2001
2. IEEE Papers as required
3. Published material from TI, ADI, ARM, Intel and others
4. Software Development for Embedded Multi-core Systems: A Practical Guide Using Embedded Intel Architecture, Max Domeika

# Annexure-II

*(MTech (SoC and EMS) Program Curriculum)*

**Mathematics for SoC and EMS (4 Credits) (SN/SKR/PGP/MDS) (New)**

Topics : This course will cover aspects of mathematics relevant to the design and analysis of Embedded Systems. We will cover aspects of discrete mathematics relevant for the analysis of switching circuits such as Boolean Algebra, logics and predicate calculus needed for the analysis of real-time systems, graph theory that is relevant in the analysis of digital circuits and development of EDA tools, probability and statistics needed for reliability analysis, Monte-Carlo simulation, linear algebra and differential equations needed for circuit simulation and computational geometry that is needed for robotics.

**References:**

1. Discrete Mathematics, Kenneth Rosen.
2. Introduction to Linear Algebra, Gilbert Strang.
3. Differential Equations, P. Blanchard, R.L. Devaney and G,R. Hall
4. Computational Geometry, Algorithms and Applications, M.de Berg, O. Cheong, M. van Kreveld, M. Overmars

# Appendix-B SoC Electives

## Testing and Design For Testability (4 Credits) (SKR/EF)

Introduction to Testing: VLSI Testing Process and Test Equipment; Test Economics and Product Quality; Fault Modeling; Test Methods : Logic and Fault Simulation; Testability Measures; Combinational Circuit Test Generation; Sequential Circuit Test Generation; Memory Test; DSP based Analog and Mixed Signal Test; Model based Analog and Mixed Signal Test; Delay Test; IDDQ Test; Design For Testability : Digital DFT and Scan Design; Built In Self Test; Boundary Scan Standard; Analog Test Bus Standard; System Test and Core Based Design; The Future of Testing.

**References:**

1. Essentials of Electronic Testing For Digital, Memory & Mixed –Signal VLSI Circuits - M. Bushnell & V. D. Agrawal

## High Level Synthesis and Optimization of Digital Circuits (4 Credits) (SKR)

**Topics** : Logic Optimization and Synthesis : Combinational Logic Synthesis : Two Level – Multiple input & multiple output minimization by exact and heuristic algorithms; Symbolic Minimization and Encoding Problems; Multiple level logic synthesis; Technology mapping; Sequential Logic Synthesis : State minimization, State assignment – For two level and multiple level logic, Multiple FSM realization, Hierarchical FSMs; High Level Synthesis : Architectural Models, Quality Measures, Design Description Languages, Register Transfer Components, Design Representation, Design Transformations, Design Partitioning, Scheduling, Allocation, Resource Sharing and Binding, Data-path and Control generation, Design Flow in High Level Synthesis, Design Methodologies in High Level Synthesis, System Level Design and Synthesis; Physical Design Synthesis : Placement, Floor-planning, Routing and Compaction.

**References:**

1. G. De Micheli, Synthesis and Optimization of Digital Circuits, McGraw Hill - International Students Edition.
2. D. D. Gajski, N. D. Dutt, A.C.H. Hu and S. Y. Lin, High Level Synthesis : Introduction to Chip and System Design, Kluwer Academic Publishers.
3. D. D. Gajski, F. Vahid, S. Narayan and J. Gong, Specification and Design of Embedded Systems, Prentice Hall.
4. Naveed Sherwani, Algorithms for VLSI Physical Design Automation, Kluwer Academics.

**Journals** : Design and Test of Computers, IEEE / ACM Journal on Electronic Design Automation / IEEE Transactions on CAD, Computers and VLSI Systems.

**Conference Proceedings** : International VLSI Conference/ Design Automation Conference (DAC) / International Conference on Computer Aided Design (ICCAD) / Asia South Pacific Design Automation Conference (ASPDAC).

## Functional Verification of SoC Designs (4 Credits) (SKR)

**Prerequisites :** Digital and Analog electronics

**References :**

1. Michael Huth & Mark Ryan, Logic in Computer Science : Modeling and Reasoning about Systems (Cambridge University Press), 2004
2. Kenneth L. McMillan, Symbolic Model Checking ( Kluwer Academic Publishers)
3. Thomas Kropf, Introduction to Formal Hardware Verification (Springer-Verlag).
4. Journals : Design and Test of Computers, IEEE / ACM Journal on Electronic Design Automation / IEEE Transactions on CAD, Computers and VLSI Systems.
5. Conference Proceedings : International VLSI Conference/ Design Automation Conference (DAC)/ International Conference on Computer Aided Design (ICCAD)/ Asia South Pacific Design Automation Conference (ASPDAC)/ Formal Methods in Computer Aided Design (FMCAD)/ Computer Aided Verification (CAV).

**Low Power CMOS VLSI Design (4 Credits) (SBS/SKR)**

The objective of the course is to understand the sources of power dissipation in VLSI SoCs and embedded-systems and techniques by which SoC power can be reduced at various abstraction levels from device(MOSFET transistor), through circuit and behavioral levels up to the software(operating system) level and the trade-offs between power dissipation, chip performance and area. Another objective of the course is to be able to re-design and optimize the circuits for low-power. Finally, software-hardware co-design aspects of low-power are considered.

**Topics :** Power Dissipation in Embedded Systems, MOS Transistor Device Physics (Revision), Physics of Power Dissipation in MOSFETs, Power Estimation: Probabilistic Techniques, glitching power, high-level estimation, Low Power Synthesis: Behavioral level,Logic Level, Circuit level, low-power in DSP,Low-Voltage Digital CMOS Circuits, Low-Power Memory Architectures, Power Management in SoCs, Adiabatic Computing, Software Design for Low Power: software power estimation & optimization.

**Lab** : Cadence or Mentor schematic design tools. Students are expected to optimize a given RTL description of a circuit into a low-power gate-level implementation possibly including clock-gating and other techniques.

**References:**

1. Low-Power CMOS VLSI Circuit Design: Kaushik Roy, Sharat C. Prasad
2. Digital Integrated Circuits: Jan Rabaey, Ananth Chandrakasan

**Static Timing Analysis and Digital Circuit Optimization (4 Credits) (SN)**

This course will cover all aspects of static timing analysis of digital circuits including concepts of delay of gates, delay modeling of gates including the Elmore delay model, logical effort, and more complicated models considering parasitic capacitance. Aspects of crosstalk analysis will also be covered. In regards to static timing analysis concepts such as PERT modeling, critical path extraction, multi-corner analysis, and early/late mode timing analysis will be discussed. In the second part of the course we examine how to optimize the delay of circuits keeping in mind area and power considerations. Convex programming formulations that allow tractable solutions to the problem will be presented. The course will

involve a semester-long software project on various aspects of static timing, delay calculation and circuit optimization.

**References:**

1. Timing, S. Sapatnekar, Kluwer Academic Publishers
2. Convex Optimization, S. Boyd and L. Vandenberghe, Cambridge University Press

**Circuit Simulation (4 Credits) (SN)**

Topics : This course presents the theoretical and practical aspects of the building a circuit simulator, such as SPICE. The theoretical basis of circuit simulation will require a good understanding of numerical algorithms, differential equations and Monte-Carlo analysis from a mathematical point of view. We will cover circuit formulation methods, nodal analysis, large-scale nonlinear DC and small signal AC analysis, moment matching, transient, inductive modeling and reduction techniques.

**References:**

Circuit Simulation, Farid Najm, Wiley Publishers

**Semiconductor Device Physics (4 Credits) (MR/SBS)**

**Topics :** The course will include energy band structure of semiconductor, electron statistic distribution, carrier transport principles, drift-diffusion model, semiconductor contact interface such as Schottky contact, ohmic contact, mobility models, MOS transistors, Metal Oxide silicon capacitors, BJTs non-ideal effects, p-n junctions for solar cells, leds and laser diodes. The course will also include GSS an open source tool in TCAD to simulate semiconductor devices.

**References:**

1. Pierret, Robert F. *Semiconductor Device Fundamentals*. Reading, MA: Addison Wesley, 1996.
2. Simon, M Sze. *Physics of Semiconductor Devices*. 3rd edition, Wiley.

**Deep Submicron Design Techniques (4 Credits) (SN)**

This course will provide a broad overview of the issues that arise in the design of deep-submicron VLSI chips.

Topics : MOS and CMOS transistor basics - Basic principles of MOS and CMOS transistors, field-effect principle, derivation of simple formulae; CMOS design styles - static CMOS designs, dynamic CMOS designs; Delay calculation - Delay calculation,

electrical wire models, timing issues in deep-submicron circuits; Abstraction levels - Abstraction levels including RTL level, logic gate level and library based design; DFT/Circuit Reliability and Signal integrity - Latch-up in CMOS circuits, electrostatic discharge, electro-migration; Layout and physical verification

**References:**

1. Digital Integrated Circuits, J.M. Rabaey, A. Chandrakasan and B. Nikolic, Prentice-Hall (Second Edition)
2. Research papers of the last few years from DAC, ICCAD.
3. Deep-submicron CMOS ICs, From Basics to ASICs, Harry Veendrick. ASICs, Kluwer Publishers

**Introduction to RF electronics (4 Credits) (MR/SBS)**

**Topics :** The course includes Resonant Circuits, impedance matching, transmission lines, Smith charts, Impedance matching, network representation, importance of S-parameters, Noise factors, Stability, Linearity, RF propagation and antenna-on-chip design, RF transceiver architecture. The course also includes design and simulation of RF transceivers using HFSS EDA tools, available in HiDES lab.

**References:**

1. Behzad Razavi, RF microelectronics,1998 Prentice Hall
2. Guillermo Gonzalez, Microwave Transistor Amplifiers Analysis and Design, 2nd edition.
3. Pozar, Microwave and RF design of wireless systems, 2000 Wiley.
4. Christopher Bowick, RF Circuit Design, 2nd edition.

**Introduction to Nanoelectronics and MEMS/NEMS devices(4 Credits) (MR)**

Topics : The course includes basics of Schrödinger equations, electrostatics, semiconductor band structures, simulation of band structures, nanoscale MOS capacitors, 3D Finfet transistors, CNT/Graphene based transistors, scattering theory for nanostructures, single electron transistors, MQCA logic gates, Accelerometers design by MEMS, Noise in MEMS, MEMS based Pressure sensor design, MEMS Packaging and assembly, Electronic interface design principles, Capacitive Position Sensing, Electrostatic actuators, modeling microresonators, Micromachining techniques for MEMS devices. The course will include open source simulation simulation tools such as SUPREM-IV - a stanford TCAD process simulator, SUGAR v3 - an open source Berkeley tool, and NEMO-3D - an open source Purdue tool.

**References:**

1. M. Lundstorm, and J. Guo, Nanoscale transistors: Device Physics, modeling and simulation, Spring 2005.
2. Ville Kaajakari, Practical MEMS: Design of Microsystems

# Appendix-C EMS Electives

## Inter Device Communications (4 Credits) (JP/MR)

**Pre-requisites** : Basic electronics, Digital Circuits, Awareness of communication protocols.

Communication between different devices happens in different ways. Various standards have been developed over time and these have evolved with usage. Some of these standards have become popular because of their inherent strengths and some because they of they ended up being widely used very early in their life. This course will cover the commonly used protocols. It also looks at certain specialized protocols to highlight how the usage scenarios mould the protocol. The course will be extremely hands on. The student will have to implement four of the protocols.

Topics : Introduction to inter-device communication; Class room exercise to specify requirements for a protocol and to design it; Specific standards/protocols including - RS-232/485, I2C, SPI, CAN, Bluetooth. Debugging of protocols using logic analyzer is also included in this course.

**References:**

1. Serial port complete edition by Jan Axelson
2. Particular specifications from each standards body.
3. Bluetooth Demystified, N J Muller, McGraw-Hill Telecom

## Digital Signal Processing (4 Credits) (PGP/DJ)

This is a first level graduate course on Digital Signal Processing principles and implementation. The course covers concepts of analog to digital conversion, LTI systems, frequency domain representation (Fourier and Z transform), Digital Filter Design, Filter realization, Fixed Point arithmetic/Quantization Effects. It will also examine application areas such as, OFDM, DCT for image/speech compression. Software implementation using Scilab and ADI Blackfin processor.

**References:**

1. Digital Signal Processing, Oppenheim and Schaefer, PHI.

## Principles of Intelligent Systems (4 Credits) (PGP)

It is believed that machines with computational intelligence will soon become ubiquitous and change the world forever. This course is a small step in that direction with focus on understanding principles and tools which help in designing intelligent machines. We call a system intelligent if it has the ability to - Develop behaviors based on input data from sensors or databases; Recognize complex patterns and make intelligent decisions; Understand and interact with the environment and learn to survive and improve its performance; Repair, reconfigure and adapt to new environments; Listen to other machines or humans and communicate well; Learn from the environment and develop

ability to navigate like humans. Purpose of this course is to work and learn along with students to get a good exposure to the area in terms of concepts and tools to design such systems in the future. The course will have assignments, paper presentation, an algorithm module implementation and project work. There will be no exams. Project work will involve development of an intelligent gadget or an intelligent software application.

**Topics :** Discussion on the nature of human intelligence : Behaviorism - All behavior is caused by external stimuli. Cognetivism - Brain designed as an Information processor. Constructivism - Learning is an active, constructive process. Humanism - Learning is a personal act to fulfill one's potential: Discussion on Artificial Intelligence and computational learning; Concepts and tools for creating artificially intelligent machines: Linear classifiers, Perceptrons and support vector machines, Data representation, Data clustering and vector quantization, Decision trees and Random forests, Adaptive Signal Processing techniques , Artificial Neural networks, Hidden Markov models and Belief Propagation Networks, Probably Approximately Correct learning, Evolutionary computing and Stochastic algorithms for learning; Some Examples where humans may have good competition : Doctorless health clinics, Pilot less aircraft design, Driverless cars, Data mining and prediction, Robot soccer and other games, Logical reasoning and knowledge representation, Research and discovery; New Honda Robot ASIMO 2012 : All features and behaviors ( http://www.youtube.com/watch?v=R8Ufe19r4cmg&feature=related )

**References:**

1. Artificial Intelligence, 3rd Edition, Patrick Henry Winston, Pearson Education, Fifth Indian Reprint, 2003
2. R. Rojas: Neural Networks, Springer-Verlag, Berlin, 1996
3. Journal Papers and other books as required

**Machine Learning (4 Credits) (GS)**

**Pre-requisites :** Mathematics for IT (Gen501), Algorithms (CS 501)

This course will cover a number of machine learning techniques with emphasis on the theory behind these techniques that affects the practice of these methods. There is also a significant amount of literature on the theory of learnability that attempts to answer questions like: What is learning — can we define learning precisely in a computational sense? How can learning be quantified — how well has an algorithm learnt something? Are there inherent limitations to machine learning — can we say some concepts are more easily learnable than others? The course will cover some amount of learnability theory, just enough to appreciate why these questions (and their answers) are important, how these lead to effective learning algorithms and how these provide benchmarks for effective learning. Also we would highlight how learnability is deeply related to information theory. This part will account for approximately 15–20% of the course. The presentation and coverage of topics will be biased towards breadth and not so much on depth. Similarly it will be biased towards sound conceptual understanding of the theoretical underpinnings and not so much on mathematical rigor. The treatment will be mathematically intense but hopefully not inaccessible. A notable omission from this course is Neural Networks and the other recent extensions of neural networks to Deep Learning Networks.

**Model Based Hardware-Software Co-Synthesis of Embedded Systems (4 Credits) (SKR)**

**Topics :** INTRODUCTION : System-Design Challenges, Abstraction Levels, Y-Chart, Processor-Level Behavioral Model , Processor-level structural model, Processor-level synthesis, System-Level Behavioral Model, System Structural Model, System Synthesis, System Design Methodology, Missing semantics , Model Algebra, System-Level Models, Platform Design, System Design Tools, Summary; SYSTEM DESIGN METHODOLOGIES : Bottom-up Methodology, Top-down Methodology, Meet-in-the-middle Methodology, Platform Methodology, FPGA Methodology ,System-level Synthesis, Processor Synthesis ,Summary; MODELING : Models of Computation, Process-Based Models , State-Based Models, System Design Languages , Netlists and Schematics , Hardware-Description Languages, System-Level Design Languages, System Modeling , Design Process , Abstraction Levels, Processor,Modeling, Application Layer, Operating System Layer, Hardware Abstraction Layer, Hardware Layer, Communication Modeling, Application Layer, Presentation Layer, Session Layer, Network Layer,

Transport Layer, Link Layer, Stream Layer , Media Access Layer, Protocol and Physical Layers, System Models , Specification Model, Network TLM, Protocol TLM, Bus Cycle-Accurate Model (BCAM), Cycle-Accurate Model (CAM), Summary; SYSTEM SYNTHESIS : System Design Trends, TLM Based Design, Automatic TLM Generation, Application Modeling, Platform Definition, Application to Platform Mapping , TLM Based Performance Estimation, TLM Semantics, Automatic Mapping, GSM Encoder Application, Application Profiling, Load Balancing Algorithm, Longest Processing Time Algorithm, Platform Synthesis, Component data models, Platform Generation Algorithm, Cycle Accurate Model Generation, Summary; SOFTWARE SYNTHESIS : Preliminaries, Target Languages for Embedded Systems, RTOS, Software Synthesis Overview, Example Input TLM, Target Architecture, Code Generation, Multi-Task Synthesis, RTOS-based Multi-Tasking, Interrupt-based Multi-Tasking, Internal Communication, External Communication , Data Formatting, Packetization, Synchronization, Media Access Control,

Startup Code, Binary Image Generation, Execution, Summary; EMBEDDED DESIGN PRACTICE: System Level Design Tools, Academic Tools , Commercial Tools , Outlook, Embedded Software Design Tools, Academic Tools, Commercial Tools, Outlook, Hardware Design Tools, Academic Tools, Commercial Tools , Outlook , Case Study, Embedded System Environment, Design Driver: MP3 Decoder, Results, Summary.

**References:**

1. Embedded System Design : Modeling, Synthesis and Verification – D. D. Gajski, S. Abdi, A. Gerstlauer, G. Schriner, Springer

**Principles of Multimedia & Multimedia Architectures (4 Credits) (JP)**

**Topics :** Introduction to Multimedia – What is multimedia? Multimedia & Hypermedia, WWW, Overview of Multimedia Software Tools; Multimedia Authoring & Tools – Multimedia Authoring, Some Useful Editing & Authoring Tools, VRML; Graphics and Image Data Representation – Data Types, Popular file formats; Color in Image and Video – Color Science, Color Models in Images & Video; Fundamental Concepts in Video –

Types of Video Signals, Analog Video, Digital Video; Basics in Audio – Digitzation of Sound, MIDI, Quantization and Transmission of Audio; Multimedia Data Compression – Lossless & Lossy Compression Algorithms, Image Compression Standards; Basic Video Compression Techniques – Compression based on Motion Compensation, H.261, H.263; MPEG Video Coding – MPEG – 1, MPEG – 2, MPEG – 4 (H.264), MPEG – 7, MPEG – 21; Basic Audeo Compression Techniques – ADPCM (G.726), Vocoders; MPEG Audio Compression – Psychoacoustics, MPEG audio – Strategy/Compression Algorithm/MPEG-2AAC, MPEG-4; Multimedia Communication and Retrieval – Computer & Multimedia Networks; Multimedia Network Communications and Applications, Wireless Networks, Content Based retrieval in Digital Libraries.

**References:**

1. Fundamentals of Multi-Media, Ze-Nian Li, Mark S. Drew, Prentice Hall of India.

**Real Time Systems -- Design, Analysis and Verification (4 Credits) (EF)**

**Topics :** Basic Real-Time Concepts; Hardware Considerations; Real Time Operating Systems; Software System Design; Programming Languages and the Software Production Process; Performance Analysis and Optimization; Engineering Considerations; Verification : Analysis of Non-Real-Time Systems; Real time Scheduling and Schedulability Analysis; Model Checking of Finite State Systems; Real Time Logic, Graph- Theoretic Analysis and Mode Chart; Timed Automata, Timed Petri-Nets; Process Algebra

**References:**

1. Real Time Systems Design and Analysis – Phillip A. Laplante, IEEE Press & John Wiley Student Edition.
2. Real Time Systems : Scheduling, Analysis and Verification – Albert M. K. Chang, IEEE Press & John Wiley Student Edition)

**Cyber Physical Systems (4 Credits) (SKR/EF)**

**Topics :** Introduction; Sensors & Actuators, Memory Architectures, Interfacing To Sensors & Actuators, Interrupts, Model Based Design, Modal Behaviour, Extended and Timed Automata, Composition of State Machines, Hierarchical State Machines, Multi-Tasking, Operating Systems, Scheduling Anamolies, Temporal Logic, Comparing State Machines, Reachability, Execution Time Analysis, Synchronous Reactive, Dataflow, and Security.

**References:**

1. Introduction to Embedded Systems – A Cyber-Physical Systems Approach, E. A. Lee and S. A. Seshia

**Embedded Software Verification and Validation (4 Credits) (MDS)**

Topics : Embedded software usually are a part of safety critical systems, and hence, there is extra focus and rigour in their verification and validation. Several certification and

safety standards emphasize usage of mathematical and formal techniques to verify such software. This course will deal with techniques for embedded software verification and validation. Relevant techniques from software testing and model checking will be covered from the side of functional testing and verification. From the side of non-functional validation, worst case execution analysis, schedulability analysis and safety assurance techniques will be covered.

**References**:

1. Embedded Systems and Software Validation, Abhik Roychoudhury, Morgan Kaufmann (Elsevier), 2009.
2. Principles of Model Checking, Christel Baier and Joost-Pieter Katoen, MIT Press, 2008.
3. Appropriate papers on the above topics.

**Design and Analysis of Embedded Software Systems (4 Credits) (SC)**

**Topics :** Software Architectures for Embedded Systems : AUTOSAR, RING, FRAME; Software Model Development Environment (SMDE) in Embedded System : Simulink, Esterel etc. based development platforms; Programming for Embedded System : Memory constrained environment performance; Testing of Embedded System Software : Performance, Response, Memory Requirements etc.

**References:**

1. Details will be provided by Prof. Sujit Chakraborty

**Computational Perception Using Multimodal Sensors (4 Credits) (DJ)**

Topics : This course will provide the students with a unified view on representations, statistical models, and algorithms to automatically analyze people's behavior in interactions, using single and multiple perceptual modalities (mainly vision and audio). The course will emphasize the comparison between modalities and the discussion of their individual and combined advantages, while introducing modeling tools for localization, segmentation, tracking, recognition, using probabilistic graphical models as the underlying formalism. The course trains students to record and analyze human-human and human-computer interactions using Kinect sensors, with interesting applications in gaming and behavioral training.

**References:**

1. Murphy, Kevin P. *Machine learning: a probabilistic perspective*. The MIT Press, 2012.
2. Bishop, Christopher M. "Pattern recognition and machine learning (information science and statistics)." (2007).

3. Thiran, Jean-Philippe, Ferran Marqus, and Herve Bourlard. *Multimodal Signal Processing: Theory and applications for human-computer interaction*. Academic Press, 2009.

**Wireless Sensor Networks (4 Credits) (JB / DD)**

**Pre-requisites** : Fundamentals of Computer Networking and Communication
Smart environments represent the next evolutionary development step in building, utilities, industrial, home, shipboard, and transportation systems automation. Like any sentient organism, the smart environment relies first and foremost on sensory data from the real world. Sensory data comes from multiple sensors of different modalities in distributed locations. Along with sensing abilities, the ability of the sensor nodes to communicate using radio channels enables the sensor nodes to form cooperative networks. In this course, we will explore the wireless sensor networks, the challenges involved, architectures, communication protocols and applications. It is expected that labs and a project will be a significant part of the course.

Topics : The Sensor Network Concept - Introduction: The vision of Smart Environment, Applications, How are sensor networks different?; Applications; Architecture - Hardware Components, Operating Systems and execution, Introduction to Cross-bow Motes family; Physical Layer : Wireless Channel and transceiver design considerations for WSN, Adaptability, Antenna considerations; Medium Access and Routing : Requirements and design constraints for MAC for WSN, Low-duty cycle protocols (S-MAC), IEEE 802.15.4 MAC protocol, Adhoc routing protocol (like AODV) and mesh networks; Localization and Positioning - Localization Approaches: Proximity, Trilaterations and Triangulation; Collaborative Signal Processing and Distributed Computation; Detection, estimation, classification problems; Energy-efficient distributed algorithms; Time Synchronization and Routing Protocols.

**References:**

1. Protocols and Architecture for Wireless Sensor Networks, Holger Karl and Andreas Willing, Wiley
2. Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, L. Guibas, Elsevier

**Embedded Systems for Healthcare (4 Credits) (SBS/RC/BG)**

In this course, we will look at how mobile communications have, and can be, leveraged as effective tools for strengthening health systems and improving health outcomes. We will concentrate our study on resource-limited settings, where the burden of infectious diseases is highest, where chronic conditions are often left unattended, where the healthcare infrastructure is least developed, and where the uptake of mobile communications is also the highest. We will start with the definitions and scope of ICT for healthcare (eHealth followed by mHealth), and then present a state of the art of mHealth as it stands today, with a special focus on the challenges that prevent its widespread adoption. In this landscape analysis, we will present the different areas and diseases where mHealth has been used, and illustrate these with concrete examples from

pilots and large-scale implementations. Thereafter, we will look at the technological aspects of mHealth implementations, introduced through our own conceptual framework. Special emphasis will be placed on the mHealth front-end user devices, the most widespread modes of communications (SMS being the primary focus) and mobile 'apps' which are gaining ground. The underlying open-source development approach will be presented, as well as the increasing use of cloud computing as the back-end of mHealth. The course will conclude with descriptions of the main technology platforms already is use for data collection, communication and aggregation: a study of these platforms is important since any new implementation necessarily has to interface with them and co-exist and co-operate. A case-study at the end of the course will allow the audience to design a new mHealth solution based on the expected health outcomes, the IT infrastructure available, and the local user profiles. This will allow the audience to appreciate the fact that hi-tech is not always necessary nor desirable, and that the primary focus of mHealth should be on the 'Health' part rather than the 'm' technology.

Course includes the following topics:
Communicable Diseases - bacteria, viruses and parasites, Non-Communicable disease - diabetes, cardiovascular, cancer, COPD, Nervous system-the processor and wiring, Circulatory System-the plumbing, Blood-fluid to fuel and protect, Lungs-the exhaust system, Overview of current laboratory techniques, Point of care diagnostic systems, Pulse oximetry-turning blood composition and pressure into electrical waveforms, Waveform analysis to derive respiration rate, Picking up and amplifying electrical activity of the heart, Waveform analysis to determine diagnosis, Standard invasive and noninvasive methods, Non invasive imaging technique, Microfluidic tools, Ongoing work to create chips for complex assays (PCR), Building better limb replacements-embedded systems arms and legs, The future-prosthetic eyes and mind controlling computers, The care process, its bottlenecks and challenges, The potential of mobile communications for healthcare, mHealth as a part of eHealth, Challenges faced by mHealth today, The economics of mHealth, Ethical and regulatory issues, Conceptual framework for implementation: Constituent elements of mHealth, Technical architectures of mHealth, Implementations, with illustrative cases, User front-end: devices and means of communication, Cloud computing as back-end: future frontier for storage and access. Major open-source platforms for the development and implementation of mHealth, Data collection and communication platforms, Data aggregation and analysis platforms, Interoperability issues, Electronics of implantable sensors and systems, Wireless transmission standards for biomedical systems, Body-area networks: potential and challenges, Instrumentation for measuring physiological parameters, Embedded electronics for data acquisition and storage, Signal processing: hardware and software, Wireless transmission and reception

**Image Signal Processing (4 Credits) (NS)**

This is already an approved elective course.

**Actuators, Sensors and Robotics (4 Credits) (GP)**

This is already an approved elective course.

iiit-b

**ANNEXURE-III**

*(Details of EMT)*

**Details of the Executive M.Tech Programme**

- The degree awarded by IIIT-B at the end of course completion will be M. Tech in Computer Science
- The entire course should normally last 3 years. On an exception basis, a student may be allowed to take 4 years to complete the course.
- Classes will take place on Fridays and Saturdays. If a particular Friday is a national holiday, compensation classes will be conducted within the following week on one of the weekdays. If a Saturday is a national holiday, the classes will take place on Sunday.
- All courses will be from those already approved by the Senate. If new courses have to be floated, they will obtain apriory approval of the Senate
- Total credits for course completion = 75 credits. ( minimum Requirement as per M/Tech manual)
- Project report deliverables should be agreed upon prior to the start of the semester between the student, the reporting manager and IIIT-B faculty expert. The project should not be directly related to the regular work being performed by the employee at SRI-B.
- If a student wishes to opt for an elective that is not offered within SRI-B premises but offered at IIIT-B campus, he can seek the permission of the reporting manager and take the elective by visiting the campus during class times.

**Course Structure:**

A tentative course structure is given below. This could be changed, by mutual consent, based on the availability of faculty, suggestion from SRI-B , demand from students etc.

**First long semester – 8 credits**

- Data Structures and Algorithms (4 credits)
- Mathematics for IT (4 credits)

**First Summer Semester – 4 credits**

- Systems (Operating and Database) – summer (4 credits)

**Second long semester - 11 credits**

- Software Architecture (4 credits)
- Networking (4 credits)
- Technical Writing (3 credits)

**Third long semester – 11 credits**

- Advanced Computer Architecture (4 credits)
- Elective 1 (4 credits)
- Strategic Marketing (3 credits)

**Second Summer Semester – 4 credits**

- Elective 2 (4 credits)

**Fourth long Semester – 12 credits**

- Elective 3 (4 credits)
- Elective 4 (4 credits)
- Interim Project report ( 4 credits)

Project report deliverables should be agreed upon prior to the start of the semester between the student, the reporting manager and IIIT-B faculty expert. The project should not be directly related to the regular work being performed by the employee at SRI-B.

**Fifth long semester – 12 credits**

- Elective 5 (4 credits)
- Elective 6 (4 credits)
- Interim Project report (4 credits)

**Sixth long semester – 13 credits**

- Elective 7 (4 credits)

- Final Project report ( 9 credits)

Electives (Offered on Friday evenings/Saturdays at SRI-B premises) – at least three of the following will be offered during the long semesters from the second year onwards

1. Software Testing
2. Advanced Algorithms
3. Cryptography
4. Computer Graphics
5. Image Processing
6. Data Analytics
7. Machine Learning
8. Wireless Access Networks
9. Advanced Computer Architecture
10. Design Techniques for CMOS integrated circuits
11. Real time Embedded Communication Systems
12. Multi Core Programming (Open MP, CL etc.)

# INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY BANGALORE

## (AGENDA AND NOTES)

## SENATE
## (40TH MEETING)

Venue: IIITB Board Room (Room 107)
Date: June 25, 2014
Time: 2:00PM

26/C , Electronics City, Hosur Road Bangalore 560100 Ph: 080 41407777

INTERNATIONAL INSTITUTE
OF INFORMATION TECHNOLOGY BANGALORE
26/C, Electronics City, Hosur Road, Bangalore 560 100
Phones: 080-28527627-635, 41407777; Fax: 080-28527636
Website :www.iiitb.ac.in

**Date: 19th June, 2014**

**Sub: 40TH MEETING OF THE SENATE OF INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY, BANGALORE BEING HELD ONJUNE 25, 2014 AT 2.00 PM**

Dear Sir/Madam,

In continuation to our earlier intimation I am to forward herewith the Agenda papers in respect of 40th Meeting of the Senate of IIITB, scheduled to be held on June 25, 2014 in the Board Room of IIIT B at 2.00 PM.

Kindly make it convenient to attend the meeting.

Thanking you,

Yours sincerely,

( A N Ramachandra)
Secretary to the Senate

## 1 Course Proposal

| | |
|---|---|
| **Course Name** | **History of Ideas** |
| Course Proposer Name(s) | Bidisha Chaudhuri |
| Course Instructor Name(s) | Bidisha Chaudhuri |
| **Course Type** *(Select one)*<br>*All course types except "Special Topics" go through the process for Academic Senate approval* | Regular Elective |
| **Credits** | 4 |
| Grading Scheme | 9-point scale (A,A-,B+,B,B-,C+,C,D,F) |
| **Area of Specialization (if applicable)** | Not Applicable (Offered in the stream of Social Sciences and Humanities) |
| **Semester** | Term: August- 2014 |
| **Pre-Requisites (where applicable, specify exact course names)** | |
| NA | |
| Course Description | |

History of Ideas or Intellectual History is an interdisciplinary field of studies traversing disciplinary boundaries of philosophy, history, natural science, art and literature, political and social thought and so on. As a field it focuses on how ideas about the world, either natural or social, have originated, evolved and transformed over time. The motive for studying such a wide field is to understand how knowledge is produced and disseminated and how epistemological lenses shape the way we perceive and conceptualize the world around us. There is no single way of talking about the history of ideas. Rather there are many ways in which this field can be approached depending on the area of focus, historical time frame, and spatial dimension and so on.

This course is in no way an exhaustive account of history of ideas. Rather it is a careful selection of intellectual trajectories and their representatives on the basis of the relevance and impact of their ideas across time and space and also their ability to permeate disciplinary boundaries and influence the overall pursuit of knowledge in social sciences. Thus, the focus of the course remains on the economic, political and social ideas growing out of different temporal and intellectual contexts that represent

INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY, BANGALORE

# 42nd Meeting of the Senate

## Agenda and Notes

**Date: October 8th, 2014**
**Time: 2.00 p.m.**
**Venue: IIITB Board Room**

26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777

**42.9 Consideration and approval of new Course proposal**

Prof V. Sridhar has submitted a course proposal titled "Dynamics of Information Networks" during the spring term for M.Tech Semester II as an Elective.

*(Annexure-III)*

**42.10. Conversion of registration from part-time to full-time PhD program**

Mr. D. Kumar (PH2013004) has applied for conversion from part-time to full-time registration starting January 2015 and has requested for institutional fellowship during his full-time registration. While his thesis supervisor and co-supervisor, Prof V. N. Muralidhara and Prof. G. Srinivasaraghavan have recommended for the conversion, there are no more unallocated institutional fellowships for the academic year 2014-15. Since the Institute does not have any full-time students without institutional fellowship or fellowships from sponsored research projects, the Senate may consider and decide on the matter.

**42.11 Announcement of call-for-applications for admissions to PhD program in January 2015**

As approved in the RDPC (Research Degree Programmes Committee) report, a separate call for admissions to Ph.D. programme in January 2015 has been made specifically for open positions in sponsored research projects, funded by DEITY and INCOIS (both under Government of India) and industry-supported fellowships, given by ABB. The Research Programme Admissions Committee (RPAC), chaired by Prof. Subir K. Roy, has been reconvened for the same. The admissions process will be the same as that was followed for admissions in August 2014, except that the principal investigators or contact persons involved in the fellowships will be application reviewers and members of the interview panels for applications pertaining to their respective project or fellowship, respectively.

**42.12 Any other item with the permission of the Chair**

# Course Proposal

| | |
|---|---|
| **Course Name** | **Dynamics of Information Networks** |
| **Course Proposer Name(s)** | V. Sridhar |
| **Course Instructor Name(s)** | V. Sridhar |
| **Course Type** *(Select one)*<br>*All course types except "Special Topics" go through the process for Academic Senate approval* | Special Topics (Level 2) |
| **Credits** | 4 |
| **Grading Scheme** | 9-point scale (A,A-,B+,B,B-,C+,C,D,F) |
| **Area of Specialization (if applicable)** | |
| **Semester** | Term: Jan-Apr Term<br>Year: 2015 |
| **Pre-Requisites (where applicable, specify exact course names)** | |

**Course Description**

Information networks of today encompass a wide variety including the traditional telecommunication networks which enable voice and data communication; peer-to-peer social networks that enable messaging and media transfers; content networks that enable linking of web pages and media; and machine-to-machine networks that transfer information across devices.

This course introduces the technology, business, economics and regulatory aspects of the above networks, reinforced with theories of graphs, network effects, externalities, game theory, and voting theory.

Students who complete this course should have a reasonable overview of the following:

1. The nature of networks, network size and dimensions, network properties of diverse types of networks.
2. The technology architecture and business models of traditional telecom networks, Internet, social and content networks; adoption in networks; diffusion in networks; critical mass formation.
3. The economics of networks, direct, indirect and cross-side network effects and pricing models of information services and platforms.
4. Deregulation and the evolution of the information networks industry, and public policy imperatives.
5. Convergence in services, devices and platforms and the associated new markets

Annexure - 1

# International Institute of Information Technology Bangalore

## 42nd Meeting of the Senate

## Minutes of the Meeting

**Date: October 8th, 2014**
**Time: 2:00pm**
**Venue: IIITB Board Room**

# Minutes
# of the
# 42nd Meeting of the senate
# International Institute of Information Technology, Bangalore

| Item No. | Item |
|---|---|
| 42.1 | Confirmation of the minutes of the 41st meeting of Senate |
| 42.2 | Action Taken Report |
| 42.3 | Consideration and Recommendation of the Student for Award of Ph D Degree |
| 42.4 | Consideration and Recommendation of the Student for Award of MS by Research Degree |
| 42.5 | Details of Students withdrawn from MTech course 2014 |
| 42.6 | Details of Students withdrawn from iMTech course 2014 |
| 42.7 | Items for Reporting |
| 42.8 | Consideration and Approval of MS Ph D Manual |
| 42.9 | Consideration and Approval of Course Proposal |
| 42.10 | Conversion of Registration from part - time to full - time on Ph.D. Programme |
| 42.11 | Announcement of Call-for-applications for admissions to Ph. D. Programme in January 2015 |
| 42.12 | Any other matter with the permission of the Chairman |

7. Item #7 in Section 7.5.4 and 7.1.4 in PhD and MSR manuals, respectively, has been replaced with the following text:
"7. The student shall make a minor revision of the accepted thesis using the feedback from the oral examination board and make a final submission of the thesis to the Registrar/ Staff Officer in the Office of Dean-Academics and the Institute Library.
8. Upon final submission of the thesis, the acceptance of thesis shall be reported to the Senate for recommendation of award of degree."

8. In Section 9, "SPECIAL ADMISSION TO PHD PROGRAMME" in MSR manual, the occurrences of the abbreviations has been removed and shorthand notations as mentioned in afore-mentioned #1 have been used.

**42.9 Consideration and approval of new Course proposal.**

The Senate has approved the course proposal based on the suggestions on the floor of the Senate. According to the suggestion of the Senate Prof V Sridhar has modified the title of the course to "Techno-Economics of Networks".

**42.10 Conversion of registration from part-time to full time PhD program.**

The Senate considered the request of converting the registration of the students from part time to full time and has opined that the student be permitted to get the conversion based on the availability of funds from any of the project grants to support the candidate on full time basis.

**42.11 Announcement of call-for-applications for admissions to PhD program in January 2015.**

The Senate has approved the decision of the Institute announcing the admissions for PhD programs for the 2nd term starting January 2015. The admissions of six candidates to be funded out on R & D projects / sponsored scholarships.

The meeting ended with thanks to the Chair.

ANNEXURE - II

# Course Proposal

| | |
|---|---|
| **Course Name** | Business Management for IT Engineers |
| **Course Proposer Name(s)** | Amit Prakash and V. Sridhar |
| **Course Instructor Name(s)** | Amit Prakash and V. Sridhar |
| **Course Type** | Core |
| **Credits** | 3 |
| **Grading Scheme** | 4-point scale (A,A-,B+,B,B-,C+,C,D,F) |
| **Area of Specialization (if applicable)**<br>**CS** – Computer Science<br>**DBIS** – Database and Information Systems<br>**NC&E** – Networking & Communication and Embedded Systems<br>**SE** – Software Engineering | NA |
| **Semester** | Summer Term (Term III) |
| **Pre-Requisites (where applicable, specify exact course names)** | |
| NA | |
| **Course Description** | |

A growing diversity in the workplace, internationalization of markets and advancements in technologies are transforming workplaces. Even in predominantly IT organizations, product development teams are required to operate in an increasingly multidisciplinary environment. Product development and market entry strategies are being jointly planned and discussed amongst IT engineers and their counterparts from various other functional areas that include marketing, strategy and finance. An appreciation of the overall business environment is helping successful IT organizations in engineering solutions of value to their target customers.

It is in this context of the changing nature of markets and workplaces that the proposed course seeks to equip IT engineers with useful business management tools that they can carry into their professional careers. The course seeks to provide the context for students to think critically about the IT industry. It is not a depth course but will introduce to the students selected concepts related to business management from the fields of operations, organizational behaviour, marketing, finance and strategy. The selection of topics and cases for the course has been done so as to be of relevance to IT engineers in problem solving and solution design in their prospective organizations.

The course will adopt a case method of teaching. This instruction format relies on the belief

ANNEXURE - III

# Course Proposal Template

| | |
|---|---|
| **Course Name** | **Data Visualization** |
| **Course Proposer Name(s)** | **Prof. Jaya Sreevalsan Nair** |
| **Course Instructor Name(s)** | **Prof. Jaya Sreevalsan Nair** |
| **Course Type** *(Select one)*<br>*"Special Topics" course proposals to be shared with faculty members for any feedback; but Academic Senate approval is not needed. All other course types need Academic Senate approval.* | Select one from the following:<br>• Core<br>• **Elective (Level 1)**<br>• Preparatory-Mandatory<br>• Preparatory-Optional<br>• Special Topics |
| **Credits** | **4** |
| **Grading Scheme** | • **4-point scale (A,A-,B+,B,B-,C+,C,D,F)**<br>• Satisfactory/Unsatisfactory (S / X) |
| **Area of Specialization (if applicable)**<br>**CS** – Computer Science<br>**DS** – Data Sciences<br>**NC&E** – Networking & Communication and Embedded Systems<br>**SE** – Software Engineering | (Choose at most two areas from the list)<br>**CS, DS** |
| **Semester** | **Term: I**<br>**Academic Year: 2015-16** |

**Pre-Requisites (where applicable, specify exact course names)**

Mathematics for IT (Gen501), Algorithms (CS 501).
Preferrably, Computer Graphics (CS606), Introduction to Scientific Computing (GEN601)..

**Course Description**

This course is an advanced graduate-level course which the goal is "to provide students with concepts and a firm mathematical foundation, as well as technical aspects of algorithms. Practical skills in programming visualization algorithms, using commercial visualization tools, and applying methodologies and techniques to new problems are taught in accompanying exercises." – this is as stated in "Curriculum for a Course on Scientific Visualization," a peer-reviewed paper by Rotard et. al in Proceedings of Eurographics/ACM Siggraph Workshop on Computer Graphics Education, in 2004, and can be extended to information visualization as well.

In short, this course will cover techniques and evaluation of visualizations of scientific and information data. This course content is categorized into 5 modules: Introduction, Scientific Visualization, Information Visualization, Visual Analytics and miscellaneous topics – modules 2-4 are the focus areas followed by the IEEE Visualization conference.

ANNEXURE - IV

# Course Proposal

| | |
|---|---|
| **Course Name** | **Computer Graphics** |
| **Course Proposer Name(s)** | **Prof. Jaya Sreevalsan Nair,**<br>**Prof. T. K. Srikanth** |
| **Course Instructor Name(s)** | **Prof. Jaya Sreevalsan Nair,**<br>**Prof. T. K. Srikanth** |
| Course Type *(Select one)*<br>*"Special Topics" course proposals to be shared with faculty members for any feedback; but Academic Senate approval is not needed. All other course types need Academic Senate approval.* | Select one from the following:<br>• Core<br>• **Elective (Level 1)**<br>• Preparatory-Mandatory<br>• Preparatory-Optional<br>• Special Topics |
| Credits | 4 |
| **Grading Scheme** | • **4-point scale (A,A-,B+,B,B-,C+,C,D,F)**<br>• Satisfactory/Unsatisfactory (S / X) |
| **Area of Specialization (if applicable)**<br>**CS** – Computer Science<br>**DS** – Data Sciences<br>**NC&E** – Networking & Communication and Embedded Systems<br>**SE** – Software Engineering | (Choose at most two areas from the list)<br>**CS** |
| **Semester** | Term: **II**<br>Academic Year: **2014-15** |
| **Pre-Requisites (where applicable, specify exact course names)** | |
| Good understanding of linear algebra and geometry<br>Good object oriented programming skills (C++ preferrable) | |
| **Course Description** | |
| This course, intended for M.Tech. 2nd semester and iMTech. 8th semester, is a revamped version of existing CS606 (we would like to retain the course number) in lines with the recently published (in 2012) AICTE syllabus for Computer Graphics for undergraduate teaching and our experiences with teaching both the basic and advanced computer graphics courses.<br><br>This course aims at introducing the theory and practice of computer graphics with an emphasis on applications programming. The following concepts will be covered:<br>• Theory and practice of computer graphics<br>• Graphics programming using C++ and OpenGL API<br>• Basics of Programmable Shaders and introduction to GLSL programming. | |

ANNEXURE - 5

# Course Proposal

| | |
|---|---|
| **Course Name** | **Advanced Computer Graphics** |
| **Course Proposer Name(s)** | **Prof. Jaya Sreevalsan Nair,**<br>**Prof. T. K. Srikanth** |
| **Course Instructor Name(s)** | **Prof. Jaya Sreevalsan Nair,**<br>**Prof. T. K. Srikanth** |
| **Course Type** *(Select one)*<br>*"Special Topics" course proposals to be shared with faculty members for any feedback; but Academic Senate approval is not needed. All other course types need Academic Senate approval.* | Select one from the following:<br>• Core<br>• **Elective (Level 2)**<br>• Preparatory-Mandatory<br>• Preparatory-Optional<br>• Special Topics |
| **Credits** | 4 |
| **Grading Scheme** | • **4-point scale (A,A-,B+,B,B-,C+,C,D,F)**<br>• Satisfactory/Unsatisfactory (S / X) |
| **Area of Specialization (if applicable)**<br>**CS** – Computer Science<br>**DS** – Data Sciences<br>NC&E – Networking & Communication and Embedded Systems<br>SE – Software Engineering | (Choose at most two areas from the list)<br>**CS** |
| **Semester** | Term: **I**<br>Academic Year: **2015-16** |
| **Pre-Requisites (where applicable, specify exact course names)** | |
| Computer Graphics (CS606)<br>Good understanding of linear algebra and geometry<br>Good object oriented programming skills (C++ preferrable) | |
| **Course Description** | |
| This course aims at ramping up on the theory and practice of computer graphics from what was covered in CS606 (Computer Graphics). The emphasis will continue to be on applications programming. Advanced topics in the following modules will be covered:<br>• Modeling<br>• Rendering<br>• Animation/Kinematics<br>• Real-time/Interactive Performance<br>The outcome of this course is to advance the knowledge and practice of graphics in students to requirements of a graduate level course. Hence while first half of the course can be broadly seen as building up the concepts required for the specific modules, the second half of the course ramps up students being able to read, understand and implement the state of | |

ANNEXURE VI
43.4.5

# Integrated M.Tech. Course Proposal

| | |
|---|---|
| **Course Name** | Introduction to Automata Theory & Computability |
| **Course Proposer Name(s)** | Shrisha Rao |
| **Course Instructor Name(s)** | Shrisha Rao |
| **Course Type** *(Select one)* | Select one from the following:<br>[ ] Core<br>[✔] Elective<br>[ ] Special Topics Elective*<br>* *All course types except "Special Topics Elective" go through the process for Academic Senate approval* |
| **Course Level** *(Select one)* | Select one from the following for elective courses:<br>[✔] Level 1 Elective<br>[ ] Level 2 Elective<br>[ ] N/A |
| **Course Category** *(Select one)* | Select one from the following:<br>[ ] Basic Sciences<br>[ ] Common Core (IT)<br>[✔] Elective<br>[ ] Engineering Science and Skills<br>[ ] HSS/M<br>[ ] IT in Domains<br>[ ] Miscellaneous |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | |
| **Grading Scheme** | Select one from the following:<br>[✔] 4-point scale (A,A-,B+,B,B-,C+,C,D,F)<br>[ ] Satisfactory/Unsatisfactory (S / X) |
| **Semester** | Term: II<br>Academic Year: 2015 and later |
| **Pre-Requisites (where applicable, specify exact course names)** | |
| Knowledge of discrete mathematics (especially proofs, basic set theory, and elementary logic), and possibly one programming language as well. | |

| | |
|---|---|
| Template Version Number | 1.2 |
| Template update date | 26 June 2013 |

ANNEXURE VII
43.4.6

# Integrated M.Tech. Course Proposal Template

| | |
|---|---|
| **Course Name** | Technical Communication |
| **Course Proposer Name(s)** | Prof. Chandrashekar R |
| **Course Instructor Name(s)** | Valsala Rajasankaran |
| **Course Type** *(Select one)* | Select one from the following:<br>X Core<br>Elective<br>Special Topics Elective*<br>** All course types except "Special Topics Elective" go through the process for Academic Senate approval* |
| **Course Level** *(Select one)* | Select one from the following for elective courses:<br>Level 1 Elective<br>Level 2 Elective<br>X N/A |
| **Course Category** *(Select one)* | Select one from the following:<br>Basic Sciences<br>Common Core (IT)<br>Elective<br>Engineering Science and Skills<br>HSS/M<br>IT in Domains<br>X Miscellaneous |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | |
| **Grading Scheme** | **Select one from the following:**<br>X 4-point scale (A,A-,B+,B,B-,C+,C,D,F)<br>Satisfactory/Unsatisfactory (S / X) |
| **Semester** | Term: II (Jan)<br>Academic Year: 2014-15 |
| **Pre-Requisites (where applicable, specify exact course names)** | |
| NONE | |
| **Course Description** | |

ANNEXURE VIII
43.4.7

# Course Proposal Template

| | |
|---|---|
| **Course Name** | Network Science for the Web |
| **Course Proposer Name(s)** | Srinath Srinivasa |
| **Course Instructor Name(s)** | Srinath Srinivasa |
| **Course Type** *(Select one)*<br>*All course types except "Special Topics" go through the process for Academic Senate approval* | Select one from the following:<br>• Elective |
| **Credits** | 4 |
| **Grading Scheme** | • IIIT-B default scale (A,A-,B+,B,B-,C+,C,D,F) |
| **Area of Specialization (if applicable)**<br>CS – Computer Science<br>DS – Data Science<br>ES – Embedded Systems<br>ITS – IT & Society<br>NC – Networking and Communication<br>SE – Software Engineering | (Choose at most two areas from the list)<br>DS |
| **Semester** | Term: (Spring)<br>Year: 2015 |

**Pre-Requisites (where applicable, specify exact course names)**

**Essential background knowledge in Graph Theory, Algorithms and Database management.**

**Course Description**

The Web is the largest participatory information network in the history of humankind. The web represents a global "socio-cognitive space" that actively augments and molds our cognitive abilities. An entire new discipline called "Web Science" has emerged in recent times in order to understand how the web is shaping the world. This course introduces the student to essential topics from Cognitive Psychology as well as Network Sciences to help equip them towards contributing to this growing field of Web Science.

**Course Content**

**Mandate 1: Information and Cognition**

Cognitive models of the following phenomena:

- Transactional analysis
- Attention, distraction and their properties
- Acquaintance, trust and entrenchment effects
- Affinity, animosity and network stability (Cartwright-Harary Theorem)
- Group psychology, conformance and bystander effects
- Persuasion and advocacy
- Brands, social identity and group affiliation

**Suggested Readings**

- Easley, D., Kleinberg, J. Networks, Crowds, and Markets: Reasoning About a Highly

ANNEXURE IX
43 4.8

# Course Proposal

| | |
|---|---|
| **Course Name** | Introduction to nonlinear dynamical systems |
| **Course Proposer Name(s)** | B. Ashok |
| **Course Instructor Name(s)** | B. Ashok |
| **Course Type** *(Select one)*<br>*All course types except "Special Topics" go through the process for Academic Senate approval* | Elective |
| **Credits** | 4 credits |
| **Grading Scheme** | A, A-, B+, B, C+, C, D, F |
| **Area of Specialization (if applicable)**<br>CS – Computer Science<br>DBIS – Database and Information Systems<br>ES – Embedded Systems<br>ITS – IT & Society<br>NC – Networking and Communication<br>SE – Software Engineering | Basic Sciences / Mathematics |
| **Semester** | Term: Spring (January - May), 2015 |

**Pre-Requisites (where applicable, specify exact course names)**

A knowledge of basic mathematics (linear algebra) is presupposed.

**Course Description**

The course will introduce the language and basic tools of nonlinear dynamics through a mixture of lectures, computer-lab work, assignments & self-reading. Everyday examples and applications showing nonlinear behaviour will be discussed.
The subject has applications over diverse fields, ranging from the behaviour of various physical, mechanical and biological systems, chemical reactions and fluid systems to climate systems, ecological systems & economics, etc.
The aim of the course is to give the fundamental background necessary for students to apply the methods of dynamical systems to areas of their interest, and is open to all students (iMTech / MTech / MS / PhD).

**Course Content**

Structure of nonlinear ODEs, linear stability analysis. Zero & one dimensional attractors- limit cycles, higher dimensional attractors. Poincare-Bendixson theorem. Null-cline method for the analysis of limit cycles, relaxation oscillations, slow and fast manifolds, introduction to local bifurcations: saddle-node, transcritical, pitchfork, Andronov-Hopf; bifurcation diagrams, integrable systems: KAM theorem, Poincare surface of section, Hamiltonian systems, Lyapunov functions & direct method for stability, dissipative systems: Lorenz equations, chaos, Lyapunov exponents, strange attractors; fractals & their dimensions, discrete dynamical systems: simple maps, cycles, cobweb diagrams, logistic map, period doubling, Feigenbaum constants, universality.

Agenda

# INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY, BANGALORE

## 43rd Meeting of the Senate

## Agenda and Notes

**Date: December 10th, 2014**
**Time: 2.00 p.m.**
**Venue: IIITB Board Room**

26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777

Agenda

INTERNATIONAL INSTITUTE
OF INFORMATION TECHNOLOGY BANGALORE
26/C, Electronics City, Hosur Road, Bangalore 560 100
Phones: 080-28527627-635, 41407777; Fax: 080-28527636
Website :www.iiitb.ac.in

Date: 9th December, 2014

**Sub: 43rd meeting of the Senate of International Institute of Information technology, Bangalore being held on December 10th, 2014 at 2.00 pm**

Dear Sir/Madam,

Please find herewith attached agenda papers and notes for the 43rd Meeting of the Senate of IIITB, being held on December 10th, 2014 in the Board Room of IIIT B at 2.00 PM.

Kindly make it convenient to attend the meeting.

Thanking you,

Yours sincerely,

(V S Prakash)
Secretary to the Senate

| | | |
|---|---|---|
| 42.9 | Consideration and Approval of Course Proposal of Professor V. Sridhar titled "Dynamics of Information Networks" during the spring term for M.Tech Semester II as an Elective. | Approved |
| 42.10 | Conversion of Registration from part - time to full - time on Ph.D. Programme of Mr. D. Kumar (PH2013004) | It will be considered the moment PhD fellowship is awarded to the student. |
| 42.11 | Announcement of Call-for-applications for admissions to Ph. D. Programme in January 2015 | Approved |

**43.3 Consideration and recommendation of the Student(s) for award of PhD degree.**

| | |
|---|---|
| Sl No | 1 |
| Roll No. | PH2008901 |
| Student Name | Sasirekha G V K |
| Thesis Title | "Bayesian Risk Management in Emergency Cognitive Radio Adhoc Networks" |
| Supervisor | Prof Jyotsna Bapat |
| Degree | PhD |
| Date of the Defense | October 17, 2014 |

| | |
|---|---|
| Sl No | 2 |
| Roll No. | Subramanian N |
| Student Name | PH2006904 |
| Thesis Title | "Threat aware intrusion Detection Approach for Dynamic Network Environments" |
| Supervisor | Prof. Shrisha Rao |
| Degree | PhD |
| Date of the Defense | November 19, 2014 |

**43.4. Consideration and Approval of Course Proposal**

**43.4.1** Core course on 'Business Management for IT Engineers' submitted by Prof Amit Prakash and Prof V Sridhar, is intended to replace the existing 'Strategy and

Marketing' core course offered to MTech students during Summer Term(Term III). The course proposal is placed at Annexure II of the Agenda.

**43.4.2** Course on 'Data Visualization' submitted by Prof Jaya Sreevalsan Nair to be offered to MTech 3rd Semister and iMtech 9th Semister during Academic Year 2015-16 (Term I) as Elective Level 1. The course proposal is placed at Annexure III of the Agenda.

**43.4.3** Course on 'Computer Graphics' submitted by Prof Jaya Sreevalsan Nair and Prof T K Srikanth to MTech 2nd Semister and iMTech 8th Semister during Academic Year 2014-15 (Term II) as Elective Level 1. The course proposal is placed at Annexure IV of the Agenda

**43.4.4.** Course on 'Advanced Computer Graphics' submitted by Prof Jaya Sreevalsan Nair and Prof T K Srikanth to be offered to MTech 3rd Semister and iMTech 9th Semister during Academic Year 2015-16 (Term I) as Elective Level 2. The course proposal is placed at Annexure V of the Agenda.

**43.4.5.** Course on 'Introduction to Automata Theory & Compatability' submitted by Prof Shrisha Rao to be offered to iMTech during Academic Year 2015 and later (Term II) as Elective Level 1. The course proposal is placed at Annexure VI of the Agenda.

**43.4.6.** Course on 'Technical Communication' submitted by Prof Chandrashekar R to be offered to MTech during the Academic year 2014-15 (Term II). The course proposal is placed at Annexure VII of the Agenda.

**43.4.7.** Course on 'Network Science for the Web' submitted by Prof Srinath Srinivasa to be offered during Academic year 2015 (Term:Spring). The course proposal is placed at Annexure VIII of the Agenda.

**43.4.8.** Course Proposal on 'Introduction to nonlinear dynamical systems' submitted by Prof B. Ashok to be offered to to be offered during Academic year 2015 (Term:Spring). The course proposal is placed at Annexure IX of the Agenda.

**43.5 Items for reporting**

**43.5.1** The following PhD student(s) has completed her Academic Milestone(s) as detailed below:

| Sl No | 1 |
|---|---|
| Roll No. | PH2011002 |
| Student Name | Ms. Yogalakshmi J |
| Supervisor | Prof Ramanathan Chandrashekar |
| Thesis title | Clustering Mixed data types and Cluster Analysis correlated variables |

ANNEXURE - I

# International Institute of Information Technology Bangalore

## 44th Meeting of the Senate

## Minutes of the Meeting

Date: February 11, 2015
Time: 2:00pm
Venue: IIITB Board Room

26/C, Electronics City, Hosur Road Bangalore 560100 Phone: 080 41407777

## Category-wise Course List

This section contains the course list organized as per the course categories given earlier. **Table 2** and **Table 3** contain a summary of the overall distribution of courses across the various categories.

| Computer Science and Engineering | | | |
|---|---|---|---|
| **Course Categories** | **Number of Courses** | **Total Credits** | **Percent** |
| Basic Engineering Science / Skills | 4 | 16 | 8% |
| CSE Core | 9 | 26 | 13% |
| Elective | 13 | 52 | 26% |
| Engineering Core | 7 | 18 | 9% |
| HSS/M Core | 2 | 8 | 4% |
| HSS/M Elective | 2 | 8 | 4% |
| Masters Project | 2 | 40 | 20% |
| Mathematics and Basic Sciences | 10 | 28 | 14% |
| Others | 4 | 4 | 2% |
| **Grand Total** | **53** | **200** | |

**Table 2: CSE Course Distribution**

| Electronics and Communication Engineering | | | |
|---|---|---|---|
| **Course Categories** | **Number of Courses** | **Total Credits** | **Percent** |
| Basic Engineering Science / Skills | 4 | 16 | 8% |
| ECE Core | 15 | 34 | 17% |
| Elective | 11 | 44 | 22% |
| Engineering Core | 7 | 18 | 9% |
| HSS/M Core | 2 | 8 | 4% |
| HSS/M Elective | 2 | 8 | 4% |
| Masters Project | 2 | 40 | 20% |
| Mathematics and Basic Sciences | 10 | 28 | 14% |
| Others | 4 | 4 | 2% |
| **Grand Total** | **57** | **200** | |

**Table 3: ECE Course Distribution**

Comments

Among the course categories, all the categories except "CSE Core" and "ECE Co are common to both CSE and ECE branches. The total count of courses is higher ECE (compared to CSE) because of the greater number of courses that have a component, which is counted as a separate course.

Basic Engineering Science and Skills

The list of courses under the Basic Engineering Science and Skills is given in Tabl below.

| Course Name | Credits | L:T:P:C |
|---|---|---|
| Programming I | 4 | 2:0:4:4 |
| Digital Design | 4 | 3:1:0:4 |
| Programming II | 4 | 3:0:2:4 |
| Signals and Systems | 4 | 3:1:0:4 |

Table 4: Basic Engineering Sciences / Skills

Comments

When compared to the existing iMTech (IT) curriculum, Digital Design course replacing the Basic Electronics course. The latter is redesigned as an exclusive cou for the ECE stream while the Digital Design course is for both CSE and ECE streams.

Mathematics and Basic Sciences

The list of courses under the Mathematics and Basic Sciences category is listed Table 5 below. All these courses are Level 1 courses.

| Course Name | Credits | L:T:P:C |
|---|---|---|
| Chemistry | 4 | 3:0:2:4 |
| Mathematics - 1 | 4 | 3:1:0:4 |
| Mathematics - 2 | 4 | 3:1:0:4 |
| Mathematics - 3 | 4 | 3:1:0:4 |
| Physics - 1 | 4 | 3:0:2:4 |
| Mathematics - 4 | 4 | 3:1:0:4 |
| Physics - 2 | 4 | 3:0:2:4 |

Table 5: Mathematics and Basic Sciences

Comments

The existing iMTech (IT) curriculum includes a course on Biosciences. The Bioscience course and Chemistry course used to be taught by external faculty under an arrangement for a period of 3 years (starting from 2012) with National College. With this arrangement coming to an end this year, Biosciences will no longer be offered as a choice. Instead, all students will do Chemistry course to be taught by IIITB faculty in IIITB campus itself.

The syllabi for the four Mathematics courses has been reviewed and revamped keeping in mind the needs of the CSE, ECE and Physics courses.

Humanities and Social Sciences / Management (HSS/M)

The courses listed in **Table 6** below are the core courses under the HSS/M category. All these courses are Level 1 courses.

| Course Name | Credits | L:T:P:C |
|---|---|---|
| Economics | 4 | 3:1:0:4 |
| History of Ideas | 4 | 4:0:0:4 |

**Table 6: HSS/M**

Comments

In iMTech (IT) curriculum, all the four HSS/M courses were listed under electives. In the new curriculum, this is being changed where two courses are core and two are electives.

Other General Core Courses

**Table 7** below contains other courses that are more general in nature. All these courses are Level 1 courses.

| Course Name | Credits | L:T:P:C |
|---|---|---|
| Physical Education 1 | 0 | 0:0:0:0 |
| English | 2 | 2:0:0:2 |
| Physical Education 2 | 0 | 0:0:0:0 |
| Technical Communication | 2 | 2:0:0:2 |

**Table 7: Other courses**

Comments

In the iMTech (IT) curriculum, a course titled Introduction to Profession was introduced as a 2 credit course. The course was primarily driven by guest lectures by eminent people in the information technology area. In its current form of delivery, the course is hard to be justified as a 2-credit graded course. The committee is of the view that the course is more relevant in the much wider "Information Technology" programme compared to more traditional CSE and ECE programmes. Hence the course is being discontinued in the CSE and ECE programmes.

Engineering Core

The courses under the Engineering Core category are mandatory for both CSE stream and ECE stream students. The list of courses is given in **Table 8** below. All these courses are Level 1 courses.

| Engineering Core Course Name | Credits | L:T:P:C |
|---|---|---|
| Data Structures and Algorithms | 6 | 3:1:4:6 |
| Computer Networks | 4 | 3:1:0:4 |
| Computer Architecture | 4 | 3:0:2:4 |
| Operating Systems | 4 | 3:0:2:4 |

**Table 8: Engineering Core**

Comments

Compared to the existing curriculum, the course "IT Infrastructure" is no longer a core course. The course titled "Digital Communication" is not a core course for CSE stream.

CSE Core

**Table 9** below contains the list of courses that are mandatory for the CSE stream. All these courses are Level 1 courses.

| CSE Core Course Name | Credits | L:T:P:C |
|---|---|---|
| Discrete Mathematics | 4 | 3:1:0:4 |
| Design and Analysis of Algorithms | 4 | 3:1:0:4 |
| Formal Languages and Automata Theory | 4 | 3:1:0:4 |
| Software Engineering | 4 | 3:0:2:3 |
| Computer Graphics | 3 | 3:0:0:3 |
| Database Systems | 4 | 3:0:2:4 |

| | | |
|---|---|---|
| Programming Languages | 3 | 3:0:0:3 |

Table 9: CSE Core

Comments

A new core course titled "Formal Languages and Automata Theory" is being introduced for the stream.

ECE Core

Table 10 below contains the list of core courses in ECE. All these courses are Level 1 courses.

| ECE Core Course Name | Credits | L:T:P:C |
|---|---|---|
| Basic Electronics | 4 | 2:0:2:4 |
| Electronic Devices & Circuit Theory * | 4 | 3:0:2:4 |
| Principles of Communication Systems* | 4 | 3:0:2:4 |
| Analog CMOS Design* | 4 | 3:0:2:4 |
| Microprocessors and Microcontrollers* | 4 | 3:0:2:4 |
| Signal Processing | 3 | 3:0:0:0 |
| Control Theory* | 3 | 3:0:0:0 |
| Digital Communication | 4 | 3:0:2:4 |
| EMT/Antenna Theory* | 4 | 3:1:0:0 |

Table 10: ECE Core Courses

Comments

Six new courses have been added to this branch. The new courses are marked with an asterisk. A majority of the courses have a lab component.

Electives

Students are required to select at least 60% of the electives from the branch they belong to. Electives can be either Level 2 or Level 3 courses. All Level 3 courses shall have at least of one of the existing Level 2 course as a pre-requisite. CSE branch students need to take a total of 13 electives (52 credits) and ECE branch students need to take a total of 11 electives (44 credits). CSE branch students must select a minimum of 8 of their electives from CSE branch while ECE students must do 7 electives from the ECE branch.

Comments

The percentage is pegged at 60% in order to encourage inter-disciplinary work across the branches. The remaining 40% of the electives could be from their own branch or from a different branch or even from outside the branch such as ITS, Mathematics or Basic Sciences.

### Specialization

iMTech students can earn specialization in specified areas within the branch provided they do 5 electives in those areas. Specialization is optional for the students and is determined at the time of graduation based on the concentration of the electives chosen by the student during the programme. The students' specialization is recorded only in the transcript issued to the student.

Based on the electives that are being offered currently, following are the specializations that are available to the students belonging to the ECE stream:

- Microelectronics and VLSI
- Networking and Communication
- Signal and Data Processing (will work across ECE and CSE streams)

Based on the electives that are being offered currently, following are the specializations that are available to the students belonging to the CSE stream:

- Theoretical Computer Science
- Data Science
- Software Engineering

Comments

In order to help distinguish IIITB's programme with degrees offered in other institutions, the committee recommends giving the students an option to specialize in a few chosen areas within CSE and ECE. In the IIITB M.Tech. (IT) programme, a student is expected to take 5 electives in the area of specialization. A similar requirement is placed for the iMTech as well.

### Masters Project / Thesis

Students have two options for meeting the Masters Project requirement:

1. (Option A) One semester (20 credits) of project work in the industry during the 9$^{th}$ semester followed by 6 month project work in the 10$^{th}$ semester (20 credits)

Agenda

## Course Sequencing for iMTech (CSE)

The course sequencing for the CSE branch is given in **Table 11** below.

| Course Name | Credits | Course Category | Level |
|---|---|---|---|
| **SEMESTER 1** | **18** | | |
| Chemistry | 3 | Mathematics and Basic Sciences | Level 1 |
| Chemistry Lab | 1 | Mathematics and Basic Sciences | Level 1 |
| Mathematics - 1 | 4 | Mathematics and Basic Sciences | Level 1 |
| Programming I | 4 | Basic Engineering Science / Skills | Level 1 |
| Physical Education 1 | 0 | Others | Level 1 |
| English | 2 | Others | Level 1 |
| Economics | 4 | HSS/M Core | Level 1 |
| **SEMESTER 2** | **22** | | |
| Mathematics - 2 | 4 | Mathematics and Basic Sciences | Level 1 |
| Digital Design | 4 | Basic Engineering Science / Skills | Level 1 |
| Data Structures and Algorithms | 4 | Engineering Core | Level 1 |
| Data Structures Lab | 2 | Engineering Core | Level 1 |
| Computer Networks | 4 | Engineering Core | Level 1 |
| History of Ideas | 4 | HSS/M Core | Level 1 |
| Physical Education 2 | 0 | Others | Level 1 |
| **SEMESTER 3** | **20** | | |
| Mathematics - 3 | 4 | Mathematics and Basic Sciences | Level 1 |
| Computer Architecture | 3 | Engineering Core | Level 1 |
| Computer Architecture Lab | 1 | Engineering Core | Level 1 |
| Programming II | 4 | Basic Engineering Science / Skills | Level 1 |
| Physics - 1 | 3 | Mathematics and Basic Sciences | Level 1 |
| Physics Lab - 1 | 1 | Mathematics and Basic Sciences | Level 1 |
| Discrete Mathematics | 4 | CSE Core | Level 1 |
| **SEMESTER 4** | **18** | | |
| Mathematics - 4 | 4 | Mathematics and Basic Sciences | Level 1 |

Agenda

| Course Name | Credits | Course Category | Level |
|---|---|---|---|
| Signals and Systems | 4 | Basic Engineering Science / Skills | Level 1 |
| Physics - 2 | 3 | Mathematics and Basic Sciences | Level 1 |
| Physics Lab - 2 | 1 | Mathematics and Basic Sciences | Level 1 |
| Design and Analysis of Algorithms | 4 | CSE Core | Level 1 |
| Technical Communication | 2 | Others | Level 1 |
| **SEMESTER 5** | **19** | | |
| Formal Languages and Automata Theory | 4 | CSE Core | Level 1 |
| Software Engineering | 3 | CSE Core | Level 1 |
| Software Engineering Lab | 1 | CSE Core | Level 1 |
| Operating Systems | 3 | Engineering Core | Level 1 |
| Operating Systems Lab | 1 | Engineering Core | Level 1 |
| Computer Graphics | 3 | CSE Core | Level 1 |
| Database Systems | 3 | CSE Core | Level 1 |
| Database Lab | 1 | CSE Core | Level 1 |
| **SEMESTER 6** | **23** | | |
| Programming Languages | 3 | CSE Core | Level 1 |
| Elective - 1 | 4 | Elective | Level 1 |
| Elective - 2 | 4 | Elective | Level 2 |
| Elective - 3 | 4 | Elective | Level 2 |
| Elective - 4 | 4 | Elective | Level 2 |
| HSS/M Elective - 1 | 4 | HSS/M Elective | Level 2 |
| **SEMESTER 7** | **20** | | |
| HSS/M Elective - 2 | 4 | HSS/M Elective | Level 2 / Level 3 |
| Elective - 5 | 4 | Elective | Level 2 / Level 3 |
| Elective - 6 | 4 | Elective | Level 2 / Level 3 |
| Elective - 7 | 4 | Elective | Level 2 / Level 3 |
| Elective - 8 | 4 | Elective | Level 2 / Level 3 |
| **SEMESTER 8** | **20** | | |
| Elective - 9 | 4 | Elective | Level 2 / Level 3 |
| Elective - 10 | 4 | Elective | Level 2 / |

Agenda

| Course Name | Credits | Course Category | Level |
|---|---|---|---|
| | | | Level |
| Elective - 11 | 4 | Elective | Level 2 Level |
| Elective - 12 | 4 | Elective | Level 2 Level |
| Elective - 13 | 4 | Elective | Level 2 Level |
| SEMESTER 9 | 20 | | |
| M.Tech. Project / Thesis | 20 | Masters Project | Master Projec |
| SEMESTER 10 | 20 | | |
| M.Tech. Project / Thesis | 20 | Masters Project | Maste Projec |

Table 11: Course Sequencing for iMTech (CSE)

Agenda

Course Sequencing for iMTech (ECE)

The course sequencing for the ECE branch is given in **Table 12** below:

| Course Name | Credits | Course Category | Level |
|---|---|---|---|
| **Semester 1** | **18** | | |
| Chemistry | 3 | Mathematics and Basic Sciences | Level 1 |
| Chemistry Lab | 1 | Mathematics and Basic Sciences | Level 1 |
| Mathematics - 1 | 4 | Mathematics and Basic Sciences | Level 1 |
| Programming I | 4 | Basic Engineering Science / Skills | Level 1 |
| Physical Education 1 | 0 | Miscellaneous | Level 1 |
| English | 2 | Miscellaneous | Level 1 |
| Economics | 4 | HSS/M Core | Level 1 |
| **Semester 2** | **22** | | |
| Mathematics - 2 | 4 | Mathematics and Basic Sciences | Level 1 |
| Digital Design | 4 | Basic Engineering Science / Skills | Level 1 |
| Data Structures and Algorithms | 4 | Engineering Core | Level 1 |
| Data Structures Lab | 2 | Engineering Core | Level 1 |
| Computer Networks | 4 | Engineering Core | Level 1 |
| History of Ideas | 4 | HSS/M Core | Level 1 |
| Physical Education 2 | 0 | Miscellaneous | Level 1 |
| **Semester 3** | **20** | | |
| Mathematics - 3 | 4 | Mathematics and Basic Sciences | Level 1 |
| Computer Architecture | 3 | Engineering Core | Level 1 |
| Computer Architecture Lab | 1 | Engineering Core | Level 1 |
| Programming II | 4 | Basic Engineering Science / Skills | Level 1 |
| Physics - 1 | 3 | Mathematics and Basic Sciences | Level 1 |
| Physics Lab - 1 | 1 | Mathematics and Basic Sciences | Level 1 |
| Basic Electronics | 2 | ECE Core | Level 1 |
| Electronics Lab | 2 | ECE Core | Level 1 |
| **Semester 4** | **18** | | |
| Mathematics - 4 | 4 | Mathematics and Basic | Level 1 |

Agenda

| Course Name | Credits | Course Category | Level |
|---|---|---|---|
| | | Sciences | |
| Signals and Systems | 4 | Basic Engineering Science / Skills | Level 1 |
| Physics - 2 | 3 | Mathematics and Basic Sciences | Level 1 |
| Physics Lab - 2 | 1 | Mathematics and Basic Sciences | Level 1 |
| Electronic Devices & Circuit Theory | 3 | ECE Core | Level 1 |
| Electronic Devices & Circuit Theory Lab | 1 | ECE Core | Level 1 |
| Technical Communication | 2 | Miscellaneous | Level 1 |
| **Semester 5** | **19** | | |
| Principles of Communication Systems | 3 | ECE Core | Level 1 |
| Principles of Communication Systems Lab | 1 | ECE Core | Level 1 |
| Analog CMOS Design | 3 | ECE Core | Level 1 |
| Analog CMOS Design Lab | 1 | ECE Core | Level 1 |
| Microprocessors and Microcontrollers | 3 | ECE Core | Level 1 |
| Microprocessors and Microcontrollers Lab | 1 | ECE Core | Level 1 |
| Operating Systems | 3 | Engineering Core | Level 1 |
| Operating Systems Lab | 1 | Engineering Core | Level 1 |
| Signal Processing | 3 | ECE Core | Level 1 |
| **Semester 6** | **23** | | |
| Control Theory | 3 | ECE Core | Level 1 |
| Digital Communication | 3 | ECE Core | Level 1 |
| Digital Communication Lab | 1 | ECE Core | Level 2 |
| Elective 1 | 4 | Elective | Level 2 |
| Elective 2 | 4 | Elective | Level 2 |
| Elective 3 | 4 | Elective | Level 2 |
| HSS/M Elective - 1 | 4 | HSS/M Elective | Level 2 |
| **Semester 7** | **19** | | |
| HSS/M Elective - 2 | 4 | HSS/M Elective | Level 2 / Level 3 |
| EMT/Antenna Theory | 4 | ECE Core | Level 1 |
| Elective - 4 | 4 | Elective | Level 2 / Level 3 |
| Elective - 5 | 4 | Elective | Level 2 / |

Agenda

| Course Name | Credits | Course Category | Level |
|---|---|---|---|
| | | | Level 3 |
| Elective - 6 | 4 | Elective | Level 2 / Level 3 |
| **Semester 8** | **20** | | |
| Elective - 7 | 4 | Elective | Level 2 / Level 3 |
| Elective - 8 | 4 | Elective | Level 2 / Level 3 |
| Elective - 9 | 4 | Elective | Level 2 / Level 3 |
| Elective - 10 | 4 | Elective | Level 2 / Level 3 |
| Elective - 11 | 4 | Elective | Level 2 / Level 3 |
| **Semester 9** | **20** | | |
| M.Tech. Project / Thesis | 20 | Masters Project | Masters Project |
| **Semester 10** | **20** | | |
| M.Tech. Project / Thesis | 20 | Masters Project | Masters Project |

**Table 12: Course Sequencing for iMTech (ECE)**

Agenda

## Integrated M.Tech. Course Proposal Template

| | |
|---|---|
| **Course Name** | Analog CMOS VLSI Design |
| **Course Branch** | Select one from the following:<br>[ ] ECE |
| **Course Proposer Name(s)** | Suhajit Sen |
| **Course Instructor Name(s)** | Subajit Sen |
| **Course Type** *(Select one)* | Select one from the following:<br>[ ] Core (ECE)<br>** All course types except "Special Topics Elective" go through the process for Academic Senate approval* |
| **Course Level** *(Select one)* | Select one from the following for elective courses:<br>[ ] N/A |
| **Course Category** *(Select one)* | Select one from the following:<br>[ ] Basic Sciences<br>[ ] **Branch Core (CSE / ECE)**<br>[ ] Elective<br>[ ] Engineering Science and Skills<br>[ ] HSS/M<br>[ ] Miscellaneous |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | **Hours** \| **Component**<br>3 hr \| Lecture (1hr = 1 credit)<br>\| Tutorial (1hr = 1 credit)<br>2 hr \| Practical (2hrs = 1 credit)<br>**4** \| **Total Credits** |
| **Grading Scheme** | Select one from the following:<br>[ ] 4-point scale (A,A-,B+,B,B-,C+,C,D,F) |

Agenda

## Integrated M.Tech. Course Proposal Template

| | |
|---|---|
| **Course Name** | Basic Electronics |
| **Course Branch** | Select one from the following:<br>[ ] ECE<br>[ ] |
| **Course Proposer Name(s)** | Madhav Rao and Subhajit Sen |
| **Course Instructor Name(s)** | Madhav Rao, Subhajit Sen, Subir Roy |
| **Course Type** *(Select one)* | Select one from the following:<br>[x] Core (ECE)<br>[ ]<br>[ ]<br>** All course types except "Special Topics Elective" go through the process for Academic Senate approval* |
| **Course Level** *(Select one)* | Select one from the following for elective courses:<br>[ ] Level 1 Elective<br>[ ] Level 2 Elective<br>[ ] N/A |
| **Course Category** *(Select one)* | Select one from the following:<br>[ ] Basic Sciences<br>[x] Branch Core (CSE / ECE)<br>[ ] Elective<br>[ ] Engineering Science and Skills<br>[ ] HSS/M<br>[ ] Miscellaneous |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | **Hours** — **Component**<br>2 hr — Lecture (1hr = 1 credit)<br>— Tutorial (1hr = 1 credit)<br>— Practical (2hrs = 1 credit)<br>**2** — **Total Credits** |
| **Grading Scheme** | Select one from the following:<br>[ ] 4-point scale (A,A-,B+,B,B-,C+,C,D,F)<br>[ ] |

Agenda

Integrated M.Tech. Course Proposal Template

| | |
|---|---|
| **Course Name** | Electronics laboratory |
| **Course Branch** | Select one from the following:<br>[ ] ECE<br>[ ] |
| **Course Proposer Name(s)** | Madhav Rao and Subhajit Sen |
| **Course Instructor Name(s)** | Madhav Rao, Subhajit Sen, Subir Roy |
| **Course Type** *(Select one)* | Select one from the following:<br>[ ] Core (ECE)<br>[ ]<br>[ ]<br>** All course types except "Special Topics Elective" go through the process for Academic Senate approval* |
| **Course Level** *(Select one)* | Select one from the following for elective courses:<br>[ ] Level 1 Elective<br>[ ] Level 2 Elective<br>[ ] N/A |
| **Course Category** *(Select one)* | Select one from the following:<br>[ ] Basic Sciences<br>[ ] Branch Core (CSE / ECE)<br>[ ] Elective<br>[ ] Engineering Science and Skills<br>[ ] HSS/M<br>[ ] Miscellaneous |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | **Hours** — **Component**<br>[ ] Lecture (1hr = 1 credit)<br>[ ] Tutorial (1hr = 1 credit)<br>4 hrs — Practical (2hrs = 1 credit)<br>**2** — **Total Credits** |
| **Grading Scheme** | Select one from the following:<br>[ ] 4-point scale (A,A-,B+,B,B-,C+,C,D,F) |

Agenda

## Integrated M.Tech. Course Proposal Template

| | |
|---|---|
| **Course Name** | Engineering Electromagnetics |
| **Course Branch** | Select one from the following:<br>X ECE<br>CSE |
| **Course Proposer Name(s)** | |
| **Course Instructor Name(s)** | |
| **Course Type** *(Select one)* | Select one from the following:<br>X Core<br>Elective<br>Special Topics Elective*<br>** All course types except "Special Topics Elective" go through the process for Academic Senate approval* |
| **Course Level** *(Select one)* | Select one from the following for elective courses:<br>Level 1 Elective<br>Level 2 Elective<br>N/A |
| **Course Category** *(Select one)* | Select one from the following:<br>Basic Sciences<br>X Branch Core (CSE / ECE)<br>Elective<br>Engineering Science and Skills<br>HSS/M<br>Miscellaneous |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | **Hours** – **Component**<br>3 – Lecture (1hr = 1 credit)<br>Tutorial (1hr = 1 credit)<br>Practical (2hrs = 1 credit)<br>**3 – Total Credits** |
| Grading **Scheme** | Select one from the following:<br>X 4-point scale (A,A-,B+,B,B-,C+,C,D,F)<br>Satisfactory/Unsatisfactory (S / X) |

# Integrated M.Tech. Course Proposal Template

| | |
|---|---|
| **Course Name** | Electronic devices and circuit theory |
| **Course Branch** | Select one from the following:<br>[ ] ECE |
| **Course Proposer Name(s)** | Madhav Rao and Subhajit Sen |
| **Course Instructor Name(s)** | Madhav Rao, Subhajit Sen, Subir Roy |
| **Course Type** *(Select one)* | Select one from the following:<br>[X] Core (ECE)<br>[ ]<br>[ ]<br>** All course types except "Special Topics Elective" go through the process for Academic Senate approval* |
| **Course Level** *(Select one)* | Select one from the following for elective courses:<br>[ ] Level 1 Elective<br>[ ] Level 2 Elective<br>[ ] N/A |
| **Course Category** *(Select one)* | Select one from the following:<br>[ ] Basic Sciences<br>[X] Branch Core (CSE / ECE)<br>[ ] Elective<br>[ ] Engineering Science and Skills<br>[ ] HSS/M<br>[ ] Miscellaneous |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | **Hours** — **Component**<br>3 hr — Lecture (1hr = 1 credit)<br>— Tutorial (1hr = 1 credit)<br>2 hr — Practical (2hrs = 1 credit)<br>**4** — **Total Credits** |
| **Grading Scheme** | Select one from the following:<br>[ ] 4-point scale (A,A-,B+,B,B-,C+,C,D,F)<br>[ ] |

Agenda

## Integrated M.Tech. Course Proposal Template

| | |
|---|---|
| **Course Name** | Control Theory |
| **Course Branch** | Select one from the following:<br>x ECE<br>CSE |
| **Course Proposer Name(s)** | |
| **Course Instructor Name(s)** | |
| **Course Type** *(Select one)* | Select one from the following:<br>X Core<br>Elective<br>Special Topics Elective*<br>** All course types except "Special Topics Elective" go through the process for Academic Senate approval* |
| **Course Level** *(Select one)* | Select one from the following for elective courses:<br>Level 1 Elective<br>Level 2 Elective<br>N/A |
| **Course Category** *(Select one)* | Select one from the following:<br>Basic Sciences<br>X Branch Core (CSE / ECE)<br>Elective<br>Engineering Science and Skills<br>HSS/M<br>Miscellaneous |
| **Credits** (L:T:P)<br>**(Lecture : Tutorial : Practical)** | **Hours** — **Component**<br>3 — Lecture (1hr = 1 credit)<br>Tutorial (1hr = 1 credit)<br>2 — Practical (2hrs = 1 credit)<br>**4 — Total Credits** |
| **Grading Scheme** | Select one from the following:<br>x 4-point scale (A,A-,B+,B,B-,C+,C,D,F)<br>Satisfactory/Unsatisfactory (S / X) |

Agenda

## Integrated M.Tech. Course Proposal Template

| | |
|---|---|
| **Course Name** | Principles of Communication Systems |
| **Course Branch** | Select one from the following:<br>x ECE<br>CSE |
| **Course Proposer Name(s)** | |
| **Course Instructor Name(s)** | |
| **Course Type** *(Select one)* | Select one from the following:<br>X Core<br>Elective<br>Special Topics Elective*<br>* *All course types except "Special Topics Elective" go through the process for Academic Senate approval* |
| **Course Level** *(Select one)* | Select one from the following for elective courses:<br>Level 1 Elective<br>Level 2 Elective<br>N/A |
| **Course Category** *(Select one)* | Select one from the following:<br>Basic Sciences<br>X Branch Core (CSE / ECE)<br>Elective<br>Engineering Science and Skills<br>HSS/M<br>Miscellaneous |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | **Hours** – **Component**<br>3 – Lecture (1hr = 1 credit)<br>Tutorial (1hr = 1 credit)<br>2 – Practical (2hrs = 1 credit)<br>4 – **Total Credits** |
| **Grading** Scheme | Select one from the following:<br>x 4-point scale (A,A-,B+,B,B-,C+,C,D,F)<br>Satisfactory/Unsatisfactory (S / X) |

Agenda

## PROPOSED COURSE DESCRIPTIONS OF THE MATHEMATICS COURSES

### Mathematics I: Proofs and Basic Calculus

| Topic | Hours |
|---|---|
| Sets. Cardinality of a set. Numbers. Principles of Inference: Negation. Disjunction. Implication. Equivalence. Truth tables and tautologies | 4 |
| Proofs and Mathematical Writing - These topics are introduced to teach the students the clarity of thought. | 3 |
| Real numbers. Sequences. Series. Limit. Continuity. Differentiability Mean value theorems and applications. Linear Approximation | 10 |
| Power series. Taylors theorem (one variable). Approximation by polynomials. Critical points. Convexity | 6 |
| Riemann integral. fundamental theorems of integral calculus. Improper integrals. Curve tracing. Graphs of polar equations | 7 |
| Space co-ordinates. lines and planes. Polar coordinates. Cylinders. Quadric surfaces, volume, area, length. Continuity. Differentiability of vector functions. arc length Functions of two or more variables. partial derivatives. Statement of Taylors theorem criteria for maxima/minima/saddle points. | 9 |
| Double, triple integrals. Jacobians. | 3 |
| Total | 42 |

Recommended books:

- Calculus and Analytic Geometry, by Thomas and Finney. 9th edition. Pearson Education India.
- Introduction to Logic. by Patrick Suppes. Dover edition. 1999. (For elementary logic portion).
- Calculus, Vol. 1: One-Variable Calculus, with an Introduction to Linear Algebra, by Tom Apostol
- Calculus, Vol. 2: Multi-Variable Calculus and Linear Algebra with Applications to Differential Equations and Probability, by Tom Apostol
- Proper web notes

Additional references:

- Mathematical Analysis. by Tom M. Apostol. Addison-Wesley. 1974.
- Theory of Computation. by Harry Lewis and Christos H. Papadimitriou. Prentice-Hall. 2nd edition. 1997. (For logic).
- Real and Complex Analysis. by Walter Rudin. McGraw - Hill. 2006.

Agenda

## Mathematics II: Linear Algebra and Introduction to Basic ODE

We are of the opinion that Linear Algebra is one of the most basic and fundamental courses in Mathematics - it provides the necessary language and forms an essential toolkit for all branches of Science and Technology as well as Economics etc. while teaching the Ordinary Differential Equations course we realized that we needed it and thus we have moved the Linear Algebra course to the second semester along with some ODE and PDE.

| Topic | Hours |
|---|---|
| Matrices, Matrix Operations (Addition, Scalar Multiplication, Multiplication, Transpose, Adjoint) and their properties; Special types of matrices (null, Identity, Diagonal, Triangular, Symmetric, Skew-Symmetric, Hermitian, Skew-Hermitin, Orthogonal, Unitary, Normal), Solution of the matrix equation Ax=b, Row-reduced Echelon form, Determinants and their properties (without proof). | 8 |
| Vector Space, Subspaces, Linear Dependence/Independence, Basis, Standard Basis of dimension, Coordinates with respect to a basis, Complementary Subspaces, Standard inner product, Norm, Gram-Schmidt Orthogonalisation Process, Generalisation to the vector space Linear Transformation form (motivation X-AX), Image of a basis identifies the linear transformation, Range Space and Rank, Null Space and Nullity, Matrix Representation of a linear transformation, Structure of the solutions of the matrix equation Ax=b, Linear Operators and their representation by matrices, Similar Matrices and linear operators, Invertible linear operators, Inverse of a non-singular matrix, Cramers method to solve the matrix equation Ax=b, Eigenvalues and eigenvectors of a linear operator, Characteristic Equation, Bounds on eigenvalues, Diagonalisability of a linear operator, Canonical forms, Statement of the Kelly-Hamilton Theorem | 12 |
| Standard Inner product, Norm, Gram-Schmidt Orthogonalisation Process, Self-Adjoint, Normal and Unit array operators, Properties of eigenvalues and eigenvectors, Spectral theorem Self-Adjoint and Normal, Quadratic form XT AX, Positive and Semi-Positive Definite Matrices. | 10 |
| Introduction and Motivation to Differential Equations, First Order ODE, Geometrical interpretation of solution, Equations reducible to separable form, Exact Equations, integrating factor, Linear Equations, Orthogonal trajectories, Picards Theorem for IVP (without proof) and Picards iteration method, Eulers Method, Improved Eulers Method. | 7 |
| Introduction to PDE, basic concepts, Maxwells equation and heat equation This is to cover the essential pre-requisites for a third semester Physics course. | 3 |
| Total | 40 |

Recommended books:

- Linear Algebra, by K. Hoffman and R. Kunz, Prentice-Hall, 1971.
- Relevant portions from the books written by Artin, Gallian, Herstein.
- Proper web notes.

Additional references:

- Linear Algebra and its Applications, by Gilbert Strang, Nelson Engineering, 2007.
- Finite Dimensional Vector Spaces, by P. R. Halmos, Princeton University Press.
- Linear Algebra, by Helson, Holden-day, 1990.
- Lectures on Abstract Algebra, volumes by N. Jacobson, Springer.

Agenda

Applied and Applicable Mathematics III: ODE and Abstract Algebra

| Topic | Hours |
|---|---|
| Surfaces, integrals, Vector Calculus,Green, Gauss, Stokes Theorems. | 5 |
| Second Order Linear differential equations, fundamental system of solutions and general solution of homogeneous equation, use of known solution to find another. Existence and uniqueness of solution of IVP, Wronskian and general solution of nonhomogeneous equations, Euler-Cauchy Equation, extensions of the results to higher order linear equations. | 12 |
| Power Series Method - application to Legendre Equations, Legendre Polynomials, Frobenius Method, Bessel equations, Properties of Bessel functions, Sturm comparison Theorem, Sturm Liouville BVP, Orthogonal functions, Fourier Series and Integrals. | 9 |
| Basic Introduction to Laplace and Fourier Transforms (with less stress on theoretical aspects) | 6 |
| Introduction to Abstract Algebra: Groups, Rings, Modules, Ideals, Fields and examples of finite fields | 10 |
| Total | 42 |

Recommended books:

- Calculus and Analytic Geometry, by Thomas and Finney, 9th edition, Pearson Education India.
- Advanced Engineering Mathematics, by Erwin Kreyszig, 8th edition, Wiley.
- Partial Differential Equations, by Fritz John, 4th edition, 1981.
- Proper web notes (NPTEL notes are available)

Additional references:

- Differential Equations with Applications and Historical Notes, by George F. Simmons, McGraw-Hill Science/Engineering/Mathematics, 2nd edition, 1991
- Introduction to Ordinary Differential Equations, by Shepley L. Ross, 4th edition, Wiley, 1989.
- Elements of Partial Differential Equations, by Ian Sneddon.
- An Elementary Course in Partial Differential Equations, by Amaranath, Alpha Science Intl. Ltd., 1997.
- Advanced Theory of Statistics, by Kendall and Stuart, all volumes.

Agenda

## Mathematics IV: (2+2 credits)

| Topic | Hours |
|---|---|
| Mathematics IVB: Statistics and Probability<br>(Adopted from : Chap. 22 and 23 Kreyszig- Part G): | |
| Data representation, average, probability, permutations and combinations, random variables, probabilistic distributions, mean and variance binomial, Poisson, hypergeometric, Normal distributions, distributions of several random variables. | 14 |
| Mathematical Statistics: random sampling, confidence intervals, testing 7-8 of hypothyses, decisions, goodnes of fit, $\chi^2$ test<br>test, linear regression. | 2 |
| Total | 21-22 |
| Mathematics IVA: Complex Analysis<br>Complex Numbers, geometric representation, powers and roots of complex numbers, Functions of a complex variable, Analytic functions, Cauchy-Riemann equations; elementary functions. | 8 |
| Contours and contour integration, Cauchys theorem, Cauchy integral formula, Power Series, term by term differentiation, Taylor series, Laurent series, Zeros, Singularities, poles, essential singularities, Residue theorem, Evaluation of real integrals and improper integrals. | 12 |
| Total | 20 |

Recommended books:

- Mathematics IVA:
  Advanced Engineering Mathematics, by Erwin Kreyszig, 8th edition, Wiley.
  Proper web notes (NPTEL notes are available)
- Mathematics IVB:
  Advanced Engineering Mathematics, by Erwin Kreyszig, 8th edition, Wiley.
  Proper web notes

Additional references:

- Mathematics IVA:
  Complex Analysis, by Ahlfors, McGraw Hill, 1979.
  Complex Variables and Applications, by James Brown and Ruel Churchill, McGraw Hill, 2008.
- Mathematics IVB:
  Introduction to Mathematical Statistics, by Hogg and Craig, 3rd edition, Macmillan, 1971.
  The Advanced Theory of Statistics, by Kendell and Stuart, Volume 3, Griffin, 1976.

Agenda

# Physics Theory I (BS107)

## Classical Physics

**(3rd semester)**

## Curriculum Details

### Mechanics / Classical Mechanics:

Introduction; kinematics, Newton's laws.
work-energy theorem; revision of integral theorems -- Gauss's divergence theorem, Green's theorem in the plane, Stokes ' theorem; curvilinear coordinates: vectors in curvilinear systems, arc length & volume element; gradient, divergence & curl in curvilinear coordinates; specific example of spherical & cylindrical coordinate systems; transformation between coordinate systems, Jacobian; 5 hours

Manipulation of gradient, divergence, curl, laplacian operators on vectors simplified by tensors; Euler-Lagrange equation: principle of least action; generalized coordinates & generalized momenta; writing the Lagrangian of a system (examples: e.g., simple pendulum, double pendulum, etc.), finding the equation of motion; cyclic /ignorable coordinates & constants of motion, Jacobi integral; rotating frames of reference; mention of symmetries & Noether's theorem; energy & momentum conservation as consequences of homogeneity of time & space respectively, angular velocity, angular momentum conservation & isotropy of space; pseudo-forces, Coriolis & centrifugal forces, effects of Coriolis force, Foucault's pendulum, precession; rigid-body motion, moment of inertia; perpendicular & parallel axes theorems; 7 hours

Central force motion, 2-body central force problem, reduction to 1-body problem; angular momentum conservation; solution of motion of a particle in a central field; the Kepler problem; virial theorem; 3 hours

Elasticity, stress strain curve, yield point, breakdown stress, etc. 1 hour

Poincare & the 2+ body problem; Phase space & chaos; examples of specific systems 2 hours

Simple harmonic motion; undamped, damped regimes, etc. 2 hours
Wave motion: free vibrations of a stretched string, phase velocity, group velocity, sound waves, water waves, interference & diffraction, etc. 3 hours

Electrostatics: flux of an electric field, Gauss's law, applications, electric potential energy, the divergence of E, Dirac delta function, conductors, capacitance & combinations of capacitors, energy density, dielectrics, dipole, dipole moment, polarization, electric field calculations of various charge configurations, etc. 6 hours

Magnetostatics: Lorentz force, cyclotron frequency, magnetic force & current-carrying wires, continuity equation, Biot-Savart law & applications, Ampere's law, magnetic dipole moment, magnetic materials, diamagnets, paramagnets & ferromagnets, magnetization & magnetic susceptibility, hysteresis, Faraday's law of electromagnetic induction, Lenz's law, electromagnetic waves, energy density, Maxwell's equations, potential formulation of electrodynamics -- gauge transformations, wave equation, polarization. 7 hours

Agenda

## Physics Theory II (BS108)
## Modern Physics
## (4th semester)
## Curriculum Details

Special theory of Relativity:
inertial frames of reference; galilean transformations, Lorentz transformations; relativistic kinematics: Lorentz-Fitzgerald length contraction, time dilation, velocity transformation; Doppler effect -- inon-relativistic and relativistic; relativistic dynamics -- effect on momentum & mass measurements. **4 hours**

Quantum Mechanics:
Need for QM, the photoelectric effect, wave-particle duality, the Compton effect; de Broglie waves, phase & group velocities; wave-function & probability; a brief discussion on interference & diffraction, particle in a box (without solving Schroedinger's eqn); Heisenberg's uncertainty principle; Thomson & Rutherford's models of the atom; atomic spectra; Bohr's model of the atom & its explanation of spectral lines; Bohr- Sommerfeld quantization; wave-function, probability density, Schroedinger's equation (steady-state & time-dependent) solution for simple problems: particle in a box, tunneling through a potential barrier, simple harmonic oscillator, hydrogen atom, etc; fundamental postulates of wave mechanics, expectation values, operators, commutator relations. **16 hours**

Nuclear physics: models for the atomic nucleus, liquid drop model; nuclear reactions & radioactive decay. **3 hours**

Statistical mechanics:
Phase space, macrostates & microstates, entropy; distinguishable & indistinguishable particles; the most probable distribution; Maxwell-Boltzmann distribution; quantum statistical mechanics, Fermi-Dirac & Bose-Einstein distributions, Fermi energy; Planck's radiation formula. **10 hours**

Specific heat of solids, Dulong-Petit law, Einstein model; free electron theories, metals; solids & crystals; origin of band structure, electrical & thermal properties of solids; **5 hours**
semiconductors;
lasers. **2 hours**

Total: 40 hours

**Recommended / suggested books:**


1. Arthur Beiser, *Concepts of Modern Physics*, Tata McGraw Hill.
2. Mathews & Venkatesan, *A textbook of quantum mechanics*
3. D. Kleppner & R. Kolenkow, *An introduction to Mechanics*, Tata McGraw Hill (2007)
4. F. Reif, *Statistical Physics* (Berkeley physics course vol.5), McGraw Hill (1967)
5. C. Kittel, *Solid State Physics* (any of the several editions).
6. Mani & Mehta, *Introduction to modern physics*, Affiliated East-West Press.
7. *The Feynman Lectures in Physics*, Narosa (2008).

Agenda

## Physics Laboratory I - BS 107P (3rd semester),
## &
## Physics Laboratory II - BS108P (4th semester)

The following experiments are representative of those to be performed over the two semesters of physics laboratory:

0. Introduction to error analysis, dimensional analysis

1. Calculation of g & coefficient of restitution for a surface

2. Determination of rigidity modulus of brass

3. Determination of Young's modulus of a metal

4. Determination of thermal diffusivity of brass

5. Determination of the value of Stefan's constant

6. Measurement of electrical & thermal conductivity of good & poor conductors, calculation of Lorentz number of Cu

7. Bridge experiments (Maxwell, de Sauty, Wien)

8. Determination of storage capacity of a CD by a simple diffraction experiment

9. Construction of a data-logging pendulum using a mouse & obtaining the phase portrait & time-series of a simple damped pendulum

10. Numerical solution of the differential equation of a forced, damped simple pendulum using 4th order Runge-Kutta technique, and obtaining the phase portrait & time series of the system under different conditions

11. Experimental verification of the Biot-Savart law for the magnetic field of a current - carrying wire

12. Determination of the magnetic field strength of a bar-magnet, obtaining the functional relationship of field-strength to distance, obtaining the magnetic moment & then approximating the value of the Bohr magneton.

13. Understanding DNA diffraction using a spring & a laser pointer

14. Numerical study of a simple, nonlinear system (e.g., a quadratic map) & obtaining its bifurcation diagram, obtaining the Feigenbaum numbers.

15. Determination of period of rotation of the sun & sunspot cycles using FFT analysis of sunspot data.

Agenda

## Integrated M.Tech. Course Proposal Template

<table>
<tr><td>Course Name</td><td>Design and Analysis of Algorithms</td></tr>
<tr><td>Course Branch</td><td>Select one from the following:<br><table><tr><td>x</td><td>CSE</td></tr><tr><td></td><td>ECE</td></tr></table></td></tr>
<tr><td>Course Proposer Name(s)</td><td>Meenakshi D'Souza</td></tr>
<tr><td>Course Instructor Name(s)</td><td>Meenakshi D'Souza</td></tr>
<tr><td>Course Type (Select one)</td><td>Select one from the following:<br><table><tr><td>x</td><td>Core</td></tr><tr><td></td><td>Elective</td></tr><tr><td></td><td>Special Topics Elective*</td></tr></table>* All course types except "Special Topics Elective" go through the process for Academic Senate approval</td></tr>
<tr><td>Course Level (Select one)</td><td>Select one from the following for elective courses:<br><table><tr><td></td><td>Level 1 Elective</td></tr><tr><td></td><td>Level 2 Elective</td></tr><tr><td></td><td>N/A</td></tr></table></td></tr>
<tr><td>Course Category (Select one)</td><td>Select one from the following:<br><table><tr><td></td><td>Basic Sciences</td></tr><tr><td>x</td><td>Branch Core (CSE / ECE)</td></tr><tr><td></td><td>Elective</td></tr><tr><td></td><td>Engineering Science and Skills</td></tr><tr><td></td><td>HSS/M</td></tr><tr><td></td><td>Miscellaneous</td></tr></table></td></tr>
<tr><td>Credits (L:T:P)<br>(Lecture : Tutorial : Practical)</td><td><table><tr><th>Hours</th><th>Component</th></tr><tr><td>3</td><td>Lecture (1hr = 1 credit)</td></tr><tr><td>1</td><td>Tutorial (1hr = 1 credit)</td></tr><tr><td></td><td>Practical (2hrs = 1 credit)</td></tr><tr><td></td><td>Total Credits</td></tr></table></td></tr>
<tr><td>Grading Scheme</td><td>Select one from the following:<br><table><tr><td>x</td><td>4-point scale<br>(A,A-,B+,B,B-,C+,C,D,F)</td></tr></table></td></tr>
</table>

## Integrated M.Tech. Course Proposal Template

| | |
|---|---|
| **Course Name** | CC 103: Computer Networks |
| **Course Branch** | Select one from the following:<br>[ ] CS<br>[X] ECE |
| **Course Proposer Name(s)** | Prof. Tricha Anjali and Prof. D. Das |
| **Course Instructor Name(s)** | Prof. Tricha Anjali and Prof. D. Das |
| **Course Type** *(Select one)* | Select one from the following:<br>[X] Core<br>[ ] Elective<br>[ ] Special Topics Elective*<br>** All course types except "Special Topics Elective" go through the process for Academic Senate approval* |
| **Course Level** *(Select one)* | Select one from the following for elective courses:<br>[ ] Level 1 Elective<br>[ ] Level 2 Elective<br>[ ] N/A |
| **Course Category** *(Select one)* | Select one from the following:<br>[ ] Basic Sciences<br>[X] Branch Core (CSE / ECE)<br>[ ] Elective<br>[ ] Engineering Science and Skills<br>[ ] HSS/M<br>[ ] Miscellaneous |
| Credits (L:T:P)<br>**(Lecture : Tutorial : Practical)** | **Hours** — **Component**<br>4 — Lecture (1hr = 1 credit)<br>— Tutorial (1hr = 1 credit)<br>— Practical (2hrs = 1 credit)<br>— **Total Credits** |
| **Grading Scheme** | Select one from the following:<br>[X] 4-point scale (A,A-,B+,B,B-,C+,C,D,F) |

Agenda

## Integrated M.Tech. Course Proposal Template

| | |
|---|---|
| **Course Name** | Programming-1 and Lab (C Part) |
| **Course Branch** | Select one from the following:<br>☐ CSE and ECE<br>☐ |
| **Course Proposer Name(s)** | Dr. Madhav Rao |
| **Course Instructor Name(s)** | |
| **Course Type** *(Select one)* | Select one from the following:<br>☐ **Core**<br>☐ Elective<br>☐ Special Topics Elective*<br>** All course types except "Special Topics Elective" go through the process for Academic Senate approval* |
| **Course Level** *(Select one)* | Select one from the following for elective courses:<br>☐ Level 1 Elective<br>☐ Level 2 Elective<br>☐ N/A |
| **Course Category** *(Select one)* | Select one from the following:<br>☐ Basic Sciences<br>☐ Branch Core (CSE / ECE)<br>☐ Elective<br>☐ Engineering Science and Skills<br>☐ HSS/M<br>☐ Miscellaneous |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | **Hours** — **Component**<br>☐ **Lecture (1hr = 1 credit)**<br>☐ Tutorial (1hr = 1 credit)<br>☐ **Practical (2hrs = 1 credit)**<br>☐ **Total Credits = 2** |
| **Grading Scheme** | Select one from the following:<br>☐ 4-point scale (A,A-,B+,B,B-,C+,C,D,F) |

Agenda

## Integrated M.Tech. Course Proposal Template

| | |
|---|---|
| **Course Name** | Programming I - Python |
| **Course Branch** | Select one from the following:<br>x CSE<br>ECE |
| **Course Proposer Name(s)** | |
| **Course Instructor Name(s)** | |
| **Course Type** *(Select one)* | Select one from the following:<br>x Core<br>Elective<br>Special Topics Elective*<br>** All course types except "Special Topics Elective" go through the process for Academic Senate approval* |
| **Course Level** *(Select one)* | Select one from the following for elective courses:<br>Level 1 Elective<br>Level 2 Elective<br>N/A |
| **Course Category** *(Select one)* | Select one from the following:<br>Basic Sciences<br>x Branch Core (CSE / ECE)<br>Elective<br>Engineering Science and Skills<br>HSS/M<br>Miscellaneous |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | **Hours** – **Component**<br>1 – Lecture (1hr = 1 credit)<br>Tutorial (1hr = 1 credit)<br>1 – Practical (2hrs = 1 credit)<br>**2 – Total Credits** |
| **Grading Scheme** | Select one from the following:<br>x 4-point scale (A,A-,B+,B,B-,C+,C,D,F) |

| | |
|---|---|
| **Course Name** | Programming I - Python |
| **Course Branch** | Select one from the following:<br>x CSE<br>ECE |
| **Course Proposer Name(s)** | |
| **Course Instructor Name(s)** | |
| **Course Type** *(Select one)* | Select one from the following:<br>x Core<br>Elective<br>Special Topics Elective*<br>* *All course types except "Special Topics Elective" go through the process for Academic Senate approval* |
| **Course Level** *(Select one)* | Select one from the following for elective courses:<br>Level 1 Elective<br>Level 2 Elective<br>N/A |
| **Course Category** *(Select one)* | Select one from the following:<br>Basic Sciences<br>x Branch Core (CSE / ECE)<br>Elective<br>Engineering Science and Skills<br>HSS/M<br>Miscellaneous |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | **Hours** – **Component**<br>1 – Lecture (1hr = 1 credit)<br>Tutorial (1hr = 1 credit)<br>1 – Practical (2hrs = 1 credit)<br>**2 – Total Credits** |
| **Grading Scheme** | Select one from the following:<br>x 4-point scale (A,A-,B+,B,B-,C+,C,D,F)<br>Satisfactory/Unsatisfactory (S / X) |
| **Pre-Requisites**<br>*(where applicable, specify exact course names)* | |

# Integrated M.Tech. Course Template

| | |
|---|---|
| **Course Name** | Data Structures and Algorithms |
| **Course Branch** | Select one from the following:<br>X CSE<br>(blank) |
| **Course Proposer Name(s)** | Muralidhara V N |
| | Muralidhara V N |
| **Course Type** *(Select one)* | Select one from the following:<br>X Core<br>Elective<br>Special Topics Elective*<br>** All course types except "Special Topics Elective" go through the process for Academic Senate approval* |
| **Course Level** *(Select one)* | Select one from the following for elective courses:<br>Level 1 Elective<br>Level 2 Elective<br>N/A |
| **Course Category** *(Select one)* | Select one from the following:<br>Basic Sciences<br>X Branch Core (CSE / ECE)<br>Elective<br>Engineering Science and Skills<br>HSS/M<br>Miscellaneous |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | **Hours** – **Component**<br>3 – Lecture (1hr = 1 credit)<br>1 – Tutorial (1hr = 1 credit)<br>1 – Practical (2hrs = 1 credit)<br>**4+1 – Total Credits** |
| **Grading Scheme** | Select one from the following:<br>4-point scale (A,A-,B+,B,B-,C+,C,D,F)<br>Satisfactory/Unsatisfactory (S / X) |

# Integrated M.Tech. Course Proposal Template

| | |
|---|---|
| **Course Name** | Discrete Mathematics |
| **Course Branch** | Select one from the following:<br>[ ] ECE<br>[✓] CSE |
| **Course Proposer Name(s)** | |
| **Course Instructor Name(s)** | |
| **Course Type** *(Select one)* | Select one from the following:<br>[✓] Core<br>[ ] Elective<br>[ ] Special Topics Elective*<br>** All course types except "Special Topics Elective" go through the process for Academic Senate approval* |
| **Course Level** *(Select one)* | Select one from the following for elective courses:<br>[ ] Level 1 Elective<br>[ ] Level 2 Elective<br>[ ] N/A |
| **Course Category** *(Select one)* | Select one from the following:<br>[ ] Basic Sciences<br>[✓] Branch Core (CSE / ECE)<br>[ ] Elective<br>[ ] Engineering Science and Skills<br>[ ] HSS/M<br>[ ] Miscellaneous |
| **Credits** (L:T:P)<br>**(Lecture : Tutorial : Practical)** | **Hours** \| **Component**<br>Lecture (1hr = 1 credit)<br>Tutorial (1hr = 1 credit)<br>Practical (2hrs = 1 credit)<br>**Total Credits**<br>(L: T) = (3:1) |
| Grading Scheme | Select one from the following:<br>[ ] 4-point scale (A,A-,B+,B,B-,C+,C,D,F)<br>[ ] Satisfactory/Unsatisfactory (S / X) |

# Integrated M.Tech. Course Proposal Template

| | |
|---|---|
| **Course Name** | Programming Languages |
| **Course Branch** | Select one from the following:<br>X CSE<br>ECE |
| **Course Proposer Name(s)** | |
| **Course Instructor Name(s)** | |
| **Course Type** *(Select one)* | Select one from the following:<br>X Core<br>Elective<br>Special Topics Elective*<br>** All course types except "Special Topics Elective" go through the process for Academic Senate approval* |
| **Course Level** *(Select one)* | Select one from the following for elective courses:<br>Level 1 Elective<br>Level 2 Elective<br>X N/A |
| **Course Category** *(Select one)* | Select one from the following:<br>Basic Sciences<br>CSE Branch Core (CSE / ECE)<br>Elective<br>Engineering Science and Skills<br>HSS/M<br>Miscellaneous |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | **Hours** / **Component**<br>40 Lecture (1hr = 1 credit)<br>Tutorial (1hr = 1 credit)<br>Practical (2hrs = 1 credit)<br>**Total Credits** |
| **Grading Scheme** | Select one from the following:<br>X 4-point scale (A,A-,B+,B,B-,C+,C,D,F)<br>Satisfactory/Unsatisfactory (S / X) |

# Integrated M.Tech. Course Proposal Template

| | |
|---|---|
| **Course Name** | Signals and Systems |
| **Course Branch** | Select one from the following:<br>[ ] ECE<br>[ ] ECE |
| **Course Proposer Name(s)** | |
| **Course Instructor Name(s)** | |
| **Course Type** *(Select one)* | Select one from the following:<br>[X] Core<br>[ ] Elective<br>[ ] Special Topics Elective*<br>** All course types except "Special Topics Elective" go through the process for Academic Senate approval* |
| **Course Level** *(Select one)* | Select one from the following for elective courses:<br>[ ] Level 1 Elective<br>[ ] Level 2 Elective<br>[ ] N/A |
| **Course Category** *(Select one)* | Select one from the following:<br>[ ] Basic Sciences<br>[X] Branch Core (CSE / ECE)<br>[ ] Elective<br>[ ] Engineering Science and Skills<br>[ ] HSS/M<br>[ ] Miscellaneous |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | **Hours** — **Component**<br>3 — Lecture (1hr = 1 credit)<br>1 — Tutorial (1hr = 1 credit)<br>— Practical (2hrs = 1 credit)<br>**4** — **Total Credits** |
| **Grading Scheme** | Select one from the following:<br>[x] 4-point scale (A,A-,B+,B,B-,C+,C,D,F)<br>[ ] Satisfactory/Unsatisfactory (S / X) |
| **Pre-Requisites**<br>*(where applicable, specify exact course names)* | |

# Integrated M.Tech. Course Proposal Template

| | |
|---|---|
| **Course Name** | Digital Signal Processing |
| **Course Branch** | Select one from the following:<br>[ ] ECE<br>[ ] ECE |
| **Course Proposer Name(s)** | |
| **Course Instructor Name(s)** | |
| **Course Type** *(Select one)* | Select one from the following:<br>[X] Core<br>[ ] Elective<br>[ ] Special Topics Elective*<br>** All course types except "Special Topics Elective" go through the process for Academic Senate approval* |
| **Course Level** *(Select one)* | Select one from the following for elective courses:<br>[ ] Level 1 Elective<br>[ ] Level 2 Elective<br>[ ] N/A |
| **Course Category** *(Select one)* | Select one from the following:<br>[ ] Basic Sciences<br>[X] Branch Core (CSE / ECE)<br>[ ] Elective<br>[ ] Engineering Science and Skills<br>[ ] HSS/M<br>[ ] Miscellaneous |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | **Hours** – **Component**<br>3 – Lecture (1hr = 1 credit)<br>1 – Tutorial (1hr = 1 credit)<br>– Practical (2hrs = 1 credit)<br>4 – **Total Credits** |
| **Grading Scheme** | Select one from the following:<br>[x] 4-point scale (A,A-,B+,B,B-,C+,C,D,F)<br>[ ] Satisfactory/Unsatisfactory (S / X) |
| **Pre-Requisites**<br>*(where applicable, specify exact course names)* | |
| Signals and Systems | |

# 3 CURRICULUM STRUCTURE

## 3.1 Learning Tasks and Achievements

The proposed program aims to create a group of professional practitioners and researchers who possess a nuanced and multi-dimensional understanding of today's information age. It will provide rigorous and broad-based training in the design and development of digital technologies, issues pertaining to the management of complex digital systems and the policy challenges of deploying them. This training will draw from computer science & engineering, data science, design, management, economics, sociology, political science and information science. Structured as a combination of coursework and an internship/thesis, the program will allow students to build a foundation for careers in the government, the corporate world, policy advocacy, academia and social enterprises. As part of the distinctive academic curriculum, students will find immense learning opportunities to work in multi-disciplinary peer groups of the kind they are increasingly likely to encounter in their careers.

## 3.2 Courses: Categories and Levels

The core curriculum - a set of seven courses, two research method courses, one projective elective and one seminar will strengthen students' foundations in technological and social science approaches to understanding the digital. A series of five electives courses will provide them a specialized skills, as well as future direction to research in various domains. Tables 1 and 2 provide an overview of the curriculum and a summary of the credit distribution in the M.Sc. (Digital Society) program.

## 3.3 Curriculum Structure: Components and Credits

The following decisions emerged after detailed discussions amongst ourselves and with outside experts, and a study of similar programs in premier institutions/universities in India and abroad.

- The period of the program will be two years.
- The total number of credits required to fulfill requirements of the program is 76.
- The broad content structure of the proposed program is summarized in Table 1&2

**Table 1: Overview of the curriculum**

| Preparatory Semester (2 weeks, 1 course, 2 credits) |
|---|
| Introduction to Digital Societies (Pass/No Pass) |
| **Semester 1 (18 weeks, 5 core courses, 18 credits)** |
| Digital Components of a Connected Society (4) |
| Interface Design for Diverse Populations (4) |
| Technology and Society (4) |
| Quantitative Methods (3) |
| Qualitative Methods (3) |
| **Semester 2 (18 weeks, 3 core courses, 1 elective, 16 credits)** |

| |
|---|
| Engineering and Management of Large Digital Systems (4) |
| The Digital and Its Discontents (4) |
| Information and Communication Technology Policy and Regulation (4) |
| Elective I (4) |
| **Summer Semester (8 weeks, 2 core courses, 6 credits)** |
| Information Management (2) |
| Project Elective (4) |
| **Semester 3 (18 weeks, 4 elective courses+1 seminar, 18 credits)** |
| Elective II, III, IV & V (4x4) |
| Seminar (2) |
| **Semester 4 (26 weeks, 16 credits)** |
| Thesis/Internship (16) |
| **Total Credits 76** |

**Table 2: Credit distribution**

| Proposed | Credits | % |
|---|---|---|
| Preparatory interdisciplinary orientation | 2 | 2.6 |
| Core courses | 26 | 34.2 |
| Research Methods | 6 | 7.8 |
| Project | 4 | 5.2 |
| Elective course credits | 20 | 26.3 |
| Internship/Thesis credits | 16 | 21 |
| Seminar | 2 | 2.6 |
| **Total credits requirement for MSc (Digital Society)** | 76 | 100 |

## 3.4 Courses

### 3.4.1 Preparatory Courses

We expect a diverse student body that represents many disciplines. Given this heterogeneity in background, we propose a mandatory introductory course of two weeks to prepare students to learn and work together in the following semesters.

- ***Introduction to Digital Societies*** *(2 credit, Pass/Not Pass)*

This is a two-week introduction to the MSc (Digital Society) program. It will provide students an overview of the course structure, course requirements, and rationale for the core and elective course offerings in the program. A combination of lectures, readings, and audio-visual material will be used to introduce the fundamentals and the epistemological approaches of technologies and the social sciences to a disciplinarily diverse student body. Students will be exposed to the foundational logic of the program and its interdisciplinary underpinnings with an overview of the conceptual toolkit for designing a digital society.
Students will be required to complete a group assignment based on these prep semester modules.

### 3.4.2 Core Courses

Students will be required to take seven courses, two research methods courses, a project and a seminar as core courses. All of these will be specifically designed keeping in mind the needs of a heterogeneous student body. Courses will provide students an understanding of technology fundamentals and a constructive critical lens to analyze how digital technologies work in the social world. The goal is to provide fundamentals to students from different backgrounds, without forcing them to repeat material they already know well. For the courses on technology fundamentals, we do this by focusing on particular dimensions of technology design and deployments such as their scale and diversity of audience, dimensions and examples that even technology students are unlikely to have encountered. Similarly, for those with a social science background, the focus on digital technologies as the object of social analysis will set the social science courses apart. The course on Research Methods will enable students to examine user needs and outcomes, and to evaluate the impact of ICTs. The project elective in the summer semester will allow students to consolidate their learning from multiple core courses, while the seminar in the third semester will provide them an opportunity to think through the questions they will tackle in their upcoming thesis/internship.

**Semester 1**

- ***Digital Components of a Connected Society*** *(4 credits)*

The Digital Society is a result of a large number of digital components that were developed in the last 75 years around digital computer to communicate, store and process data. This course gives an overview of the network of computing devices and communication links which has made the Digital Society possible. Students attending this course will gain an understanding of some of the digital components, their interconnections and their role in the connected world.

- ***Interface Design for Diverse Populations*** *(4)*

This course deals with User Interface design specifically in the context of ICT applications. ICT applications that are rolled out online have a unique challenge of being accessible to wide cross sections of the population involving diversity in language, literacy levels, technology availability and cultural preferences. Students completing this course will have had an exposure to user

interface design that is agnostic to specific demographics of the population. The course would focus on generic principles of UI design (learnability, visibility, error prevention, efficiency, and graphic design), key technologies that are in vogue and policy aspects relating accessibility. All this will be discussed in relation to the human capabilities (including perception, motor skills, color vision, attention, and human error) that motivate the need for effective UI design.

- ***Quantitative Methods****(3 credits)*

The course will provide students an overview of their statistical foundations. It will equip students with methods pertaining to collecting and describing quantitative data including sampling methods and measures of location (central tendency), dispersion and distribution. The course will also train students in using appropriate analytical methods including linear regression models and inferential procedures as part of analyzing quantitative data. In addition to learning about these descriptive and inferential statistical methods and models of quantitative research conceptually, the students will be given computer-based exercises to perform quantitative analysis.

- ***Qualitative Methods*** *(3 credits)*

This course will provide an overview of the philosophical foundations of qualitative research methodologies. It will introduce the students to the major forms of qualitative research methods such as, life histories, focus groups, participation-observation, action research, and ethnographies. The course will train students to analyze the ethical implications, the strengths and limitations of each of the methods, the conditions under which each of the methods is used, as well as the generalizability and purpose of each of the methods. In addition, students will be trained in analyzing and presenting the different forms of data collected through these methods.

- ***Technology and Society*** *(4 credits)*

Technology can be studied in its different dimension as it comprises of facts, artifacts, know-how, processes and last but not the least contexts. Understanding the context of technology turns our focus to the relationship between technology and society. The relationship between technology and society is an established field of studies within social sciences and humanities. This introductory course, notwithstanding the depth and magnitude of this field of studies, provides a preliminary and cursory overview of all these approaches across three aspects of technology, such as production of technology, consumption/reception of technology and impact of technology. In analyzing these varied aspects of technology this course will serve a basic objective, that is, to demonstrate how the relationship between technology and society is mutually inclusive.` The main objective of the course is to expose students to non-deterministic ways of thinking about technology.

**Semester 2**

- ***Engineering and Management of Large Digital Systems*** *(4 credits)*

A recent research study by University of Oxford and McKinsey & Company reveals that 71% of large IT projects face cost overruns and 33% are more than 50% over budget; they are also found to deliver 56% less value than predicted[7]. This is often a result of inconsistencies in managing the

[7] http://www.mckinsey.com/insights/business_technology/developing_talent_for_large_it_projects

design and deployment processes in these projects and it is this that the proposed course will be concerned with. Students will be introduced to conceptual frameworks and practices involved in the engineering of IT projects drawn largely from theoretical positions developed in the discipline of software engineering related to requirements specification, system architecture, design and testing and process maturity models in the first part of the course. The second part will introduce the principles involved in managing project implementation covering aspects such as project planning, scheduling, resource allocations and tracking, risk and change management etc. To the extent feasible, relevant modules from the project management methodology developed by Project Management Institute will be used to illustrate these project management principles.

- ***The Digital and Its Discontents*** *(4 credits)*

This course explores the multiplicity of social inequalities in India and the ways in which development thinking is linked to them in our contemporary digital society. Students will be trained to recognize and analyze social divides such as gender, caste, class, and region. The course will provide students a framework to examine how these divides have been progressively conceptualized and addressed with the trajectory of development discourse since post-war times as an example. While presenting a comprehensive analysis of different theories and practices of development, this course will focus on two dimensions: first, how are some of the classical inequalities and debates of development reproduced in the digital space and, second, how does the digital space give birth to new issues of contestation within the broader development discourse. This course will serve as a crucial bridge for students to pursue electives such as Internet and Identity, Gender and ICT, E-Governance and Democracy, ICT in Education, Digital Technologies for Healthcare, and Technology and Poverty in subsequent semesters.

- ***Information and Communication Technology Policy and Regulation***[8]

This course will provide an overview of how laws, technology and economics shape public policies of the ICT sector. It will focus on how laws can be used to influence and guide technological change; the underlying regulatory economics that form the basis of policies; responses of the legal system to social and ethical problems created by new or existing technology; and how emerging technologies can be nurtured and governed through innovative policies and regulation. In particular this course will cover topics including telecommunications and Internet regulation; privacy and freedom of speech; intellectual property rights; standards setting; universal access to information and communication technologies.

**Summer Semester**

- ***Information Management*** *(2 credits)*

Information Management is an area of study that deals with different aspects dealing with digital information. The specific topics of relevance to this course are information modeling, information storage and retrieval. After they complete this course, the students should be able to pursue next level courses in the areas of software application development, data analysis, information architecture and so on.

- ***Project Elective*** *(4 credits)*

This project elective requires students to apply insights from their courses in semesters 1 and 2, particularly the courses on large digital systems, and interface design. A module on technical communication will be integrated into the project elective to enhance student presentations on the

[8] http://student.mit.edu/catalog/search.cgi?search=ESD.132&style=verbatim

research process and their findings/ conclusions.

**Semester 3**

***Seminar (2 credits)***

Students will present their plans for their thesis or internship in this seminar. They will discuss their research questions, or work goals, including how they are thinking about the next semester in view of their insights from their course and project work.

### 3.4.3 Electives

Students are required to take five elective courses from a list of open electives and a project elective. Table 3 provides an indicative (not exhaustive) list of electives that will be made available to students in their second and third semesters. Electives will focus on specific technologies such as cloud or mobile platforms, social media and spatial-information systems; data analytics; human-computer interaction and/or domain-specific understanding of the technology-society interface, including issues pertaining to education, governance, gender, identity, poverty, and public health. Special attention will be given to provide enough options in both technology and social science electives, so that students can take up electives depending on their specific interests in sectors and domain pertaining to the "digital".

**Table 3: Tentative List of Open Electives**

| | |
|---|---|
| • Dynamics of IT Industry<br>• E governance and Democracy<br>• Gender and Technology<br>• Internet and Identity<br>• ICT in Education<br>• ICT Contract Management<br>• Open Data and Transparency<br>• Techno-economics of Networks<br>• Technology and Poverty | • Digital Technologies for Healthcare<br>• Geographic Information Systems<br>• Human Computer Interaction<br>• Mobile Technologies for Social Sector<br>• Web Science<br>• Advanced Research Methods<br>• ICT Product Development and Management |

*Students can also take maximum one course from already existing courses for MTech given they meet the prerequisite criteria as set by the instructors . This limit does not apply to courses which are cross listed between M.Tech and M.Sc(DS) .

### 3.4.4 Thesis/Internship

The 4th semester will consist of a 26-week thesis/internship. Students will earn 16 credits on its successful completion.

For the students pursuing Internship:

- Internships are six months (not less than five months) of supervised project work carried out at any of the relevant institutes in public, private and social sector or at academic institutions.
- The internship committee will ensure that mid-term feedback is collected for every student pursuing internship to ensure smooth progress towards completion.
- At the time of internship completion, the internship committee will also collect the certificate (satisfactory/unsatisfactory) from concerned persons at the organization. If the

| | |
|---|---|
| **Course Name** | **Digital Components of a Connected Society** |
| **Course Branch** | MSc (Digital Society) |
| **Course Proposer Name(s)** | Prof. PG Poonacha |
| **Course Instructor Name(s)** | Prof. PG Poonacha |
| **Course Type** | Core |
| **Course Level** | Level 1 |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | Lecture (3) +Tutorial (1)=4 Credits |
| **Grading Scheme** | A,A-,B+,B,B-,C+,C,D,F |

**Pre-Requisites**

None

**Course Description**

The Digital Society is a result of a large number of digital components that were developed in the last 75 years around digital computer to communicate, store and process data. This course gives an overview of the network of computing devices and communication links which has made the Digital Society possible.

**Course Outcomes**

- Understanding the role of different digital components in the connected world
- Good understanding of some of the components and their interconnections

**Course Content**

Computers: Binary representation and Basic Arithmetic. Computer Architecture. Operating Systems and compilers

Communication: Basics of Digital Transmission and characteristic of Radio propagation. Narrow-band cellular systems (GSM). Wideband Cellular Systems (CDMA, OFDM).

Data Networks: Access Mechanisms and Quality of Service Metrics

Internet Network architecture. FTP, HTTP and WWW, Servers, Gateways and clouds. Privacy and Security Issues over Internet. Simple examples to achieve privacy and security.

Wireless sensor network architectures, communication protocols and Internet of Things/Humans

**Assessments / Grading**

Suggested assessment criteria:

- Assignments --- 20%
- Midterm Exam – 20%
- Paper submission/presentation. Some general reading references are given below - 30%
- End Sem Exam – 20%

**Text Book / References**

Articles from : http://www.internetsociety.org
Articles from IEEE Magazines and web.
Cellular Technologies For Emerging Markets 2G, 3G And Beyond Ajay R. Mishra Nokia Siemens Networks, John Wiley and Sons, 2010
General Reading: References:

The Zero Marginal Cost Society: The Internet of Things, the Collaborative Commons, and the Eclipse of Capitalism – 2014 Jeremy RifkinThe Third Industrial Revolution: How Lateral Power Is Transforming Energy, the Economy, and the World, 2013, Jeremy Rifkin

The Rise of the Network Society: The Information Age: Economy, Society, and Culture Volume I Paperback – August 17, 2009by Manuel Castells

| | |
|---|---|
| **Course Name** | **Interface Design for Diverse Populations** |
| **Course Branch** | MSc (Digital Society) |
| **Course Proposer Name(s)** | Prof. G.Srinivasaraghavan |
| **Course Instructor Name(s)** | TBD |
| **Course Type** (Select one) | Core |
| **Course Level** (Select one) | Level 1 |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | Lecture (2)+Tutorial (1)+Practical (1)= 4 Credits |
| **Grading Scheme** | A,A-,B+,B,B-,C+,C,D,F |

**Pre-Requisites**

(where applicable, specify exact course names)

None

**Course Description**

This course deals with User Interface design specifically in the context of ICT applications. ICT applications that are rolled out online have a unique challenge of being accessible to wide cross sections of the population involving diversity in language, literacy levels, technology availability and cultural preferences.

The following is the highly recommended standard textbook for UI design.

Mullet, Kevin, and Darrell Sano. Designing Visual Interfaces: Communication Oriented Techniques. Prentice Hall, 1994. ISBN: 9780133033892.

The following textbooks and study materials are recommended as additional reference:

- Baecker, Ronald M., Jonathan Grudin, et al. Readings in Human-Computer Interaction: Toward the Year 2000. 2nd ed. Morgan Kaufmann, 1995. ISBN: 9781558602465. [Preview with Google Books]
- Raskin, Jef. The Humane Interface: New Directions for Designing Interactive Systems. Addison-Wesley Professional, 2000. ISBN: 9780201379372. [Preview with Google Books]
- Jhonson, Jeff. GUI Bloopers: Don'ts and Do's for Software Developers and Web Designers (Interactive Technologies). Morgan Kaufmann, 2000. ISBN: 9781558605824. [Preview with Google Books]
- Card, Stuart K., Thomas P. Moran, and Allen Newell, eds. The Psychology of Human-Computer Interaction. Lawrence Erlbaum, 1983. ISBN: 9780898592436. [Preview with Google Books]

| | |
|---|---|
| **Course Name** | **Studying the Digital: Qualitative Methods** |
| **Course Branch** | MSc (Digital Society) |
| **Course Proposer Name(s)** | Prof. Jillet Sarah Sam |
| **Course Instructor Name(s)** | Prof. Jillet Sarah Sam |
| **Course Type** | Core |
| **Course Level** | Level 1 |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | Lecture (3)+Tutorial (1)= 4 credits |
| **Grading Scheme** | (A,A-,B+,B,B-,C+,C,D,F) |
| **Pre-Requisites**<br>(where applicable, specify exact course names) | |
| None | |
| **Course Description** | |
| This course will provide an overview of the philosophical foundations of qualitative research methodologies and introduce the students to the major forms of qualitative research methods. The course will train students to analyze the ethical implications, the strengths and limitations of each of the methods, the conditions under which each of the methods is used, as well as the generalizability and purpose of each of the methods. In addition to learning about specific methods such as life histories, focus groups, participation-observation, action research, and ethnographies, the students will be trained in analyzing and presenting the different forms of data collected through these methods. | |
| Course Outcomes | |

The following is a list of required references:

Geertz, Clifford (1973). The Interpretation of Cultures. New York: Basic Books Inc.

Hine, Christine (2005) Virtual Methods: Issues in Social Science Research on the Internet. Oxford; New York: Berg.

Jones, Steve (1999) Doing Internet Research: Critical Issues and Methods for Examining the Net. Thousand Oaks, CA: Sage.

Markham, Annette and Nancy Baym. (2009) Internet Inquiry: Conversations about Method. Thousand Oaks, CA: Sage.

Miles, M. B., & Huberman, A. M. (1994). Qualitative data analysis: An expanded sourcebook. Thousand Oaks, CA: Sage.

Wolcott, H. F. (2002). Sneaky kid and its aftermath: Ethics and intimacy in fieldwork. Walnut Creek, CA: Alta Mira Press.

Wolcott, H. F. (1994). Transforming qualitative data: Description, analysis, and interpretation. Thousand Oaks, CA: Sage.

Warren, C.A.B. & Karner, Tracy X. (2005). Discovering qualitative methods: Field research, interviews, and analysis. CA: Roxbury Publishing Company.

| | |
|---|---|
| **Course Name** | **Quantitative Research Methods** |
| **Course Branch** | MSc (Digital Society) |
| **Course Proposer Name(s)** | Prof. Amit Prakash & Dr.Mandar Kulkarni |
| **Course Instructor Name(s)** | Prof. Amit Prakash & Dr.Mandar Kulkarni |
| **Course Type** | Core |
| **Course Level** | Level 1 |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | Lecture (2)+Tutorial (1)=3 credits |
| **Grading Scheme** | (A,A-,B+,B,B-,C+,C,D,F) |
| **Pre-Requisites**<br>(where applicable, specify exact course names) | |
| None | |
| **Course Description** | |

Reference Books


- Levin, R. I., and Rubin, D. S. (1995). Statistics for Management, Sixth Edition. New Delhi, India: Prentice-Hall of India Private Limited. ISBN: 81-203-0893-X.
- Trosset, M. W. (2009). An Introduction to Statistical Inference and Its Application with R. Chapman and Hall/CRC. ISBN-13: 978-1584889472; ISBN-10: 1584889470.
- Vanderstoep, S. W., and Johnston, D. D. (2009). Research Methods for Everyday Life: Blending Qualitative and Quantitative Approaches. San Francisco, CA: Jossey-Bass, A Wiley Imprint. ISBN: 978-0-470-34353-1.
- Gray, P. S., Williamson, J. B., Karp, D. A., and Dalphin, J. R. (2007). The Research Imagination: An Introduction to Qualitative and Quantitative Methods. Cambridge, UK: Cambridge University Press. ISBN-13: 978-0-521-70555-4; ISBN-10: 0-521-70555-X.
- Bertsekas, D. P., and Tsitsiklis, J. N. (2002). Introduction to Probability. Massachusetts, USA: Athena Scientific. ISBN: 1-886529-40-X.


| **Course Name** | **Technology and Society** |
|---|---|
| **Course Branch** | MSc (Digital Society) |
| **Course Proposer Name(s)** | Prof.Bidisha Chaudhuri |
| **Course Instructor Name(s)** | Prof. Bidisha Chaudhuri |
| **Course Type** | Core |
| **Course Level** | Level 1 |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | Lecture (3)+ Tutorial (1)= 4 credits |
| **Grading Scheme** | A,A-,B+,B,B-,C+,C,D,F |
| **Pre-Requisites (where applicable, specify exact course names)** | |
| NA | |
| **Course Description** | |
| Technology can be studied in its different dimension as it comprises of facts, artifacts, know-how, processes and last but not the least contexts. Understanding the context of technology turns our focus to the relationship between technology and society. The relationship between technology and society is an established field of studies within social sciences and humanities. This introductory course, notwithstanding the depth and magnitude of this field of studies, provides a preliminary and cursory overview of all these approaches across three aspects of technology, such as production of technology, consumption/reception of technology and impact of technology. In analyzing these varied aspects of technology this course will serve a basic objective, that is, to demonstrate how the relationship between technology and society is mutually inclusive.' | |
| **Course Outcomes**<br>By the end of the course students are expected to Understand and Know: | |

the Philosophy of Technology. Willey-Blackwell, 2012

- Sismondo, Sergio. An Introduction to Science and Technology Studies. London: Blackwell, 2010

**Journal Articles**:

- Barley, Stephen R. "What can we learn from the history of technology?." Journal of Engineering and Technology Management 15.4 (1998): 237-255
- Bijker, W.E. Of Bicycles, Bakelites and Bulbs: Toward a Theory of Sociotechnical Change. MIT Press, 1997
- Bromley, D. Allan. "Science, technology, and politics." Technology in Society 24.1 (2002): 9-26
- Marx, Leo. "Technology The Emergence of a Hazardous Concept" Technology and Culture, 51(3), July 2010, pp. 561-577
- Winner, Langdon. "Upon opening the black box and finding it empty: Social constructivism and the philosophy of technology." Science, Technology, & Human Values 18.3 (1993): 362-378

Additional readings will be circulated as and when required.

| **Course Name** | **Engineering and Management of Large Digital Systems** |
|---|---|
| **Courses Branch** | MSc (Digital Society) |
| **Course Proposer Name(s)** | Prof. Amit Prakash |
| **Course Instructor Name(s)** | Prof. Amit Prakash |
| **Course Type** | Core |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | Lecture (3)+Tutorial (1)= 4credits |
| **Grading Scheme** | ,A-,B+,B,B-,C+,C,D,F |

**Pre-Requisites (where applicable, specify exact course names)**

NA

**Course Description**

A recent research study by University of Oxford and McKinsey & Company reveals that 71% of large IT projects face cost overruns and 33% are more than 50% over budget; they are also found to deliver 56% less value than predicted. This is often a result of inconsistencies in managing the design and deployment processes in these projects and it is this that the proposed course will be concerned with. Students will be introduced to conceptual frameworks and practices involved in the engineering of IT projects drawn largely from theoretical positions developed in the discipline of systems engineering related to requirements specification, system architecture, design and testing and process maturity models in the first part of the course. The second part will introduce the principles involved in managing project implementation covering aspects such as project planning, scheduling, resource allocations and tracking, risk and change management etc. To the extent feasible, relevant modules from the project management methodology developed by Project Management Institute will be used to illustrate these project management principles.

**Course Outcome**

**At the end of the course students are expected to UDERSTAND :**

- The basic concepts of systems engineering and its various constituents
- The various processes involvedin the design of IT systemsincluding in the phases of requirement specification, conceptual, preliminary and component level architecture and design

- A Guide to the Project Management Body of Knowledge (Fifth Edition). Project Management Institute. 2013.
- Scott Berkun. 2008. Making Things Happen: Mastering Project Management (Theory in Practice). O'Reilly.

Other relevant references drawn from research and practitioner articles will also be used for various topics, wherever required.

| | |
|---|---|
| **Course Name** | **The Digital and its Discontents** |
| **Course Branch** | MSc (Digital Society) |
| **Course Proposer Name(s)** | Prof. Janaki Srinivasan |
| **Course Instructor Name(s)** | Prof. Janaki Srinivasan |
| **Course Type** | Core |
| **Course Level** | Level 1 |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | Lecture (3)+ Tutorial(1) = 4 credits |
| **Grading Scheme** | (A,A-,B+,B,B-,C+,C,D,F) |

**Pre-Requisites**

*(where applicable, specify exact course names)*

None

**Course Description**

This course explores how the digital space shapes a multiplicity of social inequalities in contemporary society. Students will be trained to recognize social divides rooted in gender, caste, race, class, and region, and understand how these divides have been progressively conceptualized and addressed. The course will focus on two dimensions of social divides in the digital era: first, how classical inequalities and debates about them are reproduced in the digital space and, second, how the digital space might open up opportunities to challenge these divides. A majority of the course will be focused on examining these themes with the example of socio-economic divides and the trajectory of development thinking since the 1950s. This course will serve as a crucial bridge for students to pursue electives such as Internet and Identity, Gender and ICT, E-Governance and Democracy, ICT in Education, Digital Technologies for Healthcare, and Technology and Poverty in subsequent semesters.

**Course Outcomes**

At the end of this course, following are expected outcomes.

The student is expected to UNDERSTAND and KNOW:

- Types of social divides, and their roots in gender, class, caste, race and region
- Theories of development and contemporary debates around them

International Institute of Information Technology Bangalore

# 46th Meeting of the Senate

## Minutes of the Meeting

Date: July 1, 2015

Time: 2:00pm

Venue: IIITB Board Room

26/C, Electronics City, Hosur Road Bangalore 560100 Phone: 080 41407777

Annexure - 2

## Course Proposal - GEN 503

| | |
|---|---|
| **Course Name** | GEN 503 Probability Theory and Statistics |
| **Course Proposer Name(s)** | Prof. V. N. Muralidhara |
| **Course Instructor Name(s)** | Prof. Neelam Sinha<br>Prof. Jaya Sreevalsan Nair, |
| **Course Type** *(Select one)*<br>*"Special Topics" course proposals to be shared with faculty members for any feedback; but Academic Senate approval is not needed. All other course types need Academic Senate approval.* | • Core |
| **Credits** | 2 |
| **Grading Scheme** | • 4-point scale (A,A-,B+,B,B-,C+,C,D,F) |
| **Area of Specialization (if applicable)**<br>**CS** - Computer Science<br>**DS** - Data Sciences<br>**NC&E** - Networking & Communication and Embedded Systems<br>**SE** - Software Engineering | (Choose at most two areas from the list) |
| **Semester** | Term: I<br>Academic Year: 2015-16 |
| **Pre-Requisites (where applicable, specify exact course names)** | |
| | |
| **Course Description** | |
| This course provides an introduction to concepts in Probability Theory and Statistics, which are used widely in designing engineering systems in Information Technology. | |
| **Course Content** | |

## Course Proposal - GEN 502

| | |
|---|---|
| **Course Name** | GEN 502 Discrete Mathematics |
| **Course Proposer Name(s)** | Prof. Meenakshi D'Souza<br>Prof. V. N. Muralidhara |
| **Course Instructor Name(s)** | Prof. Meenakshi D'Souza |
| **Course Type** *(Select one)*<br>*"Special Topics" course proposals to be shared with faculty members for any feedback; but Academic Senate approval is not needed. All other course types need Academic Senate approval.* | Core |
| **Credits** | 2 |
| **Grading Scheme** | 4-point scale<br>(A,A-,B+,B,B-,C+,C,D,F) |
| **Area of Specialization (if applicable)**<br>**CS** - Computer Science<br>**DS** - Data Sciences<br>**NC&E** - Networking & Communication and Embedded Systems<br>**SE** - Software Engineering | Not applicable. |
| **Semester** | Term: I<br>Academic Year: 2015-16 |

**Pre-Requisites (where applicable, specify exact course names)**

None.

**Course Description**

This course provides an introduction to concepts in Discrete Mathematics at a post-graduate level, which are used widely in designing engineering systems in Information Technology.

**Course Content**

- Set Theory, sequences, summations
- Logic: Propositional logic and predicate logic
- Functions, relations, equivalence relations, partial orders
- Combinatorics: Sum rule, product rule, pigeon hole principle, binomial coefficients, generalized permutations and combinations, inclusion-exclusion, generating functions
- Induction and Recursion: Mathematical induction, strong induction, well ordering, recursion

**Assessments (optional for Special Topics courses)**

Mid-term exam, final exam, class tests.

**Text Book / References**

1. Kenneth Rosen, Discrete Mathematics and its applications, Mc-GrawHill, 7th edition, 2012.

*Prep Term: July; Term I: Aug - Nov; Term II: Jan - Apr; Term III: Jun - July;*

Course Proposal - GEN 504

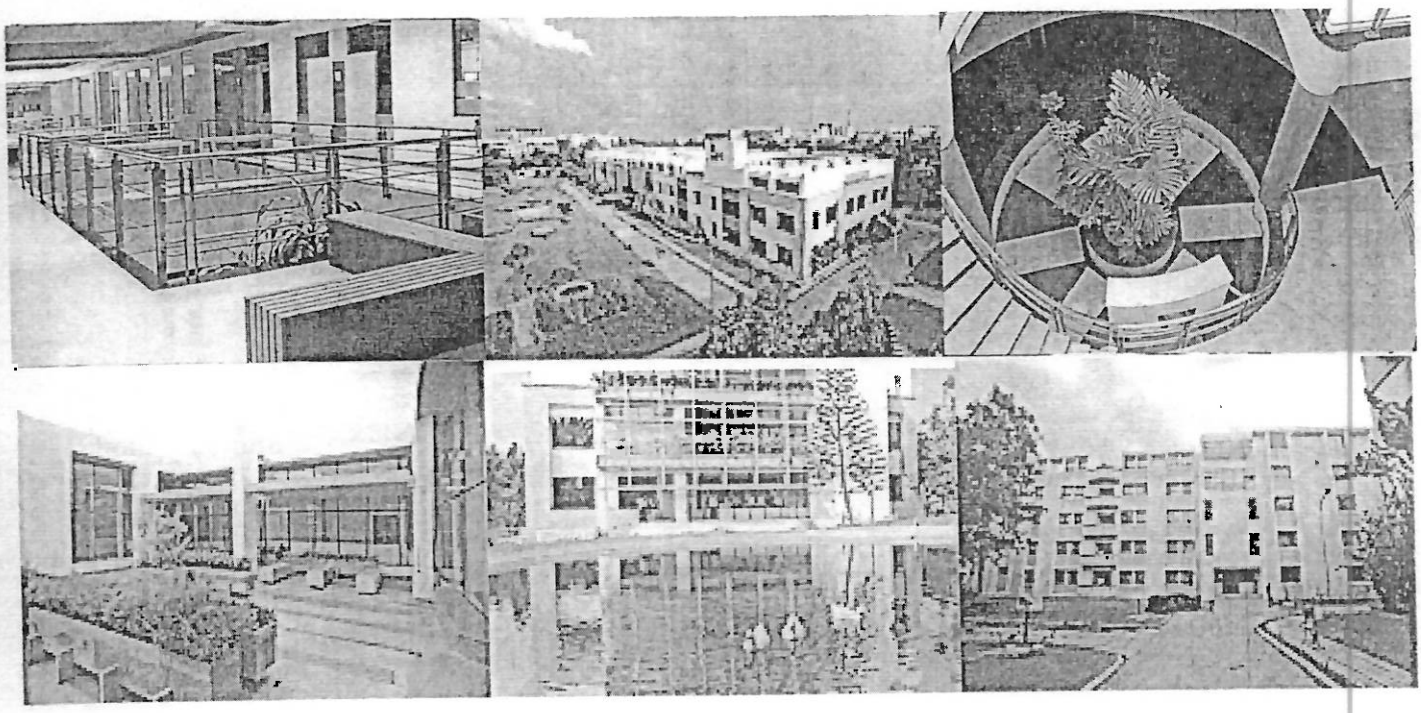
| | |
|---|---|
| **Course Name** | GEN 504 Linear Algebra |
| **Course Proposer Name(s)** | Prof. V. N. Muralidhara |
| **Course Instructor Name(s)** | Prof. Jaya Sreevalsan Nair,<br>Prof. Neelam Sinha |
| **Course Type** *(Select one)*<br>*"Special Topics" course proposals to be shared with faculty members for any feedback; but Academic Senate approval is not needed. All other course types need Academic Senate approval.* | • Core |
| **Credits** | 2 |
| **Grading Scheme** | • 4-point scale<br>(A,A-,B+,B,B-,C+,C,D,F) |
| **Area of Specialization (if applicable)**<br>**CS** - Computer Science<br>**DS** - Data Sciences<br>**NC&E** - Networking & Communication and Embedded Systems<br>**SE** - Software Engineering | (Choose at most two areas from the list) |
| **Semester** | Term: I<br>Academic Year: 2015-16 |
| **Pre-Requisites (where applicable, specify exact course names)** | |
| | |
| **Course Description** | |
| This course provides an introduction to concepts in Linear Algebra, which are used widely in designing engineering systems in Information Technology. | |
| **Course Content** | |

Annexure I

# INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY, BANGALORE

## 47th Meeting of the Senate

## Minutes of the Meeting



Date: August 19, 2015
Time: 2.00 p.m.
Venue: IIITB Board Room

26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777

INTERNATIONAL INSTITUTE
OF INFORMATION TECHNOLOGY BANGALORE
26/C, Electronics City, Hosur Road, Bangalore 560 100
Phones: 080-28527627-635, 41407777; Fax: 080-28527636
Website :www.iiitb.ac.in

Date: September 14, 2015

**Sub: Minutes of 47th Senate meeting of the International Institute of Information technology, Bangalore held on August 19, 2015 at 2.00 pm.**

Dear Sir/Madam,

Please find herewith attached Minutes of the 47th Meeting of the Senate of IIITB held on August 19, 2015 in the Board Room of IIIT B at 2.00 PM.

Best Regards

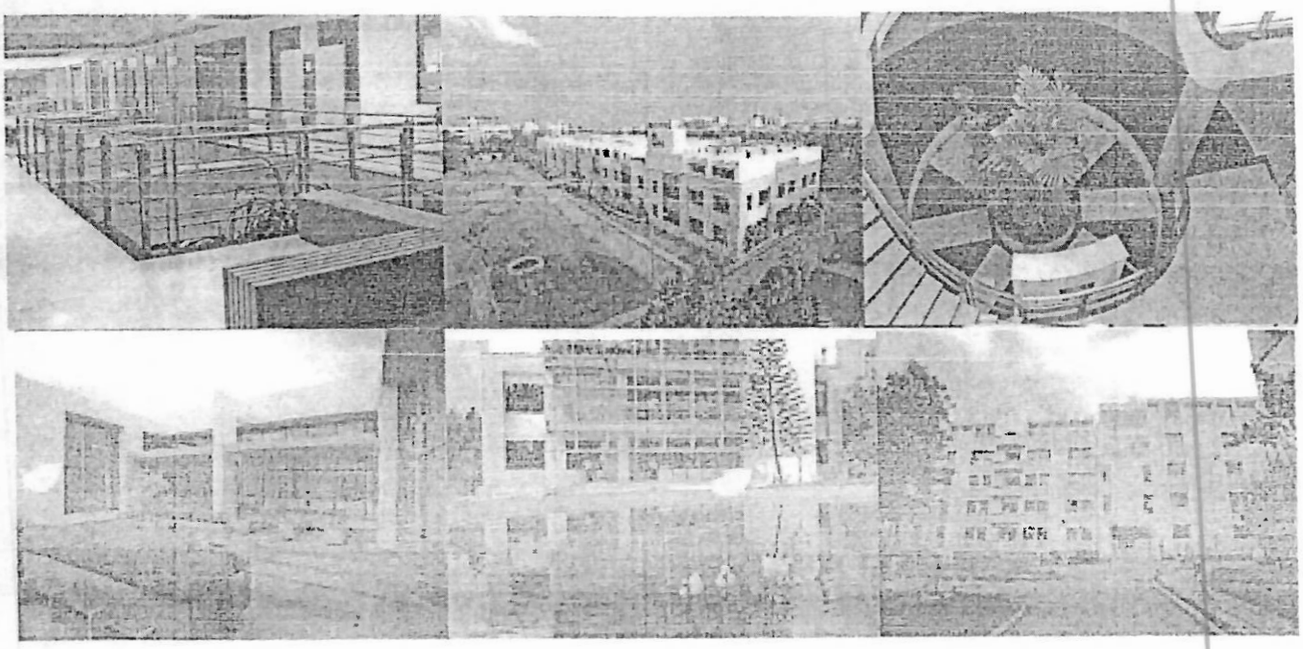
(V S Prakash)
Registrar &
Secretary to the Senate

Annexure 1

# INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY, BANGALORE

## 48th Meeting of the Senate

## Minutes of the Meeting



Date: December 9, 2015
Time: 2.00 p.m.
Venue: IIITB Board Room

26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777

The Senate also noted that keeping in mind the long-term vision of a research-oriented degree programme, this decision must be revisited in the future once sufficient faculty strength is there to enable supervision of Master's Thesis for the entire batch of students.

The Senate also suggested that keeping in mind the logistics of sequencing the activities, the Master's project work in the industry for iMTech students be done in the 10th semester rather than 9th semester. This will help leverage the on-going internship and placement activities without any disruption or additional cycles in the same year.

b) IT in Domains

The Senate suggested that electives in the category of "IT in Domains" be retained as is and not to merge it with "IT Electives" at this time.

**47.5. Restructuring M.Tech. "GEN 501 Mathematics for IT" Core Course**

The M. Tech. core course GEN 501 Mathematics for IT is a 4 credit course comprised of 4 modules: Probability Theory and Statistics, Linear Algebra and Matrix Theory, Discrete Mathematics, Optimization - Convex Programming. A committee comprising the faculty members who had taught the course previously and the M. Tech Programme Coordinator was formed in the month of January 2015 to review the course. The members of the committee are Prof. Meenakshi D'souza, Prof. Neelam Sinha, Prof. P G Poonacha, Prof. GNS Prasanna, Prof. G Srinivasa Raghavan and Prof. Muralidhara VN. The key observations of the committee are as follows:

- It was not easy to identify one or two faculty members to teach all the four modules of the course.
- It was felt that more time is required for each of the modules.
- There is no room in the Curriculum to increase the number of courses.
- Not all the four modules are required for all the elective courses. For example, Discrete maths may not be required for Networking and Communication courses.
- Optimization is not covered in any core course for in the iM.Tech Curriculum, there will be separate elective courses common to both M.Tech and iMtech students covering various aspects of Optimization. It was observed that none of the electives had optimization as a prerequisite.

Further to the comments of the committee, a proposal for some changes to the course was presented to the Senate. The Senate discussed and approved the following changes to the course:

- Split the course into three separate courses of 2 credits each:
  - (a) Probability Theory and Statistics (2 credits)
  - (b) Linear Algebra (2 credits)
  - (c) Discrete Mathematics (2 credits)
- Students have to choose at least two out of the three modules.

The approved course proposal documents are included in Annexure -1.

**47.6. Proposal for a new letter grade 'W'**

The Senate suggested that the implications of the proposed grade 'W' be studied further and a holistic review of other possible transitional grades be carried out. Inputs from other universities' grade policies may be taken into consideration too and a revised proposal be placed for the Senate.

**47.7. Items for Reporting:** The senate noted the details provided.

**47.7.8** Medical leave was sanctioned from February 2014 till July 2015 to Mr Satyabrat student Roll no. MS2012008. The said student is under the supervision of Prof P G Poonacha and Prof Neelam Sinha. He has joined the institute.

**47.7.9** Senate noted the announcement of call-for-applications for admissions to Ph.D. programme in January 2016.

**47.7.10** 48th meeting of the Senate of IIITB is scheduled to be held on October 14, 2015.

**47.8 Any other item(s) with the permission of the Chair:**
Chairman thanked the members.and the meeting ended with thanks to the Chair

**********

Annexure - 1

## Course Proposal - GEN 503

| | |
|---|---|
| **Course Name** | GEN 503 Probability Theory and Statistics |
| **Course Proposer Name(s)** | Prof. V. N. Muralidhara |
| **Course Instructor Name(s)** | Prof. Neelam Sinha<br>Prof. Jaya Sreevalsan Nair, |
| **Course Type** *(Select one)*<br>*"Special Topics" course proposals to be shared with faculty members for any feedback; but Academic Senate approval is not needed. All other course types need Academic Senate approval.* | • Core |
| **Credits** | 2 |
| **Grading Scheme** | • 4-point scale (A,A-,B+,B,B-,C+,C,D,F) |
| **Area of Specialization (if applicable)**<br>**CS** - Computer Science<br>**DS** - Data Sciences<br>**NC&E** - Networking & Communication and Embedded Systems<br>**SE** - Software Engineering | (Choose at most two areas from the list) |
| **Semester** | Term: I<br>Academic Year: 2015-16 |
| **Pre-Requisites** (where applicable, specify exact course names) | |
| | |
| **Course Description** | |
| This course provides an introduction to concepts in Probability Theory and Statistics, which are used widely in designing engineering systems in Information Technology. | |
| **Course Content** | |

## Course Proposal - GEN 502

| | |
|---|---|
| **Course Name** | GEN 502 Discrete Mathematics |
| **Course Proposer Name(s)** | Prof. Meenakshi D'Souza<br>Prof. V. N. Muralidhara |
| **Course Instructor Name(s)** | Prof. Meenakshi D'Souza |
| Course Type *(Select one)*<br>*"Special Topics" course proposals to be shared with faculty members for any feedback; but Academic Senate approval is not needed. All other course types need Academic Senate approval.* | Core |
| Credits | 2 |
| **Grading Scheme** | 4-point scale<br>(A,A-,B+,B,B-,C+,C,D,F) |
| **Area of Specialization (if applicable)**<br>**CS** - Computer Science<br>**DS** - Data Sciences<br>**NC&E** - Networking & Communication and Embedded Systems<br>**SE** - Software Engineering | Not applicable. |
| **Semester** | Term: I<br>Academic Year: 2015-16 |
| Pre-Requisites (where applicable, specify exact course names) | |
| None. | |
| **Course Description** | |
| This course provides an introduction to concepts in Discrete Mathematics at a post-graduate level, which are used widely in designing engineering systems in Information Technology. | |
| Course Content | |
| • Set Theory, sequences, summations<br>• Logic: Propositional logic and predicate logic<br>• Functions, relations, equivalence relations, partial orders<br>• Combinatorics: Sum rule, product rule, pigeon hole principle, binomial coefficients, generalized permutations and combinations, inclusion-exclusion, generating functions<br>• Induction and Recursion: Mathematical induction, strong induction, well ordering, recursion | |
| Assessments (optional for Special Topics courses) | |
| Mid-term exam, final exam, class tests. | |
| **Text Book / References** | |

1. Kenneth Rosen, Discrete Mathematics and its applications, Mc-GrawHill, 7th edition, 2012.

*Prep Term: July; Term I: Aug - Nov; Term II: Jan - Apr; Term III: Jun - July;*

## Course Proposal - GEN 504

| | |
|---|---|
| **Course Name** | GEN 504 Linear Algebra |
| **Course Proposer Name(s)** | Prof. V. N. Muralidhara |
| **Course Instructor Name(s)** | Prof. Manisha Kulkarni |
| **Course Type** *(Select one)* *"Special Topics" course proposals to be shared with faculty members for any feedback; but Academic Senate approval is not needed. All other course types need Academic Senate approval.* | • Core |
| **Credits** | 2 |
| **Grading Scheme** | • 4-point scale (A,A-,B+,B,B-,C+,C,D,F) |
| **Area of Specialization (if applicable)**<br>CS - Computer Science<br>DS - Data Sciences<br>NC&E - Networking & Communication and Embedded Systems<br>SE - Software Engineering | (Choose at most two areas from the list) |
| **Semester** | Term: I<br>Academic Year: 2015-16 |
| **Pre-Requisites (where applicable, specify exact course names)** | |
| | |
| Course Description | |
| This course provides an introduction to concepts in Linear Algebra, which are used widely in designing engineering systems in Information Technology. | |
| Course Content | |

Annexure II - 1

# Introduction to Ethics

| | |
|---|---|
| **Course Name** | Introduction to Ethics |
| **Course Proposer Name** | Chetan D. Parikh |
| **Course Instructor Name** | Chetan D. Parikh |
| **Course Type** | Elective |
| **Credits** | 4 |
| **Grading Scheme** | 4-point scale (A,A-,B+,B,B-,C+,C,D,F) |
| **Area of Specialization** | HSS |
| **Semester** | Term: II<br>Academic Year: 2015-16 |

**Pre-Requisites**

English, HSS M I, HSS M II.

**Course Description**

Ethics is controversial and difficult to teach. But developing the ability to think about and answer ethical questions in an objective and mature manner is an essential skill as a
professional and a human being.

This course will expose students to the various aspects of the field of ethics, and through readings, group discussions and reflections, it will develop in students the analytical and cognitive skills to think logically as well as intuitively about ethical issues, to engage in rational discussions, and to arrive at their own conclusions.

A student completing this course will acquire the abilities to:

- Explain important concepts, principles and theories of ethics
- Apply these principles and theories to ethical decision-making as an engineer and a human being.
- Engage in discussions about ethical questions and present logically

**Course Content**

1. Introduction
2. Metaethics: Why should I be moral? Can there be a universal ethics? Where do
ethical values come from?
3. Normative ethics: Theories of philosophers: Aristotle, Kant, Rousseau, Bentham.
Theories of religions: Hindu, Buddhist, Christian, Muslim, Baha'i.

Annexure II - 2

# Course Proposal Template

| | |
|---|---|
| **Course Name** | **Geometric Modelling** |
| **Course Proposer Name(s)** | **Prof. T. K. Srikanth,** |
| **Course Instructor Name(s)** | **Prof. T. K. Srikanth,** |
| Course **Type** *(Select one)*<br>*All course types except "Special Topics" go through the process for Academic Senate approval* | Select one from the following:<br>• Core<br>• Regular Elective ✓<br>• Preparatory-Mandatory<br>• Preparatory-Optional |
| Credits | 4 |
| Grading **Scheme** | • 4-point scale ✓<br>(A,A-,B+,B,B-,C+,C,D,F) |
| **Area of Specialization (if applicable)**<br>**CS** – Computer Science<br>**DBIS** – Database and Information Systems<br>**NC&E** – Networking & Communication and Embedded Systems | (Choose at most two areas from the list)<br>CS |
| **Semester** | Term: (I / II / III ✓ / Prep)<br>Academic Year: 2016-17 |
| **Pre-Requisites (where applicable, specify exact course names)** | |
| Good understanding of linear algebra and geometry<br>Good object oriented programming skills (C++ preferable)<br>CS 606 - Computer Graphics (preferred) | |
| Course **Description** | |
| This course aims at introducing the basics of geometric modelling, specifically curve, surface and solid modelling, as relevant to Computer Graphics, medical visualization and 3D Printing. The course explores computational and representational techniques for geometric objects in these domains, as well as geometric algorithms involving such objects, covering traditional solid modelling as well as data-driven surface and volume modelling. The course includes implementation of geometric algorithms, programmatic design of geometric models using 3D modelling tools, and 3D printing. | |
| Course **Content** | |
| Module 1: Curves and Surfaces | |

ANNEXURE II - 3

# Course Proposal

| | |
|---|---|
| **Course Name** | **Foundations of Cryptography** |
| **Course Proposer Name(s)** | Ashish Choudhury |
| **Course Instructor Name(s)** | Ashish Choudhury |
| **Course Type** | Elective for IM.Tech students (3rd Year Onward) and M.Tech students (1st Year Onward) |
| **Credits** | 4 |
| **Grading Scheme** | A, A-, B+, B, B-, C+, C, D, F<br>Points as per IIIT-B Default Scheme |
| **Area of Specialization (if applicable)**<br>**CS** – Computer Science<br>**DS** – Data Science<br>**ES** – Embedded Systems<br>**ITS** – IT & Society<br>**NC** – Networking & Communication<br>**SE** – Software Engineering | CS / NC |
| **Semester** | Spring (Jan-May) – 2016. The course will be offered every year during Jan-May semester. It has already been offered last year and the detailed course homepage for that course is available here: https://sites.google.com/site/ashishcrypto/Courses/2015-cs-nc-813 |

**Pre-Requisites (where applicable, specify exact course names)**

There are no pre-requisites for this course. However it is expected that the students who are interested to take this course have had some exposure to a basic course on discrete mathematics, algorithms, or theory of computation. Having said that, I ensure that a significant effort will be made from my side to simplify the overall presentation of the course and make it easily accessible.

**Course Description**

This is the first course in the series of two crypto courses that I will be offering as an elective. The second course will be on advanced level research topic namely "Computing on Private Data". As the name suggests, this first course provides the basic paradigm and principles of modern cryptography. The focus of this course will be on definitions and constructions of various cryptographic objects. We will try to understand what security properties are desirable in such objects, how to formally define these properties, and how to design objects that satisfy the definitions. The aim is that at the end of this course, the students are able to understand a

ANNEXURE II - 4

# Course Proposal

| | |
|---|---|
| **Course Name** | **Computing on Private Data** |
| **Course Proposer Name(s)** | Ashish Choudhury |
| **Course Instructor Name(s)** | Ashish Choudhury |
| **Course Type** | Elective for IM.Tech students (4th Year onward) and M.Tech students (2nd Year) |
| **Credits** | 4 |
| **Grading Scheme** | A, A-, B+, B, B-, C+, C, D, F<br>Points as per IIIT-B Default Scheme |
| **Area of Specialization (if applicable)**<br>**CS** – Computer Science<br>**DS** – Data Science<br>**ES** – Embedded Systems<br>**ITS** – IT & Society<br>**NC** – Networking & Communication<br>**SE** – Software Engineering | CS / NC |
| **Semester** | Fall (Aug-Dec) – 2016. This course will be offered every year during the Aug-Dec semester. The course is currently being offered (Aug-Dec 2015) with the name "Secure Computation". The detailed course homepage for this course is available here: https://sites.google.com/site/ashishcrypto/Courses/2015-cs-nc-857 |

**Pre-Requisites (where applicable, specify exact course names)**

A student is applicable to *credit* this course *only if he/she has credited "Foundations of Cryptography course.* The course requires familiarity with some of the basic concepts covered in the first course in the cryptography series, apart from the basic knowledge of the concepts from discrete mathematics and algorithms. Having said that, I will ensure that a significant effort will be made from my side to simplify the overall presentation of the course and make it easily accessible.

**Course Description**

This will be the second course in the series of crypto courses. In the first course, we rigorously learn about various cryptographic objects, like encryption schemes, signature schemes, message authentication codes, hash functions, etc. This course will discuss about how using these cryptographic primitives, one can do computation on distributed and sensitive data, also known as

# Course Proposal Template

Annexure II - 5

| | |
|---|---|
| **Course Name** | **Scientific Computing II** |
| **Course Proposer Name(s)** | **Prof. Jaya Sreevalsan Nair**<br>**Prof. Shiva Kumar Malapaka** |
| **Course Instructor Name(s)** | **Prof. Jaya Sreevalsan Nair**<br>**Prof. Shiva Kumar Malapaka** |
| **Course Type** *(Select one)*<br><br>*"Special Topics" course proposals to be shared with faculty members for any feedback; but Academic Senate approval is not needed. All other course types need Academic Senate approval.* | Select one from the following:<br>• Core<br>• **Elective**<br>• Preparatory-Mandatory<br>• Preparatory-Optional<br>• Special Topics |
| Credits | **4** |
| **Grading Scheme** | • **4-pointscale (A,A-,B+,B,B-,C+,C,D,F)** |
| Area **of Specialization (if applicable)**<br>**CS** – Computer Science<br><br>**DS** - Data Sciences<br>**NC&E** - Networking & Communication and Embedded Systems | (Choose at most two areas from the list)<br>**N/A – GEN category** |
| Semester | Term: (I / II / III / Prep)<br>Academic Year: **2016-17** |

Pre-Requisites (where applicable, specify exact course names)

Algorithms, Programming (C/Matlab), numerical analysis, calculus and matrix operations (linear algebra) are assumed, Introduction to Scientific Computing (GEN601)

Course Description

This course, intended for M.Tech. 3rd semester and iMTech. 7th semester, is an advanced course, after the introductory GEN601, in lines with the our experiences with teaching GEN601 and proposal for introducing a course on high performance computing.

The goal of this course is numerical computation for mathematical, computational, and engineering problems of complex nature. These problems involve usually ordinary or partial differential equations and need a great deal of optimization. Further, these problems are not easily solvable on simple computers owing either to their complexity or to the large amount of required computation time. Hence the need for parallel computing on super computers. This process of moving from simple serial codes to parallel codes and from a simple computing to complex parallel computing architecture will be highlighted.

| | |
|---|---|
| Template Version Number | 1.6 |
| Template update date | 02 Mar 2013 |

INTERNATIONAL INSTITUTE
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Date: December 14, 2015

Sub: Minutes of 48th Senate meeting of the International Institute of Information technology, Bangalore held on December 9, 2015 at 2.00 pm.

Dear Sir/Madam,

Please find herewith attached Minutes of the 48th Meeting of the Senate of IIITB held on December 9, 2015 in the Board Room of IIIT B at 2.00 PM.

Best Regards

(V S Prakash)
Registrar &
Secretary to the Senate

| Date of the Defense | November 24, 2015 |
|---|---|

**48.4 Consideration and Approval of new Course Proposal:**

The Senate has approved the course proposals as detailed below:

**48.4.1** Course on 'Introduction to Ethics' submitted by Prof Chetan Parikh to be offered to iMTech Students as Elective during Term II of the Academic Year 2015-16.

**48.4.2** Course on 'Geometric Modelling' submitted by Prof T K Srikanth and Prof Jaya Sreevalsan Nair to MTech 3rd Semester and iMTech 7th Semester students during the Academic Year 2016-17.

**48.4.3** Course on 'Foundation of Cryptography' submitted by Prof Ashish Choudhury to iMTech 3rd year and MTech 1st year students.

**48.4.4** Course on 'Computing on Private Data' submitted by Prof Ashish Choudhury to iMTech 4th year and MTech 2nd year students.

**48.4.5** Course on 'Scientific Computing' submitted by Prof Jaya Sreevalsan Nair and Prof Shiva Kumar Malapaka during the Academic Year 2016-17.

**48.5 Review of Strength and Structure of IIITB Senate:**

The revised rules' regarding Review of Strength and Structure of IIITB Senate was discussed and the Senate recommended that it may be placed before the Governing Body for approval.

48.6. Items for Reporting: The Senate noted the details provided.

**48.6.3** 49th meeting of the Senate of IIITB is scheduled to be held on 10th February, 2016

**48.7** Any other item(s) with the permission of the Chair:

1. The Senate approved the course proposals which were tabled as detailed below:

    a. New course proposal for iMTech : Automotive IT - Car IT, Connected Cars and Automotive Cybersecurity.

    b. New course proposal for MSc Digital Society: On Social Media Communication.

## C. Recommendations

### (a) The curriculum, specialization streams and the title of the degree.

The committee recommends that the title of the degrees are not changed . Thus the degrees will continue to be Master of Technology in Information Technology ( M.Tech(IT)) and Master of Technology in Electronic System Design ( M.Tech ( ESD)). The committee recommends that the specialisation streams in the IT branch is reduced to three from the current four. This is based on the preferences shown by the students in choosing the streams and electives over the last four years. The recommended streams are

- Computer Science & Engineering,
- Data Sciences
- Networking & Communication and Signal-processing

The Committee recommends that the existing specialisation stream under ESD branch is continued. They are :

- Systems on Chip Embedded Systems

### (b) The admissions process

The committee does not recommend any change in the admission process or rules. GATE will continue to be used to generate the merit list and offers.

### (c) The graduation requirements of the degree

The Committee recommends a reduction minimum credit requirements from 75 to 64 for the award of M.Tech degree. The minimum course credit a student has to enrol for is reduced from 59 to 48 and the minimum internship/project/thesis credit is kept unchanged at 16. The committee further recommends , out of a minimum of 48 course credits , not more than 12 credits be obtained by enrolling in to Project Elective / Reading Elective .

### (d) The load and distribution of course credits

The Committee recommends that out of the 48 course credits , a minimum of 16 credits are earned by enrolling in to core courses. The Balance credits may be completed by enrolling in at least eight elective courses . If at least five of the electives from a specialization stream , say DS then M.Tech(IT) with specialization in DS is awarded. If this condition is not met MTech (IT) is awarded. Similarly if at least five of the electives from a specialization stream ( SOC or Embedded systems) is completed the student is awarded M.Tech (ESD) with that specialisation stream. Others are open electives

### (e) Core Courses:

**Technical Communication**

The Committee recommends that the course " Technical Communication " is mandated to be undertaken who are found deficient, through an examination conducted during the first semester. The course will be scheduled during the second semester and will be of zero credit. The grade will be Pass/Fail. The other non IT core course " Business Management for

IT engineers" is dropped. One Credit Seminar course is merged with Project Elective\Research elective .

**Core Courses for M.Tech (IT)**

The following table provides the list of core courses recommended by the Committee.

| Course | Credits | Semester |
|---|---|---|
| Introductory Programming 1 | 0 | Prep term |
| Introductory Programming 2 | 0 | Prep term |
| Mandatory | | |
| Data Structures and Algorithms | 4 | Semester1 |
| Operating Systems | 2 | Semester 1 |
| Database Systems | 2 | Semester 1 |
| **Choice List** ( students have to choose courses from the list below totalling at least 8 credits and at most 12 credits) | | |
| Computer Networking & Communication and Embedded System | 4 | Semester 1 |
| Software Engineering theory and Practice | 4 | Semester 1 |
| IT Project and Product Management | 4 | Semester 1 |
| Discrete Mathematics | 2 | Semester 1 |
| Probability and Statistics | 2 | Semester 1 |
| Linear Algebra | 2 | Semester 1 |

**Core courses for M.Tech (ESD)**

The following table provides the list of core courses for the M.Tech (ESD)

| Course | Credits | Semester |
|---|---|---|
| C Programming | 0 | Prep term |
| Basic Electronics | 0 | Prep term |
| Choice List ( students have to choose four out of the following five) | | |
| Analysis and Design of Digital IC | 4 | Semester1 |
| Introduction to CMOS Fabrication and Analogue CMOS VLSI Design | 4 | Semester 1 |
| MATHS for ESD | 4 | Semester 1 |
| Principles of Embedded systems & Operating Systems | 4 | Semester 1 |
| Algorithm and data structures | 4 | Semester 1 |

## D. The internship and thesis options

No change is being recommended in the internship/thesis options.

## E. Sponsored M.Tech

The committee examined bringing similar changes to the Sponsored M. Tech programme too. It recommends

- We recommend that a standing committee of the Senate be constituted to finalise course structure and curriculum for offering specialised M.Tech ( for example M.Tech in Computer Science ) with the following stipulations.
  - Admission through GATE Or Entrance Test conducted by IITB
  - Minimum credit 64 , minimum duration 2 years , maximum five years

Annexure 2 B

# M.Tech. (IT)
# Programme Curriculum
(Effective from academic year 2016-17)


International Institute of Information Technology
Bangalore – 560100
January 2016

# 1 Overall M.Tech. Programme Structure

Tables 1 and 2 provide a summary of the credit distribution in the M.Tech. programme.

Table 1: Overview of the curriculum

| | |
|---|---|
| **Preparatory Term (3 weeks)** | **0 credits**<br>• Introductory Programming (C and Java)<br>• (PASS / FAIL mandatory courses) |
| **Semester 1 (15 weeks)** | **16 credits**<br>• core courses Three Courses ( 8 credits ) mandatory<br>• Balance 8 credits to be acquired by choosing courses from a list |
| **Semester 2 (15 weeks)** | **16 credits**<br>• 4 electives<br>**0 credits**<br>• Technical Communication for those found deficient in a test conducted in Semester 1<br>• Pass /Fail |
| **Semester 3 (15 weeks)** | **16 credits**<br>• 4 electives |
| **Semester 4 (26 weeks)** | **16 credits**<br>• Internship / Thesis |
| **Total** | **64 credits** |

Table 2: Credit Distribution

| Proposed | Credits | % |
|---|---|---|
| IT Core Course Credits | 16 | 25 % |
| Elective Course Credits | 32 | 50 % |
| Internship / Thesis Credits | 16 | 25 % |
| **Total credits requirement for M.Tech.** | **64** | |

# 2 Areas of specialization

The M.Tech. curriculum has three areas of specialization:

- Computer Science and Engineering (CSE)
- Data Science(DS)
- Networking & Communication and Signal-processing (NCS)

## 3 Preparatory courses

Students entering the M.Tech. programme are expected to come with some prior knowledge of programming. While we do not wish to conduct full-fledged programming courses at the Masters level, we will provide an opportunity for the students to hone up their programming skills in a structured way as part of the preparatory term. The preparatory term has two courses in programming (covering C and Java). The two courses will not carry any credit. However, they are mandatory courses with a PASS/FAIL grade. These Programming courses will be taught with emphasis on hands-on programming exercises and projects.

## 4 IT Core courses

Core courses are those that all the students must take in the prep and first semester. The complete list of core IT courses is provided in Table 1 below.

**Table 3: List of core IT courses**

| Course | Credits | Semester |
|---|---|---|
| Introductory Programming 1 | 0 | Prep term |
| Introductory Programming 2 | 0 | Prep term |
| Data Structures and Algorithms | 4 | Semester 1 |
| Operating Systems | 2 | Semester 1 |
| Database Systems | 2 | Semester 1 |
| **Choice List** ( students have to choose courses from the list below totaling at least 8 credits and at most 12 credits) | 8 | Semester 1 |
| *Computer Networking & Communication* | *4* | *Semester 1* |
| *Software Engineering theory and Practice* | *4* | *Semester 1* |
| *IT Project and Product Management* | *4* | *Semester 1* |
| *Discrete Mathematics* | *2* | *Semester 1* |
| *Probability and Statistics* | *2* | *Semester 1* |
| *Linear Algebra* | *2* | *Semester 1* |

Details regarding objectives, syllabus and lecture hours for each course are provided in the Appendix-A.

## Appendix-A

This section provides on the core courses in the curriculum. Each subsection below contains details regarding the various core courses. Elective courses topics will be given by the respective faculty member(s) and it will be processed through the Senate, before addition to the semester's elective.

### Introductory Programming

Students come for M.Tech. from many different branches of Engineering. They all have varying levels of programming knowledge. Good programming skills are recognized as being a minimum pre-requisite for virtually all the courses (both core and elective). The goal of the preparatory term is to give a fast-track introduction to programming. The following table highlights some of the details of the course:

| **Course Name** | Introductory Programming I & II |
|---|---|
| **Term** | Preparatory Term |
| **Course Credits** | 0 |
| **Duration** | 3 weeks |

| Introductory Programming I<br>C Programming<br>(Morning) | | Introductory Programming I<br>Java Programming<br>(Afternoon) | |
|---|---|---|---|
| **Session duration** | 3 hours per day | **Session duration** | 3 hours per day |
| **Sessions per week** | 5 | **Sessions per week** | 5 |
| **Total duration** | 45 hours (3 weeks) | **Total duration** | 45 hours (3 weeks) |

**Course Objectives:** At the end of the course, the students should have knowledge and competencies in the following areas:

- C Programming Language
  - Knowledge on the proper usage of all C programming constructs.
  - Ability to compile, debug and run multi-file C programs in a Linux environment.
- Java Programming Language

## Mathematics

**Course Objectives:** Three courses, of two credits each, are offered in the first semester. They provide an introduction to Mathematical Concepts which are used widely in designing engineering systems.

**Discrete Mathematics:**

- Basic logic: Propositional logic: logical connectives, truth tables, normal forms (conjunctive and disjunctive), predicate logic, modus ponens and modus tollens.
- Proof techniques: Notions of implication, converse, inverse, contra-positive, negation, and contradiction, the structure of formal proofs, direct proofs, proof by counter example, proof by contraposition, proof by contradiction, mathematical induction, strong induction.
- Set Theory: Definition of set, relations, equivalence relations and equivalence classes, cardinality and countability.
- Combinatorics: Pigeonhole principle, inclusion-exclusion principle, generating functions, recurrence relations.
- Groups, rings and fields, with application.

**Probability Theory and Statistics:**

- Sample space, axioms of Probability theory, random variables, distribution function and density function, mean, variance, characteristic function and central limit theorem.
- Law of large numbers, introduction to Stochastic processes with examples.
- Statistical estimation, parametric distribution estimation, non-parametric distribution estimation, optimal detector design and hypothesis testing, Chebyshev and Chernobounds

**Linear Algebra and Matrix Theory:**

- Vector spaces, subspaces and bases, norms, inner product spaces, Gram Schmidt orthogonization, linear transformations.
- Matrices, Eigenvalues and Eigen vectors, LU and QR factorization, trace and determinant, quadratic forms and canonical forms, singular value decomposition, least squares problem and Moore Penrose inverse.

## SE Theory and Practices

Knowledge of software engineering principles is critical for any IT professional. Students can imbibe and internalize these principles only by applying in a systematic and structured manner. The Software Engineering Practices course is designed with a greater emphasis on hands-on practices of well-known principles. The course is divided two components:

1. Lecture (about 25 hours) - January - April
2. Project (about 6 months duration) - January - June

While the lecture components will cover all essential concepts and principles, the project component will provide an opportunity for the students to actually put the principles into practice. The project component will also help in filling the void created by the absence of projects in the OS, Databases, and Data Structures and Algorithm courses as per the revised curriculum.

Assessments will be done based on about 70% weight given to the project and about 30% weight given to the lecture component, thus emphasizing the importance of practicing what is being taught.

The Software Engineering Practices course is intended to be offered as a fifth course in the second semester because the value of the course is fully realized only when the project component happens in parallel. The following table highlights some of the details of the course:

| **Course Name** | Software Engineering Theory and Practices |
|---|---|
| **Course Credits** | 4 |
| **Lectures Hours per week** | 2 |
| **Total number of lecture hours (per semester)** | 25 |
| **Project Duration** | 6 Months |

**Course objectives:** At the end of the course, students should have knowledge and competencies in the following areas:

- Practical application of project management practices
- Awareness of practices for developing programs with emphasis on quality
- Defining project tasks with guidance from well-defined process models
- Effective management of source code
- Familiarity with basic terminology associated with process models and quality models.

- Product deliverables (as defined and evaluated by the project mentor).
- SE practices (as defined and evaluated by the course instructors).

In effect, if 100 marks are allocated for the overall course, following is the recommended break up of evaluation:

- Lecture component – 30 marks (exam-based evaluation)
- Project – SE practices – 20 marks (documentation-based evaluation)
- Project – Product deliverables – 50 marks (demo and testing-based evaluation)

## Database Systems

The following table highlights some of the details of the database systems course:

| **Course Name** | Database Systems |
|---|---|
| **Course Credits** | 2 |
| **Lectures hours per week** | 3 |
| **Total number of lecture hours (per semester)** | 24 |

**Course objectives:** At the end of the course, the students should have knowledge and competencies in the following areas:

- Understand the principles of conceptual modeling
- Design databases
- Principles of database programming
- Knowledge of DBMS components
- Other data management technologies (e.g., data exchange, in-memory, etc.)

**Course contents:**

- Information systems (2 hours): Basic concepts (models, schema, data, information, knowledge), elements of information systems, overview of database systems.
- Conceptual modeling (3 hours): Introduction to conceptual modeling, entity relationship models, UML class diagrams.
- Relational databases (11 hours): Relational data model, database design concepts, DB design via OR mapping, relational algebra, SQL tutorial, functional dependencies, overview of normal forms (till BCNF)

- DBMS (7 hours): Components of a DBMS, storage structures – primary, clustering, secondary, multi-level, query processing – overview, query transformation, query evaluation, transaction processing – overview, ACID properties, concurrency control – schedules, serializability, deadlocks.

Application development (3 hours): Database programming (SQL, embedded SQL, JDBC etc.), overview of 2-tier, 3-tier and n-tier architectures

## IT Project and Product Management

| | |
|---|---|
| **Course Name** | IT Project and Product Management |
| **Course Credits** | 4 |
| **Lectures hours per week** | 2 |
| **Total number of lecture hours (per semester)** | 45 |

COURSE OVERVIEW AND OBJECTIVES

Good project and product management has become necessity for large IT service firms. The first part of the course covers the life cycles of software project management including processes, tools and methods, organizational, financial and market analysis. A detailed exposure is given to the students in different knowledge areas of project management including, risk management, human resource management, estimation procedures, scope and requirements management and financial management of projects. Since most of the IT projects span geographical locations, culture, time zones and common protocols for distributed projects will also be discussed. Agile and lean methodologies in project management literature will also be discussed. The second part of the course deals with product management. The specific case of market analysis and the product-market fit will be discussed complemented by cases in the knowledge area. Processes for large scale product management will also be discussed. Most of the product management firms struggle with governance structure, either in terms of co-existing with services part of the business or stand alone. These and regulatory issues relating to IT products in areas such as Intellectual Property, data privacy and security, regulatory arbitrage will also be illustrated with associated cases. Finally, the ethical issues firms face in product and project management will also be discussed.

COURSE CONTENTS

- Project management life cycle, knowledge areas

## Operating Systems

The following table highlights some of the aspects of the Operating Systems course:

| Course Name | Operating Systems |
|---|---|
| Course Credits | 2 |
| Lectures hours per week | 3 |
| Total number of lecture hours (per semester) | 24 |

The following topics will be covered course in the first regular semester:

- General ideas about operating systems
- The evolution of operating systems, types of operating systems
- System calls; user vs. super- user
- Processes and threads, process scheduling and management
- IPC (Inter Process Communication) and the dining philosophers problem
- Race conditions and mutual exclusion, scheduling
- Memory, virtual memory and memory management
- Paging vs. segmentation
- Page replacement algorithms
- Distributed systems, briefly
- Message-passing vs. shared memory
- Logical clocks and the ordering of events, impossibility results and proofs
- Security issues
- Threats, encryption, symmetric vs. asymmetric, attacksfrom within the system and from outside, protection mechanisms
- A selection of advanced and related topics including introduction to RTOS, Mobile OS etc.

There will be no project component in this course.

## Networking and Communication

| Course Name | Networking and Communication |
|---|---|
| Course Credits | 4 |
| Lectures hours per week | 2 |
| Total number of lecture hours (per semester) | 45 |

**Objectives:** This is an era of networking between computers, mobiles and Internet of Things. Hence, this course covers the fundamental concepts of networking and communication. At the completion of the course, the student should be able to understand the following topics:

- End to end Architecture (topology + protocols) of Data networks.
- Functionalities of various layers in ISO model and interaction between them.
- Principle aspects of communication

**Main Modules:**

- Data Network Architecture (3 week): In depth conceptual understanding of all the topologies and layers of the ISO models and the associated protocols.
- Application Layer (2 weeks): HTTP protocol, SMTP protocol (e mail), DNS, socket programming
- Transport Layer (3 weeks): TCP concepts, UDP concepts, congestion/flow control, multiplexing/de-multiplexing
- Network Layer (2 weeks): Routing algorithms, internet signalling, IP addressing
- Datalink Layer (2 weeks): ARP protocol, MAC protocol, error correction/detection
- Physical Layer (3 weeks): Channel capacity, modulation and basics of FEC.

## Data Structures and Algorithms

**Objectives:** Students passing this course are expected to have basic familiarity with the presented topics.

This document does not mandate a specific teaching style, text book or load distribution across the topics. A suggested ideal time distribution is presented across each topic. Suggested textbook is Cormen et al. Introduction to Algorithms (popularly called CLR earlier -- and now CLRS book).

Total credits: 4
Class hours (per week): 3

- Algorithmic analysis (1 week): Asymptotic notations for algorithms, recurrence tree methods, complexity classes
- Abstract Data Structures(5 weeks): Properties of: Arrays, stacks, queues, linked lists, trees, binary trees, heaps, DAGs, balanced trees, hash tables, graphs, regular graphs
- Algorithmic paradigms: Divide and conquer, Dynamic Programming, greedy algorithms (4 weeks): General method of divide and conquer, example divide and conquer algorithms: merge sort, quick sort, Strassen's matrix multiplication, binary search, general method of dynamic programming, relaxation techniques, knapsack problems.
- Search and Traversal (4 weeks): Searching in Binary Trees, Graph traversals: DFS and BFS, backtracking methods, branch and bound techniques with examples from graph algorithms, spanning tree algorithms, Algorithms based on graph cuts.
- Randomized Algorithms (1 week): Las Vegas and Monte Carlo paradigms, some example randomized algorithms.

platforms in the form of SoCs, which integrate not only the core digital functionality, but also the analog mixed signal functionalities. It is also consistent with the curriculum name being adopted by several reputed universities all over the world.

In the new curriculum, 50% of the students will specialize in SoC and 50% will specialize in EMS. The decision of a student going to either of the two stream will be based on his performance in the first semester and the number of students preferring a particular stream. The students will be given this information during the counseling done on joining the program and at the start of the program.

## 2 Overall M.Tech. in ESD Programme Structure

Tables 1 and 2 provide a summary of the credit distribution in the M.Tech. programme.

**Table 1: Overview of the curriculum**

| | |
|---|---|
| **Preparatory Term (3 weeks)** | **0 credits**<br>• C Programming<br>• Principles of Electronics<br>(PASS / FAIL mandatory courses) |
| **Semester 1 (15 weeks)** | **16 credits**<br>• 4 core courses out of the five |
| **Semester 2 (15 weeks)** | **16 credits**<br>• 4 Electives<br>(4 X 4 credits = 16 credits) |
| **Semester 3 (15 weeks)** | **16 credits**<br>• 4 electives<br>(4 X 4 credits = 16 credits) |
| **Semester 4 (26 weeks)** | **16 credits**<br>• Internship / Thesis |
| **Total** | **64 credits** |

**Table 2: Credit Distribution**

| Proposed | Credits | % |
|---|---|---|
| ESD Core Course Credits | 16 | 25 % |

| | | |
|---|---|---|
| Elective Course Credits | 32 | 50% |
| Internship / Thesis Credits | 16 | 25 % |
| **Total credits requirement for M.Tech.** | **64** | |

## 3 Area of specializations

The proposed M.Tech. in ESD curriculum has two area of specializations:

- System on Chip (SoC)
- Embedded Systems (EMS)

## 4 Preparatory courses

Students entering the M.Tech in ESD programme are expected to come with some prior knowledge of C programming and basic electronics. While we do not wish to conduct full-fledged C programming courses at the Masters level, we will provide an opportunity for the students to hone up their C programming skills in a structured way as part of the preparatory term. The preparatory term has one course in programming (covering C). The other course on basic electronics will provide an opportunity to get hands-on with circuits and simulation tools. The two courses will not carry any credit. However, they are mandatory courses with a PASS/FAIL grade. The Programming and Basic Electronics courses will be taught with emphasis on hands-on activities.

## 5 ESD Core courses

Core courses are those that all the students must take mandatorily. The complete list of core courses is provided in Table 1 below.

**Table 3: List of core ESD courses**

| Course | Credits | Semester |
|---|---|---|
| C Programming | 0 | Prep term |
| Basic Electronics | 0 | Prep term |
| Four to be chosen from the five below | | |
| Analysis and Design of Digital IC | 4 | Semester1 |
| Analog CMOS VLSI Design | 4 | Semester 1 |
| MATHS for ESD | 4 | Semester 1 |
| Principles of Embedded System Design (2) + Operating systems ( 2) | 4 | Semester 1 |

| Data structures and Algorithms | 4 | Semester 1 |
|---|---|---|

Apart from courses in the Preparatory term, the core courses to be covered in the first regular semester are:

- Analysis and design of Digital IC (4 credits)
- Introduction to CMOS fabrication and Analog CMOS VLSI Design (4 credits)
- Mathematics for ESD (4 credits)
- Operating Systems (2 credits) &Principles of Embedded Systems (2 credits)
- Datastructures and algorithms ( 4 Credits)
-

The Students have to choose a minimum of four out of the above 5 .

Details regarding objectives, syllabus and lecture hours for each course are provided in the Appendix-A. The elective courses are listed in Appendix B and C.

## 6 Electives

The number of electives to be completed by each student is **eight**. Thus the total number of credits that can be accumulated through electives is now 32 credits. Each elective will be associated with one or more area of specializations with the exception of elective courses from the Information Technology and Society area of specialization, which will be offered as open electives. Each student is required to take at least **five** electives from his/her area of specialization. For example, for a student from the SoC area of specialization, all electives that are listed under EMS area of specialization (and not cross-listed under SoC) will be considered as open electives. The open electives also includes courses from IT-Society, Data-Science (DS), Software-Engineering (SE), Networking and Communication (NC), Computer Science (CS) streams of our regular MTech in IT curriculum. Students from the regular M. Tech. in IT curriculum specializing in CS, DS, SE, and NC can also take the electives offered in the new M. Tech. in ESD curriculum as open electives. Moreover, these electives can also be taken as regular electives by students from the iMTech curriculum.

Design of an elective course will be addressed in details by the faculty concerned. This design of the course will be presented to faculty-meeting/Senate before being offered to students.

## 7 Project Electives /Supervised Reading (Reading Elective)

1. There are two forms of special electives called: Project Elective (PE) and Reading Elective (RE). These electives are intended for experiential and guided learning.

2. Every PE course at least have the following characteristics:
   - Overall Plan
   - Visible Output
   - Direct Supervision

3. PE and RE follow the usual letter grading pattern available to other courses.
4. Mtech students may opt for at most one PE and at most one RE course, per semester. The total number of PE/RE shall not exceed 3 in the entire programme
5. Involvement of external institutional entities if any, as part of a PE course, should be expedited within the framework of the existing collaboration and IP policies of the Institute.

These above rules are same as existing in the regular M. Tech. for IT curriculum.

## 8 Thesis/Internship

Thesis/Internship shall be of 26 weeks duration and a student can accumulate 16 credits on successful completion of thesis or internship.

For the students pursuing Internship:

- Internships to be considered as six months (not less than five months) of supervised project work carried out at industry or academic institutions.
- The internship committee will ensure that a mid-term feedback is collected (for every student pursuing internship) to ensure smooth progress towards completion.
- At the time of internship completion the internship committee will also collect the certificate (satisfactory/unsatisfactory) from concerned person of the organization. If the certificate is unsatisfactory then the institute internship committee will review the matter and if they agree with the certificate given, and then the student has to carry on the internship again at same or different place. It the certificate is satisfactory then the student full fills the requirement of internship.

For students pursuing thesis, the following guidelines hold:

## Appendix-A Core courses

This section provides on the core courses in the curriculum. Each subsection below contains details regarding the various core courses. Elective courses topics will be given by the respective faculty member(s) and it will be processed through the Senate, before addition to the semester's elective.

### C Programming

Students come for M.Tech. from Electronics, Electrical and Instrumentation Engineering background. They all have varying levels of programming knowledge. Good programming skills are recognized as being a minimum pre-requisite for virtually all the courses (both core and elective). The goal of the preparatory term is to give a fast-track introduction to programming in C. The following table highlights some of the details of the course:

| | |
|---|---|
| **Course Name** | C Programming |
| **Term** | Preparatory Term |
| **Course Credits** | 0 |
| **Duration** | 3 weeks |
| **Session duration** | 3 hours per day |
| **Sessions per week** | 5 |
| Total duration | 45 hours (3 weeks) |

**Course Objectives:** At the end of the course, the students should have knowledge and competencies in the following areas:

- Preliminaries: Introduction to Unix, Introduction to case study
- Data types and expressions: Variables and data types, scope and lifetime of variables, type casting and data type conversion, expression evaluation
- Control flow: if statement, if-else statement, switch-case statement, for loop, while loop, do-while loop
- Functions: User-defined functions, parameters and return values, global variables, static variables, multi-file programming, introduction to built-in libraries (math.h, string.h, etc.).
- Recursion: Recursion for divide-and-conquer

- Arrays: 1-d array, 2-d array and n-d array
- Pointers: Pointers and addresses, pointers and function arguments, pointers and arrays, address arithmetic, character pointers and functions
- More on pointers: Pointer arrays, pointers to pointers, pointers to functions
- Structures: Basics of structures, structures and functions, arrays of structures
- Advanced structures and unions: Pointers to structures, self-referential structures, unions, bit-fields
- File I/O: Text I/O sequential access, binary I/O sequential access, binary I/O random access

The course is divided into multiple **modules**. Each module is comprised of **lecture session**(s) and **lab session**(s). A session typically has a one hour lecture followed by a 2 hour lab every day.

## Principles in Electronics

The goal of basic electronics preparatory course is to revise and clarify some of the basic concepts in electronics. This will help them to get more confidence in designing circuits and logics in regular semesters. Good electronic designing and trouble shooting skills are required throughout the MTech curriculum. The following table highlights some of the details of the course:

| Course Name | Principles in Electronics |
|---|---|
| **Term** | Preparatory Term |
| **Course Credits** | 0 |
| **Duration** | 3 weeks |
| **Session duration** | 3 hours per day |
| **Sessions per week** | 5 |
| **Total duration** | 45 hours (3 weeks) |

**Course Objectives:** At the end of the course, the students should have knowledge and competencies in the following areas:

Design of RLC filter circuits, Rectifier circuits; Ebers-Moll model applied to basic transistor circuits, BJTs and MOSFETS amplifier circuits; FET switches. Feedback and operational amplifiers and use of Opamps as amplifiers, peak detector, differentiators, integrator circuits, Schmitt Trigger and comparators. Active filters and Oscillators, TTL and CMOS, Digital gates using MOSFETs, Decoders, Multiplexers, Latch, Flip-Flops, Counters, Registers, Memories, Mealy and Moore machines, Finite State Machine, state equivalence and machine minimization; Algorithmic state machines, Analog/Digital Conversions, and Introduction to different microcontroller boards such as Arduino, Raspberry Pi, Galileo Development boards, Verilog example codes.

The course is divided into multiple **modules.** Each module is comprised of **lecture session**(s) and **lab session**(s). A session typically has a one hour lecture followed by a 2 hour lab every day.

## Mathematics for Electronic Systems Design

This course will cover aspects of mathematics relevant to the design and analysis of Embedded Systems, and Semiconductor devices. We will cover aspects of discrete mathematics relevant for the analysis of switching circuits such as Boolean Algebra, logics and predicate calculus needed for the analysis of real-time systems, graph theory that is relevant in the analysis of digital circuits and development of EDA tools, probability and statistics needed for reliability analysis, Monte-Carlo simulation, linear algebra and differential equations needed for circuit simulation, understanding CMOS technology and semiconductor physics. Computational geometry will also be included that is needed for robotics.

## Analog CMOS VLSI Design (4 credits) (SBS/CP)

**Prerequisites** : Kirchoff's Laws(KCL/KVL) in electrical networks, Linear circuits: Thevenin/Norton theorems, phasor analysis. Some exposure to diodes/transistors, biasing and small-signal analysis would be useful.

The course has two objectives :

(1) To explain how robust Analog MOS circuits can be designed with a good understanding of VLSI Technology and MOS Device Physics.

The course will discuss how Analog circuits are designed in a VLSI chip environment. The methodology adopted for teaching this course is to first provide a simple physical model of the MOSFET transistor that is capable of abstracting the essential electrical behavior of the device. Following this a related small-signal MOSFET model can be derived. The application of DC and small-signal analysis methods on MOSFET circuits can then follow.
The main aim of the course will be to learn how to analyze and build CMOS amplifiers that are the building blocks of almost all VLSI mixed-signal systems. At every stage of the course the students are expected to design, on paper as well as simulation, the circuits discussed in the class. An important aspect of the course will be a project in which the students are expected to design and simulate (using Spice simulator).

**Topics** : MOS device physics, Common-source, common-gate, common-drain, and cascode stages, Differential amplifiers, Current mirrors, Frequency response of amplifiers, One and two-stage operational amplifiers, Stability and frequency compensation. The course will be useful for those interested in VLSI Design, mixed-signal embedded hardware and is a pre-requisite for RF Design.

**References:**


1. Design of Analog CMOS Integrated Circuits, B. Razavi, Tata McGraw-Hill.
2. CMOS : Circuit Design, Layout and Simulation, R. Jacob Baker, IEEE Press/Wiley Student Edition.
3. Silicon VLSI Technology Fundamentals, Practice and Modeling, J. D. Plummer, M. D. Deal, and P. B. Griffin

## Analysis and design of CMOS Digital IC (4credit hours) (MR/SKR)

**Topics :** The theory part includes CMOS logic, latches, flip-flops, CMOS layout, MOSFET Current and Capacitances, Non-ideal MOSFET Effects, CMOS Delay Estimation, Logical effort, Delay optimization and logical effort, Power estimation: Static and Dynamic, Low-Power design, Static Combinational CMOS Logic Styles, Dynamic Combination CMOS Logic styles, Static and Dynamic Sequential Circuit Design, Technology scaling, and VLSI design methodologies. The course will include a lab component of 1credit hour. This will require students to spend 2 hours per week in the lab. Lab component includes Schematic and layout of Digital circuits using Electric. HDL simulation, and synthesis using Mentographics/Xlinix/LASI digital design software tools. Digital prototyping on FPGA board is also included in this course.

**References:**


1. Neil H. E. Weste and David Harris, CMOS VLSI Design: A circuits and systems perspective, 4th edition, 2011.
2. Verilog HDL: A guide to digital design and synthesis, S. Palnikar, 1996.
3. J. Rabaey, A. Chandrakasan, and B. Nikolic, "Digital Integrated Circuits," 2nd Edition, Pearson Education, 2003.


## Operating Systems (2 credit hours) (PGP/SKR)

The following topics will be covered course in the first regular semester:

- System calls; user vs. super- user
- Processes and threads, process scheduling and management
- IPC (Inter Process Communication) and the dining philosophers problem
- Process synchronization using mutex locks, semaphores, monitors.
- Memory, virtual memory and memory management
- Message-passing vs. shared memory
- Kernel modules: changes and compilation

There will be no project component in this course.

**References:**


1. A. Silberschatz, P. Galvin, G. Gagne, Operating System Concepts, 9th Edition, John Wiley and Sons, 2012.

## Principles of Embedded Systems (2 Credits) (PGP) (Approved Elective)

**Description :** Embedded systems are everywhere and most of the electronic systems have a computer inside to do smart things. Due to great demand a large number of embedded systems are available in the market from many companies. Purpose of this course is to help students understand existing architectures of embedded systems and also understand principles involved in designing such systems. In this course we will learn various issues involved in designing embedded systems meeting performance, cost, physical size and weight as well as power consumption requirements. Complex algorithms, user interface along with real time constraints make embedded computing more challenging than normal computing without any constraints on time. The course will start with Shannon's paper on switching circuits, simple microcontrollers and all the way up to distributed embedded computing. In order to understand the engineering aspects better each student or groups of students will study one of the existing platforms and share the knowledge with the class and also do some experiments on embedded systems. The course will involve more open discussions to discover principles and lab to get hands on experience in working with embedded systems.

**Topics :** Relay circuits, Boolean Algebra, Gates, Shift Registers, CPUs, Memories and Busses, Complex systems and Microprocessors, Embedded system design process and Formalisms for design, Instruction sets, CPU and Memory, I/O Devices and Component Interfacing, Program Design , Analysis and Optimization, Operating systems with real time constraints, Design Methodologies and Architecture design, Power management techniques for single and multi core systems, Multi core Embedded systems , Future Embedded systems, Neural computers and Quantum computers.

References:


1. Computers as Components, Principles of Embedded Computing System Design, Wayne Wolf, Princeton University, Morgan Kauffman Publishers, Academic Press, 2001
2. IEEE Papers as required
3. Published material from TI, ADI, ARM, Intel and others
4. Software Development for Embedded Multi-core Systems: A Practical Guide Using Embedded Intel Architecture, Max Domeika

## Mathematics for Electronic Systems Design (4 Credits) (SN/SKR/PGP/MDS)

Topics : This course will cover aspects of mathematics relevant to the design and analysis of Embedded Systems. We will cover aspects of discrete mathematics relevant for the analysis of switching circuits such as Boolean Algebra, logics and predicate calculus needed for the analysis of real-time systems, graph theory that is relevant in the analysis of digital circuits and development of EDA tools, probability and statistics needed for reliability analysis, Monte-Carlo simulation, linear algebra and differential equations needed for circuit simulation and computational geometry that is needed for robotics.

**References:**


1. Discrete Mathematics, Kenneth Rosen.
2. Introduction to Linear Algebra, Gilbert Strang.
3. Differential Equations, P. Blanchard, R.L. Devaney and G,R. Hall
4. Computational Geometry, Algorithms and Applications, M.de Berg, O. Cheong, M. van Kreveld, M. Overmars


## Data Structures and Algorithms (4 Credits)

**Objectives:** Students passing this course are expected to have basic familiarity with the presented topics. This document does not mandate a specific teaching style, text book or load distribution across the topics. A suggested ideal time distribution is presented across each topic. Suggested textbook is Cormen et al. Introduction to Algorithms (popularly called CLR earlier – and now CLRS book).

Total credits: 4

Class hours (per week): 3

Algorithmic analysis (1 week): Asymptotic notations for algorithms, recurrence tree methods, complexity classes

Abstract Data Structures(5 weeks): Properties of: Arrays, stacks, queues, linked lists, trees, binary trees, heaps, DAGs, balanced trees, hash tables, graphs, regular graphs. Algorithmic paradigms: Divide and conquer, Dynamic Programming, greedy algorithms (4 weeks): General method of divide and conquer, example divide and conquer algorithms: merge sort, quick sort, Strassen's matrix multiplication, binary search, general method of dynamic programming, relaxation techniques, knapsack problems. Search and Traversal (4 weeks): Searching in Binary Trees, Graph traversals: DFS and BFS, backtracking methods, branch and bound techniques with examples from graph algorithms, spanning tree algorithms, Algorithms based on graph cuts. Randomized Algorithms (1 week): Las Vegas and Monte Carlo paradigms, some example randomized algorithms.

## Appendix-B SoC Electives

### Testing and Design For Testability (4 Credits) (SKR/EF)

Introduction to Testing: VLSI Testing Process and Test Equipment; Test Economics and Product Quality; Fault Modeling; Test Methods : Logic and Fault Simulation; Testability Measures; Combinational Circuit Test Generation; Sequential Circuit Test Generation; Memory Test; DSP based Analog and Mixed Signal Test; Model based Analog and Mixed Signal Test; Delay Test; IDDQ Test; Design For Testability : Digital DFT and Scan Design; Built In Self Test; Boundary Scan Standard; Analog Test Bus Standard; System Test and Core Based Design; The Future of Testing.

**References:**


1. Essentials of Electronic Testing For Digital, Memory & Mixed –Signal VLSI Circuits - M. Bushnell & V. D. Agrawal


### High Level Synthesis and Optimization of Digital Circuits (4 Credits) (SKR)

**Topics** : Logic Optimization and Synthesis : Combinational Logic Synthesis : Two Level – Multiple input & multiple output minimization by exact and heuristic algorithms; Symbolic Minimization and Encoding Problems; Multiple level logic synthesis; Technology mapping; Sequential Logic Synthesis : State minimization, State assignment – For two level and multiple level logic, Multiple FSM realization, Hierarchical FSMs; High Level Synthesis : Architectural Models, Quality Measures, Design Description Languages, Register Transfer Components, Design Representation, Design Transformations, Design Partitioning, Scheduling, Allocation, Resource Sharing and Binding, Data-path and Control generation, Design Flow in High Level Synthesis, Design Methodologies in High Level Synthesis, System Level Design and Synthesis; Physical Design Synthesis : Placement, Floor-planning, Routing and Compaction.

**References:**


1. G. De Micheli, Synthesis and Optimization of Digital Circuits, McGraw Hill - International Students Edition.
2. D. D. Gajski, N. D. Dutt, A.C.H. Hu and S. Y. Lin, High Level Synthesis : Introduction to Chip and System Design, Kluwer Academic Publishers.
3. D. D. Gajski, F. Vahid, S. Narayan and J. Gong, Specification and Design of Embedded Systems, Prentice Hall.
4. Naveed Sherwani, Algorithms for VLSI Physical Design Automation, Kluwer Academics.


**Journals** : Design and Test of Computers, IEEE / ACM Journal on Electronic Design Automation / IEEE Transactions on CAD, Computers and VLSI Systems.

**Conference Proceedings** : International VLSI Conference/ Design Automation Conference (DAC) / International Conference on Computer Aided Design (ICCAD) / Asia South Pacific Design Automation Conference (ASPDAC).

## Functional Verification of SoC Designs (4 Credits) (SKR)

**Prerequisites :** Digital and Analog electronics

System on Chip (SoC) designs inherit all the well known verification and validation difficulties associated with complex ASIC designs, besides adding their own set of newer problems. These arise because SoCs are primarily implemented by re-using Intellectual Property (IP) cores. It is well known that verification today constitutes about 70% to 80% of the total design effort, thereby, making it the most expensive component in terms of cost and time, in the entire design flow. It is expected to get even worse for SoC designs. In a complex SoC design flow functional verification is very important; any behavioral or functional bug escaping this phase will not be detected in the subsequent implementation phases and will surface only after the first silicon is integrated into the target system, resulting in costly design and silicon iterations. Many of the issues relate to intrinsic limitations of some of the verification approaches taken; while others have to do with the quality of the design information, by way of, design descriptions, design documentations and design specifications, from which the overall verification objectives are derived. SoCs have brought to focus the need to carry out design and verification concurrently. For the design and verification task to proceed concurrently there is a need to capture formally, design information and implementation details at various levels of abstraction. Another reason for the need to formalize is that, as designs become more complex, functional verification will have to be carried out using the divide and conquer approach. For these approaches to succeed, specifications of either, the individual modules, or individual IPs, if any are used, have to be stated formally. The proposed course will address the state of the art in the area of functional verification. It will focus on existing methodologies, tools, and practical approaches based on universal simulation, emulation, formal verification, and semi-formal verification that can be employed to overcome the SoC verification problem. A number of case studies based on real life verification projects will be presented describing the various techniques used and the effectiveness of these techniques.

**Topics :** Introduction : Need for high level verification. Simulation/Emulation, Formal/Semi-formal, Design Representation; High Level Design Flow and Verification Issues : System Design, Requirements, Specifications, Functional Descriptions, Implementation, Verification Problems, Verification Techniques; Simulation Based Verification : Introduction, Types of Simulation, Quality of Verification and Coverage Analysis, Test Bench Automation Emulation : Systems, Flows, FPGAs as Logic Emulators, Drawbacks, Commercial Emulators; Formal Verification Techniques for FSM Models : Model Checking and Formal Engines, SAT Solvers, BDDs, Symbolic Model Checking with BDDs, Model Checking using SAT, Model Checking in Practice, Academic and Industrial Model Checker,

Equivalence Checking; Semi-Formal Verification Techniques : Symbolic Simulation, Symbolic Trajectory Evaluation, Generalized Symbolic Trajectory Evaluation, Bounded Model Checking, Guided Search, Smart Simulation; Formal Verification of Analog Mixed Signal Circuits; Case Studies : Formal, Semi-Formal, Generalized Symbolic Trajectory Evaluation, FV of Analog Mixed Signal Circuits; Verification Project : To run concurrently with theory units above.

Lab for Course Requirements: Mentor Graphics QuestaSim (Constraint Driven Verification Tool); VIS (Formal Verification Tool) from University of California, Berkeley; CheckMate (AMS FV Tool) from Carnegie Mellon University.

**References :**


1. Michael Huth & Mark Ryan, Logic in Computer Science : Modeling and Reasoning about Systems (Cambridge University Press), 2004
2. Kenneth L. McMillan, Symbolic Model Checking ( Kluwer Academic Publishers)
3. Thomas Kropf, Introduction to Formal Hardware Verification (Springer-Verlag).
4. Journals : Design and Test of Computers, IEEE / ACM Journal on Electronic Design Automation / IEEE Transactions on CAD, Computers and VLSI Systems.
5. Conference Proceedings : International VLSI Conference/ Design Automation Conference (DAC)/ International Conference on Computer Aided Design (ICCAD)/ Asia South Pacific Design Automation Conference (ASPDAC)/ Formal Methods in Computer Aided Design (FMCAD)/ Computer Aided Verification (CAV).


**Low Power CMOS VLSI Design (4 Credits) (SBS/SKR)**

The objective of the course is to understand the sources of power dissipation in VLSI SoCs and embedded-systems and techniques by which SoC power can be reduced at various abstraction levels from device(MOSFET transistor), through circuit and behavioral levels up to the software(operating system) level and the trade-offs between power dissipation, chip performance and area. Another objective of the course is to be able to re-design and optimize the circuits for low-power. Finally, software-hardware co-design aspects of low-power are considered.

**Topics :** Power Dissipation in Embedded Systems, MOS Transistor Device Physics (Revision), Physics of Power Dissipation in MOSFETs, Power Estimation: Probabilistic Techniques, glitching power, high-level estimation, Low Power Synthesis: Behavioral level,Logic Level, Circuit level, low-power in DSP,Low-Voltage Digital CMOS Circuits, Low-Power Memory Architectures, Power Management in SoCs, Adiabatic Computing, Software Design for Low Power: software power estimation & optimization.

**Lab** : Cadence or Mentor schematic design tools. Students are expected to optimize a given RTL description of a circuit into a low-power gate-level implementation possibly including clock-gating and other techniques.

**References:**

1. Low-Power CMOS VLSI Circuit Design: Kaushik Roy, Sharat C. Prasad
2. Digital Integrated Circuits: Jan Rabaey, Ananth Chandrakasan

## Static Timing Analysis and Digital Circuit Optimization (4 Credits) (SN)

This course will cover all aspects of static timing analysis of digital circuits including concepts of delay of gates, delay modeling of gates including the Elmore delay model, logical effort, and more complicated models considering parasitic capacitance. Aspects of crosstalk analysis will also be covered. In regards to static timing analysis concepts such as PERT modeling, critical path extraction, multi-corner analysis, and early/late mode timing analysis will be discussed. In the second part of the course we examine how to optimize the delay of circuits keeping in mind area and power considerations. Convex programming formulations that allow tractable solutions to the problem will be presented. The course will involve a semester-long software project on various aspects of static timing, delay calculation and circuit optimization.

**References:**

1. Timing, S. Sapatnekar, Kluwer Academic Publishers
2. Convex Optimization, S. Boyd and L. Vandenberghe, Cambridge University Press

## Circuit Simulation (4 Credits) (SN)

Topics : This course presents the theoretical and practical aspects of the building a circuit simulator, such as SPICE. The theoretical basis of circuit simulation will require a good understanding of numerical algorithms, differential equations and Monte-Carlo analysis from a mathematical point of view. We will cover circuit formulation methods, nodal analysis, large-scale nonlinear DC and small signal AC analysis, moment matching, transient, inductive modeling and reduction techniques.

**References:**

Circuit Simulation, Farid Najm, Wiley Publishers

## Semiconductor Device Physics (4 Credits) (MR/SBS)

**Topics :** The course will include energy band structure of semiconductor, electron statistic distribution, carrier transport principles, drift-diffusion model, semiconductor contact interface such as Schottky contact, ohmic contact, mobility models, MOS transistors, Metal Oxide silicon capacitors, BJTs non-ideal effects, p-n junctions for solar cells, leds and laser diodes. The course will also include GSS an open source tool in TCAD to simulate semiconductor devices.

**References:**


1. Pierret, Robert F. *Semiconductor Device Fundamentals*. Reading, MA: Addison Wesley, 1996.
2. Simon, M Sze. *Physics of Semiconductor Devices*. 3rd edition, Wiley.


## Deep Submicron Design Techniques (4 Credits) (SN)

This course will provide a broad overview of the issues that arise in the design of deep-submicron VLSI chips.

Topics : MOS and CMOS transistor basics - Basic principles of MOS and CMOS transistors, field-effect principle, derivation of simple formulae; CMOS design styles - static CMOS designs, dynamic CMOS designs; Delay calculation - Delay calculation, electrical wire models, timing issues in deep-submicron circuits; Abstraction levels - Abstraction levels including RTL level, logic gate level and library based design; DFT/Circuit Reliability and Signal integrity - Latch-up in CMOS circuits, electrostatic discharge, electro-migration; Layout and physical verification

**References:**


1. Digital Integrated Circuits, J.M. Rabaey, A. Chandrakasan and B. Nikolic. Prentice-Hall (Second Edition)
2. Research papers of the last few years from DAC, ICCAD.
3. Deep-submicron CMOS ICs, From Basics to ASICs, Harry Veendrick. ASICs, Kluwer Publishers


## Introduction to RF electronics (4 Credits) (MR/SBS)

**Topics :** The course includes Resonant Circuits, impedance matching, transmission lines, Smith charts, Impedance matching, network representation, importance of S-parameters, Noise factors, Stability, Linearity, RF propagation and antenna-on-chip design, RF transceiver architecture. The course also includes design and simulation of RF transceivers using HFSS EDA tools, available in HiDES lab.

**References:**


1. Behzad Razavi, RF microelectronics, 1998 Prentice Hall
2. Guillermo Gonzalez, Microwave Transistor Amplifiers Analysis and Design, 2nd edition.
3. Pozar, Microwave and RF design of wireless systems, 2000 Wiley.
4. Christopher Bowick, RF Circuit Design, 2nd edition.


**Introduction to Nanoelectronics and MEMS/NEMS devices(4 Credits) (MR)**

Topics : The course includes basics of Schrödinger equations, electrostatics, semiconductor band structures, simulation of band structures, nanoscale MOS capacitors, 3D Finfet transistors, CNT/Graphene based transistors, scattering theory for nanostructures, single electron transistors, MQCA logic gates, Accelerometers design by MEMS, Noise in MEMS, MEMS based Pressure sensor design, MEMS Packaging and assembly, Electronic interface design principles, Capacitive Position Sensing, Electrostatic actuators, modeling microresonators, Micromachining techniques for MEMS devices. The course will include open source simulation simulation tools such as SUPREM-IV - a stanford TCAD process simulator, SUGAR v3 - an open source Berkeley tool, and NEMO-3D - an open source Purdue tool.

**References:**


1. M. Lundstorm, and J. Guo, Nanoscale transistors: Device Physics, modeling and simulation, Spring 2005.
2. Ville Kaajakari, Practical MEMS: Design of Microsystems
3. S. Datta, Quantum transport: Atom to Transistor, Cambridge University Press, 2005.
4. C ..u, Foundations of MEMS, Pearson Prentice Hall, 2 .. edition, 2012


**Analysis and Design of VLSI subsystems (4 credits) (MR)**

Purpose of this course is to help students understand principles of advanced and current design techniques of VLSI subsystems. The course discusses various aspects of a digital system design in terms of delay, power, and layout area. The course is focused towards MTech ESD students who are specializing in System on Chip (SoC) stream to develop skills to design systems for various VLSI architectures. Students are also expected to complete substantial design project as a part of the course, which involves extensive use of layout and design tools.

**Course Outline**

1. Combinational Circuit Design includes different circuit families, circuit pitfalls, power analysis of different combinational circuit families, and SOI circuit design.
2. Sequential Circuit Design includes sequencing methods, circuit design using latches and flip-flops, sequencing dynamic circuits.
3. Datapath subsystems includes adders, subtractors, comparators, counters, multipliers, shifters, other boolean logical operations.
4. Array subsystems includes various memory technology, and Programmable logic arrays.
5. Analysis of 3D Interconnect technology for digital hybrid circuits, and magnetic logic devices as an alternate to digital subsystems.

**Textbook/References:**

1. Neil H. E. Weste and David Harris, CMOS VLSI Design: A circuits and systems perspective, 4th edition, 2011.
2. J. M. Rabaey, A. Chandrakasan, B. Nikolic, Digital Integrated Circuits A Design Perspective, 2nd edition, 1999.
3. Technical Papers on magnetic logic devices, memory design, and interconnect design.

**Advanced Analog Design (4 credits) (SS/CP)**

Pre-requisite: Analog CMOS VLSI Design

Introduction: This course is a follow-up to the first semester MTech core course on Analog CMOS VLSI Design. It will take the student to further depths and areas of analog VLSI design. The course will have many circuit simulation based assignments, and one major project involving the design of an analog system.

Topics: Noise in amplifiers: Thermal and flicker noise, calculation of noise in circuits. Switched-capacitor circuits: MOS switches, their characteristics and error sources; switched-capacitor amplifiers and filters. Review of feedback in electronic circuits. Nonlinearity and mismatch in analog circuits: Causes of nonlinearity, effect of negative feedback, linearization techniques, offset cancellation techniques. Layout techniques. Comparators: Opamp-based, latch and dynamic comparators, speed and power considerations. Band-gap references: Achieving temperature independence, supply-independent biasing, speed and noise issues. Oscillators: Ring, LC and voltage-controlled oscillators. Filters: Types of analog filters and their circuits. Phase-locked loops (PLLs): First- and second-order PLLs, charge-pump PLLs, nonideal effects, applications.

**References**

4. Design of Analog CMOS Integrated Circuits, B. Razavi, Tata McGraw-Hill.
5. Analog Integrated Circuit Design, D.A. Johns and K. Martin, Wiley.

6. CMOS : Circuit Design, Layout and Simulation, R. Jacob Baker, IEEE Press/Wiley Student Edition.
7. RF Microelectronics, B. Razavi, Prentice-Hall.
8. The Design of CMOS Radio-Frequency Integrated Circuits, 2nd ed., Thomas H. Lee, Cambridge.

**Mixed Signal Circuits (4 credits) (SS/CP)**

Pre-requisites: Analog CMOS VLSI Design, Advanced Analog Design

Introduction: This is the third in the sequence of courses on analog and mixed-signal design, the first two being the pre-requisites of this course. In this course, the focus will be on mixed-signal circuits, with a primary emphasis on data converters. Students will do multiple simulation-based assignments, and one major project involving the design of a particular data converter architecture.

Contents: Fundamental considerations of data converters: Resolution, sampling rate, integral nonlinearity, differential nonlinearity, signal-to-noise ratio, spurious-free dynamic range, speed. Architectures and detailed circuit & system designs of digital-to-analog converters: Resistor string, weighted resistor, R-2R ladder, capacitive, switched-capacitor based, current steering, cyclic and pipelined. Architectures and detailed circuit & systems designs of analog-to-digital converters: Flash, pipeline, integrating, successive approximation register, oversampling.

**References**


1. CMOS : Circuit Design, Layout and Simulation, R. Jacob Baker, IEEE Press/Wiley Student Edition.
2. Principles of Data Conversion System Design, Behzad Razavi, Wiley-Blackwell.
3. CMOS: Mixed-Signal Circuit Design, R. Jacob Baker, IEEE Press.
4. Data Converters, Franco Maloberti, Springer.

# Appendix-C EMS Electives

## Inter Device Communications (4 Credits) (JP/MR)

**Pre-requisites** : Basic electronics, Digital Circuits, Awareness of communication protocols.

Communication between different devices happens in different ways. Various standards have been developed over time and these have evolved with usage. Some of these standards have become popular because of their inherent strengths and some because they of they ended up being widely used very early in their life. This course will cover the commonly used protocols. It also looks at certain specialized protocols to highlight how the usage scenarios mould the protocol. The course will be extremely hands on. The student will have to implement four of the protocols.

Topics : Introduction to inter-device communication; Class room exercise to specify requirements for a protocol and to design it; Specific standards/protocols including - RS-232/485, I2C, SPI, CAN, Bluetooth. Debugging of protocols using logic analyzer is also included in this course.

**References:**


1. Serial port complete edition by Jan Axelson
2. Particular specifications from each standards body.
3. Bluetooth Demystified, N J Muller, McGraw-Hill Telecom


## Digital Signal Processing (4 Credits) (PGP/DJ)

This is a first level graduate course on Digital Signal Processing principles and implementation. The course covers concepts of analog to digital conversion, LTI systems, frequency domain representation (Fourier and Z transform), Digital Filter Design, Filter realization, Fixed Point arithmetic/Quantization Effects. It will also examine application areas such as, OFDM, DCT for image/speech compression. Software implementation using Scilab and ADI Blackfin processor.

**References:**


1. Digital Signal Processing, Oppenheim and Schaefer, PHI.


## Principles of Intelligent Systems (4 Credits) (PGP)

It is believed that machines with computational intelligence will soon become ubiquitous and change the world forever. This course is a small step in that direction with focus on understanding principles and tools which help in designing intelligent machines. We call a system intelligent if it has the ability to - Develop behaviors based on input data from sensors or databases; Recognize

complex patterns and make intelligent decisions; Understand and interact with the environment and learn to survive and improve its performance; Repair, reconfigure and adapt to new environments; Listen to other machines or humans and communicate well; Learn from the environment and develop ability to navigate like humans. Purpose of this course is to work and learn along with students to get a good exposure to the area in terms of concepts and tools to design such systems in the future. The course will have assignments, paper presentation, an algorithm module implementation and project work. There will be no exams. Project work will involve development of an intelligent gadget or an intelligent software application.

**Topics** : Discussion on the nature of human intelligence : Behaviorism - All behavior is caused by external stimuli, Cognetivism - Brain designed as an Information processor, Constructivism - Learning is an active, constructive process, Humanism - Learning is a personal act to fulfill one's potential; Discussion on Artificial Intelligence and computational learning; Concepts and tools for creating artificially intelligent machines: Linear classifiers, Perceptrons and support vector machines, Data representation, Data clustering and vector quantization, Decision trees and Random forests, Adaptive Signal Processing techniques , Artificial Neural networks, Hidden Markov models and Belief Propagation Networks, Probably Approximately Correct learning, Evolutionary computing and Stochastic algorithms for learning; Some Examples where humans may have good competition : Doctorless health clinics, Pilot less aircraft design, Driverless cars, Data mining and prediction, Robot soccer and other games, Logical reasoning and knowledge representation, Research and discovery; New Honda Robot ASIMO 2012 : All features and behaviors ( http://www.youtube.com/watch?v=R8IJeT9r4cmg&feature=related )

**References:**


1. Artificial Intelligence, 3rd Edition, Patrick Henry Winston, Pearson Education, Fifth Indian Reprint, 2003
2. R. Rojas: Neural Networks, Springer-Verlag, Berlin, 1996
3. Journal Papers and other books as required


**Machine Learning (4 Credits) (GS)**

**Pre-requisites** : Mathematics for IT (Gen501), Algorithms (CS 501)

This course will cover a number of machine learning techniques with emphasis on the theory behind these techniques that affects the practice of these methods. There is also a significant amount of literature on the theory of learnability that attempts to answer questions like: What is learning — can we define learning precisely in a computational sense? How can learning be quantified — how well has an algorithm learnt something? Are there inherent limitations to machine learning — can we say some concepts are more easily learnable than others? The course will cover some amount of learnability theory, just enough to appreciate why these questions

Biases, Dealing with Large Amounts of Data, Data Snooping, Design of Learning Systems; Reflections, Discussion.

**References:**


1. Yaser S. Abu-Mostafa, Mailk Magdon-Ismail, and Hsuan-Tien Lin. Learning From Data — A Short Course. AMLbook.com, 2012.
2. Kevin P. Murphy. Machine Learning - A Probabilistic Perspective. Second Edition, MIT Press, 2012.
3. Christopher M. Bishop. Pattern Recognition and Machine Learning. Ed. by M.Jordan, J.Kleinberg, and B.Scholkopf. Information Science and Statistics. Springer, 2006


**Model Based Hardware-Software Co-Synthesis of Embedded Systems (4 Credits) (SKR)**

Topics : INTRODUCTION : System-Design Challenges, Abstraction Levels, Y-Chart, Processor-Level Behavioral Model , Processor-level structural model, Processor-level synthesis, System-Level Behavioral Model, System Structural Model, System Synthesis, System Design Methodology, Missing semantics , Model Algebra, System-Level Models, Platform Design, System Design Tools, Summary; SYSTEM DESIGN METHODOLOGIES : Bottom-up Methodology, Top-down Methodology, Meet-in-the-middle Methodology, Platform Methodology, FPGA Methodology ,System-level Synthesis, Processor Synthesis ,Summary; MODELING : Models of Computation, Process-Based Models , State-Based Models, System Design Languages , Net-lists and Schematics , Hardware-Description Languages, System-Level Design Languages, System Modeling , Design Process , Abstraction Levels, Processor Modeling, Application Layer, Operating System Layer, Hardware Abstraction Layer, Hardware Layer, Communication Modeling. Application Layer, Presentation Layer, Session Layer, Network Layer, Transport Layer, Link Layer, Stream Layer , Media Access Layer, Protocol and Physical Layers, System Models , Specification Model, Network TLM, Protocol TLM, Bus Cycle-Accurate Model (BCAM), Cycle-Accurate Model (CAM), Summary; SYSTEM SYNTHESIS : System Design Trends, TLM Based Design, Automatic TLM Generation, Application Modeling, Platform Definition, Application to Platform Mapping , TLM Based Performance Estimation, TLM Semantics, Automatic Mapping, GSM Encoder Application, Application Profiling, Load Balancing Algorithm, Longest Processing Time Algorithm, Platform Synthesis, Component data models, Platform Generation Algorithm, Cycle Accurate Model Generation, Summary; SOFTWARE SYNTHESIS : Preliminaries, Target Languages for Embedded Systems, RTOS, Software Synthesis Overview, Example Input TLM, Target Architecture, Code Generation, Multi-Task Synthesis, RTOS-based Multi-Tasking, Interrupt-based Multi-Tasking, Internal

Communication, External Communication , Data Formatting, Packetization, Synchronization, Media Access Control,
Startup Code, Binary Image Generation, Execution, Summary; EMBEDDED DESIGN PRACTICE: System Level Design Tools, Academic Tools , Commercial Tools , Outlook, Embedded Software Design Tools, Academic Tools, Commercial Tools, Outlook, Hardware Design Tools, Academic Tools, Commercial Tools , Outlook , Case Study, Embedded System Environment, Design Driver: MP3 Decoder, Results, Summary.

**References:**

1. Embedded System Design : Modeling, Synthesis and Verification - D. D. Gajski, S. Abdi, A. Gerstlauer, G. Schriner, Springer

**Principles of Multimedia & Multimedia Architectures (4 Credits) (JP)**

**Topics** : Introduction to Multimedia – What is multimedia? Multimedia & Hypermedia, WWW, Overview of Multimedia Software Tools; Multimedia Authoring & Tools – Multimedia Authoring, Some Useful Editing & Authoring Tools, VRML; Graphics and Image Data Representation – Data Types, Popular file formats; Color in Image and Video – Color Science, Color Models in Images & Video; Fundamental Concepts in Video – Types of Video Signals, Analog Video, Digital Video; Basics in Audio – Digitzation of Sound, MIDI, Quantization and Transmission of Audio; Multimedia Data Compression – Lossless & Lossy Compression Algorithms, Image Compression Standards; Basic Video Compression Techniques – Compression based on Motion Compensation, H.261, H.263; MPEG Video Coding – MPEG – 1, MPEG – 2, MPEG – 4 (H.264), MPEG – 7, MPEG – 21; Basic Audeo Compression Techniques – ADPCM (G.726), Vocoders; MPEG Audio Compression – Psychoacoustics, MPEG audio – Strategy/Compression Algorithm/MPEG-2AAC, MPEG-4; Multimedia Communication and Retrieval - Computer & Multimedia Networks; Multimedia Network Communications and Applications, Wireless Networks, Content Based retrieval in Digital Libraries.

**References:**

1. Fundamentals of Multi-Media, Ze-Nian Li, Mark S. Drew, Prentice Hall of India.

**Real Time Systems -- Design, Analysis and Verification (4 Credits) (EF)**

**Topics** : Basic Real-Time Concepts; Hardware Considerations; Real Time Operating Systems; Software System Design; Programming Languages and the Software Production Process; Performance Analysis and Optimization; Engineering Considerations; Verification : Analysis of Non-Real-Time Systems; Real time Scheduling and Schedulability Analysis; Model Checking of Finite State Systems; Real Time Logic, Graph- Theoretic Analysis and Mode Chart; Timed Automata, Timed Petri-Nets; Process Algebra

**References:**

1. Real Time Systems Design and Analysis – Phillip A. Laplante, IEEE Press & John Wiley Student Edition.
2. Real Time Systems : Scheduling, Analysis and Verification – Albert M. K. Chang, IEEE Press & John Wiley Student Edition)

**Cyber Physical Systems (4 Credits) (SKR/EF)**

**Topics :** Introduction; Sensors & Actuators, Memory Architectures, Interfacing To Sensors & Actuators, Interrupts, Model Based Design, Modal Behaviour, Extended and Timed Automata, Composition of State Machines, Hierarchical State Machines, Multi-Tasking, Operating Systems, Scheduling Anamolies, Temporal Logic, Comparing State Machines, Reachability, Execution Time Analysis, Synchronous Reactive, Dataflow, and Security.

**References:**

1. Introduction to Embedded Systems – A Cyber-Physical Systems Approach, E. A. Lee and S. A. Seshia

**Embedded Software Verification and Validation (4 Credits) (MDS)**

Topics : Embedded software usually are a part of safety critical systems, and hence, there is extra focus and rigour in their verification and validation. Several certification and safety standards emphasize usage of mathematical and formal techniques to verify such software. This course will deal with techniques for embedded software verification and validation. Relevant techniques from software testing and model checking will be covered from the side of functional testing and verification. From the side of non-functional validation, worst case execution analysis, schedulability analysis and safety assurance techniques will be covered.

**References:**

1. Embedded Systems and Software Validation, Abhik Roychoudhury, Morgan Kaufmann (Elsevier), 2009.
2. Principles of Model Checking, Christel Baier and Joost-Pieter Katoen, MIT Press, 2008.
3. Appropriate papers on the above topics.

**Design and Analysis of Embedded Software Systems (4 Credits) (SC)**

**Topics :** Software Architectures for Embedded Systems : AUTOSAR, RING, FRAME; Software Model Development Environment (SMDE) in Embedded System : Simulink, Esterel etc. based development platforms; Programming for Embedded System : Memory constrained environment performance; Testing of

Embedded System Software : Performance, Response, Memory Requirements etc.

**References:**

1. Details will be provided by Prof. Sujit Chakraborty

**Computational Perception Using Multimodal Sensors (4 Credits) (DJ)**

Topics : This course will provide the students with a unified view on representations, statistical models, and algorithms to automatically analyze people's behavior in interactions, using single and multiple perceptual modalities (mainly vision and audio). The course will emphasize the comparison between modalities and the discussion of their individual and combined advantages, while introducing modeling tools for localization, segmentation, tracking, recognition, using probabilistic graphical models as the underlying formalism. The course trains students to record and analyze human-human and human-computer interactions using Kinect sensors, with interesting applications in gaming and behavioral training.

**References:**


1. Murphy, Kevin P. *Machine learning: a probabilistic perspective*. The MIT Press, 2012.
2. Bishop, Christopher M. "Pattern recognition and machine learning (information science and statistics)." (2007).
3. Thiran, Jean-Philippe, Ferran Marqus, and Herve Bourlard. *Multimodal Si- al Processing: Theory and applications f- human-computer interaction*. Academic Press, 2009.


**Internet of Things (IoT) (4 Credits) (JB / DD)**

Pre-requisites : Fundamentals of Computer Networking and Communication

Smart environments represent the next evolutionary development step in building, utilities, industrial, home, shipboard, and transportation systems automation. Like any sentient organism, the smart environment relies first and foremost on sensory data from the real world. Sensory data comes from multiple sensors of different modalities in distributed locations. Along with sensing abilities, the ability of the sensor nodes to communicate using radio channels enables the sensor nodes to form cooperative networks and leads to IoT eco-system. In this course, we will explore the wireless networks, the challenges involved, architectures, communication protocols and applications. It is expected that labs and a project will be a significant part of the course.

Topics : The Sensor Network Concept - Introduction: The vision of Smart Environment, Applications, How are sensor networks different?; Applications; Architecture -Hardware Components, Operating Systems and execution, Introduction to Cross-bow Motes family; Physical Layer : Wireless Channel and transceiver design considerations for WSN, Adaptability, Antenna considerations; Medium Access and Routing : Requirements and design constraints for MAC for WSN, Low-duty cycle protocols (S-MAC), IEEE 802.15.4 MAC protocol, Adhoc routing protocol (like AODV) and mesh networks; Localization and Positioning - Localization Approaches: Proximity, Trilaterations and Triangulation; Collaborative Signal Processing and Distributed Computation; Detection, estimation, classification problems; Energy-efficient distributed algorithms; Time Synchronization and Routing Protocols.

**References:**


1. Protocols and Architecture for Wireless Sensor Networks, Holger Karl and Andreas Willing, Wiley
2. Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, L. Guibas, Elsevier


**Embedded Systems for Healthcare (4 Credits) (SBS/RC/BG)**

In this course, we will look at how mobile communications have, and can be, leveraged as effective tools for strengthening health systems and improving health outcomes. We will concentrate our study on resource-limited settings, where the burden of infectious diseases is highest, where chronic conditions are often left unattended, where the healthcare infrastructure is least developed, and where the uptake of mobile communications is also the highest. We will start with the definitions and scope of ICT for healthcare (eHealth followed by mHealth), and then present a state of the art of mHealth as it stands today, with a special focus on the challenges that prevent its widespread adoption. In this landscape analysis, we will present the different areas and diseases where mHealth has been used, and illustrate these with concrete examples from pilots and large-scale implementations. Thereafter, we will look at the technological aspects of mHealth implementations, introduced through our own conceptual framework. Special emphasis will be placed on the mHealth front-end user devices, the most widespread modes of communications (SMS being the primary focus) and mobile 'apps' which are gaining ground. The underlying open-source development approach will be presented, as well as the increasing use of cloud computing as the back-end of mHealth. The course will conclude with descriptions of the main technology platforms already is use for data collection, communication and aggregation; a study of these platforms is important since any new implementation necessarily has to interface with them and co-exist and co-operate. A case-study at the end of the course will allow the audience to design a new mHealth solution based on the expected health

outcomes, the IT infrastructure available, and the local user profiles. This will allow the audience to appreciate the fact that hi-tech is not always necessary nor desirable, and that the primary focus of mHealth should be on the 'Health' part rather than the 'm' technology.

Course includes the following topics:
Communicable Disease - bacteria, viruses and parasites, Non-Communicable disease - diabetes, cardiovascular, cancer, COPD, Nervous system-the processor and wiring, Circulatory System-the plumbing, Blood-fluid to fuel and protect, Lungs-the exhaust system, Overview of current laboratory techniques, Point of care diagnostic systems, Pulse oximetry-turning blood composition and pressure into electrical waveforms, Waveform analysis to derive respiration rate, Picking up and amplifying electrical activity of the heart, Waveform analysis to determine diagnosis, Standard invasive and noninvasive methods, Non invasive imaging technique, Microfluidic tools, Ongoing work to create chips for complex assays (PCR), Building better limb replacements-embedded systems arms and legs, The future-prosthetic eyes and mind controlling computers, The care process, its bottlenecks and challenges, The potential of mobile communications for healthcare, mHealth as a part of eHealth, Challenges faced by mHealth today, The economics of mHealth, Ethical and regulatory issues, Conceptual framework for implementation: Constituent elements of mHealth, Technical architectures of mHealth, Implementations, with illustrative cases, User front-end: devices and means of communication, Cloud computing as back-end: future frontier for storage and access. Major open-source platforms for the development and implementation of mHealth, Data collection and communication platforms, Data aggregation and analysis platforms, Interoperability issues, Electronics of implantable sensors and systems, Wireless transmission standards for biomedical systems, Body-area networks: potential and challenges, Instrumentation for measuring physiological parameters, Embedded electronics for data acquisition and storage, Signal processing: hardware and software, Wireless transmission and reception

**Actuators, Sensors and Robotics (4 Credits) (GP)**

Topics : Introduction to Measurable Physical Properties: Distance, Force, Light and Electromagnetic Radiation, Sound, Smell, Texture; Sensors and their Characterization : Position, Force/Torque, Light, Sound, etc; Basic Properties: Accuracy, Dynamic Range, Repeatability; Linear and Rotary Encoders; Force/Torque Measurement devices; Photocells; Piezosensors; Hall Effect and other EM sensors...; Actuators and their Characterization - Position, Force/Torque, Light, Sound, etc; Basic Properties: Accuracy, Dynamic Range, Repeatability; Linear and Rotary Motors; Photodiodes; Piezoactuators; Voice Coils; Applications in Robotics, Automotive.

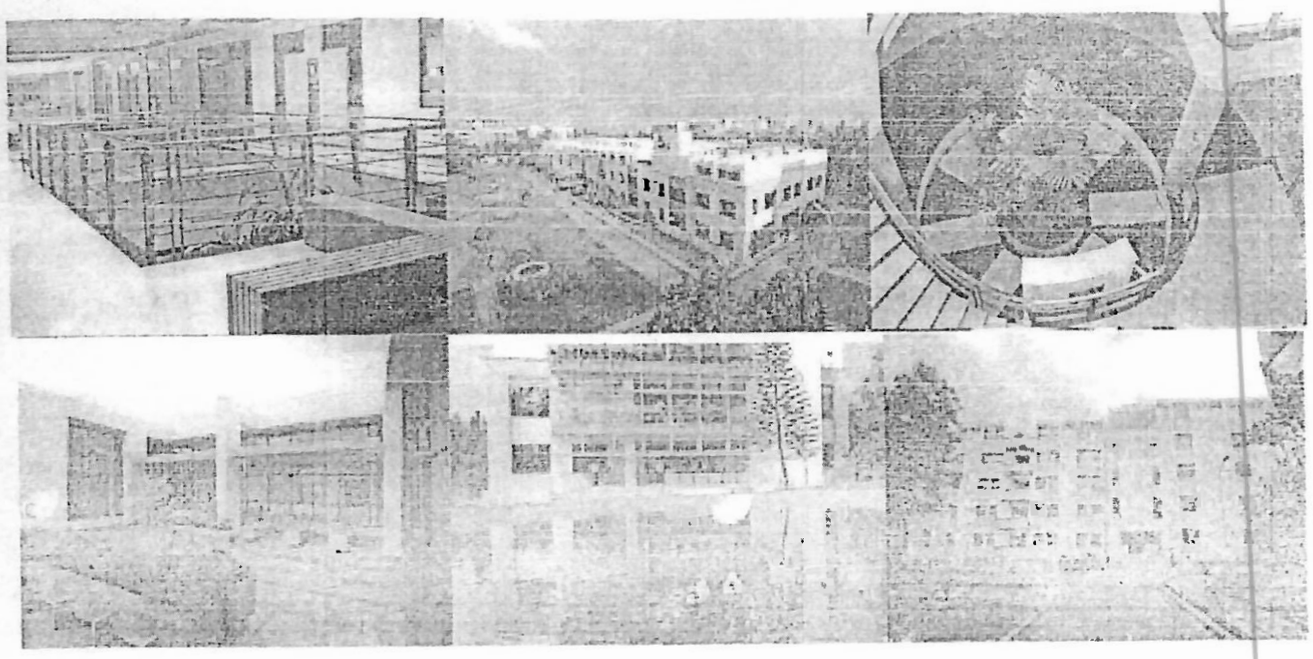
**Image Signal Processing (4 Credits) (NS)**
This is already an approved elective course.

Rajeshwari

# INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY, BANGALORE

## 49th Meeting of the Senate

## Agenda and Notes



**Date: February 10, 2016**
**Time: 2.00 p.m.**
**Venue: IIITB Board Room**

26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777

INTERNATIONAL INSTITUTE
OF INFORMATION TECHNOLOGY BANGALORE
26/C, Electronics City, Hosur Road, Bangalore 560 100
Phones: 080-28527627-635, 41407777; Fax: 080-28527636
Website :www.iiitb.ac.in

Date: February 1, 2016

Dear Sir/Madam,

**Sub: 49th meeting of the Senate of International Institute of Information technology, Bangalore being held on February 10, 2016 at 2.00 pm.**

Please find herewith attached agenda papers and notes for the 49th Meeting of the Senate of IIITB, being held on February 10, 2016 in the Board Room of IIIT B at 2.00 PM.

Kindly make it convenient to attend the meeting.

Thanking you,

Yours sincerely,

(V S Prakash)
Registrar &
Secretary to the Senate

4. Major Recommendations:
    a. Reducing the total minimum credit requirements from 75 to 64
    b. Doing away with the core course on Business Management for IT Engineers
    c. Converting Technical Communication to a non-credit course, mandatory for those found deficient through an examination in the first semester
    d. Merging Seminar ( 1 credit) with PE/RE
    e. Reducing the Maximum Number of PE/RE to 3 from current 4
    f. Merging the specialisations of Computer Science and Software engineering in to ' Computer Science and Engineering"
    g. Suggestion to constitute a standing committee of the senate to finalise structure, curriculum and course details for specialised sponsored M.Tech programme with titles of degrees named to reflect the specialisation
    h. No change in the admission process and no change in the titles of the degrees
5. The Committee has recommended that the proposed changes be effected from students admitted on or after 1st January 2016. Students admitted in 2015 may also be shifted to this new scheme, provided they meet all the requirements as suggested in the report and the revised curriculum documents.
6. The revised M.Tech(IT) curriculum document is at Annexure II B and the revised M Tech ( ESD) curriculum Document is at Annexure II C
7. The Senate may consider and if deemed fit approve the report and recommendations.

**49. 5 Admissions to different programs in 2016-17**

Yearly intake for each programme:

| | |
|---|---|
| MTech (IT) | 150 |
| MTech (ESD) | 30 |
| iMTech (CSE) | 60 |
| iMTech (ECE) | 30 |
| MSc Digital Society | 30 |
| MS by Research | 15 |
| PhD | 25 |

**49. 6 Update on Ph.D. students on leave for 3 or more semesters**

Payal Prakash (PH2013007) - The student has communicated uncertainty in her plans to re-join. The Senate may take the decision to terminate the registration in the PhD programme. The email communication with the student is placed at Annexure III

Annexure - I

# INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY, BANGALORE

## 50th Meeting of the Senate

## Minutes of the Meeting

**Date: April 6, 2016**
**Time: 2.00 p.m.**
**Venue: IIITB Board Room**

26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777

**50.7 Consideration and Approval of Course Proposal**

The Senate approved the course proposal on SMART CITIES: 'URBAN LABELLING' AND BEYOND.

**50.8 Items for Reporting:** The Senate noted the details provided.

**50.9 Any other matter with the permission of the Chair - Tabled Agenda - 50th meeting of the Senate, being held on April 6, 2016**

The Senate approved the course proposal on 'Advanced Qualitative Research Methods' submitted by Professor Janaki Srinivasan

The meeting ended with vote of thanks to the Chair.

**********

**50.9 Any other matter with the permission of the Chair - Tabled Agenda - 50th meeting of the Senate, being held on April 6, 2016**

**50.9.1 Consideration and Approval of Course Proposal**

Course on 'Advanced Qualitative Research Methods' submitted by Professor Janaki Srinivasan is placed herewith.

**********

# Course Proposal Template

| | |
|---|---|
| **Course Name** | Advanced Qualitative Research Methods |
| **Course Proposer Name(s)** | Janaki Srinivasan |
| **Course Instructor Name(s)** | TBD |
| **Course Type** *(Select one)*<br>*All course types except "Special Topics" go through the process for Academic Senate approval* | Select one from the following:<br>• Core<br>• **Regular Elective**<br>• Preparatory-Mandatory<br>• Preparatory-Optional<br>• Special Topics |
| **Credits** | 4 |
| **Grading Scheme** | • **4-point scale** (A,A-,B+,B,B-,C+,C,D,F)<br>• Satisfactory/Unsatisfactory (S / X) |
| **Area of Specialization (if applicable)**<br>**CS** – Computer Science<br>**DBIS** – Database and Information Systems<br>**NC&E** – Networking & Communication and Embedded Systems<br>**SE** – Software Engineering | (Choose at most two areas from the list) |
| **Semester** | Term: (I / II / III / Prep)<br>Academic Year: 2016 |

**Pre-Requisites (where applicable, specify exact course names)**

Qualitative Research Methods or permission from instructor

**Course Description**

This is a follow-up course to Qualitative Research Methods. It will delve deeper into specific qualitative methods, particularly participant observation and ethnographic methods. Students will build a mini research project from scratch, crafting research questions; identifying appropriate methods for gathering and analyzing data; and finally writing up this research.

**Course Outcome**

**At the end of the course students are expected to UNDERSTAND :**

(i) Which methods and methodologies work best for a given research question or theoretical orientation

(ii) What are the pros and cons of various qualitative methods

(iii) What are the ethical considerations associated with each of the methods we study

# International Institute of Information Technology Bangalore

51st Meeting
of the
Senate

## Agenda and Notes

Date: June 22, 2016
Time: 2:00 pm
Venue: IIITB Board Room

26/C, Electronics City, Hosur Road Bangalore 560100 Phone: 080 41407777

INTERNATIONAL INSTITUTE
OF INFORMATION TECHNOLOGY BANGALORE
26/C, Electronics City, Hosur Road, Bangalore 560 100
Phones: 080-28527627-635, 41407777; Fax: 080-28527636
Website :www.iiitb.ac.in

**Date: June 16, 2016**

Dear Sir/Madam,

**Sub: 51st meeting of the Senate of International Institute of Information Technology, Bangalore being held on June 22, 2016 at 2.00 pm.**

Please find herewith attached agenda papers and notes for the 51st Meeting of the Senate of IIITB, being held on June 22, 2016 in the Board Room of IIIT B at 2.00 PM.

Kindly make it convenient to attend the meeting.

Thanking you,

Yours sincerely,

(V S Prakash)
Registrar &
Secretary to the Senate

**Agenda and notes**
**for the**
**51st meeting of the Senate of the**
**International Institute of Information Technology, Bangalore**
**June 22, 2016 at 2.00 pm**

## 51.1 Confirmation of the minutes of the 50th meeting held on April 6, 2016

Minutes of the 50th meeting of the Senate is placed at Annexure-1 for confirmation.

## 51.2 Action taken report

Details of the action taken on the minutes of the 50th meeting of the Senate are placed for perusal.

| Agenda Point | Decision Points | Action/s Taken |
|---|---|---|
| 50.4 | Conversion of registration from MS by Research to PhD Program | Offer letter is issued to the student |
| 50.7 | Consideration and Approval of Course Proposal | Approved the course proposal DT 302 (SMART CITIES: 'URBAN LABELLING' AND BEYOND) |

## 51.3 Consideration and recommendation of the Student for award of PhD degree.

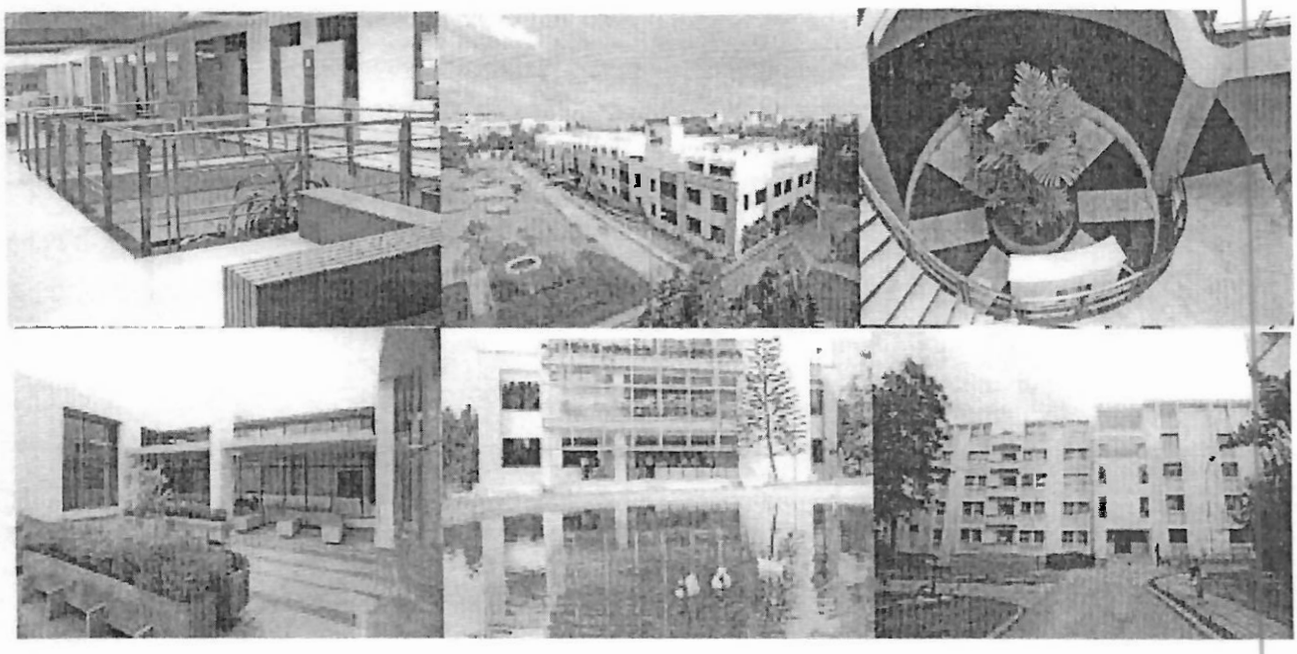
| | |
|---|---|
| Sl No | 1 |
| Roll No. | PH2009903 |
| Student Name | Nidhi Singh |
| Thesis Title | Online Learning Mechanisms for Large Scale Workload Prediction |
| Supervisor | Prof. Shrisha Rao |
| Degree | Ph.D. |
| Date of the Defense | Nov. 30, 2015 |

| | |
|---|---|
| Sl No | 2 |
| Roll No. | PH2011003 |
| Student Name | Pragati Agrawal |
| Thesis Title | Algorithmic Approaches to Energy-Efficient Scheduling |
| Supervisor | Prof. Shrisha Rao |
| Degree | Ph.D. |
| Date of the Defense | June 13, 2016 |

# INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY, BANGALORE

## 51st Meeting of the Senate

## Minutes of the Meeting



**Date: June 22, 2016**
**Time: 2.00 p.m.**
**Venue: IIITB Board Room**

26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777

INTERNATIONAL INSTITUTE
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26/C, Electronics City, Hosur Road, Bangalore 560 100
Phones: 080-28527627-635, 41407777; Fax: 080-28527636
Website :www.iiitb.ac.in

Date: June 23, 2016

**Sub: Minutes of 51st Senate meeting of the International Institute of Information technology, Bangalore held on June 22, 2016 at 2.00 pm.**

Dear Sir/Madam,

Please find herewith attached Minutes of the 51st Meeting of the Senate of IIITB held on June 22, 2016 in the Board Room of IIIT B at 2.00 PM.

Best Regards

(V S Prakash)
Registrar &
Secretary to the Senate

The Chairman welcomed all the members for the 51st meeting of the Senate and initiated the meeting.

**51.1 Confirmation of the Minutes of the 50th meeting held on April 6, 2016.**

Prof. Sonde pointed out that in Section 50.4 of the minutes, the degree name "MS by Research" should be replaced by "Master of Science by Research," which is as per the current approved degree name. Updated minutes of the 50th Meeting is attached in Annexure II

**51.2 Action taken report.**

The Chairman, Senate briefed the members about the action taken on the items of the previous Senate meeting including the approval of Course proposal DT303 on 'Advanced Qualitative Research Methods' submitted by Professor Janaki Srinivasan. Action taken report was noted.

**51.3 Consideration and recommendation of the Student(s) for award of PhD degree.**

The Senate has recommended to the Governing Body for conferring the PhD degree to the following:

| | |
|---|---|
| Sl No | 1 |
| Roll No. | PH2009903 |
| Student Name | Nidhi Singh |
| Thesis Title | Online Learning Mechanisms for Large Scale Workload Prediction |
| Supervisor | Prof. Shrisha Rao |
| Degree | Ph.D. |
| Date of the Defense | Nov. 30, 2015 |

| | |
|---|---|
| Sl No | 2 |
| Roll No. | PH2011003 |
| Student Name | Pragati Agrawal |
| Thesis Title | Algorithmic Approaches to Energy-Efficient Scheduling |
| Supervisor | Prof. Shrisha Rao |
| Degree | Ph.D. |
| Date of the Defense | June 13, 2016 |

The full list of students recommended by the Senate to the Governing body for the award of PhD in the forthcoming convocation to the candidate(s) is included in Annexure - 1.

**51.4 Consideration and Recommendation of the Student(s) for Award of Master of Science by Research Degree**

The Senate has recommended to the Governing Body for conferring the Master of Science by Research degree awards to following:

INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY, BANGALORE

# 52nd Meeting of the Senate

## Agenda and Notes

**Date: July 27, 2016**
Time: **2.00 p.m.**
**Venue: IIITB Board Room**

26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777

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OF INFORMATION TECHNOLOGY BANGALORE
26/C, Electronics City, Hosur Road, Bangalore 560 100
Phones: 080-28527627-635, 41407777; Fax: 080-28527636
Website :www.iiitb.ac.in

**Date: July 19, 2016**

Dear Sir/Madam,

**Sub: 52nd meeting of the Senate of International Institute of Information Technology, Bangalore being held on July 27, 2016 at 2.00 pm.**

Please find herewith attached agenda papers and notes for the 52nd Meeting of the Senate of IIITB, being held on July 27, 2016 in the Board Room of IIIT B at 2.00 PM.

Kindly make it convenient to attend the meeting.

Thanking you,

Yours sincerely,

(V S Prakash)
Registrar &
Secretary to the Senate

## 52.3 Review of Academic Rules

The Student Affairs Committee was constituted to review the rules and regulations pertaining to student academic and non-academic matters. The report was reviewed by the IQAC (Internal Quality Assurance Committee) comprised of the Dean (Academics and R&D), Associate Dean (Academics) and the Programme Coordinators. After holding due deliberations on the contents of the report and extensive discussions and comparison with practices of other leading institutions, the IQAC hereby recommends adoption of the suggestions noted in the report. The proposed rules and regulations on academic matters are being placed before the Senate for due consideration and approval. The extract of the report of the Student Affairs Committee containing the academic recommendations is included in **Annexure 2.**

## 52.4. Consideration and Approval of Course Proposal

Core course proposal on 'IT Project and Product Management' submitted by Prof Amit Prakash and Prof V Sridhar is placed at **Annexure 3** of the Agenda for approval.

## 52.5 Change in the name of Master of Science by Research degree program

Senate to consider and approve changing name of the degree program from "Master of Science by Research" to "Master of Science (Engineering)". This is to avoid ambiguity in the use of abbreviation "M.S." for the concerned degree programme as "M.S." is expanded as Master of Surgery in UGC Notification pertaining to Specification of Degrees, published in the Gazette of India in July 2014.

## 52.6 Admission to Master of Science by Research PhD programmes

Senate to consider and approve the proposal for removal of the requirement of "employment with an organization for at least two years" for admission to Master of Science by Research or Ph.D. programs with part-time registration.

Annexure 3

# IT Project and Product Management
## GENERAL COURSE INFORMATION

| | |
|---|---|
| **Course Name** | **IT Project and Product Management** |
| **Term** | M.Tech. Term I; IM.Tech. Term IX; M.Sc. (DT) Term III |
| **Instructor(s)** | V. Sridhar & Amit Prakash |
| **Course credits** | 4 |
| **Pre-requisite(s)** | - |

## COURSE OVERVIEW AND OBJECTIVES

Having pioneered the off-shore information Technology outsourcing, India is in a transition to building Information and Communication Technology (ICT) platforms and products for domestic consumption and for other newer markets. This course offers a comprehensive overview of the essentials of project and product management and delves into details of innovation and entrepreneurship and ICT platform businesses.

The first part of the course covers life cycles of project management including processes, tools and methods, organizational, financial and market analysis. A detailed exposure will be given to the students in different knowledge areas of project management including, scope and requirements management, estimation procedures, risk management, human resource management, and financial management of projects. Since most of the IT projects span geographical locations, culture, time zones and common protocols for globally distributed projects will also be discussed. Agile and lean methodologies in project management literature will also be discussed for effective management of rapidly evolving requirements.

The second part of the course deals with product management. The specific case of market analysis and the product-market fit will be discussed complemented by cases in the knowledge area. One of the critical components of information products, namely, Intellectual Property Rights (IPR) and licensing monetization will also be discussed. Students will be exposed to the concepts of business models and a few approaches to develop them.

The third part of the course will introduce the students to basic concepts in innovation and entrepreneurship and will help them in the synthesis of their project and product management learning in the context of ICT platform enabled businesses. Concepts on network economics, two-sided market analysis, valuation methods, product-market fit, scaling of ventures will be discussed. The students will be expected to develop a business plan for a product idea at the end of the course.

## COURSE CONTENTS

**1. Project Management (10 sessions):**

1.1 scoping/requirements (VS/AP – 2 sessions);
1.2 estimation, planning & scheduling (VS – 2 sessions);
1.3 finance (VS – 2 sessions);

INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY, BANGALORE

# 53rd Meeting of the Senate

## Minutes of the Meeting

**Date: October 05, 2016**
**Time: 2.00 p.m.**
**Venue: IIITB Board Room**

26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777

INTERNATIONAL INSTITUTE
OF INFORMATION TECHNOLOGY BANGALORE
26/C, Electronics City, Hosur Road, Bangalore 560 100
Phones: 080-28527627-635, 41407777; Fax: 080-28527636
Website :www.iiitb.ac.in

Date: October 26, 2016

**Sub: Minutes of 53rd Senate meeting of the International Institute of Information technology, Bangalore held on October 05, 2016 at 2.00 pm.**

Dear Sir/Madam,

Please find herewith attached Minutes of the 53rd Meeting of the Senate of IIITB held on October 5, 2016 in the Board Room of IIIT B at 2.00 PM.

Best Regards

Commodore S R Sridhar (Retd)
Registrar &
Secretary to the Senate

ANNEXURE – II

# Course Proposal Template

| | |
|---|---|
| **Course Name** | Topological Data Analysis |
| **Course Proposer Name(s)** | Dr. Amit Chattopadhyay |
| **Course Instructor Name(s)** | Dr. Amit Chattopadhyay |
| **Course Type** *(Select one)*<br>*"Special Topics" course proposals to be shared with faculty members for any feedback; but Academic Senate approval is not needed. All other course types need Academic Senate approval.* | Elective |
| **Credits** | 4 |
| **Grading Scheme** | • 4-point scale (A,A-,B+,B,B-,C+,C,D,F)<br>• Satisfactory/Unsatisfactory (S/X) |
| **Area of Specialization (if applicable)**<br>CSE – Computer Science and Engineering<br>DS – Data Sciences<br>NCS – Networking & Communication and Signals<br>ES – Embedded Systems<br>SoC - System on Chip | (Choose at most two areas from the list)<br><br>DS, CSE |
| **Semester** | Term: II<br>Academic Year: 2016-2017 |

| **Pre-Requisites (where applicable, specify exact course names)** |
|---|
| Algorithm, Programming skill in C++, Basic mathematics (primarily, Linear Algebra and Calculus) |

| **Course Description** |
|---|
| "Topology Data Analysis" is an emerging branch of scientific data analysis which introduces important tools for extracting or computing topological features from the spatial data, e.g. number or connected components, holes, tunnels or cavities in the data. This course will teach designing efficient algorithms and data-structures for computing such topological features and demonstrate their applications for understanding various scientific data. |

Template Version Number 2.0
Template update date 06 June 2016

# Course Proposal Template

| | |
|---|---|
| **Course Name** | Computational Geometry |
| **Course Proposer Name(s)** | Dr. Pradeesha Ashok |
| **Course Instructor Name(s)** | |
| **Course Type** *(Select one)*<br>*"Special Topics" course proposals to be shared with faculty members for any feedback; but Academic Senate approval is not needed. All other course types need Academic Senate approval.* | Select one from the following:<br>• Core<br>• **Elective**<br>• Preparatory-Mandatory<br>• Preparatory-Optional<br>• Special Topics |
| **Credits** | |
| **Grading Scheme** | • **4-point scale (A,A-,B+,B,B-,C+,C,D,F)**<br>• ~~Satisfactory/Unsatisfactory (S/X)~~ |
| **Area of Specialization (if applicable)**<br>**CSE** – Computer Science and Engineering<br>**DS** – Data Sciences<br>**NCS** – Networking & Communication and Signals<br>**ES** – Embedded Systems<br>**SoC** - System on Chip | (Choose at most two areas from the list)<br><br>CSE<br>DS |
| **Semester** | Term: II<br>Academic Year: 2016-17 |

| **Pre-Requisites (where applicable, specify exact course names)** |
|---|
| Data Structures<br>Design & Analysis of Algorithms |
| **Course Description** |
| This course covers algorithms and techniques from the field of geometry. The problems are motivated by applications in areas like computer graphics, geographic information systems (GIS), robotics etc. The emphasis of the course will be on different classes of geometric problems and the concepts and techniques needed to solve it. |
| **Course Content** |

Template Version Number 2.0
Template update date 06 June 2016

# International Institute of Information Technology Bangalore

## 54th Meeting of the Senate

## Agenda and Notes

**Date: December 14, 2016**
**Time: 2:00 pm**
**Venue: IIITB Board Room**

26/C, Electronics City, Hosur Road Bangalore 560100 Phone: 080 41407777

INTERNATIONAL INSTITUTE
OF INFORMATION TECHNOLOGY BANGALORE
26/C, Electronics City, Hosur Road, Bangalore 560 100
Phones: 080-28527627-635, 41407777; Fax: 080-28527636
Website :www.iiitb.ac.in

Date: December 06, 2016

Dear Sir/Madam,

**Sub: 54th meeting of the Senate of the International Institute of Information Technology, Bangalore being held on December 14, 2016 at 2.00 pm.**

Please find herewith attached agenda papers and notes for the 54th Meeting of the Senate of IIITB, being held on December 14, 2016 in the Board Room of IIIT B at 2.00 PM.

Kindly make it convenient to attend the meeting.

Thanking you,

Yours sincerely,

S R Sridhar
Commodore (Retd)
Registrar & Secretary to the Senate

## 54.3 Consideration and Approval of Course Proposals

54.3.1 Course on 'Topological Data Analysis' submitted by Prof Amit Chattopadhyay to be offered to MTech Students as Elective during Term II of the Academic Year 2016-17.

54.3.2 Course on 'Computational Geometry' submitted by Prof Pradeesha Ashok to be offered to MTech Students as Elective during Term II of the Academic Year 2016-17.

The course proposals are placed at Annexure II of the Agenda.

## 54.4 For consideration and approval of the Senate with regard to the following (Annexure III):

**54.4.1** Senate may approve the request of the following student to convert his student status from full time to part time.

| Sl. No. | Roll Number | Student Name | Supervisor |
|---|---|---|---|
| 1 | MS2015014 | Vinay A Jawgal | Prof V N Muralidhara |

**54.4.2** Senate may approve the request of the following student to withdraw from the research programme due to personal reasons.

| Sl. No. | Roll Number | Student Name | Supervisor |
|---|---|---|---|
| 1 | PH2015011 | Sainath Shanbhag | Prof Jaya Sreevalsan Nair |

**54.4.3** Senate may take suitable action regarding the poor performance of the following student over the semesters as well as during academic probation.

| Sl. No. | Roll Number | Student Name | Supervisor |
|---|---|---|---|
| 1 | MS2014008 | Vikrant Mhaske | Prof T K Srikanth |

## 54.5. Items for Reporting:

**54.5.1.** The following PhD student(s) have completed their Academic Milestone(s) as detailed below:

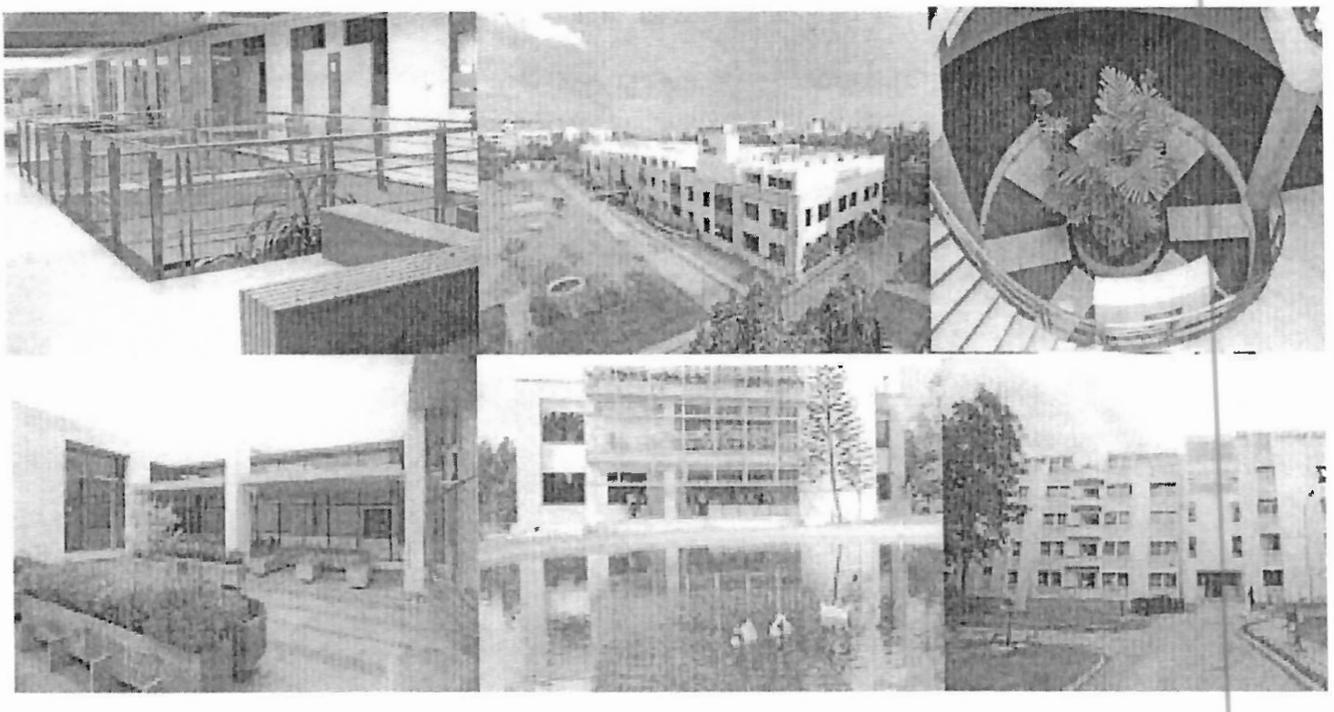
| | |
|---|---|
| Sl.No. | 1 |
| Roll No. | PH2012002 |
| Student Name | Shilpi Banerjee Tushar |
| Supervisor | Prof. Chandrashekar R and Prof. N J Rao |
| Thesis title | Design of Quality Assessment Instruments for Engineering Courses |

Annexur

# INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY, BANGALORE

## 54th Meeting of the Senate

## Minutes of the Meeting



**Date: December 14, 2016**
**Time: 2.00 p.m.**
**Venue: IIITB Board Room**

**26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777**

INTERNATIONAL INSTITUTE
OF INFORMATION TECHNOLOGY BANGALORE
26/C, Electronics City, Hosur Road, Bangalore 560 100
Phones: 080-28527627-635, 41407777; Fax: 080-28527636
Website :www.iiitb.ac.in

**Date: December 26, 2016**

**Sub: Minutes of 54th Senate meeting of the International Institute of Information technology, Bangalore held on December 14, 2016 at 2.00 pm.**

Dear Sir/Madam,

Please find herewith attached Minutes of the 54th Meeting of the Senate of IIITB held on December 14, 2016 in the Board Room of IIIT B at 2.00 PM.

Best Regards

Cmde S R Sridhar (Retd)
Registrar &
Secretary to the Senate

The Chairman welcomed all the members for the 54th meeting of the Senate and initiated the meeting.

**54.1 Confirmation of the Minutes of the 53rd meeting held on October 5, 2016.**

As no comments were received, the Senate confirmed the Minutes of the 53rd meeting held on October 5, 2016.

**54.2 Action taken report.**

Senate took note of the action taken report.

**54.3 Consideration and Approval of Course Proposals**

Senate approved the following course proposals

1. 'Topological Data Analysis' submitted by Prof Amit Chattopadhyay
2. 'Computational Geometry' submitted by Prof Pradeesha Ashok

Senate also suggested making the following changes in course template:

- The term "Academic Senate" to be replaced with "Senate" throughout the course proposal template
- Mentioning the specific year of offering of the course to be avoided
- Full bibliographic reference of the text book to be included as part of the course proposals.

**54.4 For consideration and approval of the Senate with regard to the following**

**54.4.1** Senate approved the request of the following student to convert his student status from full time to part time.

| Sl. No. | Roll Number | Student Name | Supervisor |
|---|---|---|---|
| 1 | MS2015014 | Vinay A Jawgal | Prof V N Muralidhara |

**54.4.2** Senate approved the request of the following student to withdraw from the research programme due to personal reasons.

| Sl. No. | Roll Number | Student Name | Supervisor |
|---|---|---|---|
| 1 | PH2015011 | Sainath Shanbhag | Prof Jaya Sreevalsan Nair |

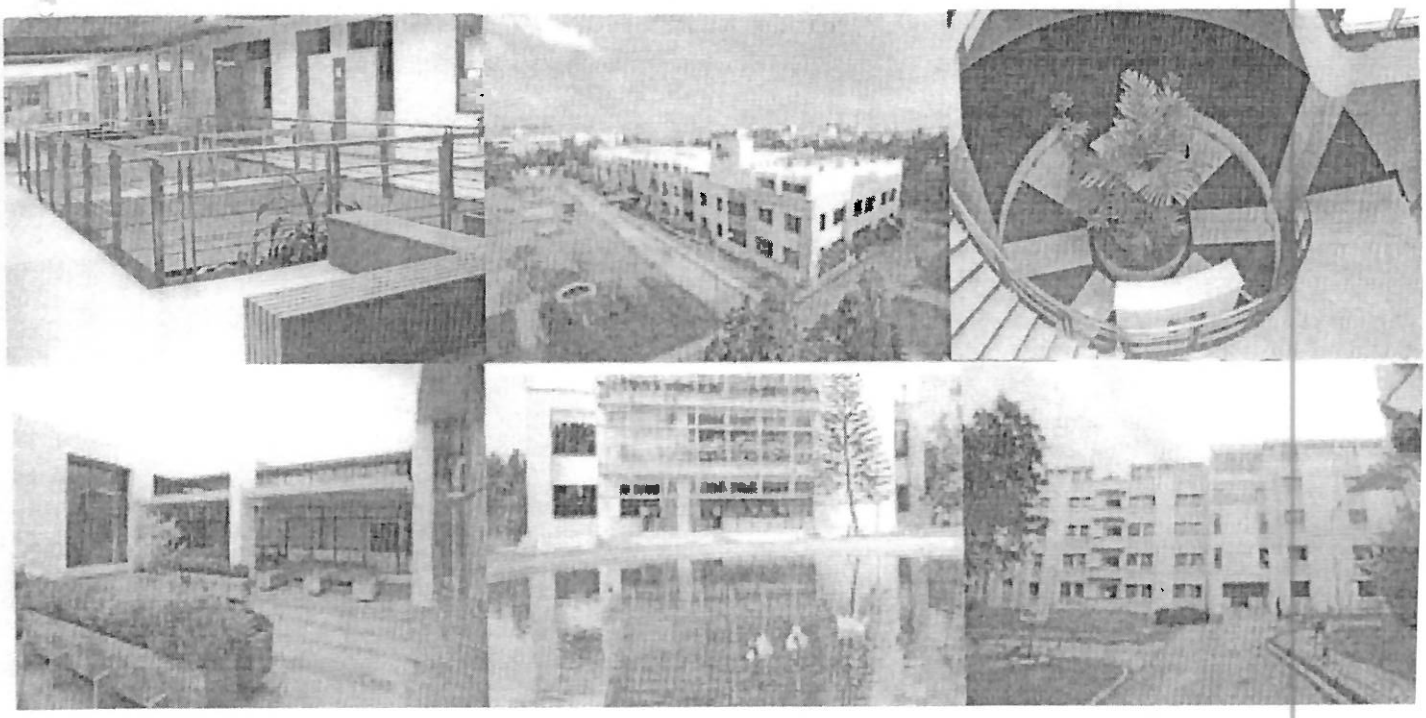
**54.4.3** The Senate discussed regarding the continuation of the following student in the programme. It was recommended that a formal letter be issued as to why his admission should not be terminated and the same to be recorded in the student file. Formal termination may be initiated if no response is received within one month.

| Sl. No. | Roll Number | Student Name | Supervisor |
|---|---|---|---|

# INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY, BANGALORE

## 55th Meeting of the Senate

## Minutes of the Meeting



**Date: February 15, 2017**
**Time: 2.00 p.m.**
**Venue: IIITB Board Room**

26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777

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26/C, Electronics City, Hosur Road, Bangalore 560 100
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Website :www.iiitb.ac.in

**Date: March 07, 2017**

**Sub: Minutes of 55th Senate meeting of the International Institute of Information technology, Bangalore held on February 15, 2017 at 2.00 pm.**

Dear Sir/Madam,

Please find herewith attached Minutes of the 55th Meeting of the Senate of IIITB held on February 15, 2017 in the Board Room of IIIT B at 2.00 PM.

Best Regards

S R Sridhar
Commodore (Retd)
Registrar &
Secretary to the Senate

The Chairman welcomed the new Deans Prof R Chandrashekar, Prof Jyotsna Bapat, Prof Srinath Srinivasa and all the members for the 55th meeting of the Senate and initiated the meeting. The Senate also placed on record the services of the outgoing Deans Prof Debabrata Das and Prof Balaji Parthasarathy.

**55.1 Confirmation of the Minutes of the 54th meeting held on December 14, 2016.**

As no comments were received, the Senate confirmed the Minutes of the 54th meeting held on December 14, 2016.

**55.2 Action taken report.**

Professor R Chandrashekar suggested changing the course no's as below

1. Topological Data Analyses CS/DS 715
2. Computational Geometry CS/DS 716

Registrar gave an update in respect of Mr Vikrant Mhaske (Roll no. MS2014008). The Senate suggested formalising his termination.

Senate took note of other points mentioned in the action taken report.

**55. 3 Consideration and recommendation of the following Students for award of PhD degree.**

The Senate considered the proposal and recommended to the Governing Body for award of PhD degree to:

| | |
|---|---|
| Sl.No. | 1 |
| Roll No. | PH2013009 |
| Student Name | Sumant Kulkarni |
| Supervisor | Professor Srinath Srinivasa |
| Thesis title | Mining Labeled Semantics across Terms and Documents in User Generated Text Corpora |
| Degree | PhD |
| Date of the Defense | December 21, 2016 |

| | |
|---|---|
| Sl.No. | 2 |
| Roll No. | PH2012006 |
| Student Name | R Rajika |
| Supervisor | Professor Neelam Sinha |

### 55.6 Changes in Specialization Name

The Senate after discussion approved to change the name of the specialization to "Signal Processing and Pattern Recognition" as proposed in the agenda document.

### 55.7 Degree for iMTech students

The Senate after discussion decided to write to UGC with regard to the issuance of certificate to the graduating iMTech students.

### 55.8. Items for Reporting:

**55.8.1** The Senate noted the following items as detailed below:

| Sl.No. | 1 |
|---|---|
| Roll No. | PH2014014 |
| Student Name | Manjunath K E |
| Supervisor | Professor Dinesh Babu Jayagopi |
| Thesis title | Study of Multilingual Phone Recognition using Indian Languages |
| Academic Milestone | PhD Comprehensive examination |
| Date of the Seminar | December 26, 2016 |

| Sl.No. | 2 |
|---|---|
| Student Name | Ramakrishnan Raman |
| Supervisor | Professor Meenakshi D'Souza |
| Thesis title | Knowledge Based Frameworks for Architecture of Complex Systems and System-of-Systems |
| Academic Milestone | State of the Art Seminar |
| Date of the Seminar | January 18, 2017 |

| Sl.No. | 3 |
|---|---|
| Roll No. | PH2014011 |
| Student Name | V Krishna Sashank Dara |
| Supervisor | Professor V N Muralidhara |
| Thesis title | Towards Privacy Preserving Intrusion Detection |
| Academic Milestone | State of the Art Seminar |
| Date of the Seminar | January 19, 2017 |

| Sl.No. | 4 |
|---|---|
| Roll No. | PH2008903 |
| Student Name | V Ranganathan |
| Supervisor | Professor V Sridhar |
| Thesis title | Innovation, IT Service Management, Adoption |
| Academic Milestone | Comprehensive Examination |

# DT385: CYBERSPACE, GLOBALIZATION, and LOCATION

INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY
26/C Electronics City, Bangalore - 560100
Instructor: Balaji Parthasarathy

**Course objectives:** The conjuncture of economic globalization, and advances in information and communication technologies (ICTs), has led to sweeping claims about the decreasing relevance of the location of socio-economic activities in territorial place. The claims are exemplified by slogans such as "the death of distance" or that the "world is flat". But if location has ceased to matter, and distance is "dead", then why is it that Silicon Valley remains the leading center of the ICT industry, London dominates the world of finance, Hollywood/ Bollywood are where they are, and Las Vegas or Dubai, despite being in the middle of desert lands, are prominent tourist destinations? Or, why is it that the prosperity of North America and Western Europe not evident in South Asia or in Africa and, as the economist Thomas Piketty compellingly shows, inequality in the world is rising? This course will challenge popular claims about the decreased significance of location by providing analytical tools to think about *how and why* territorial place retains a compelling influence on our lives.

**The issues and the framework:** Economic globalization in recent decades, and advances in ICTs, has greatly increased international flows of ideas, capital, goods, and, to a lesser extent, people. Certain activities, such as retailing, can indeed be carried out effectively online. However, flows from one location to another, i.e., the spatial separation of, say, production from consumption, does not reduce the significance of the locations themselves. Further, a considerable proportion of socio-economic activity is not so footloose as to be able to flow across the globe. For instance, government activities, or the provision of services such as education or healthcare, are primarily local, as their social characteristics, and the regulatory demands they are subject to, vary across political jurisdictions. Similarly, visiting a tourist site, or going on pilgrimage, is experiential and not merely transactional. As a result, many activities demand physical proximity, the need for which cannot be wished away by technology.

Yet, locational determinants keep changing. As technological change makes possible the production of new goods and services, it opens up new "windows of locational opportunity". Where those goods can be produced - either because of the cost and availability of inputs like specific skills, or because of politically negotiated policies governing intellectual property rights, or access to venture capital – opens up new locational possibilities which, in turn, is accompanied by shifts in the direction and volume of global flows.

The course will draw on theoretical frameworks from economic geography and development geography to unravel the complexity of locational decisions with examples. The course will begin with static theories of comparative advantage that explain how individual firms in specific sectors chose optimal locations based on access to raw materials and final markets. It will then move to explain how firm location is also determined by proximity to other firms, many of whom may be competitors. This is because of access to shared institutions, such as universities supplying skilled labor, or inputs such as new ideas, which are intangible. The short term costs of locating in such agglomerations are outweighed by the long term benefits of being in a place where, as the British economist Alfred Marshall, pointed out, "the secrets of the trade are in the air".

The course will also examine how globalization opens up opportunities beyond national boundaries as firms and their activities are spread across the world. Countries and regions that have the infrastructure, the technology and the skills are in the best position to benefit. However, when such conditions are not met, development geography describes and explains the cases of

# Analog Circuits and systems course proposal

| | |
|---|---|
| **Course Name** | Analog circuits and systems |
| **Course Branch** | Select one from the following:<br>ECE |
| **Course Proposer Name(s)** | Subhajit Sen, Chetan Parikh and Madhav Rao |
| **Course Instructor Name(s)** | Subhajit Sen |
| **Course Type** *(Select one)* | Select one from the following:<br>**Core (ECE)**<br>* *All course types except "Special Topics Elective" go through the process for Academic Senate approval* |
| **Course Level** *(Select one)* | Select one from the following for elective courses:<br>Level 1 Elective<br>Level 2 Elective<br>**N/A** |
| **Course Category** *(Select one)* | Select one from the following:<br>Basic Sciences<br>**ECE** Branch Core (CSE / **ECE**)<br>Elective<br>Engineering Science and Skills<br>HSS/M<br>Miscellaneous |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | **Hours** – **Component**<br>**3 hr** – Lecture (1hr = 1 credit)<br>Tutorial (1hr = 1 credit)<br>**2 hr** – Practical (2hrs = 1 credit)<br>**4** – **Total Credits** |
| **Grading Scheme** | Select one from the following:<br>4-point scale (A,A-,B+,B,B-,C+,C,D,F) |
| **Pre-Requisites**<br>*(where applicable, specify exact course names)* | Electronic devices and circuit theory and Laboratory: ECE202 and ECE202P |

| | |
|---|---|
| Template Version Number | 1.3 |
| Template update date | 4 March 2015 |

# INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY, BANGALORE

**55th Meeting of the Senate**

**Agenda and Notes**

**Date: February 15, 2017**
**Time: 2.00 p.m.**
**Venue: IIITB Board Room**

26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777

**Agenda and notes**
**For the**
**55th meeting of the Senate of the**
**International Institute of Information Technology, Bangalore**
**February 15, 2017 at 2.00 pm**

## 55.1 Confirmation of the minutes of the 54th meeting held on December 14, 2016

Minutes of the 54th meeting of the Senate is placed at **Annexure-I** for confirmation.

## 55.2 Action taken report

Details of the action taken on the minutes of the 54th meeting of the Senate are placed for perusal.

| Agenda Point | Decision Points | Action/s Taken |
|---|---|---|
| 54.3 | Consideration and Approval of Course proposals | Implemented<br>1. Topological Data Analyses CS/DS 815 715<br>2. Computational Geometry CS/DS 816 716 |
| 54.4.2 | Request of Mr Sainath Saibhag to withdraw from the Research programme | Communication sent to the student. |
| 54.4.3 | Regarding poor performance of the Mr Vikranth Mhaske | Student was formally communicated on 25th January and was given time till 4th February to respond. However the student has not responded to the same despite a reminder. Formal termination being initiated. |

## 55. 3 Consideration and recommendation of the following Students for award of PhD degree.

| | |
|---|---|
| Sl.No. | 1 |
| Roll No. | PH2013009 |
| Student Name | Sumant Kulkarni |

| Sl. No. | Roll Number | Student Name | Supervisor |
|---|---|---|---|
| | | | Srinivasaraghavan |

### 55.6 Changes in Specialization Name

As per the current iMTech Curriculum, there is a specialization named "Signal and Data Processing" for iMTech (ECE) students. It is proposed that the specialization name be changed to "Signal Processing and Pattern Recognition." Senate is requested to consider the proposed change and approve the same if deemed appropriate.

### 55.7 Degree for iMTech students

In the 44th Meeting of Senate held on February 11, 2015, the Senate approved a change to the iMTech programme as per which only one degree (i.e., M.Tech) will be awarded to the iMTech graduates as opposed to dual degrees (i.e., B.Tech and M.Tech) as originally intended at the time of designing the programme.

Further to the interaction with MHRD and UGC, it has been clarified that IIITB can award dual degrees to the iMTech graduates from 2017 onwards. As suggested by MHRD officials, a letter from IIITB to MHRD regarding the same has been sent (**Annexure III**).

The Senate is requested to permit issuance of both B.Tech. and M.Tech. degrees to graduates of iMTech from the 2017 convocation onwards. The requirements for award of the degrees remain the same.

### 55.8. Items for Reporting:

**55.8.1** The following PhD student(s) have completed their Academic Milestone(s) as detailed below:

| Sl.No. | 1 |
|---|---|
| Roll No. | PH2014014 |
| Student Name | Manjunath K E |
| Supervisor | Professor Dinesh Babu Jayagopi |
| Thesis title | Study of Multilingual Phone Recognition using Indian Languages |
| Academic Milestone | PhD Comprehensive examination |
| Date of the Seminar | December 26, 2016 |

| Sl.No. | 2 |
|---|---|
| Student Name | Ramakrishnan Raman |
| Supervisor | Professor Meenakshi D'Souza |
| Thesis title | Knowledge Based Frameworks for Architecture of Complex Systems and System-of-Systems |

# INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY BANGALORE

**56th Meeting of the Senate**

**Agenda and Notes**

**Date: May 31, 2017**
**Time: 2.00 p.m.**
**Venue: IIIT-B Board Room**

26/C, Electronics City, Hosur Road, Bengaluru 560 100 Phones: 080-28527627-635, 41407777

INTERNATIONAL INSTITUTE
OF INFORMATION TECHNOLOGY BANGALORE
26/C, Electronics City, Hosur Road, Bangalore 560 100
Phones: 080-28527627-635, 41407777; Fax: 080-28527636
Website :www.iiitb.ac.in

**Date: May 24, 2017**

Dear Sir/Madam,

**Sub: 56th meeting of the Senate of the International Institute of Information Technology, Bangalore being held on May 31, 2017 at 2.00 pm.**

Please find herewith attached agenda papers and notes for the 56th Meeting of the Senate of IIIT-B, being held on May 31, 2017 in the Board Room of IIITB at 2.00 PM.

Kindly make it convenient to attend the meeting.

Thanking you,

Yours sincerely,

S R Sridhar
Commodore (Retd)
Registrar & Secretary to the Senate

*The Governing Body upon the recommendation of the Senate of the Institute hereby confers upon XXXXXX the degree of Bachelor of Technology in Information Technology under the Integrated Master of Technology programme, given this 2nd Day of July, Two Thousand and Seventeen at Bangalore.*

**M.Tech. Certificate**
*The Governing Body upon the recommendation of the Senate of the Institute hereby confers upon XXXXXX the degree of Master of Technology in Information Technology under the Integrated Master of Technology programme, given this 2nd Day of July, Two Thousand and Seventeen at Bangalore.*

**Specialization**
The transcript of the Integrated MTech graduates specifies the Specialization of the student. For iMTech in Information Technology programme, the Senate had approved two broad areas of specializations - Computer Science and Information System (CSIS) and Electronics and Communication Engineering (ECE). Subsequently, the iMTech curriculum was revised to create new focussed specializations for Integrated MTech from the 2015 batch onwards.

It is proposed that for iMTech (IT) for batches prior to 2015, the same set of specializations (noted below) be made available:

- Computer Science and Engineering (CSE)
- Data Science (DS)
- Networking and Communication and Signals (NCS)

This list of specialization is same as what is approved for iMTech (Computer Science) from 2015 batch onwards. Students are awarded specialization in one of the above areas provided they do 5 electives from the respective area.

**56.6.2 M.Sc. (Digital Society):**

The Senate is requested to consider for approval the following wordings for the first batch of M.Sc. (Digital Society) graduates:

*The Governing Body upon the recommendation of the Senate of the Institute hereby confers upon XXXXXX the degree of Master of Science in Digital Society, given this 2nd Day of July, Two Thousand and Seventeen at Bangalore.*

**56.7 Proposal for Revision of Math for ESD course**

Students in M.Tech. (IT) are required to opt two of the three components of Maths. The three components are Discrete Maths (2 credit hours), Linear Algebra (2 credit hours), and Probability and Statistics (2 credit hours). The curriculums of three Math components are Senate approved and are available in LMS.

Students in M.Tech. (ESD) currently are not given any choice and are offered a single course in Mathematics. The Mathematics for ESD course consists of Linear algebra for circuit simulation, Discrete Maths relevant for the analysis of switching circuits such as Boolean algebra, logics, and Probability and Statistics needed for reliability analysis, Monte-Carlo simulation.

Since there is considerable amount of overlap in the course content between the two Math courses, it is proposed that both MTech (IT) and MTech (ESD) choose from the same set of three Math courses offered to MTech and discontinue the separate Math course being offered to MTech (ESD) Senate is requested to consider the proposed change and approve the same if deemed appropriate.

## 56.8 Deficient Students

The students who have CGPA of less than 2.0 at the end of Term II (2016-17),if the CGPA continues to be less than 2.0 after the Grade Improvement Exam scheduled in July 2017, the students will be required to repeat the previous academic year.

The Senate is requested to consider for approval the following administrative procedure for repetition of the academic year:

- For students who have completed their 1st year, they have to repeat Semester 1 and Semester 2.
- For students who have completed the 2nd year, they may choose to repeat 1st or 3 semester followed by 2nd or 4th semester during the next academic year. Similar combinations of odd and even semesters can be chosen by those who have to repeat the academic year from 3rd year onwards.
- The previous grade obtained will be replaced by the new grades (irrespective of whether it is better or not).

## 56.9 Consideration and Approval of Course Proposals (Annexure V)

**56.9.1** Course on DT385: CYBERSPACE, GLOBALIZATION, and LOCATION submitted by Prof Balaji Parthasarathy to be offered to M.Sc. Digital Society students.
This course was offered on a trial basis in August 2016 titled "From Territorial Place to Cyberspace: The Political Economy of Location". The changed title, outline and syllabus incorporate some of the feedback from that version and a few new ideas.

**56.9.2** Proposal to replace Analog CMOS Design course with a new course titled "Analog Circuits and Systems" for iMTech ECE students in 5th Semester.

The contents of the course are approved by IIITB faculty and all comments and suggestions were incorporated. Details of the course are given in the analog-circuits-and-systems document which is attached.

**56.9.3** The Integrated M.Tech (CSE) curriculum includes a new core course titled "Formal Languages and Automata Theory" that is to be offered from the academic year 2017-18 onwards. There is an existing course titled "Introduction to Automata Theory & Computability" that is offered as an elective to Integrated M.Tech (IT) students. Due to similar course content, it is proposed to convert "Introduction to Automata Theory and Computability" into a core course for Integrated M.Tech (CSE) for students belonging to 2015 batch onwards as a replacement for "Formal Languages and Automata Theory."

## 56.10 Items for Reporting:

**56.10.1** The following PhD student(s) have completed their Academic Milestone(s) as detailed below:

| Sl.No. | 1 |
|---|---|
| Roll No. | PH2012010 |
| Student Name | Shiva Kumar Venkataraman |
| Supervisor | Prof P G Poonacha and Prof. G N S Prasanna |
| Thesis title | Visual SLAM for Blind Navigation |
| Academic Milestone | State of the Art Seminar |
| Date of the Seminar | March 14, 2017 |

| Sl.No. | 2 |
|---|---|
| Roll No. | PH2011002 |
| Student Name | J Yogalakshmi |
| Supervisor | Prof Chandrashekar Ramanathan |
| Thesis title | Clustering on Heterogeneous Data Using a De-Centralized Analytics Framework |
| Academic Milestone | Open Seminar |
| Date of the Seminar | March 30, 2017 |

| Sl.No. | 3 |
|---|---|
| Roll No. | PH2015016 |
| Student Name | Avijit Mandal |
| Supervisor | Prof Meenakshi D'Souza |
| Thesis title | Program analysis for Robotics programming environment |
| Academic Milestone | Comprehensive Examination |
| Date of the Seminar | March 31, 2017 |

| Sl.No. | 4 |
|---|---|
| Roll No. | PH2014007 |
| Student Name | Hari Bhaskar |
| Supervisor | Prof Jayprakash Lalchandani |

**Tabled Agenda**
**56th meeting of the Senate of the**
**International Institute of Information Technology, Bangalore**
**May 31, 2017 at 2.00 pm**

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**56.11 Any other matter with the permission of the Chair -**

**56.11.1 Consideration and recommendation of the Student for award of PhD degree.** (Annexure VI)

The following PhD student has completed the Academic Milestone as detailed below:

| | |
|---|---|
| Sl.No. | 1 |
| Roll No. | PH2012005 |
| Student Name | Prashant Wali |
| Supervisor | Professor Debabrata Das |
| Thesis title | Energy Efficient Medium Access Control Algorithms for LTE-Advanced |
| Degree | PhD |
| Date of the Defense | 26/05/2017 |

**56.11.2 Consideration and Approval of Course Proposal** (Annexure VII)

Course on 'Foundations of Computer Graphics' submitted by Prof(s) T K Srikanth and Jaya Sreevalsan Nair to be offered to iMTech Students as core course.

**********

# Integrated M.Tech. Course Proposal Template

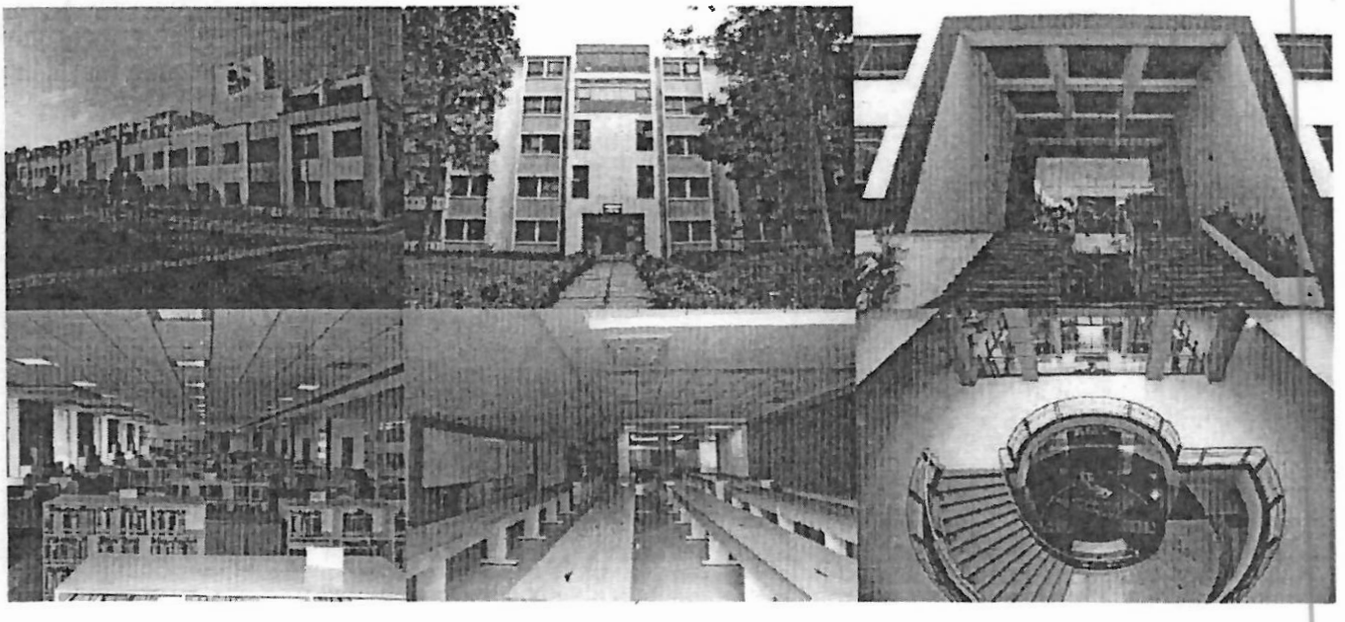
| | |
|---|---|
| **Course Name** | Foundations of Computer Graphics |
| **Course Branch** | Select one from the following: (Place X appropriately)<br>[ ] ECE<br>[X] CSE |
| **Course Proposer Name(s)** | T. K. Srikanth and Jaya Sreevalsan Nair |
| **Course Instructor Name(s)** | T. K. Srikanth and Jaya Sreevalsan Nair |
| **Course Type** *(Select one)* | Select one from the following: (Place X appropriately)<br>[X] Core<br>[ ] Elective<br>[ ] Special Topics Elective*<br>** All course types except "Special Topics Elective" go through the process for Senate approval* |
| **Course Level** *(Select one)* | Select one from the following for elective courses: (Place X appropriately)<br>[ ] Level 1 Elective<br>[ ] Level 2 Elective<br>[X] N/A |
| **Course Category** *(Select one)* | Select one from the following: (Place X appropriately)<br>[ ] Basic Sciences<br>[X] Branch Core (CSE / ~~ECE~~)<br>[ ] Elective<br>[ ] Engineering Science and Skills<br>[ ] HSS/M<br>[ ] Miscellaneous |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | (Place X appropriately)<br>**Hours** – **Component**<br>3 – Lecture (1hr = 1 credit)<br>0 – Tutorial (1hr = 1 credit)<br>0 – Practical (2hrs = 1 credit)<br>**3 – Total Credits** |
| **Grading Scheme** | Select one from the following: (Place X appropriately)<br>[X] 4-point scale (A,A-,B+,B,B-,C+,C,D,F)<br>[ ] Satisfactory/Unsatisfactory (S / X) |
| **Pre-Requisites**<br>*(where applicable, specify exact course names)* | |

| | |
|---|---|
| Template Version Number | 1.4 |
| Template update date | 30 May 2017 |

INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY BANGALORE

# 58th Meeting of the Senate

## Minutes of the Meeting



**Date: July 26, 2017**
**Time: 11.00 a.m.**
**Venue: IIITB Board Room**

26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777

INTERNATIONAL INSTITU
OF INFORMATION TECHNOLOGY BANGALO
26/C, Electronics City, Hosur Road, Bangalore 560
Phones: 080-28527627-635, 41407777; Fax: 080-285276
Website :www.iiitb.ac

**Date: July 28, 2017**

**Sub: Minutes of 58th Senate meeting of the International Institute of Information technology, Bangalore held on July 26, 2017 at 1100 AM.**

Dear Sir/Madam,

Please find herewith attached Minutes of the 58th Meeting of the Senate of IIITB held on July 26, 2017 in the Board Room of IIIT B at 1100 AM.

Best Regards

S R Sridhar, Cmde (Retd)
Registrar &
Secretary to the Senate

Annexure 10

# Integrated M.Tech. Course Proposal Template

| | |
|---|---|
| **Course Name** | Computational Chemistry Lab (SM101P) |
| **Course Branch** | Select one from the following: (Place X appropriately)<br>ECE X<br>CSE X |
| **Course Proposer Name(s)** | Brijesh Kumar Mishra |
| **Course Instructor Name(s)** | Brijesh Kumar Mishra |
| **Course Type** *(Select one)* | Select one from the following: (Place X appropriately)<br>Core X<br>Elective<br>Special Topics Elective*<br>** All course types except "Special Topics Elective" go through the process for Senate approval* |
| **Course Level** *(Select one)* | Select one from the following for elective courses: (Place X appropriately)<br>Level 1 Elective<br>Level 2 Elective<br>N/A X |
| **Course Category** *(Select one)* | Select one from the following: (Place X appropriately)<br>Basic Sciences X<br>Branch Core (CSE / ECE)<br>Elective<br>Engineering Science and Skills<br>HSS/M<br>Miscellaneous |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | (Place X appropriately)<br>**Hours Component**<br>Lecture (1hr = 1 credit)<br>Tutorial (1hr = 1 credit)<br>**Practical (2hrs = 1 credit) X**<br>**Total Credits: 1** |

| | |
|---|---|
| **Grading Scheme** | Select one from the following:<br>(Place X appropriately)<br><br>4-point scale<br>(A,A-,B+,B,B-,C+,C,D,F) X<br>Satisfactory/Unsatisfactory (S / X) |

**Pre-Requisites**
*(where applicable, specify exact course names)*

Chemistry Theory Course (Ist Semester)

**Course Description**
*A brief description of the course*

Students will learn various molecular modelling techniques with the help of free/commercial computational chemistry software packages. They will apply the knowledge gained in the preceding chemistry course.

**Course Outcomes**
*Course Outcomes are statements that describe what students are expected to know, and be able to do at the end of the course. These relate to the skills, knowledge, and behavior that students acquire in their progress through the course.*

At the end of this course, the student is expected to:

1. Know how to draw and manipulate various molecular systems.
2. Know how to calculate energy of a molecule/molecular clusters.
3. Know how to investigate potential energy profiles and locate minima/maxima.
4. Develop basic understanding of generating various spectra and interpreting them.

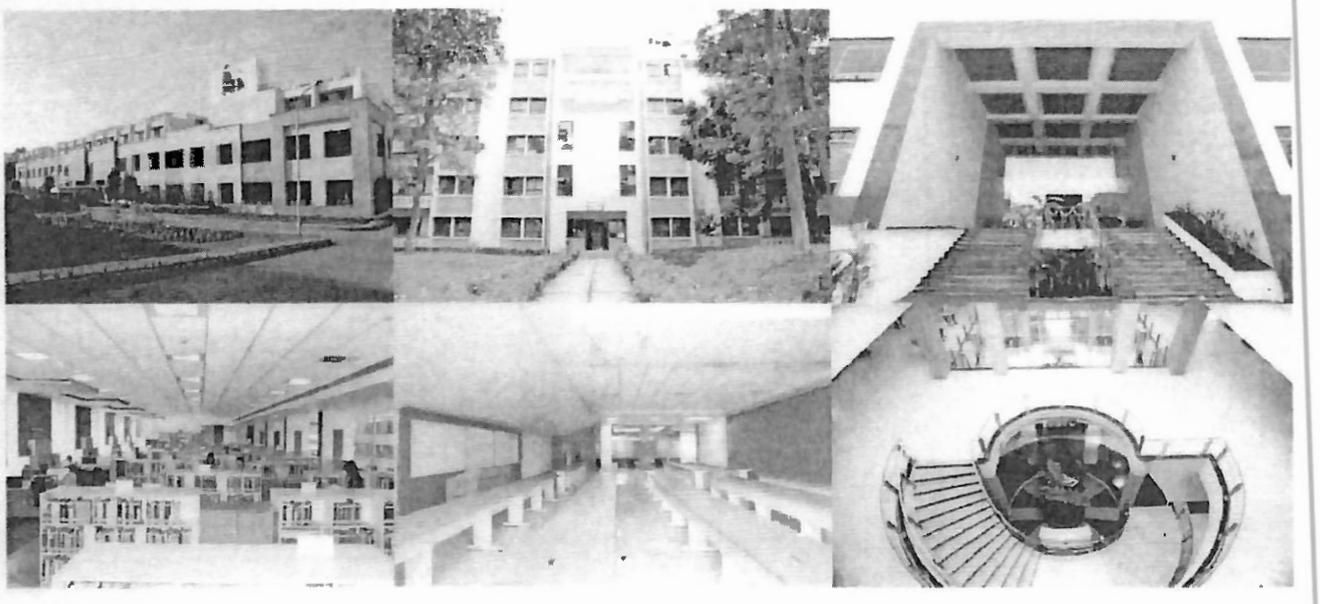
**Course Content**

The following labs will be conducted :
Introduction to computational graphics visualisation, Introduction to Gaussian/Gamess software package, Introduction to Basis set/method, Geometry optimisation, Potential energy profile calculations, Vibrational frequency and IR spectra, Thermochemistry, Transition state search and reaction path, Computing the pKa of alcohols, amines, carboxylic acids, Modeling in solution, Homology modeling.

# INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY BANGALORE

## 59th Meeting of the Senate

## Agenda and Notes



**Date: December 6, 2017**
**Time: 2.00 p.m.**
**Venue: IIITB Board Room**

26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777

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OF INFORMATION TECHNOLOGY BANGALORE
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Website :www.iiitb.ac.in

**Date: November 21, 2017**

Dear Sir/Madam,

**Sub: 59th meeting of the Senate of International Institute of Information Technology, Bangalore being held on December 6, 2017 at 2.00 PM.**

Please find herewith attached agenda papers and notes for the 59th Meeting of the Senate of IIITB, being held on December 6, 2017 in the Board Room of IIIT B at 2.00 PM.

Kindly make it convenient to attend the meeting.

Thanking you,

Yours sincerely,

S R Sridhar, Cmde (Retd)
Registrar &
Secretary to the Senate

**59.9 Consideration and Approval of Course Proposal**

Core course proposal on Computational Chemistry Lab (SM101P) submitted by Prof Brijesh Kumar Mishra is placed Annexure 10 of the agenda for approval.

**59.10 Any other items(s) with the permission of the Chair**

**********

# Course Proposal

| | |
|---|---|
| **Course Name** | **Machine Learning (CS/DS 612)** |
| **Course Proposer Name(s)** | Prof. G. Srinivasaraghavan |
| **Course Instructor Name(s)** | Dinesh Babu J<br>Ramasubramanian V |
| **Course Type** | Elective |
| **Credits** | 4 |
| **Grading Scheme** | A, A-, B+, B, B-, C+, C, D, F<br>Points as per IIIT-B Default Scheme |
| **Area of Specialization (if applicable)**<br>**CSE** – Computer Science and Engineering<br>**DS** – Data Science<br>**NCSP** – Networking & Communication and Signal Processing | Computer Science and Engineering<br>Data Science |
| **Semester** | Term II (Jan – May 2018) |

**Pre-Requisites (where applicable, specify exact course names)**

- None

**Course Description**

This course is intended to be an intense, in-depth course in Statistical Learning methods. Primary Reference would be:

1. Trevor Hastie, Robert Tibshirani and Jerome Friedman. "The Elements of Statistical Learning ". Second Edition. Springer. 2008. Freely Downloadable.

**Course Content**

## Module 1 (Machine Learning, Unsupervised Learning)

- Introduction to Learning from data – Unsupervised, Supervised
- K-means
- Hierarchical Clustering

## Module 2 (Supervised Learning, Linear Models)

- Statistical Decision Theory
- Regression: Linear Regression

Tabled Agenda
59th meeting of the Senate of the
International Institute of Information Technology, Bangalore
December 6, 2017 at 2.00 PM

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## 59.10 Any other matter with the permission of the Chair -

### 59.10.1 Consideration and Approval of Course Proposals

I. Course on **'Math for ML (CS/DS 611)'** submitted by Prof G Srinivasaraghavan.
II. Course on **'Machine Learning (CS/DS 612)'** submitted by Prof G Srinivasaraghavan.

The course proposals are attached herewith.

59.10.2 Senate may approve the following:

| Sl. No. | Roll Number | Student Name | Supervisor | |
|---|---|---|---|---|
| 1 | PH2015021 | Sanjay V P | Prof Amit Prakash | Convert the student status from Full time to part time |
| 2 | PH2014014 | Manjunath K E | Prof Dinesh Babu Jayagopi | Change in supervisor - Prof V Ramasubramanian as Supervisor and Prof Dinesh Babu Jayagopi as Co-supervisor |

# Course Proposal

| | |
|---|---|
| **Course Name** | **Math for ML (CS/DS 611)** |
| **Course Proposer Name(s)** | G. Srinivasaraghavan |
| **Course Instructor Name(s)** | G. Srinivasaraghavan<br>Ramasubramanian V |
| **Course Type** | Elective |
| **Credits** | 4 |
| **Grading Scheme** | A, A-, B+, B, B-, C+, C, D, F<br>Points as per IIIT-B Default Scheme |
| **Area of Specialization (if applicable)**<br>**CSE** – Computer Science and Engineering<br>**DS** – Data Science<br>**NCSP** – Networking & Communication and Signal Processing | Computer Science and Engineering<br>Data Science |
| **Semester** | Spring (Jan-May) |

**Pre-Requisites (where applicable, specify exact course names)**

- Maths for IT or Courses covering basic Probability Theory, Linear Algebra and Discrete Mathematics
- First Course in Algorithms

*Those opting for this course would require to have got at least a **B** in the above prerequisite courses unless they can convince the instructor that they need to be treated as an exception.*

**Course Description**

This is similar to a course taught by John E. Hopcroft and Ravindran Kannan. The book "Foundations of Data Science" by Hopcroft and Kannan based on this course is freely available for download.

**Course Content**

## Module 1 (The Probabilistic Method – Primer on Randomized Algorithms)

- Common Distributions and their characteristics
- Chernoff Bounds, Martingales
- Lovasz Local Lemma
- PAC (Probably Approximately Correct) Algorithms

# Course Proposal

| | |
|---|---|
| **Course Name** | **Math for ML (CS/DS 611)** |
| **Course Proposer Name(s)** | G. Srinivasaraghavan |
| **Course Instructor Name(s)** | G. Srinivasaraghavan<br>Ramasubramanian V |
| **Course Type** | Elective |
| **Credits** | 4 |
| **Grading Scheme** | A, A-, B+, B, B-, C+, C, D, F<br>Points as per IIIT-B Default Scheme |
| **Area of Specialization (if applicable)**<br>**CSE** – Computer Science and Engineering<br>**DS** – Data Science<br>**NCSP** – Networking & Communication and Signal Processing | Computer Science and Engineering<br>Data Science |
| **Semester** | Spring (Jan-May) |

**Pre-Requisites (where applicable, specify exact course names)**

- Maths for IT or Courses covering basic Probability Theory, Linear Algebra and Discrete Mathematics
- First Course in Algorithms

*Those opting for this course would require to have got at least a **B** in the above prerequisite courses unless they can convince the instructor that they need to be treated as an exception.*

**Course Description**

This is similar to a course taught by John E. Hopcroft and Ravindran Kannan. The book "Foundations of Data Science" by Hopcroft and Kannan based on this course is freely available for download.

**Course Content**

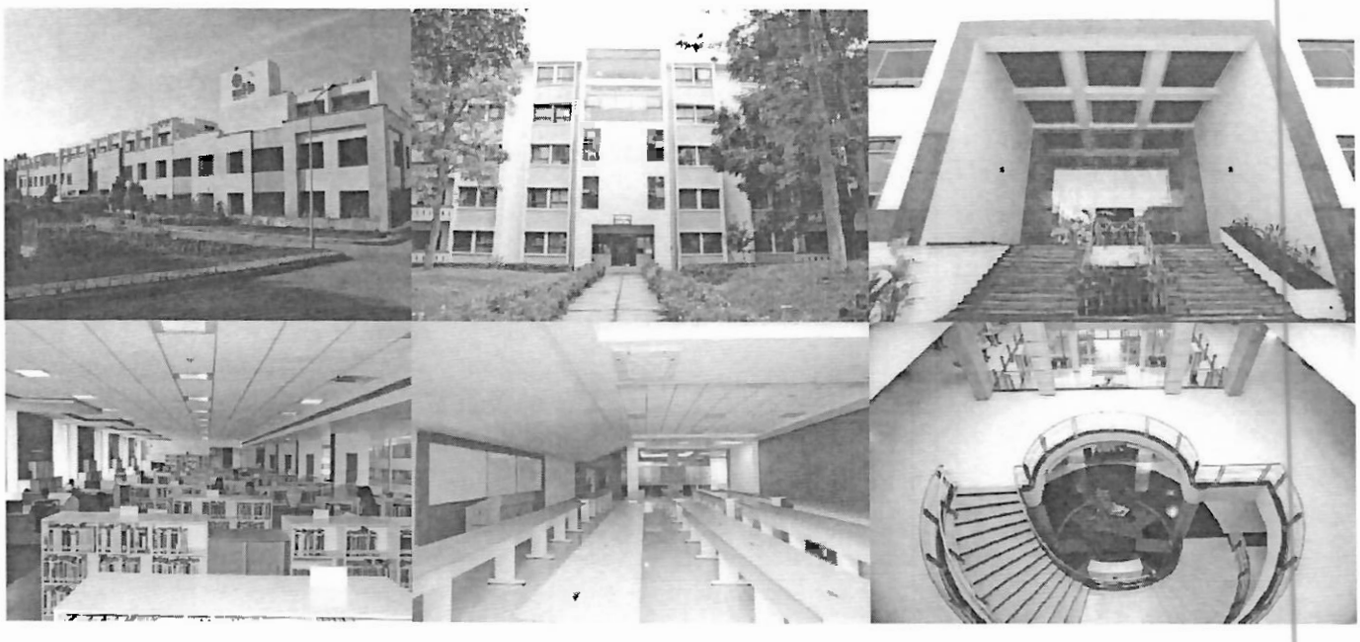
## Module 1 (The Probabilistic Method – Primer on Randomized Algorithms)

- Common Distributions and their characteristics
- Chernoff Bounds, Martingales
- Lovasz Local Lemma
- PAC (Probably Approximately Correct) Algorithms

INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY BANGALORE

# 59th Meeting of the Senate

## Agenda and Notes



**Date: December 6, 2017**
**Time: 2.00 p.m.**
**Venue: IIITB Board Room**

26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777

INTERNATIONAL INSTITUTE
OF INFORMATION TECHNOLOGY BANGALORE
26/C, Electronics City, Hosur Road, Bangalore 560 100
Phones: 080-28527627-635, 41407777; Fax: 080-28527636
Website :www.iiitb.ac.in

**Date: November 21, 2017**

Dear Sir/Madam,

**Sub: 59th meeting of the Senate of International Institute of Information Technology, Bangalore being held on December 6, 2017 at 2.00 PM.**

Please find herewith attached agenda papers and notes for the 59th Meeting of the Senate of IIITB, being held on December 6, 2017 in the Board Room of IIIT B at 2.00 PM.

Kindly make it convenient to attend the meeting.

Thanking you,

Yours sincerely,

S R Sridhar, Cmde (Retd)
Registrar &
Secretary to the Senate

**Agenda and notes**
**For the**
**59th meeting of the Senate of the**
**International Institute of Information Technology, Bangalore**
**December 6, 2017 at 2.00 PM**


| Item No. | Item | Page No. |
|---|---|---|
| 59.1 | Confirmation of the minutes of the 58th meeting of Senate | 4 |
| 59.2 | Action Taken Report | 4 |
| 59.3 | Consideration and Recommendation of the Students for Award of PhD Degree | 4 |
| 59.4 | Consideration and Recommendation of the Student(s) for Award of Master of Science by Research Degree | 5 |
| 59.5 | Consideration and recommendation of the Sponsored MTech Student for Award of MTech degree. | 5 |
| 59.6 | Proposed joint programme with IBAB | 5 |
| 59.7 | For consideration and approval of the Senate with regard to the extension in respect of the research students | 5-6 |
| 59.8 | Items for Reporting | 6-8 |
| 59.9 | Consideration and Approval of Course Proposal | 9 |
| 59.10 | Any other matter with permission of the Chair. | 9 |



| No | Annexures |
|---|---|
| 1 | Minutes of the 58th Senate Meeting |
| 2 | PhD student Banerjee Shilpi Tushar's report |
| 3 | MS student Karthik V's report |
| 4 | SMTech student Shashi Ray's report |
| 5 | IBAB-Details of the proposed PGD Big Data in Biology-DBT |
| 6 | MS & PHD students list for extension |
| 7 | List of students admitted for research programme - August 2017 batch |
| 8 | iMTech 2017-22: List of iMTech students |
| 9 | Dean's list |
| 10 | New course proposal |

**Agenda and notes**
**59th meeting of the Senate of the**
**International Institute of Information Technology, Bangalore**
**December 6, 2017 at 2.00PM**

## 59.1 Confirmation of the minutes of the 58th meeting held on July 26, 2017

Minutes of the 58th meeting of the Senate is placed at **Annexure-1** for confirmation.

## 59.2 Action taken report

Details of the action taken on the minutes of the 58th meeting of the Senate are placed for perusal.

| Agenda Point | Decision Points | Action/s Taken |
|---|---|---|
| 58.3 | Branch Change Process for Integrated MTech. | Implemented |
| 58.5.3 | The Senate noted the details regarding admissions to the MSc (Digital Society) 2017-2019 batches and advised to form a committee to look into the admissions to the MSc (Digital Society) | Committee has been constituted |
| 58.6 | Addition of Core Course Option for MTech. (ESD) | implemented |

## 59.3 Consideration and Recommendation of the Students for Award of PhD Degree

| | |
|---|---|
| Sl No | 1 |
| Roll No. | PH2012002 |
| Student Name | Banerjee Shilpi Tushar |
| Thesis Title | Design of Quality Assessment Instruments for Engineering Courses |
| Supervisor | Prof N J Rao and Prof Chandrashekar R |
| Degree | PhD |
| Date of the Defense | October 30, 2017 |

The Senate may consider award of PhD degree and recommend to the Governing Body, if approved, conferring the said degree to her. Relevant report placed at Annexure 2.

**59.4 Consideration and Recommendation of the Student(s) for Award of Master of Science by Research Degree**

| | |
|---|---|
| Sl No | 1 |
| Roll No. | MS2011005 |
| Student Name | V Karthik |
| Thesis Title | MD-Tree: A search-optimized Index Structure for Flash/Non-volatile memory |
| Supervisor | Prof G N Srinivasa Prasanna |
| Degree | Master of Science by Research |
| Date of the Defense | November 24, 2017 |

The Senate may consider award of Master of Science by degree and recommend to the Governing Body, if approved, conferring the said degree to him. Relevant report placed at Annexure 3.

**59.5 Consideration and recommendation of the Sponsored MTech Student for Award of MTech degree.**

The Senate may consider the award of MTech degree to Samsung student SMT2014021 Shashi Ray and recommend to the Governing Body, if approved conferring the said degree to him. Relevant report placed at Annexure 4.

**59.6 Proposed joint programme with IBAB**

IBAB is has proposed to conduct a joint programme on Big Data analytics in be informatics. The programme is financially supported by DST. A copy of the proposal approved by DST is placed at Annexure 5.

This programme will be administered by a Senate subcommittee to be appointed by the Chairman, Senate. The item is being placed before the Senate for due consideration and approval.

**59.7 For consideration and approval of the Senate**

**A.** Extension of the term of research students as per the list placed at Annexure 6

**B.** inclusion of co supervisor in respect of the following research students

**59.8.5** The Senate noted the details of student(s) withdrawn.
A. from MTech course 2017

| S. No. | Roll Number | Name and date withdrawn |
|---|---|---|
| 1 | MT2016128 | Shivam Asati ( 14th August, 2017) |

B. from PhD course

| S. No. | Roll Number | Name and date withdrawn |
|---|---|---|
| 1 | PH2015002 | Amudheesan @ Aadhithan (15th November, 2017) |

**59.8.6** The Senate noted the date of 60th meeting of the Senate of IIITB which is scheduled on February 14, 2018.

**59.9** The Senate approved the following Core Course proposal on Computational Chemistry Lab (SM101P) submitted by Prof Brijesh Kumar Mishra.

**59.10 Any other items(s) with the permission of the Chair**

**59.10.1** The Senate discussed the following two course proposals:

I. Course on **'Math for ML (CS/DS 611)'** submitted by Prof G Srinivasaraghavan.
   a. Avoid abbreviations in the course title.
   b. Since the contents of the **"Mathematics for Machine Learning"** are generic in nature, it will be good give the course a generic name too. The course should recommended to be listed under the "general elective" (GEN) category and not just to CS (Computer Science) and/or DS (Data Science) category.
   c. The course content is approved.

II. Course on **'Machine Learning (CS/DS 612)"** submitted by Prof G Srinivasaraghavan.
   a. The course is approved

**Action Required:** The two courses to be included in the course catalogue.

**59.10.2** The Senate approved the following:

## A3.2 M.Tech. (ESD) Programme Changes

Programme Structure

The following changes are proposed to the existing M.Tech. (Electronic Systems Design) programme.

| Change | Existing | Proposed |
|---|---|---|
| **Name of the Programme** | M.Tech. (Electronic Systems Design) | M.Tech. (Electronics and Communication Engineering) |
| **Specializations** | 1) System on Chip (SOC)<br>2) Embedded Systems | 1) VLSI Design (VLSI)<br>2) Signal Processing and Pattern Recognition (SP)<br>3) Networking and Communication (NC) |
| **Preparatory Term** | 3 weeks Preparatory Term (zero credits) | 2 weeks Programme Orientation (zero credits) |
| **Total Number of Credits** | 64 | 64 |
| **Total Intake** | 30 | 50 |
| **UG Branch for Admissions** | BE/B.Tech. in any Branch | BE/B.Tech. in any Branch |
| **Entrance Examination** | GATE | No change |
| **GATE Subject** | • EC - Electronics and Communication Engineering<br>• IN - Instrumentation Engineering | • EC - Electronics and Communication Engineering<br>• IN - Instrumentation Engineering<br>• EE – Electrical Engineering |

Credit Structure

| Type of Credits | Number of Credits | Duration | Calendar |
|---|---|---|---|
| Preparatory Term | 0 | 2 weeks | July - Last two weeks |
| Foundational Courses | 16 | 16 weeks | Aug – Dec (Semester 1) |
| Electives | 16 | 16 weeks | Jan – April (Semester 2) |
| Electives | 16 | 16 weeks | Aug – Dec (Semester 3) |
| Thesis / Project | 16 | 22 weeks | Jan – Jun (Semester 4) |
| **Total** | **64** | **2 years** | |

** Preparatory Term is optional for Sponsored M.Tech. Programme*

** Minimum credits required for graduation is 64*

Foundational Courses

4 courses (16 credits) need to be taken from the following list of courses:

- Analog CMOS VLSI Design (4 credits)
- Analysis and Design of CMOS Digital IC (4 credits)

- Networking and Communication (4 credits)
- Advanced Mathematics (4 credits)
- Machine Learning (4 credits)
- Algorithms (4 credits)

## A3.3 M.Tech. (IT) Programme Changes

Programme Structure

The following changes are proposed to the M.Tech. (Information Technology) programme.

| Change | Existing | Proposed |
|---|---|---|
| **Name of the Programme** | M.Tech. (Information Technology) | M.Tech. (Computer Science and Engineering) |
| **Specializations** | • Computer Science & Engineering, (CSE)<br>• Data Science (DS)<br>• Networking & Communication and Signal-processing (NCS) | • Theory and Systems (TS)<br>• Data Science (DS)<br>• Networking and Communication (NC)<br>• Signal Processing and Pattern recognition (SP) |
| **Preparatory Term** | 3 weeks Preparatory Term (zero credits) | 2 weeks Programme Orientation (zero credits) |
| **Total Number of Credits** | 66 | 66 |
| **Total Intake** | 150 | 130 |
| **UG Branch for Admissions** | BE/B.Tech. in any Branch | BE/B.Tech. in any Branch |
| **Entrance Examination** | GATE | No change |
| **GATE Subject** | • CS – Computer Science and IT<br>• EC - Electronics and Communication Engineering<br>• EE - Electrical Engineering | • CS – Computer Science and IT |

Credit Structure

| Type of Credits | Number of Credits | Duration | Calendar |
|---|---|---|---|
| Preparatory Term | 0 | 2 weeks | July - Last two weeks |
| Foundational Courses | 16 | 16 weeks | Aug – Dec (Semester 1) |
| Electives | 16 | 16 weeks | Jan – April (Semester 2) |
| Electives | 16 | 16 weeks | Aug – Dec (Semester 3) |
| Thesis / Project | 16 | 22 weeks | Jan – Jun (Semester 4) |
| **Total** | **64** | **2 years** | |

** Minimum credits required for graduation is 64*

Foundational Courses

4 courses (16 credits) need to be taken from the following list of foundational courses:

1. Algorithms (4 credits)
2. Machine Learning (4 credits)
3. Advanced Mathematics (4 credits)
4. Networking and Communication (4 credits)
5. Data Modelling (4 credits)

## A3.4 MSc (Digital Society) Programme Changes

Programme Structure

The following changes are proposed to the M.Sc. (Digital Society) programme.

| Change | Existing | Proposed |
|---|---|---|
| **Name of the Programme** | M.Sc. (Digital Society) | No change |
| **Specializations** | None | • Human-centered digital design<br>• Data intensive digital design<br>• Research and policy studies |
| **Preparatory Term** | 2 weeks Preparatory Term (2 credits) | 2 weeks Preparatory Term (2 credits) |
| **Total Number of Credits** | 76 | 68 |
| **Total Intake** | 30 | No change |
| **UG Branch for Admissions** | An under-graduate degree (of at least 3 years duration) in any discipline with a first division/class from a recognized University. | No change |

Credit Structure

| Type of Credits | Number of Credits | Duration | Calendar |
|---|---|---|---|
| Preparatory Term | 0 | 2 weeks | July - Last two weeks |
| Core Courses | 18 | 16 weeks | Aug – Dec (Semester 1) |
| Electives | 16 | 16 weeks | Jan – April (Semester 2) |
| Electives | 16 | 16 weeks | Aug – Dec (Semester 3) |
| Thesis / Project | 16 | 22 weeks | Jan – Jun (Semester 4) |
| **Total** | **66** | **2 years** | |

** Minimum credits required for graduation is 66*

Core Courses

The following core courses (30 credits) need to be taken by all the students across two semesters:

First Semester

1. Digital Components of a Connected Society (4 credits)
2. Tools for a Connected Society (2 credits) - *new*
3. Interface Design *(substantially redesigned with a Digital Design focus)* (4 credits)
4. Research Methods (Quantitative and Qualitative) (4 credits) - *new*
5. Technology and Society (4 credits)

Second Semester

6. Technology in Development- new title (4 credits)
7. ICT Policy and Regulation (4 credits)
8. Social Complexity and Systems Thinking- *new title* (4 credits)

Tentative Pool of electives for semesters 2 and 3, categorized by specialization (note: an elective may appear in more than one specialization; more electives may be added depending on future need and interest of students and faculty members. Students have the option of choosing from the listed M.Tech. electives too provided the student has the necessary pre-requisite knowledge and background.)

| **Human Centered Design/ Digital Design** | **Data Intensive Design / Digital Design** | **Research and Evaluation of Digital Production and Use Contexts/ Research and Policy Studies** |
|---|---|---|
| • Advanced Qualitative Research Methods<br>• Advanced Interface Design/HCI *(new)*<br>• E-Governance Application Design<br>• IT Product and Project Management<br>• Smart Cities<br>• Social Media Communication | • Advanced Quantitative Methods/ Data Manipulation *(new)*<br>• Data Modeling*<br>• Data Visualization*<br>• Geographical Information Systems*<br>• IT Product and Project Management*<br>• Machine Learning*<br>• Information Networks*<br>• Multi-agent Systems* | • Advanced Qualitative Research Methods<br>• Advanced Quantitative Methods/ Data Manipulation *(new)*<br>• Dynamics of the IT Industry<br>• E-Governance Application Design<br>• Political Economy of Location<br>• Smart Cities<br>• Social Media Communication<br>• Techno-Economics of Networks |

* M.Tech. Elective

## A3.5 Integrated M.Tech. Programme Changes

In order to take advantage of the synergy across the M.Tech. and Integrated M.Tech. programmes and the elective courses, it is proposed that the same set of specializations be offered across both M.Tech. and iMTech.

| Programme | Existing Specializations | Proposed Specializations |
|---|---|---|
| **iMTech (CSE)** | • Theoretical Computer Science<br>• Data Science<br>• Software Engineering | • Theory and Systems (TS)<br>• Data Science (DS)<br>• Networking and Communication (NC)<br>• Signal Processing and Pattern recognition (SP) |
| **iMTech (ECE)** | • Microelectronics and VLSI<br>• Networking and Communication<br>• Signal Processing and Pattern Recognition | • VLSI Design (VLSI)<br>• Networking and Communication (NC)<br>• Signal Processing and Pattern Recognition (SP) |

- M. Tech. (ESD) graduates of the SoC specialization were more satisfied with the programme, than those of the Embedded Systems specialization.
- The reason for this as indicated was that there are currently five faculty members (full-time) in SoC area, whereas none in Embedded Systems area.
- All the respondents were unanimous that the M. Tech. (ESD) is a good programme, and efforts may be made to continue it.

From these responses, the Review Committee has opined that there is a good case for IIIT-B to consider a strategy of engaging new faculty members for the Embedded Systems area (A difficult task indeed!) or to take steps for re-orientating a few identified faculty members to this area (A good/workable option!) for continuing with the Embedded Systems area in the M. Tech. (ESD) programme. However, as the responses clearly indicate that the SoC area is already attracting students, it needs to be continued under M. Tech. (ESD) and strengthened further to meet the growing demands of specialists in this subject.

***D. Programme Nomenclature:***

The Review Committee has noted that term 'Electronic System Design' is too broad as it encompasses a wide range of topics and may not be reflective of only SoC or Embedded Systems included under this specialization. Besides, this may mislead the students of the programme in enabling them a proper choice of the specialization. Therefore, the programme of study could be suitably renamed to indicate its major part, i.e., 'VLSI Design' or 'VLSI Design and Applications'

The Review Committee has also noted that indicating too narrow specializations under M. Tech. (ESD) like SoC or Embedded Systems may not be desirable as this could limit the scope and opportunities of the postgraduates in their career options. Hence, these may not be included in the Degree Certificates issued. Moreover, the specialization areas can become evident from the transcripts issued to them by the

Institute at the conclusion of the programme. In such a transcript, the course credits earned subject-wise and for the Project Work/Thesis conducted can reflect the specialization effectively.

***E. Curriculum Structure:***

The Review Committee noted the desirability of having a more effective curriculum structure for the M. Tech. (ESD) programme fully covering the four main semesters together with one summer semester and also ensuring that every student needs to conduct a long-term project work and also gain industrial experience. Towards meeting this requirement, the Review Committee is of the opinion that inclusion of too many elective credits (32) in the programme as at present may be reviewed at IIIT-B.

**3. Recommendations:**

***A. General:***

The Review Committee is of the opinion that the M. Tech. (ESD) programme is attractive to students and is relevant to the needs of industry with ample scope for research & development as well, and is a good programme for IIIT-Bangalore to continue to offer. The Review Committee recommends that the programme be continued and made better and more useful, for which, some suggested modifications are given below.

***B. Programme Nomenclature -Level:***

- M. Tech. (ESD) is too broad a title for a programme primarily covering VLSI Design and Applications, and can be often misleading to the stakeholders. It

may be more appropriate to rename it as M. Tech. in VLSI Design or as M. Tech. in VLSI Design & Applications, i.e., M. Tech. (VD) or M. Tech. (VDA).

- Currently, the programme offers two specializations – SoC (Silicon on Chip) Design, and Embedded System Design. Given the issues covered in the previous section, it may be appropriate to merge the two separate narrow specializations into one, whose curriculum will cover courses in VLSI Design and Applications, with an emphasis on SoC Design.

### *C. Curriculum Structure-Level:*

The Review Committee recommends that IIIT-B may consider modifying its current M. Tech. curriculum structure as given below by broadly following the practices at leading institutions in India and abroad. This can be of much help in rectifying the various *concerns* in the current curriculum structure pointed out earlier.

- The curriculum for all current M. Tech. programmes at IIIT-B consists of three semesters of course work, followed by an internship or a thesis in the fourth semester; and the summer semester at the end of the first year is a vacation period. The Review Committee proposes two new alternative schemes for the consideration of the Institute, as outlined in Table 1. While *Option 1* shall lead to the M. Tech. Degree in the chosen specialization, *Option 2* shall lead to the M. Tech. by Research Degree in the chosen research area. The Institute may choose to adopt either or both the *Options* for its M. Tech. programmes.
- Every M. Tech. student shall be required to work on long-term project(16-20 Credits) and undergo final viva voce on the work done/Report prepared. Further, the student shall have to undergo Industry Internship of 8 credits (jointly monitored/assessed by IIIT-B Faculty and Industry Executive). On the other hand, every M. tech. (Research) student shall prepare a thesis based on

**Report of the MTech (IT) Curriculum Revision Committee 2018**

## Introduction

Prof. Sadagopan, Senate Chairman and Director, on 9th of January 2018 constituted the following committee for the 3-year review of the M.Tech. (IT) programme:

1. Prof. Chandrashekar Ramanathan (Chair)
2. Prof. Muralidhara V N (Convener)
3. Prof. Debabrata Das (Member)
4. Prof. Srinivasaraghavan (Member)

The term of reference given to the Committee was to review and suggest recommendations to the Academic Senate on,

a. The curriculum, specialization streams and the title of the degree.
b. The admissions process
c. Preparatory term
d. Any other matter that may have impact on the above terms of reference

The Committee met three times between 10th January and 1st of February. The Committee made a presentation to the Senate Chairman on 6th of February 2018. The comments received was discussed and this report is the outcome of these deliberations.

## Recommendations

### The curriculum, specialization streams and the title of the degree.

The committee recommends that the title of the degree be changed to Master of Technology in Computer Science and Engineering, M. Tech (CSE) from the present degree Master of Technology in Information Technology ( M. Tech(IT)). The committee noted that first batch of Samsung Sponsored M. Tech Students graduated in July 2017, with M. Tech (CSE). The first batch of IM. Tech students will graduate with M. Tech (CSE) in the year 2020. Since, both Sponsored and IM. Tech students, do the same set of course as regular M. Tech students, it is more appropriate to rename the degree as Master of Technology in Computer Science and Engineering.

The committee recommends that the area of specialisation in the two year programme be as that of the five year Integrated M. Tech programme. The recommends the following area of specialisation for M. Tech (CSE)

- Theory and Systems
- Data Sciences
- Network , Communication and Signal Processing

### The admissions process

The committee recommends that selection to the M. Tech (CSE) programme is based on the valid GATE score in Computer Science and Information Technology (CS).

**Preparatory Term :**

The committee recommends that the Preparatory Term be reduced to 11 days, from the present three weeks. Students do a 0 credit Programming Course focusing on problem solving techniques.

**First Semester Courses:**

The committee recommends that the Students of M. Tech (CSE) will register for at least four of the following course, accounting for at least 16 credits in the first Semester. All these course are of four credits each.

6. CS 511 Algorithms
7. DS 511 Machine Learning
8. GEN 511 Advanced Mathematics
9. NC 511 Networking and Communications
10. DS 512 Data Modelling

The above list was arrived after considering that the students will be admitted based on the GATE score in CS, so they will be familiar with the undergraduate Computer Science courses like Data Bases, Operating Systems, Discrete Mathematics, Linear Algebra and Probability etc. Advanced courses in these area may be offered in the 2nd and 3rd semesters. Most of the students register for Machine Learning, Advanced Mathematics and Data Modelling in the second semester.

## Implementation

The Committee recommends that the revised scheme is implemented for all students admitted to M. Tech programmes on or after 1st January 2018.


## Acknowledgment

The Committee places on record its deep sense of appreciation and gratitude to the Chairman ( senate) for entrusting this task to the Committee, all faculty colleagues who offered comments , suggestions and advice both in and out of meetings.


Annexure 3.3

**Report of the MTech Curriculum Revision Committee 2018**

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**INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY BANGALORE**

# 60th Meeting of the Senate

## Agenda and Notes

**Date: February 21, 2018**

**Time: 2.00 p.m.**
**Venue: IIITB Board Room**

**26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777**

INTERNATIONAL INSTITUTE
OF INFORMATION TECHNOLOGY BANGALORE
26/C, Electronics City, Hosur Road, Bangalore 560 100
Phones: 080-28527627-635, 41407777; Fax: 080-28527636
Website :www.iiitb.ac.in

Date: February 26, 2018

Sub: Minutes of 60th Senate meeting of the International Institute of Information technology, Bangalore held on February 21, 2018 at 2.00 PM.

Dear Sir/Madam,

Please find herewith attached Minutes of the 60th Meeting of the Senate of IIITB held on February 21, 2018 in the Board Room of IIIT B at 2.00PM.

Best Regards

S R Sridhar, Cmde (Retd)
Registrar &
Secretary to the Senate

The Senate suggested that other changes not included in the approval above be discussed with the faculty members and a comprehensive programme structure including course contents be presented to the Senate.

**Action required:** Detailed M.Tech. (ECE) curriculum document along with list of courses and course descriptions as per the Course Proposal Document template to be prepared.

**60.4.3 Changes to M.Sc. (Digital Society)**

Amongst the changes that were proposed by the Change Management Subcommittee, the following

The following changes are proposed to the M.Sc. (Digital Society) programme.

| Change | Existing | Proposed |
|---|---|---|
| **Name of the Programme** | M.Sc. (Digital Society) | No change |
| **Specializations** | None | • Human-centered digital design<br>• Data intensive digital design<br>• Research and policy studies |
| **Preparatory Term** | 2 weeks Preparatory Term (2 credits) | 2 weeks Programme Orientation on various topics outside of regular curriculum |
| **Total Number of Credits** | 76 | 66 |
| **Total Intake** | 30 | No change |
| **UG Branch for Admissions** | An under-graduate degree (of at least 3 years duration) in any discipline with a first division/class from a recognized University. | No change |

Credit Structure

**Programme Orientation (2 weeks)**

1. Technical Foundations (to cover programming and database fundamentals) - *new*
2. Social Science Foundations (to cover some fundamental ideas in social science, reading comprehension and writing practice) - *new*

Semester 1 (16 weeks, 18 credits, 5 core courses)

1. Digital Components of a Connected Society (4)

2. Tools for a Connected Society (2) - *new*
3. Interface Design *(substantially redesigned with a Digital Design focus)* (4)
4. Research Methods (Quantitative and Qualitative) (4) - *new*
5. Technology and Society (4)

Semester 2 (16 weeks, 16 credits, 3 core courses, 1 elective)

1. Technology in Development- *new title*
2. ICT Policy and Regulation
3. Social Complexity and Systems Thinking- *new title*

Semester 3 (16 weeks, 16 credits, 4 electives)

Semester 4 (22 weeks, 16 credits Thesis/Internship)

Tentative Pool of electives for semesters 2 and 3, categorized by specialization
(note: an elective may appear in more than one specialization; more electives may be added depending on future need and interest of students and faculty members. Students have the option of choosing from the listed M.Tech. electives too provided the student has the necessary pre-requisite knowledge and background.)

| **Human Centered Design/ Digital Design** | **Data Intensive Design / Digital Design** | **Research and Evaluation of Digital Production and Use Contexts/ Research and Policy Studies** |
|---|---|---|
| • Advanced Qualitative Research Methods<br>• Advanced Interface Design/HCI *(new)*<br>• E-Governance Application Design<br>• IT Product and Project Management<br>• Smart Cities<br>• Social Media Communication | • Advanced Quantitative Methods/ Data Manipulation *(new)*<br>• Data Modeling*<br>• Data Visualization*<br>• Geographical Information Systems*<br>• IT Product and Project Management*<br>• Machine Learning*<br>• Information Networks*<br>• Multi-agent Systems* | • Advanced Qualitative Research Methods<br>• Advanced Quantitative Methods/ Data Manipulation *(new)*<br>• Dynamics of the IT Industry<br>• E-Governance Application Design<br>• Political Economy of Location<br>• Smart Cities<br>• Social Media Communication<br>• Techno-Economics of Networks |

* M.Tech. Elective can be taken provided the student satisfies the necessary pre-requisites and suggested by the respective course instructor

# Course Proposal Template

| | | | |
|---|---|---|---|
| **Course Name** | Algorithms | | |
| **Course Proposer Name(s)** | Muralidhara V N | | |
| **Course Instructor Name(s)** | Muralidhara V N | | |
| **Credits** | 4 | | |
| **Grading Scheme** (Choose by placing X against appropriate row) | X | 4-point scale (A,A-,B+,B,B-,C+,C,D,F) | |
| | | Satisfactory/Unsatisfactory (S / X) | |

**Area of Specialization**
(Choose by placing X against not more than two areas from the list)

| | | | | |
|---|---|---|---|---|
| X | Theory and Systems | | | Networking and Communication |
| | Data Science | | | Signal Processing and Pattern Recognition |
| | VLSI Design | | | General Elective |

**Pre-Requisites (where applicable, specify exact course names)**

Basic Data Structures like Arrays, stacks, queues, linked lists, trees, binary trees and travels methods, binary heaps, hashing and graph representation.

**Course Description**
*A brief description of the course*

This course will covered some of the advanced data structures like Fibonacci Heaps, Treaps, AVL and red black trees. It covers the algorithms design techniques like Divide and Conquer, Greedy algorithms and Dynamic Programming. It also covers Graph algorithms including shortest path problem and Minimum Spanning tree and Network flows.

**Course Content**

- Algorithmic analysis : Review of Asymptotic notations for algorithms, recurrence tree methods, complexity classes
- Abstract Data Structures: Binomial and Fibonacci Heaps, Balanced Binary Search Trees, AVL Trees and Red Black Trees and their applications
- Algorithmic paradigms: Divide and conquer, Dynamic Programming, greedy algorithms including metroid's:
- Graph Algorithms: Graph traversals: DFS and BFS, shortest path problem and the spanning tree problems. Network Flow and applications.
- Randomized Algorithms: Las Vegas and Monte Carlo paradigms, some example randomized algorithms.

**Assessments**

Two class tests, one mid-term exam and one final exam and three programming tests.

**Text Book / References**

Introduction to Algorithms by Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, MIT Press, 3rd Edition 2009.

# Course Proposal Template

| | | | |
|---|---|---|---|
| **Course Name** | Analog CMOS VLSI Design | | |
| **Course Proposer Name(s)** | Chetan Parikh | | |
| **Course Instructor Name(s)** | Chetan Parikh | | |
| **Credits** | 4 | | |
| **Grading Scheme** (Choose by placing X against appropriate row) | X | 4-point scale (A,A-,B+,B,B-,C+,C,D,F) | |
| | | Satisfactory/Unsatisfactory (S / X) | |

**Area of Specialization**
(Choose by placing X against not more than two areas from the list)

| | | | | |
|---|---|---|---|---|
| | Theory and Systems | | | Networking and Communication |
| | Data Science | | | Signal Processing and Pattern Recognition |
| X | VLSI Design | | | General Elective |

**Pre-Requisites (where applicable, specify exact course names)**

NIL

**Course Description**
*A brief description of the course*

The course will discuss how Analog circuits are designed in a VLSI chip environment starting from an understanding of VLSI technology and fabrication. The methodology adopted for teaching this course is to first provide a simple physical model of the MOSFET transistor that is capable of abstracting the essential electrical behavior of the device. Following this a related small-signal MOSFET model can be derived. The application of DC and small-signal analysis methods on MOSFET circuits can then follow.
The main aim of the course will be to learn how to analyze and build CMOS amplifiers that are the building blocks of almost all VLSI mixed-signal systems. At every stage of the course the students are expected to design, on paper as well as simulation, the circuits discussed in the class. An important aspect of the course will be a project in which the students are expected to design and simulate (using Spice simulator).

**Course Content**

**Topics :** MOS device physics, Common-source, common-gate, common-drain, and cascode stages, Differential amplifiers, Current mirrors, Frequency response of amplifiers, One and two-stage operational amplifiers, Stability and frequency compensation, feedback networks, Memory design.

**Assessments**

Midterm (30%), Final exam (30%), Assignments (20%), and Quizzes(20%).

**Text Book / References**

- B. Razavi, Design of Analog CMOS Integrated Circuits, Latest Edition.

# Course Proposal Template

| | | | |
|---|---|---|---|
| **Course Name** | Digital CMOS VLSI Design | | |
| **Course Proposer Name(s)** | Madhav Rao | | |
| **Course Instructor Name(s)** | Madhav Rao | | |
| **Credits** | 4 | | |
| **Grading Scheme** (Choose by placing X against appropriate row) | X | 4-point scale (A,A-,B+,B,B-,C+,C,D,F) | |
| | | Satisfactory/Unsatisfactory (S / X) | |

**Area of Specialization**
(Choose by placing X against not more than two areas from the list)

| | | | | |
|---|---|---|---|---|
| | Theory and Systems | | | Networking and Communication |
| | Data Science | | | Signal Processing and Pattern Recognition |
| | VLSI Design | | X | General Elective |

**Pre-Requisites (where applicable, specify exact course names)**

NIL

**Course Description**
*A brief description of the course*

Design, layout, simulation, and test of Design custom digital CMOS/VLSI chips, using a CMOS cell library and state-of-the-art CAD tools. Digital CMOS static and dynamic gates, flip flops, CMOS array structures commonly used in digital systems. Top down design example of a bit slice processor.

**Course Content**

Topics : Includes CMOS logic, latches, flip-flops, CMOS layout, MOSFET Current and Capacitances, Non-ideal MOSFET Effects, CMOS Delay Estimation, Delay optimization and logical effort, Power estimation: Static and Dynamic, Low-Power design, Static Combinational CMOS Logic Styles, Dynamic Combination CMOS Logic styles, Static and Dynamic Sequential Circuit Design, Technology scaling, and VLSI design methodologies. the course also includes Schematic and layout of Digital circuits using Electric and Cadence tool.

**Assessments**

Midterm (30%), Final exam (30%), Assignments (20%), and Quizzes(20%).

**Text Book / References**

Neil H. E. Weste and David Harris, CMOS VLSI Design: A circuits and systems perspective, 4th edition, 2011.

# Course Proposal Template

| | | | | |
|---|---|---|---|---|
| **Course Name** | Discrete Mathematics and Computability | | | |
| **Course Proposer Name(s)** | Meenakshi D'Souza and Srinivas Vivek | | | |
| **Course Instructor Name(s)** | Meenakshi D'Souza and Srinivas Vivek | | | |
| **Credits** | 4 | | | |
| **Grading Scheme** (Choose by placing X against appropriate row) | X | 4-point scale (A,A-,B+,B,B-,C+,C,D,F) | | |
| | | Satisfactory/Unsatisfactory (S / X) | | |

**Area of Specialization**
(Choose by placing X against not more than two areas from the list)

| | | | | |
|---|---|---|---|---|
| X | Theory and Systems | | | Networking and Communication |
| | Data Science | | | Signal Processing and Pattern Recognition |
| | VLSI Design | | | General Elective |

**Pre-Requisites (where applicable, specify exact course names)**

Design and Analysis of Algorithms, Theory of Computation – both at undergraduate level.

**Course Description**
*A brief description of the course*

This course will provide an introduction to topics from Discrete Mathematics and Computability theory towards pursuing further electives in Computer Science (Theory) and research electives in this area. The course will cover many topics in Combinatorics and also discuss Turing machines, computability and complexity theory, especially Class-P, Class-NP, NP-complete problems and class PSPACE.

**Course Content**

Discrete Mathematics:

- Propositional logic, sets, functions, relations, partial orders, countability.
- Combinatorics: sum rule, product rule, permutations and combinations, inclusion-exclusion principle, pigeon-hole principle, recursion, generating functions, number of onto functions, partitions and Stirling numbers of second kind.

Computability:

- Computability: Turing machines, equivalent models of Turing machines, decidable and undecidable problems, reductions, Rice's theorem.
- Complexity theory: Class P, Class NP, NP-complete problems, PSPACE completeness, Savitch's theorem.

**Assessments**

Two class tests, one mid-term exam and one final exam.

**Text Book / References**


- Kenneth Rosen, Discrete Mathematics and its applications, 7th edition, McGraw Hill, 2012.
- Ronald L. Graham, Donald E. Knuth, and Oren Patashnik, Concrete Mathematics: A Foundation for Computer Science, 2nd edition, 1994.
- Ralph P. Grimaldi, Discrete and Combinatorial Mathematics: An Applied Introduction, 5th

# Course Proposal Template

| | | | |
|---|---|---|---|
| **Course Name** | Principles of Embedded Systems | | |
| **Course Proposer Name(s)** | Poonacha P G, Madhav Rao | | |
| **Course Instructor Name(s)** | External Faculty | | |
| **Credits** | 2 | | |
| **Grading Scheme** (Choose by placing X against appropriate row) | X | 4-point scale (A,A-,B+,B,B-,C+,C,D,F) | |
| | | Satisfactory/Unsatisfactory (S / X) | |

**Area of Specialization**
(Choose by placing X against not more than two areas from the list)

| | | | | |
|---|---|---|---|---|
| | Theory and Systems | | | Networking and Communication |
| | Data Science | | | Signal Processing and Pattern Recognition |
| X | VLSI Design | | | General Elective |

**Pre-Requisites (where applicable, specify exact course names)**

NIL

**Course Description**
*A brief description of the course*

Embedded systems are everywhere and most of the electronic systems have a computer inside to do smart things. Due to great demand a large number of embedded systems are available in the market from many companies. Purpose of this course is to help students understand existing architectures of embedded systems and also understand principles involved in designing such systems. In this course we will learn various issues involved in designing embedded systems meeting performance, cost, physical size and weight as well as power consumption requirements. Complex algorithms, user interface along with real time constraints make embedded computing more challenging than normal computing without any constraints on time. The course will start with Shannon's paper on switching circuits, simple microcontrollers and all the way up to distributed embedded computing. In order to understand the engineering aspects better each student or groups of students will study one of the existing platforms and share the knowledge with the class and also do some experiments on embedded systems. The course will involve more open discussions to discover principles and lab to get hands on experience in working with embedded systems.

**Course Content**

**Topics : :** Relay circuits, Boolean Algebra, Gates, Shift Registers, CPUs, Memories and Busses, Complex systems and Microprocessors, Embedded system design process and Formalisms for design, Instruction sets, CPU and Memory, I/O Devices and Component Interfacing, Program Design , Analysis and Optimization, Operating systems with real time constraints, Design Methodologies and Architecture design, Power management techniques for single and multi core systems, Multi core Embedded systems , Future Embedded systems, Neural computers and Quantum computers.

**Assessments**

Midterm (30%), Final exam (30%), Assignments (20%), and Quizzes(20%).

**Text Book / References**

- Computers as Components, Principles of Embedded Computing System Design, Wayne Wolf, Princeton University, Morgan Kauffman Publishers, Academic Press, 2001.

# Course Proposal Template

| | | | |
|---|---|---|---|
| **Course Name** | System design with FPGA | | |
| **Course Proposer Name(s)** | ESD Faculty | | |
| **Course Instructor Name(s)** | External faculty | | |
| **Credits** | 2 | | |
| **Grading Scheme** (Choose by placing X against appropriate row) | X | 4-point scale (A,A-,B+,B,B-,C+,C,D,F) | |
| | | Satisfactory/Unsatisfactory (S / X) | |

**Area of Specialization**
(Choose by placing X against not more than two areas from the list)

| | | | | |
|---|---|---|---|---|
| | Theory and Systems | | | Networking and Communication |
| | Data Science | | | Signal Processing and Pattern Recognition |
| X | VLSI Design | | | General Elective |

**Pre-Requisites (where applicable, specify exact course names)**

NIL

**Course Description**
*A brief description of the course*

This course covers the use of Verilog for the design of digital integrated circuits and programming them on to field programmable devices (FPGAs). The course will cover the following: Syntax and Semantics of Verilog which includes the following: Variable types, arrays, Operators, expressions and signal assignments, modules, nets and registers. Next, the course describes the definition of hierarchical HDL structures, Concurrent and sequential constructs, User Defined Primitive (UDP) Declarations, conditional statements. Finally, the course will cover test bench design and design examples which can be synthesised on to the hardware and programmed on to FPGAs.

**Course Content**

1. System-level architecture design for FPGAs. Review basics of hardware description languages. Syntax: data types, Operators, expressions and signal assignments, system tasks, compiler directives. Modules and Ports Module definition, port declaration, connecting ports, hierarchical name referencing.
2. Gate-Level Modeling using gate primitives, example- description of and/or gates, rise, fall min, max, and typical delays. Dataflow Modeling: Continuous assignments, delay specification, expressions, operators, operands, operator types.
3. Behavioral Modeling: initial and always blocks, blocking and nonblocking statements, delay control, generate statement, event control, conditional statements, loops, sequential and parallel blocks. Understanding a testbench design. Design and simulate examples using a Verilog simulator.
4. FPGA programming.
5. Understand serial interfaces (SPI,I2C) and write an SPI master to interface to an ADC (working as slave), and some assignments related to Capture a signal from signal generator (say triangular wave) and build an IIR digital filter using 16-bit fixed-point arithmetic. Capture a signal waveform using ADC, filter it and display the filtered waveform either using a DAC or on the PC. Capture a sample image (say from a camera or an image file). Filter the image (say to remove noise). Build a VGA or HDMI interface to display the image on a VGA display.

# Course Proposal Template

| | | | | |
|---|---|---|---|---|
| **Course Name** | Mathematics for Machine Learning | | | |
| **Course Proposer Name(s)** | G. Srinivasaraghavan | | | |
| **Course Instructor Name(s)** | Neelam Sinha<br>G. Srinivasaraghavan | | | |
| **Credits** | 4 | | | |
| **Grading Scheme**<br>(Choose by placing X against appropriate row) | X | 4-point scale (A,A-,B+,B,B-,C+,C,D,F) | | |
| | | Satisfactory/Unsatisfactory (S / X) | | |
| **Area of Specialization**<br>(Choose by placing X against not more than two areas from the list) | | | | |
| | Theory and Systems | | | Networking and Communication |
| X | Data Science | | X | Signal Processing and Pattern Recognition |
| | VLSI Design | | | General Elective |
| **Pre-Requisites (where applicable, specify exact course names)** | | | | |
| • Probability Theory, Linear Algebra | | | | |
| **Course Description**<br>*A brief description of the course* | | | | |
| This course is intended to be an intense, in-depth course in Statistical Learning methods. Primary Reference would be:<br>1. Trevor Hastie, Robert Tibshirani and Jerome Friedman. "The Elements of Statistical Learning ". Second Edition. Springer. 2008. Freely Downloadable. | | | | |
| **Course Content** | | | | |

## Module 1 (Machine Learning, Unsupervised Learning)

- Introduction to Learning from data – Unsupervised, Supervised
- K-means
- Hierarchical Clustering

## Module 2 (Supervised Learning, Linear Models)

- Statistical Decision Theory
- Regression: Linear Regression
- Classification: K-NN, Bayes Classifier, Logistic Regression, Linear Discriminant Analysis, Perceptron

## Module 3 (Non linear Models, Regularization and Model Selection)

- Non linear Models: Non linear features, Neural networks, Kernels
- Bias-Variance Trade off
- Cross Validation

- Advanced Regression – L2, L1 regularization (LASSO)

## Module 4 (Kernel Methods and Support Vector Machines)

- Kernel Trick
- SVM Classification

### Suggested Reading:

a) Nello Cristianini and John Shawe-Taylor. "Support Vector Machines". Cambridge University Press. 2000. ISBN 978-0-521-78019-3.

b) Bernhard Scholkopf and Alexander Smola. "Learning with Kernels". The MIT Press. 2012. ISBN 0-262-17475-9.

## Module 5 (The Probabilistic Method – Primer on Randomized Algorithms)

1. Common Distributions and their characteristics
2. Chernoff Bounds, Martingales
3. Lovasz Local Lemma
4. PAC (Probably Approximately Correct) Algorithms
5. Probabilistic Decision Theory
6. Frequentist vs Bayesian Approaches

### Suggested Reading:

- James O. Berger. "Statistical Decision Theory and Bayesian Analysis". 2$^{Nd}$ Edition. Springer. 1980. ISBN 3-540-96098-8.
- Sheldon M. Ross. "Introduction to Probability and Statistics for Engineers and Scientists". Elsevier Academic Press 2009. ISBN 13: 978-0-12-370483-2.

## Module 6 (Statistical Decision Theory)

1. Empirical Risk Minimization
2. VC dimension
3. Structural Risk Minimization

### Suggested Reading:

Vapnik, Vladimir Naumovich. "An overview of statistical learning theory." IEEE transactions on neural networks 10.5 (1999): 988-999.

## Module 7 (Decision Trees and Random Forests)

- Decision Tree Classification
- Decision Tree Regression
- Random Forests
- Model Averaging & Stacking
- Boosting

# Course Proposal Template

| | | | |
|---|---|---|---|
| **Course Name** | Mathematics for Machine Learning | | |
| **Course Proposer Name(s)** | G. Srinivasaraghavan | | |
| **Course Instructor Name(s)** | G. Srinivasaraghavan, V. Ramasubramanian | | |
| **Credits** | 4 | | |
| **Grading Scheme** (Choose by placing X against appropriate row) | X | 4-point scale (A,A-,B+,B,B-,C+,C,D,F) | |
| | | Satisfactory/Unsatisfactory (S / X) | |

**Area of Specialization**
(Choose by placing X against not more than two areas from the list)

| | | | | |
|---|---|---|---|---|
| | Theory and Systems | | | Networking and Communication |
| | Data Science | | | Signal Processing and Pattern Recognition |
| | VLSI Design | | X | General Elective |

**Pre-Requisites (where applicable, specify exact course names)**

- Probability Theory, Linear Algebra

**Course Description**
*A brief description of the course*

This course intends to provide the advanced math background essential for Machine Learning and other advanced courses, and can be viewed as a combination of three main topics: Convex optimization, Advanced Linear Algebra and Advanced Probability.

**Course Content**

Module 1 (Convex optimization)

- Convex sets, Convex functions
- Unconstrained minimization
- Equality constrained minimization
- Inequality constrained minimization
- Lagrange multipliers
- KKT Multipliers
- Primal form, Dual form

Suggested Reading:
Boyd, Stephen, and Lieven Vandenberghe. Convex optimization. Cambridge university press, 2004.

Module 2 (Matrix Diagonalization)

- Matrix Transformation, Trace, Determinant
- Eigen decomposition
- Singular Value Decomposition
- Moore Penrose Pseudoinverse

Suggested Reading:
a) David C. Lay; Steven R. Lay; Judi J. McDonald "Linear Algebra and its applications, 1997."
b) Golub, Gene H.; Van Loan, Charles F.. "Matrix Computations" (3rd ed.), Johns Hopkins,

# Course Proposal Template

| | | | | |
|---|---|---|---|---|
| **Course Name** | Networking and Communication | | | |
| **Course Proposer Name(s)** | Prof. Debabrata Das and Prof. Jyotsna Bapat | | | |
| **Course Instructor Name(s)** | Prof. Debabrata Das and Prof. Jyotsna Bapat | | | |
| **Credits** | 4 | | | |
| **Grading Scheme** (Choose by placing X against appropriate row) | X | 4-point scale (A,A-,B+,B,B-,C+,C,D,F) | | |
| | | Satisfactory/Unsatisfactory (S / X) | | |
| **Area of Specialization (if applicable)** (Choose by placing X against not more than two areas from the list) | | | | |
| | Theory and Systems | | X | Networking and Communication |
| | Data Science | | | Signal Processing and Pattern Recognition |
| | VLSI Design | | | General Elective |
| **Pre-Requisites (where applicable, specify exact course names)** | | | | |
| Undergraduate course on Computer Networks | | | | |
| **Course Description** *A brief description of the course* | | | | |
| This is a course on concepts of Internet systems and evolution to next generation. You will learn about how the different kind of networks are interconnected and the various types of applications run over them from one part of the globe to the other efficiently as well as their limitations. Hence the course deals with the concepts of application, transport, and network layers protocols/algorithms. It also covers Data-link layer wired and wireless medium access control protocols. The above deeper understanding is important to envisioned 5G service oriented architecture on software defined network and network function virtualization.<br>For the digital communication part; channel capacity, channel coding, transmission through band-limited channels will be covered. Characteristics of wireless channels will be explored along with principles of OFDM, MIMO systems. | | | | |
| **Course Content** | | | | |
| **Lectures 1-2**<br>The first lecture is to make the students oriented towards the subjects to be covered in this course and why. The grading system and the books referred. Logical and physical topologies and why we need so many topologies?<br>**Lecture 3**<br>Client, Server, Connection oriented and connectionless services, Layered architecture, Internet protocol layer, Concepts on – why packet switching will take over circuit switching? | | | | |

# Course Proposal Template

| | | | | |
|---|---|---|---|---|
| **Course Name** | Software Systems | | | |
| **Course Proposer Name(s)** | Prof. Thangaraju and Prof. JayPrakash T L | | | |
| **Course Instructor Name(s)** | Prof. Thangaraju and Prof. JayPrakash T L | | | |
| **Credits** | 4 | | | |
| **Grading Scheme** (Choose by placing X against appropriate row) | X | 4-point scale (A,A-,B+,B,B-,C+,C,D,F) | | |
| | | Satisfactory/Unsatisfactory (S / X) | | |
| **Area of Specialization** (Choose by placing X against not more than two areas from the list) | | | | |
| X | Theory and Systems | | | Networking and Communication |
| | Data Science | | | Signal Processing and Pattern Recognition |
| | VLSI Design | | | General Elective |
| **Pre-Requisites (where applicable, specify exact course names)** | | | | |
| Undergraduate course on programming, data structures and operating systems | | | | |

**Course Description**
*A brief description of the course*

The course has two major modules:

- System Software
- Enterprise Software Development

MODULE 1: SYSTEM SOFTWARE

This module starts with the introduction of the computer architecture, operating system and kernel architecture. Different types of kernel design namely monolithic, micro and hybrid architecture are analyzed. File, process, signals and memory management has been explained with the suitable live examples. Signals, inter process communication and synchronization mechanisms are explained in a practical point of view. The implementation of soft real time systems according to POSIX standard are analyzed. Finally the difference between application program and kernel module are discussed. During Lab, the students will be asked to write code from scratch for more than 30 real time/live exercise.

This comprehensive hands-on course provides the knowledge and skills of system programming and most of the concept such as File, Process, Signals and IPC are compatible with the UNIX variants like UNIX, Linux, Solaris, HP-UX and AIX.

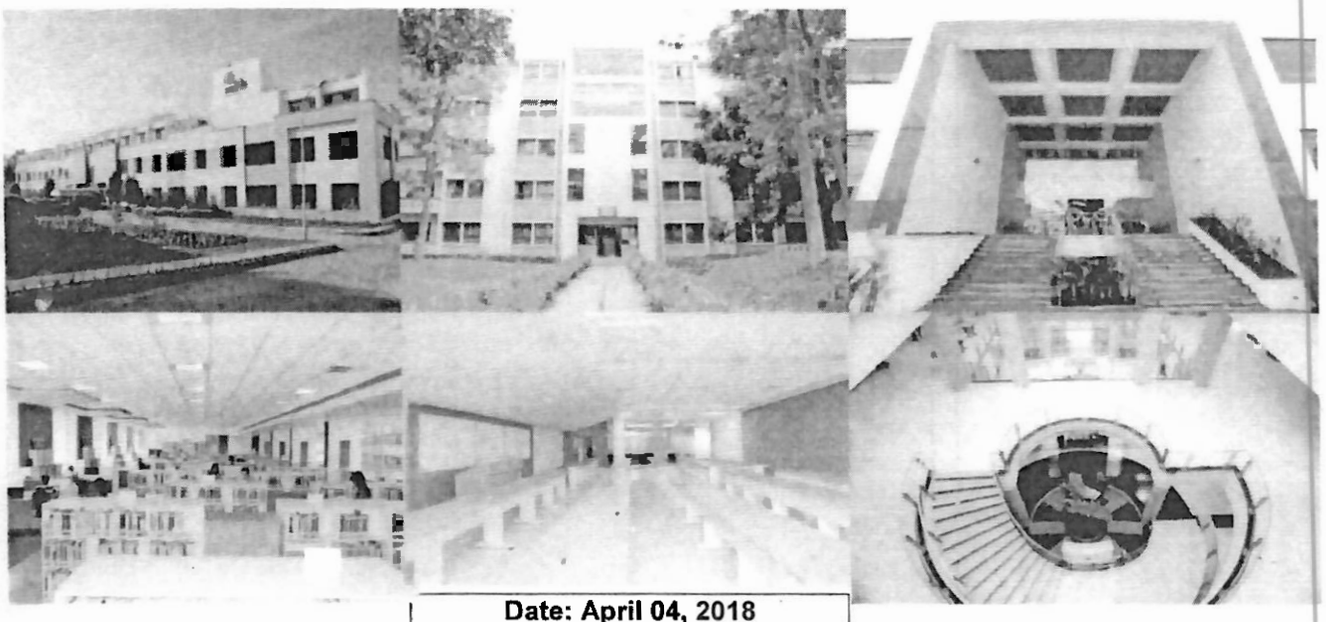
MODULE 2: ENTERPRISE SOFTWARE DEVELOPMENT

In this module, student is exposed to the elements of enterprise software development with primary focus on web application development and mobile application development.

**INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY BANGALORE**

# 61st Meeting of the Senate

## Agenda and Notes



**Date: April 04, 2018**

**Time: 2.00 p.m.**
**Venue: IIITB Board Room**

**26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777**

**INTERNATIONAL INSTITUTE**
**OF INFORMATION TECHNOLOGY BANGALORE**
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**Phones: 080-28527627-635, 41407777; Fax: 080-28527636**
**Website :www.iiitb.ac.in**

**Date: March 26, 2018**

Dear Sir/Madam,

Sub: 61st meeting of the Senate of International Institute of Information Technology, Bangalore being held on April 04, 2018 at 2.00 PM.

Please find herewith attached agenda papers and notes for the 61st Meeting of the Senate of IIITB, being held on April 04, 2018 in the Board Room of IIIT B at 2.00 PM.

Kindly make it convenient to attend the meeting.

Thanking you,

Yours sincerely,

S R Sridhar, Cmde (Retd)
Registrar &
Secretary to the Senate

**61.3 Consideration and Recommendation of the Students for Award of Master of Science by Research Degree**

| | |
|---|---|
| Sl No | 1 |
| Roll No. | MS2013005 |
| Student Name | Anshu Bhardwaj |
| Thesis Title | SECURE ARCHITECTURE FOR HIGH ASSURANCE SYSTEM DESIGN |
| Supervisor | Prof Subir K Roy |
| Degree | Master of Science by Research |
| Course Credits | 16 |
| Research Credits | 104 |
| **Milestone Checklist** | |
| Comprehensive Exam | PASSED |
| State of the Art Seminar | COMPLETED |
| Open Seminar | COMPLETED |
| Thesis Examination | PASSED |
| Thesis Oral Examination | PASSED |
| Fulfillment of requirements for award of Degree Reviewed by | Programme Coordinator |

The Senate may consider award of Master of Science by Research degree and if approved, recommend to the Governing Body conferring the said degree to them. The students have completed all the requirements required for the award of said degree. Relevant report placed at Annexure 2.

**61.4 Consideration and recommendation for Award of MTech degree**

The Senate may consider the award of MTech degree to Samsung student Ajith Kumar Velutheri, Roll No. EMT2013002 and recommend to the Governing Body, if approved conferring the said degree to him. Relevant report placed at Annexure 3.

**61.5 Revamp of M.Tech. First Semester Courses**

Further to the changes to the Master of Technology programmes approved in the 60th Meeting of the Senate, following is the list of courses proposed to be offered during the First Semester.

**First Semester Courses M.Tech. (CSE)**
(Students must choose 16 credits from the following)

| Courses | Credit hours |
|---|---|

| | |
|---|---|
| Algorithms | 4 |
| Networking and Communication | 4 |
| Machine Learning | 4 |
| Mathematics for Machine Learning | 4 |
| Networking and Communication | 4 |
| Software Systems | 4 |
| Discrete Mathematics and Computability | 4 |

**First Semester Courses M.Tech. (ECE)**
(Students must choose 16 credits from the following)

| Courses | Credit hours |
|---|---|
| Digital CMOS VLSI Design | 4 |
| Analog CMOS VLSI Design | 4 |
| Machine Learning | 4 |
| Mathematics for Machine Learning | 4 |
| Networking and Communication | 4 |
| System Software (offered as part of Software Systems)* | 2 |
| System design with FPGA* | 2 |
| Principles of Embedded Systems* | 2 |

* Any two out of the three

Detailed course proposals included in Annexure 4.

**61.6 Items for Reporting:**

61.6.1 The following PhD student(s) have completed their Academic Milestone(s) as detailed below:

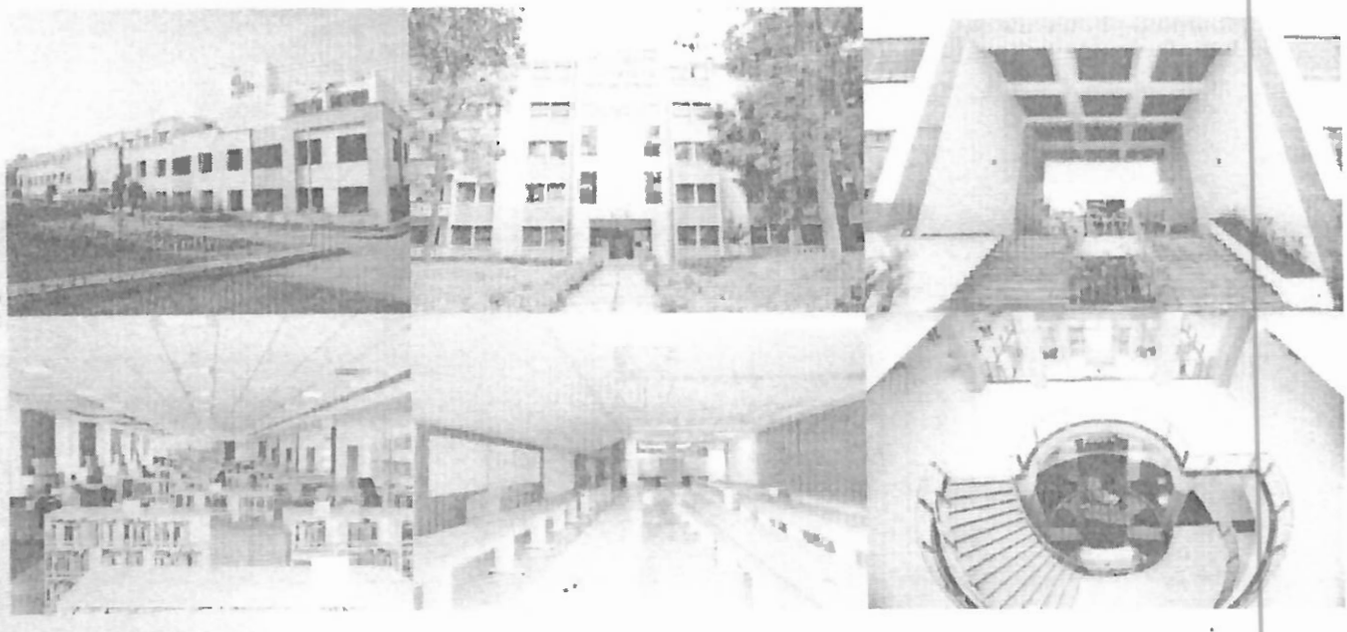
| | |
|---|---|
| Sl.No. | 1 |
| Roll No. | PH2015001 |
| Student Name | Abhishek Singh |
| Supervisor | Prof Meenakshi D'Souza |
| Thesis Keywords | Model checking, safety critical systems, real-time operating systems. |
| Academic Milestone | Comprehensive Examination |
| Date of the Exam | 26th February, 2018 |

| | |
|---|---|
| Sl.No. | 2 |
| Roll No. | PH2015021 |
| Student Name | Sanjay V P |
| Supervisor | Professor Amit Prakash |
| Thesis title | ICT and Development, Indian Agriculture, Smallholder Farmers, Agricultural Markets |
| Academic Milestone | Comprehensive Examination |
| Date of the Seminar | 19th March, 2018 |

# INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY BANGALORE

## 62nd Meeting of the Senate

## Minutes of the Meeting



**Date: June 20, 2018**
**Time: 2.00 p.m.**
**Venue: IIITB Board Room**

26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777

INTERNATIONAL INSTITUTE
OF INFORMATION TECHNOLOGY BANGALORE
26/C, Electronics City, Hosur Road, Bangalore 560 100
Phones: 080-28527627-635, 41407777; Fax: 080-28527636
Website :www.iiitb.ac.in

Date: June 22, 2018

**Sub: Minutes of 62nd Senate meeting of the International Institute of Information technology, Bangalore held on June 20, 2018 at 2.00 pm.**

Dear Sir/Madam,

Please find herewith attached Minutes of the 62nd Meeting of the Senate of IIITB held on June 20, 2018 in the Board Room of IIIT B at 2.00 PM.

Best Regards

S R Sridhar, Cmde (Retd)
Registrar &
Secretary to the Senate

# Course Proposal Template

| | | | | |
|---|---|---|---|---|
| **Course Name** | Network Science for the Web | | | |
| **Course Proposer Name(s)** | Srinath Srinivasa | | | |
| **Course Instructor Name(s)** | Srinath Srinivasa, Sridhar Mandyam | | | |
| **Credits** | 4 | | | |
| **Grading Scheme** (Choose by placing X against appropriate row) | **X** | 4-point scale (A,A-,B+,B,B-,C+,C,D,F) | | |
| | | Satisfactory/Unsatisfactory (S / X) | | |

**Area of Specialization (if applicable)**
(Choose by placing X against not more than two areas from the list)

| | | | | |
|---|---|---|---|---|
| X | Theory and Systems | | | Networking and Communication |
| X | Data Science | | | Signal Processing and Pattern Recognition |
| | VLSI Design | | | General Elective |

**Pre-Requisites (where applicable, specify exact course names)**

Preliminary background knowledge in Graph Theory, Algorithms, Probability and Statistics. Multi-Agent Systems (DS/CS704) is highly recommended as a pre-requisite, but not mandatory. Essential concepts of Game Theory from DS/CS704 will be covered separately for this course.

**Course Description**
*A brief description of the course*

This course introduces the student to several elements of Network Analysis and reasoning over complex networks of interacting agents. The course addresses primarily social information networks -- more generally, the world wide web, as the underlying network of study.

**Course Outcomes**
*Course Outcomes are statements that describe what students are expected to know, and be able to do at the end of the course. These relate to the skills, knowledge, and behavior that students acquire in their progress through the course.*

At the end of the course, the students are expected to show evidence of their understanding of essential concepts of Network Science as applied to the web, and demonstrate their ability to use Network Science as a tool to analyze some kind of web-related phenomena.

**Course Content**

Mandate 1 : Network Science and Game Theory Essentials

Centrality measures

- Degree centrality
- Eccentricity
- Closeness
- Radiality

- Stress centrality
- Betweenness centrality
- Vitality

Game Theory essentials

- Basic definitions, Rational utility, Rational empathy and Social welfare
- Simultaneous games and their analysis
- Strategy and belief, pure and mixed strategies
- Solution concepts: equilibrium, iterated dominance, pareto optimality, maxmin heuristic

Mandate - 2: Characteristics of Social Networks

Acquaintance Networks

- Random graphs
- Triadic closure
- Entrenchment, random links and the small-world phenomenon
- The strength of weak ties
- Scale-free networks and their generative models
    - Preferential attachment
    - Growth and saturation

Network Stability

- Affinity and disaffinity
- Cartwright Harary theorem

Mandate - 3: Allocation in Networks of Agents

Microeconomic Perspectives and a problem overview

- Strategic vs. Cooperative Behaviour
- Network Complexities
- Notions of Fairness
- Optimality
- Connections to Network Centrality Measures

Cooperative Game Theoretic Approach

- Basic Terminology and Models
- Solution Concepts: Shapley Value
- Shapley Value applied to Networks

Social Welfare Based Allocation Approach

- Overview of Utility Functions
- Risk Aversion and its implications
- Social Welfare, Positive and Negative externalities
    - Possible Formulations

- Resource Allocation problem formulation
  - Social welfare maximization as an optimization problem
- Specific Solutions with
  - Exponential utilities
  - Log utilities
- Solution Highlights
  - Dominance over Neighbourhood (DON) properties
  - Pareto frontier
- Applications to different types of networks
  - Star, Rings, and bipartite graphs, arbitrarily connected networks
  - Practical Application Scenarios
    - Microfinance

Mandate - 4: Social Learning in Networks

Introduction to Social Learning

- Origins, Basic Terminology, Definitions
- Learning by Communication and Observation
- Role of Social Influence, Attention, Trust
- Implication of Networks and their Structure
- Some application examples

Models of Social Learning

- Alternative Theoretical Approaches
  - Overview: Bayesian, Non-Bayesian, and Ad hoc Models
  - Bayesian Social Learning
    - States, Signals, Beliefs, Decisions and Actions
    - Rationality, Information, Bayesian Updating
    - Limitations
    - Some examples

Bayesian Learning in Networks

- Complexities due to multiple agents
- Aggregation of Private and Social Information
- Observational models and herding behavior
- Some examples

Non-Bayesian Learning in Networks

- The DeGroot Model
  - Basic Ideas on myopic learning
    - Influence or attention weights and beliefs

- Markov chain analogue
- Conditions for the emergence of Consensus
  - Examples and some analyses
  - Extensions to the DeGroot Model
- Problems with the DeGroot Model
- Other Ad hoc methods for varying influence

Open world vs closed world models

- An example of a open world model for social learning
- Modelling external information sources

**Assessments**

Assessment is based on student participation in each mandate. Students may choose to contribute to each learning mandate in one of several ways like forum discussions, essays, seminars and any other specific activity. In addition, a reflection session (Quiz) is conducted at the end of each mandate. Every activity is graded, and unless otherwise specified, all activities have equal weightage towards the final grade.

**Text Book / References**

**Reference Texts:**


Easley, D. Kleinberg, J. Networks, Crowds, and Markets: Reasoning About a Highly Connected World. ISBN 9781139490306. http://books.google.co.in/books?id=atfCl2agdi8C 2010. Cambridge University Press

Brandes, Ulrik. *Network analysis: methodological foundations*. Vol. 3418. Springer Science & Business Media, 2005.

Chamley CP, *Rational Herds: Economic Models of Social Learning*, Cambridge University Press, 2004.

Jackson, MO, *Social and Economic Networks*, Princeton University Press, 2008.


**Suggested Reading:**


J. Kleinberg, S. Lawrence. The Structure of the Web. Science 294 (2001), 1849.

J. Kleinberg. Navigation in a Small World. Nature 406 (2000), 845.

M. Mitzenmacher. A Brief History of Generative Models for Power Law and Lognormal Distributions. Allerton Conference 2001.

# Course Proposal Template

| | | |
|---|---|---|
| **Course Name** | The Web and the Mind | |
| **Course Proposer Name(s)** | Srinath Srinivasa | |
| **Course Instructor Name(s)** | Srinath Srinivasa | |
| **Credits** | 2 | |
| **Grading Scheme** (Choose by placing X against appropriate row) | **X** | 4-point scale (A,A-,B+,B,B-,C+,C,D,F) |
| | | Satisfactory/Unsatisfactory (S / X) |

**Area of Specialization (if applicable)**
(Choose by placing X against not more than two areas from the list)

| | | | | |
|---|---|---|---|---|
| | Theory and Systems | | | Networking and Communication |
| | Data Science | | | Signal Processing and Pattern Rec |
| | VLSI Design | | X | General Elective |

**Pre-Requisites (where applicable, specify exact course names)**

None.

**Course Description**
*A brief description of the course*

This course is an introduction to the cognitive and psychological dimension of human participation in the World Wide Web. The web is a global, participatory social space where human cognition is continuously moulded. This course provides the student, a brief introduction to essential elements of cognitive science, and looks at how the web affects our cognition.

**Course Outcomes**
*Course Outcomes are statements that describe what students are expected to know, and be able to do at the end of the course. These relate to the skills, knowledge, and behavior that students acquire in their progress through the course.*

By the end of the course, students should be able to provide evidence of their understanding of essential concepts of the cognitive dimension of web use. They should be able to take up some issue concerning web use (like crowdsourcing, online campaigns, online privacy, etc.) and analyze it from the perspective of human cognition.

**Course Content**

Mandate - 1: Models of the web

- History of the web

- Models of the web
  - Web as a database
  - Web as a digital library
  - Web as a cognitive extension of ourselves
  - Web as a socio-cognitive space rather than as a tool
- Introduction to social machines

Mandate - 2: Essential Cognitive Science

- Organization of long-term memory and working memory
- Semantic and Episodic memory
- Attention and its characteristics
- Priming, Anchoring and the Availability heuristic
- Modeling Emotions: Arity and Intensity
- Prospect theory and the handling of risk

Mandate - 3: Essential Social Psychology

- Acquaintance, FOAF and Triadic closure
- Entrenchment, Trust and Novelty
- The strength of weak ties
- Affinty, Disaffinity and Network stability
- Social conformity
- Emotional contagion
- Social identity and branding

Mandate - 4: Attention on the web

- PageRank and the dynamics of online attention flow
- Personalization and Attention traps
- Sustained versus cursory online attention
- Attention and social capital

Mandate - 5: Privacy and online identity

- Evolution of privacy concerns on the web
- Online disinhibition effect
- Privacy versus Transparency versus Security
- Informed consent models for the web
- Self, identity and online projection of identity
- Online avatars and the Proteus Effect

- Jung's collective subconscious and the web

**Assessments**

Assessment is based on student participation in each mandate. Students may choose to contribute to each learning mandate in one of several ways like forum discussions, essays, seminars and any other specific activity. In addition, a reflection session (Quiz) is conducted at the end of each mandate. Every activity is graded, and unless otherwise specified, all activities have equal weightage towards the final grade.

**Text Book / References**

Suggested Reading:


Berners-Lee, Tim, Mark Fischetti, and Michael L. Dertouzos. *Weaving the Web: The original design and ultimate destiny of the World Wide Web by its inventor*. Harper Information, 2000.

M. Granovetter. The strength of weak ties. American Journal of Sociology, 78(6):1360-1380, 1973.

Easley, D. Kleinberg, J. Networks, Crowds, and Markets: Reasoning About a Highly Connected World. ISBN 9781139490306. http://books.google.co.in/books?id=atfCl2agdi8C 2010. Cambridge University Press

Suler, John. "The online disinhibition effect." Cyberpsychology & behavior 7, no. 3 (2004): 321-326.

Kahneman, Daniel, and Amos Tversky. "Prospect theory: An analysis of decision under risk." In Handbook of the fundamentals of financial decision making: Part I, pp. 99-127. 2013.

Sheehan, Kim Bartel. "Toward a typology of Internet users and online privacy concerns." The Information Society 18, no. 1 (2002): 21-32.

Yee, Nick, and Jeremy Bailenson. "The Proteus effect: The effect of transformed self-representation on behavior." Human communication research 33, no. 3 (2007): 271-290.

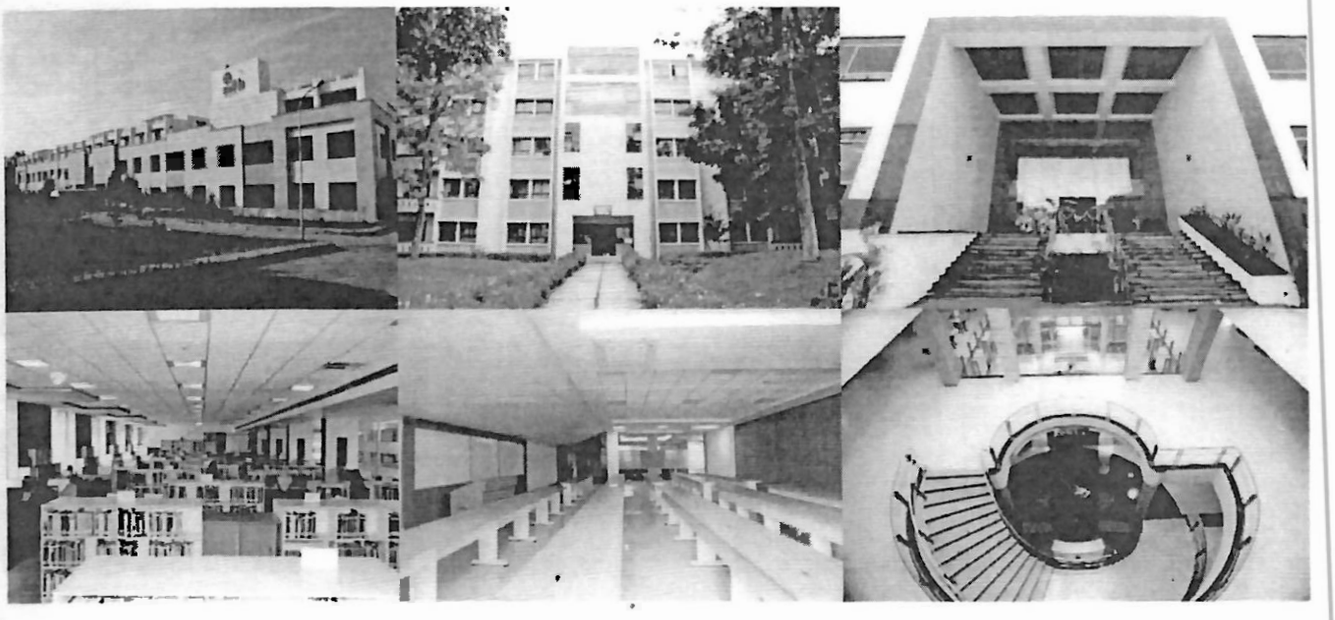
Kramer, Adam DI, Jamie E. Guillory, and Jeffrey T. Hancock. "Experimental evidence of massive-scale emotional contagion through social networks." Proceedings of the National Academy of Sciences 111, no. 24 (2014): 8788-8790.

Ribbink, Dina, Allard CR Van Riel, Veronica Liljander, and Sandra Streukens. "Comfort your online customer: quality, trust and loyalty on the internet." Managing Service Quality: An International Journal 14, no. 6 (2004): 446-456.

# INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY BANGALORE

## 63rd Meeting of the Senate

## Agenda and Notes



**Date: July 25, 2018**
**Time: 2.00 p.m.**
**Venue: IIITB Board Room**

26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777

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OF INFORMATION TECHNOLOGY BANGALORE
26/C, Electronics City, Hosur Road, Bangalore 560 100
Phones: 080-28527627-635, 41407777; Fax: 080-28527636
Website :www.iiitb.ac.in

Date: July 12, 2018

Dear Sir/Madam,

**Sub: 63rd meeting of the Senate of International Institute of Information Technology, Bangalore being held on July 25, 2018 at 2.00 pm.**

Please find herewith attached agenda papers and notes for the 63rd Meeting of the Senate of IIITB, being held on July 25, 2018 in the Board Room of IIIT B at 2.00 pm.

Kindly make it convenient to attend the meeting.

Thanking you,

Yours sincerely,

S R Sridhar, Cmde (Retd)
Registrar &
Secretary to the Senate

**63.3 Consideration and Approval of the Senate for Course Proposals**

Course proposals on 'Network Science for the Web' and 'The Web and the mind' submitted by Prof Srinath Srinivasa is placed at **Annexure 2** of the Agenda for approval.

**63.4 For Consideration and Approval of the Senate with regard to the research students** (Annexure III)

| Sl. No. | Roll Number | Student Name | Supervisor | Approval for |
|---|---|---|---|---|
| 1 | MS2016004 | Sree Darshini | Prof Subhajit Sen | Conversion from Full time to Part time |

**63.5 Consideration and Approval of the Senate for changes proposed in the iMTech curriculum**

1. Due to the change in the MTech curriculum, it is proposed to have 2 electives in the 5th semester of iMTech Program. This will help them get ready for advanced electives from 6$^{th}$ semester onwards. The students will take 3 core courses and 2 electives in the proposed 5th semester of iMTech curriculum.
2. CS304 Foundations of Computer Graphics offered as core course in the 5th semester of iMTech CSE program is proposed to be made elective and will be offered in even semesters.
3. EC301 Analog Circuits and Systems offered as core course in the 5th semester of iMTech ECE program is proposed to be made elective and will be offered in odd semesters.
4. Antennas and Propagation course to be offered as Special topic (elective) course instead of EC401 Electromagnetic and antenna theory in the 7th semester of iMTech ECE program.
5. Physics syllabus for Integrated M.Tech. has been updated as attached.

**63.6. Items for Reporting:**

**63.6.1 The following PhD student(s) have completed their Academic Milestone(s) as detailed below:**

| Sl.No. | 1 |
|---|---|
| Roll No. | PH 2015005 |
| Student Name | Gaonkar Pradnya Tukaram |
| Supervisor | Prof Jyotsna Bapat - Thesis supervisor<br>Prof Debabrata Das - Thesis co supervisor |
| Thesis title | Energy Cost and Comfort Optimization in Semi-Public Buildings |

INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY BANGALORE

# 64th Meeting of the Senate

## Minutes of the Meeting

**Date: October 10, 2018**
**Time: 2.00 p.m.**
**Venue: IIITB Board Room**

26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777

INTERNATIONAL INSTITUTE
OF INFORMATION TECHNOLOGY BANGALORE
26/C, Electronics City, Hosur Road, Bangalore 560 100
Phones: 080-28527627-635, 41407777; Fax: 080-28527636
Website :www.iiitb.ac.in

**Date: October 10, 2018**

**Sub: Minutes of 64th Senate meeting of the International Institute of Information technology, Bangalore held on October10, 2018 at 2.00 pm.**

Dear Sir/Madam,

Please find herewith attached Minutes of the 64th Meeting of the Senate of IIITB held on October 10, 2018 in the Board Room of IIIT B at 2.00 PM.

Best Regards

S R Sridhar, Cmde (Retd)
Registrar &
Secretary to the Senate

The Senate Sub Committee met on October 3, 2018 and approved the list of 288 candidates for the award of PG Diploma in Data Science. This is for the information of the Senate. The report is placed at Annexure - 6.

**64.5.6 The Senate noted the details of the students withdrawn from MTech & iMTech Programme.**

| S. No. | Roll Number | Name and date withdrawn |
|---|---|---|
| 1 | MT2017094 | Ravi Ranjan Date - 28th September, 2018 |
| 2 | MT2018132 | Vikash Tyagi Date - 19th September, 2018 |
| 3 | IMT2015513 | Manoj Kulkarni Date - 1st October, 2018 |

**64.5.7** The Senate noted the date of 65th meeting of the Senate of IIITB which is scheduled on December 05, 2018.

**64.6 Any other item(s) with the permission of the Chair - Tabled item**

Prof Madhav Rao tabled the following item for approval by the senate which was duly approved:-

The EC 509 Analog Circuits and Systems course is an elective course open to M.Tech(ECE) and Integrated MTech (ECE) students. Currently the course has a L:T:P structure of 3:0:1. To enhance the lab content of the course, it is proposed to change the structure to 2:0:2.

Action Required:

**The meeting ended with thanks to the Chair.**

**********

INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY BANGALORE

# 65th Meeting of the Senate

## Agenda and Notes

**Date: December 05, 2018**
**Time: 2.00 p.m.**
**Venue: IIITB Board Room**

26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777

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Website :www.iiitb.ac.in

**Date: November 26, 2018**

Dear Sir/Madam,

**Sub: 65th meeting of the Senate of International Institute of Information Technology, Bangalore being held on December 05, 2018 at 2.00 pm.**

Please find herewith attached agenda papers and notes for the 65th Meeting of the Senate of IIITB, being held on December 05, 2018 in the Board Room of IIIT B at 2.00 pm.

Kindly make it convenient to attend the meeting.

Thanking you,

Yours sincerely,

S R Sridhar, Cmde (Retd)
Registrar &
Secretary to the Senate

**Agenda and notes**
**for**
**65th meeting of the Senate of the**
**International Institute of Information Technology, Bangalore**
**December 05, 2018 at 2.00 pm**

## 65.1 Confirmation of the minutes of the 64th meeting held on October 10, 2018

Minutes of the 64th meeting of the Senate is placed at **Annexure 1** for confirmation.

## 65.2 Action taken report

Details of the action taken on the minutes of the 64th meeting of the Senate are placed for perusal.

| Agenda Point | Decision Points | Action/s Taken |
|---|---|---|
| 64.4 | Consideration and Recommendation of the Student for Award of MTech degree to Anshuumaan Dwivedi, MT2015021 | Recommended to the Governing Body for award of MTech degree to Anshuumaan Dwivedi, MT2015021. Provisional degree is issued. |
| 64.5.5 | update from Senate Sub-Committee for PGDDS | Convocation held on November 24, 2018 |
| 64.6 | Tabled item by Prof Madhav Rao- EC 509 Analog Circuits and Systems course - Change of structure | Necessary changes will be incorporated |

## 65.3 Senate may consider and approve the new course proposal

Course proposal on **'Digital Sociology'** submitted by Prof Bidisha Chaudhuri at **Annexure 2** will be tabled during the meeting.

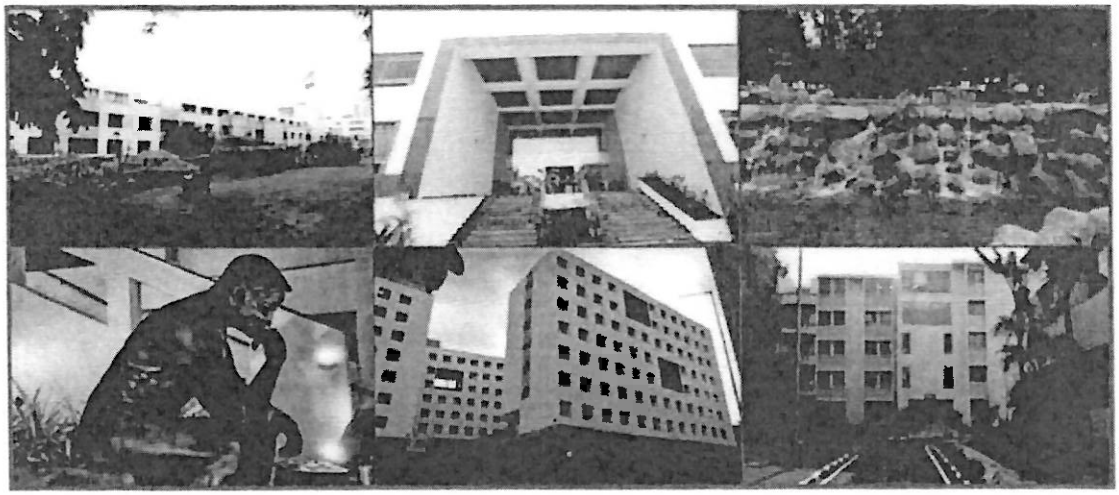
## 65.4 Consideration and Recommendation of the Student(s) for Award of Master of Science by Research Degree

The following student(s) having met all the requirements and qualified for the award of Master of Science by Research degree is recommended for the award of degree. Report(s) at **Annexure 3** will be tabled during the meeting.

INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY BANGALORE

# 65th Meeting of the Senate

## Agenda and Notes



**Date: December 05, 2018**
**Time: 2.00 p.m.**
**Venue: IIITB Board Room**

26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777

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OF INFORMATION TECHNOLOGY BANGALORE
26/C, Electronics City, Hosur Road, Bangalore 560 100
Phones: 080-28527627-635, 41407777; Fax: 080-28527636
Website :www.iiitb.ac.in

**Date: November 26, 2018**

Dear Sir/Madam,

**Sub: 65th meeting of the Senate of International Institute of Information Technology, Bangalore being held on December 05, 2018 at 2.00 pm.**

Please find herewith attached agenda papers and notes for the 65th Meeting of the Senate of IIITB, being held on December 05, 2018 in the Board Room of IIIT B at 2.00 pm.

Kindly make it convenient to attend the meeting.

Thanking you,

Yours sincerely,

S R Sridhar, Cmde (Retd)
Registrar &
Secretary to the Senate

Table Agenda
65th meeting of the Senate of the
International Institute of Information Technology, Bangalore
December 05, 2018 at 2.00 PM

**65. 6 Any other matter with the permission of the Chair -**

**65.6.1 Consideration and Approval of Course Proposal**

Course proposal on **'News Media Literacies'** submitted by Prof Preeti Mudliar is placed at **Annexure 5** of the Agenda for approval.

**********

| | |
|---|---|
| **Course Name** | Digital Sociology |
| **Course Branch** | iMTech elective (6th Semester) |
| **Course Proposer Name(s)** | Bidisha Chaudhuri |
| **Course Instructor Name(s)** | Bidisha Chaudhuri |
| **Course Type** | Elective |
| **Course Level** | Level 1 |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | Lecture (3)+ Tutorial (1)= 4 credits |
| **Grading Scheme** | A,A-,B+,B,B-,C+,C,D,F |

**Pre-Requisites (where applicable, specify exact course names)**

NA

**Course Description**

Digital Sociology is a sub-field of Sociology. Sociology as a discipline concerns itself with the intricate and infinite ways in which the relationships between individual and society unfold. Thus, there is hardly any sphere of our existence that sociologists are not interested in, starting from intimate personal relationships to large scale circulation of ideas, institutions, practices, goods and people (Warwick, Department of Sociology, n.d.). While the scope of the discipline is limitless, its uniqueness in dealing with this wide variety of subjects lies in what C.W. Mills called the "sociological imagination" (1959), the ability to connect all social events and human actions to specific historical and social contexts. Thus, changing historical and social context considerably shape the scope of Sociology.

Digital Sociology deals with the changes brought in by increasing and almost ubiquitous use of digital technologies in our lives. In this course, we will focus on the historical and social context of digital society – an increasingly digitized world that permeates everyday existence of our lives, from self to interpersonal relationships, from institutions to practices, from knowledge to ways of knowing. The term digital Sociology is meant to capture human relationships and events in connection to the larger context of digital society.

The work of digital sociologists is broadly categorised into four themes (Lupton 2015): a) Professional digital practice - using digital media tools for professional purposes of Sociological work; b) Digital data analysis -using digital data for social research; c) Sociological analyses of digital use - researching the ways in which people's use of digital media configures their sense of selves, their embodiment and their social relations; d) Critical digital sociology : undertaking reflexive and critical analysis of digital media informed by social and cultural theory. In this course we will take on a combination of the last two themes. In doing so, we will draw on research in Internet studies, information and communication studies, media and cultural studies, the sociology of science and technology, surveillance studies, and computer science to cultivate a "sociological imagination" that connects us and our everyday experience to the contemporary digital society.

**Course Outline**

**Module 1 (Week 1 & 2): Introduction – What is to be a Sociologist in a Digital Society?**

A. Sociological Imagination
B. Sociological Consciousness
C. Critical Digital Sociology

**Module 2 (Weeks 3-6): Social Institutions in a Digital Society**

A. Diverse Technology, Diverse Use
B. Digital Culture
C. Sharing Economy
D. E-health
E. Digital Politics

**Module 3 (Weeks 7-10): Social Relationships in a Digital Society**

A. Self and the Intimate
B. Caste
C. Gender
D. Race
E. Labour

**Module 4 (Week 11-14): Digital Spaces**

A. Moving beyond the Private and Public
B. Social Media
C. Smart Cities
D. Apps and Platforms
E. Bodies as Digital Spaces: Of Surveillance and Identities

**Wrap Up: Week 15.**

**Course Outcomes**

By the end of the course students are expected to Understand and Know:

- Theoretical insights, current discourses and key concepts in Digital Sociology that relate to the study of social events and human actions in a digitized world
- How technology is interpreted and embedded in the wider social context.

Students are expected to DO:

- Problematise use and implications of digital technologies in our everyday lives.
- Critically appraise the context of technology use in different times and places, by diverse groups of people

**Readings**

1. Berger. P. (1963). Sociology as a form of Consciousness in Invitation to Sociology. Anchor

Books/Doubleday & Company, Inc.
2. Castells, M. (2011). The rise of the network society (Vol. 12). John Wiley & Sons.
3. Clark. J. et al. (2014). Participations: Dialogues on the Participatory Promise of Contemporary Culture and Politics. International Journal of Communication 8 (2014), 1446–1473
4. Couldry, N. (2015). The myth of 'us': digital networks, political change and the production of collectivity. Information, Communication & Society, 18(6), 608-626.
5. Daniels. J, Gregory. K, and Cottom. T.M. (Ed.) (2017). Digital Sociologies. Polity Press (Selected Chapters)
6. Gillespie, T. (2010). The politics of 'platforms'. New media & society, 12(3), 347-364.
7. Lupton, D. (2014). Apps as artefacts: Towards a critical perspective on mobile health and medical apps. Societies, 4(4), 606-622.
8. Lupton, D. (2016). Digital companion species and eating data: Implications for theorising digital data–human assemblages. Big Data & Society, 3(1), 2053951715619947.
9. Lupton. D. (2015). Digital Sociology. Routledge (Selected Chapters)
10. Mills. C.W. (1959). The Sociological Imagination. Oxford University Press.
11. Mossberger.K, Tolbert. C.J, and McNeal. R.S. (2008). Digital Citizenship: the Internet, Society, and Participation. MIT Press (Selected Chapters)
12. Orton-Johnson. K and Prior. N. (Ed.)(2013). Digital Sociology: Critical Perspectives. Palgrave Macmillan (Selected Chapters)
13. Wajcman. J and Dodd.N (Ed.) (2017). The Sociology of Speed: Digital, Organizational, and Social Temporalities. Oxford University Press (Selected Chapters)
14. Wilhelm. A.G. (2004). Digital Nation: Toward an Inclusive Information Society. MIT Press (Selected Chapters)

**Assessments (optional for Special Topics courses)**

We will expect students to have read assigned reading material and come to class prepared to discuss this material.

Class attendance will count for 5% of the grades.

One Individual Reading Response (5%): Students will be required to present at 2 sessions of reading responses (out of 15 pre-designated sessions). These will be short responses to questions that test whether students have read assigned material and made an effort to engage with it in preparing for class. Students' participation in 3 of the reading responses (selected by the student) will be graded for 5% each.

Participation in two group activities (2x10%): This will take the form of storyboard-based group assignments conducted at the end of each of the three modules of instruction. Student groups will be presented storyboards ahead of time and asked to present their ideas in class on the designated activity day. These storyboards may include texts as well as audio visual mediums.

Writing (70%): Four Term Papers – After every module students will have to write a 700-800 words essay relating to the topic of the module. The term papers will be graded out of 10, 15, 20 and 25 respectively. Topics for these papers will be discussed in the class well in advance.

| | |
|---|---|
| **Course Name** | **News Media Literacies** |
| **Course Branch** | iMTech elective (6th Semester) |
| **Course Proposer Name(s)** | Preeti Mudliar |
| **Course Instructor Name(s)** | Preeti Mudliar |
| **Course Type** | Elective |
| **Course Level** | Level 1 |
| **Credits (L:T:P)**<br>**(Lecture : Tutorial : Practical)** | Lecture (3)+ Tutorial (1)= 4 credits |
| **Grading Scheme** | A,A-,B+,B,B-,C+,C,D,F |

**Pre-Requisites (where applicable, specify exact course names)**

NA

**Course Description**

The purpose of this course is to introduce students to news media processes and media literacies of news and digital platforms. Over the last few years the proliferation of digital platforms, changes in news distribution and organizational revenue streams, and the rapidly fragmenting discourse of public life have combined to transform the production, circulation, and consumption of news. Not only has the production and distribution of news changed from traditional news gathering and gatekeeping models, but it has also led to concerns about bias and accuracy in news production. This has often compromised people's abilities to verify and discern news from misinformation circulating on digital platforms, sometimes with repercussions of societal violence. These changes around news media have led to serious concerns about the implications and challenges they pose to being an informed citizen of a democracy. This course hence seeks to equip students with a news media sensibility that will allow them to become perceptive, critical, and analytical consumers of news. Through readings and practical assignments, students will be exposed to the intersection of news practices and digital platforms that will help them approach and appreciate news from a more literate and knowledgeable vantage point. The course draws from and acknowledges contributions from a workshop on disinformation and fake news organized by the Digital Asia Hub in Jakarta, Indonesia in August 2018 and the news literacy program at the Centre for News Literacy at the State University of New York (SUNY), Stony Brook.

**Course Outline**

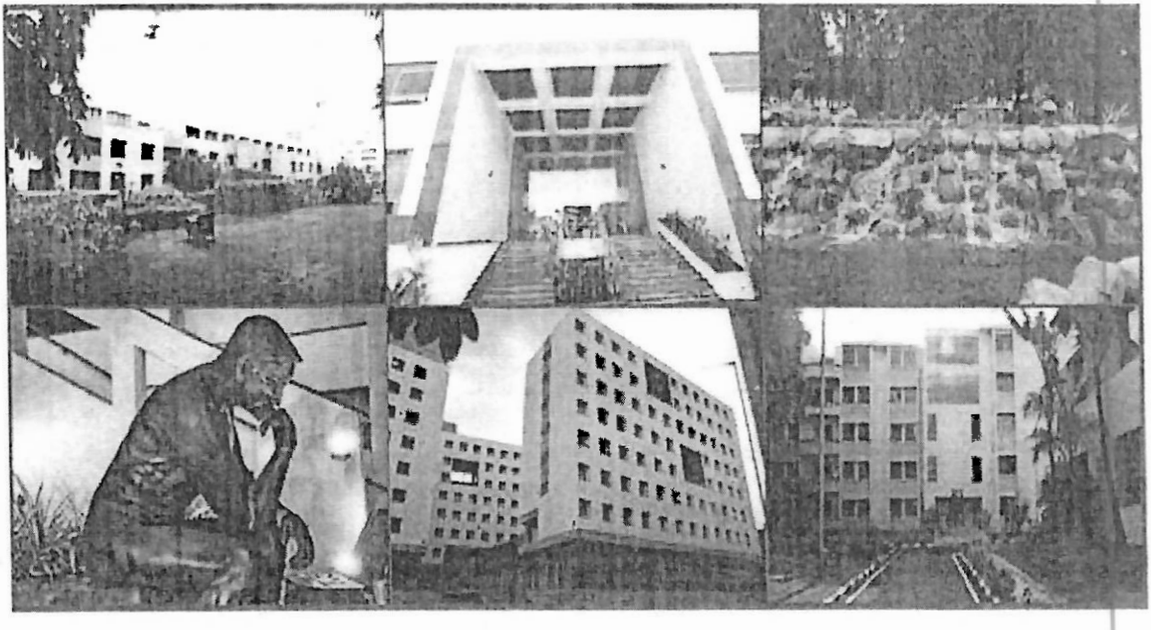
**Week 1 - 2**
**Theme: News media literacies – What is it and how do we respond to it in the digital age?**

- Journalism, democracy, and the informed citizen
- Gutenberg to Zuckerberg - How has news changed?
- Where do we get our news from in the digital age?

INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY BANGALORE

# 71st Meeting of the Senate

## Minutes of the Meeting



**Date: December 04, 2019**
**Time: 2.00 p.m.**
**Venue: R 109**

26/C, Electronics City, Hosur Road, Bangalore 560 100 Phones: 080-28527627-635, 41407777

INTERNATIONAL INSTITUTE
OF INFORMATION TECHNOLOGY BANGALORE
26/C, Electronics City, Hosur Road, Bangalore 560 100
Phones: 080-28527627-635, 41407777; Fax: 080-28527636
Website :www.iiitb.ac.in

Date: December 04, 2019

**Sub: Minutes of 71st Senate meeting of the International Institute of Information technology, Bangalore held on December 04, 2019 at 2.00 pm.**

Dear Sir/Madam,

Please find herewith attached Minutes of the 71st Meeting of the Senate of IIITB held on December 04, 2019 in room R109 of IIIT B at 2.00 PM.

Best Regards

S R Sridhar, Cmde (Retd)
Registrar &
Secretary to the Senate

# Course Proposal Template

| | | | |
|---|---|---|---|
| **Course Name** | Topics in Artificial General Intelligence (AGI) | | |
| **Course Proposer Name(s)** | Srinath Srinivasa | | |
| **Course Instructor Name(s)** | Srinath Srinivasa | | |
| **Credits** | 4 | | |
| **Grading Scheme** (Choose by placing X against appropriate row) | **X** | 4-point scale (A,A-,B+,B,B-,C+,C,D,F) | |
| | | Satisfactory/Unsatisfactory (S / X) | |

**Area of Specialization (if applicable)**
(Choose by placing X against not more than two areas from the list)

| | | | | |
|---|---|---|---|---|
| X | Theory and Systems | | | Networking and Communication |
| X | Data Science | | | Signal Processing and Pattern Recognition |
| | VLSI Design | | | General Elective |

**Pre-Requisites (where applicable, specify exact course names)**

- First level course in Discrete math and logic
- First level course in Graph Theory
- First level course in Probability and Statistics
- First level course in AI/ML

Students wishing to take this course on credit, should have secured at least B+ or higher grade in the pre-requisite courses.
First offering of this course is limited to a class size of 10 students who have taken the course on credit.

**Course Description**
*A brief description of the course*

The field of AI started off with a quest for mechanized general intelligence. But much of present day AI may be termed "narrow" or "weak" AI. They represent models created for specific domains or problems, and require specialised knowledge structures, or training data. In contrast to this, the original goal of AI which is now called Artificial General Intelligence (AGI), is to explore computational models representing intelligence of a general nature. This entails some element of "common sense" ability that can be applied across domains, as well as be useful for acquiring specialised intelligence on the fly.

Given the several false starts and "AI winters," some experts believe that AGI may never be realised, and its quest is somewhat like the quest for perpetual machines, which can never be possible. Nevertheless, the grand quest for understanding general intelligence has resulted in a number of interesting computational models that have variegated and versatile applications.

The proposed course explores some such topics relevant to the overarching goal of AGI.

**Course Outcomes**
*Course Outcomes are statements that describe what students are expected to know, and be able to do at the end of the course. These relate to the skills, knowledge, and behaviors that students acquire in their progress through the course.*

By the end of this course, the students should **know** about various concepts that are central to the idea of general intelligence. They should also know one or more models that have addressed these concepts.

By the end of this course, the students should be able to **do** one or more of the following:

- Represent knowledge based on generalizing on observations
- Solve an open-world problem using strategies rather than algorithms
- Perform inference using qualified truth (modal logics) and/or non-monotonic reasoning
- Build a TMS (Truth Maintenance System) computational entity that can display a sense of agency and autonomy towards maintaining certain characteristics attributed to itself.

**Course Content**

**Mandate - 1: Philosophy of AI and AGI**

- History of AI/AGI
- Interpretations of Intelligence
  - Observability (Turing Test)
  - Consciousness (Chinese room argument)
  - Symbol manipulation (Strong AI)
  - Physical Grounding Hypothesis (Machines vs Societies)
- AGI IQ Tests
  - Turing Test
  - Coffee Test
  - College Student Test
- Commonsense Informatic Situation
- AI/AGI Ethics

Reading materials:

- John McCarthy. The Philosophy of AI and the AI of Philosophy. http://jmc.stanford.edu/articles/aiphil2.html
- Horst, Steven (Fall 2005), "The Computational Theory of Mind", in Zalta, Edward N. (ed.), *The Stanford Encyclopedia of Philosophy*.
- "What is Artificial General Intelligence (AGI)? | 4 Tests For Ensuring Artificial General Intelligence". *Talky Blog*. 13 July 2019.
- Searle, John R. "Minds, brains, and programs." *Behavioral and brain sciences* 3, no. 3 (1980): 417-424.
- Brooks, Rodney (1990), "Elephants Don't Play Chess", *Robotics and Autonomous Systems*, **6** (1–2): 3–15.
- Allen, Colin, Wendell Wallach, and Iva Smit. "Why machine ethics?." *IEEE Intelligent Systems* 21, no. 4 (2006): 12-17.
- Gunkel, David J. *The machine question: Critical perspectives on AI, robots, and ethics*. MIT Press, 2012.

**Mandate - 2: Knowledge Representation**

- Concepts, Types and Instances