INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY BANGALORE

73B Meeting of the Senate

Minutes of the Meeting

Date: April 22, 2020
2.00 p.m.
Venue: through conference call

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

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Date: April 24, 2020

Sub: Minutes of 73B Senate meeting of the International Institute of Information technology, Bangalore held on April 22 at 2.00 pm via conference call.

Dear Sir/Madam,

Please find herewith attached Minutes of the 73B Meeting of the Senate of IIITB held on April 22 at 2.00 pm via conference call.

Best Regards

S R Sridhar, Cmde (Retd)
Registrar &
Secretary to the Senate

Minutes of the 73B Senate meeting

International Institute of Information Technology, Bangalore

April 22, 2020 at 2.00 pm through conference call

Minutes of the 73B Senate Meeting held on April 22, 2020- Members Present:
1. Prof S Sadagopan, Director – Chair
2. Prof S S Prabhu, Member, Educationist of repute
3. Prof Kriti Ramamritham, Educationist of repute
4. Dr Roland Haas, Educationist of repute
5. Mr S Nagarajan, Educationist of repute
6. Prof R Chandrashekar, Dean (Academics)
7. Prof Jyotsna Bapat, Dean (Faculty)
8. Prof Srinath Srinivasa, Dean (R&D)
Professors:
9. Prof S Rajagopalan
10. Prof Debabrata Das
11. Prof Balaji Parthasarathy
12. Prof G N Srinivasa Prasanna
13. Prof T K Srikanth
14. Prof G Srinivasaraghavan
15. Prof Shrisha Rao
16. Prof Subir Kumar Roy
17. Prof V Sridhar
18. Prof V Ramasubramanian
19. Prof Chetan Parikh
20. Prof B Thangaraju
Associate Professors:
21. Prof V N Muralidhara
22. Prof Manisha Kulkarni
23. Prof Neelam Sinha
24. Prof Jaya Sreevalsan Nair
25. Prof Balakrishnan Ashok
26. Prof Subhajit Sen
27. Prof Amit Prakash
28. Prof Tricha Anjali
29. Prof Meenakshi D'Souza
30. Prof Madhav Rao
31. Prof Dinesh Babu Jayagopi
32. Prof Ashish Choudhury
Assistant Professors from the major areas
33. Prof Bidisha Chaudhuri – IT and Society
Non-Teaching Members:
34. Cmde S R Sridhar (Retd) – Registrar and Secretary to the Senate
35. Ms. Cynthia D'Mello – Staff Officer-Deans' office
36. Ms. Ramadevi S – Librarian
37. Mr M K Durai Murugan – Systems Manager
38. Mr DV Jagadish - CEO, Outreach and Innovation Centre
Leave of absence granted to:
39. Prof Manish Gupta

ANNEXURE 1

List of Changes Approved to Integrated M.Tech Curriculum

1. List of Specializations would be as per the following:

S. No.	Specialization Name	Specialization Code
a)	Theory and Systems for Computing and Data	TSCD
b)	Artificial Intelligence and Machine Learning	AIML
c)	Networking and Communication	NC
d)	VLSI Systems	VLSI
e)	Digital Society	DT

2. Branch Electives Rule:
    a. A set of Electives that are deeply embedded in the respective branch are tagged as “Branch Electives”
    b. A minimum of 24 credits needs to be earned through 6 or more course electives (i.e., other than RE/PE) drawn from “Branch Electives”
    c. For CSE branch, all course electives offered under TSCD are designated as "Branch Elective"
    d. For ECE branch, all course electives offered under NC and VLSI are designated as "Branch Elective"
3. Specialization Electives Rule
    a. An elective course can count towards at most one Specialization area. Elective courses that do not count towards any Specialization area is designated as “Open Elective.”
    b. A student can obtain a “Specialization” by earning 20 credits (through 5 or more courses) from electives designated under the respective Specialization, irrespective of the branch to which the student belongs.
    c. Credits counted under Branch Electives shall NOT be double counted towards Specialization Electives.
    d. A student may earn more than one Specialization provided that the requisite credits are earned under the specializations

Curriculum Changes
A. Credit Changes
Existing Curriculum: Programming I is a 4 credit course that includes C and Python as the programming languages taught (L:T:P 2:0:4) **Proposed Curriculum:** Split Programming I into Programming IA covering C language and Programming IB covering Python, of 2 credits each. (L:T:P 1:0:2)

B. Changes to Mathematics and Basic Sciences	
Existing Curriculum: 4 Maths + 2 Physics + 1 Chemistry **Proposed Curriculum:** 3 Maths + 1 Physics + 1 elective from pool of Basic Science & Maths electives. Chemistry not offered. * Updated syllabus / topics given later in the report	
C. Changes to Humanities and Social Sciences	
Existing Curriculum: 4 Compulsory HSS Courses that includes 2 "mandatory electives" from HSS **Proposed Curriculum:** 3 Compulsory HSS Courses that includes 1 "mandatory elective" from HSS. Students may take the HSS elective in any semester starting from 5th semester	
D. Changes to Core Courses	
Existing Curriculum: Microprocessor and Microcontrollers is a 4-credit **core** course for ECE **Proposed Curriculum:** Microprocessor and Microcontrollers would be a 4-credit "**branch elective**" course for ECE	
Existing Curriculum: Programming Languages is a 4-credit **core** course for CSE **Proposed Curriculum:** Programming Languages would be a 4-credit "**branch elective**" course for CSE	
Existing Curriculum: Not applicable **Proposed Curriculum:** New core course titled Mobile Computing	
E. Changes to Course Sequencing	
Digital Design	Moved to 1st semester from 2nd semester
Computer Architecture	Moved to 2nd semester from 3rd semester
Signals and Systems	Moved to 3rd semester from 4th semester
Operating System	Moved to 4th semester from 6th semester
(ECE) Signal Processing	Moved to 4th semester from 5th semester

(CSE) Database Systems	Moved to 4th semester from 5th semester
(ECE) Principles of Communication System	Moved to 4th semester from 5th semester
(ECE) Digital Communication	Moved to 5th Semester from 6th semester
(ECE) Control Systems	Moved to 5th Semester from 7th semester
E. Changes to 9th Semester	
Existing Curriculum: 20 credits project **Proposed Curriculum:** Combination of project credits and elective credits totaling 20 credits. Course credits can count towards Branch Electives and Specialization Electives.	
F. Changes to Project Elective (PE) / Reading Elective (RE)	
Existing Curriculum: Students can take a maximum of **FOUR** PE/RE **Proposed Curriculum:** Students can take a maximum of **SIX** PE/RE	

Full Course Plan for Integrated M.Tech.

Sem	Programming	Systems	Core Engineering	Basic Sciences & Maths	Humanities	Total (Credits)
1st sem	Programming-1A:C (2) Programming IB: Python (2)	Digital Systems (4)		Maths-1 (4)	Economics (4), English (2)	18
2nd sem	Datastructures & Algorithms (6)	Computer Networks (4), Computer Architecture (4)		Maths-2 (4)	Technical Communication (2)	20
3rd sem	Programming-2: C++ + Java (4)		(CSE) Discrete Maths (4) / (ECE) Basic Electronic Circuits (4) Signals and systems (4)	Maths-3 (4), Physics (4)		20
4th sem		Operating systems (4)	(CSE) Design and Analysis of Algorithms (3) / (ECE) Analog Circuits (4), sem(ECE) Signal Processing (3), (ECE) Principles of Communication System (4) / (CSE) Database systems (4)	1-Elective in Basic Science and Maths (4)	History of Ideas (4)	**(CSE) 19 / (ECE) 23**
5th sem			(ECE) Control Systems (3) / (CSE) Introduction to Automata Theory and Computability (3),			**(CSE) 23 / (ECE) 19**

			(ECE) Digital Communication (4) / (CSE) Software Engineering (4) (ECE) Mobile Computing (4) (CSE) Elective (4) Elective (4) Elective (4)			
6th sem	5 Electives					**20**
7th sem	5 Electives					**20**
8th sem	5 Electives					**20**
9th sem	Combination of Project & Electives					**20**
10th sem	Thesis or Internships					**20**
Total 200 Credits						

Integrated M.Tech. (CSE) Credits Mapping to AICTE (first four years)

Heads	Credits	Percentages	AICTE recommendations
Programming	14	7%	16
System	16	8%	62
Core Engineering (CSE)	22	11%	
Branch Elective (CSE)	24	12%	
Basic Science and Maths	20	10%	24
Humanities and Social Sciences	16	8%	12
Other Electives	48	24%	NA

Integrated M.Tech. (ECE) Credits Mapping to AICTE (first four years)

Heads	Credits	Percentages	AICTE recommendations
Programming	14	7%	16
System	16	8%	72
Core Engineering (ECE)	30	15%	
Branch Elective (ECE)	24	12%	
Basic Science and Maths	20	8%	24
Humanities and Social Sciences	16	8%	12
Other Electives	40	20%	NA

Applicability to Existing Students

Integrated M.Tech.
IMTech 2017, 2018, 2019 batches Course sequencing changes **not applicable** New specializations would be available Branch Electives requirement would be applicable 9th semester: Combination of courses and project totaling 20 credits. **IMTech 2016 batch** 9th semester: Combination of courses and project totaling 20 credits.
M.Tech
• **MTech 2020 batch (new batch)** New specializations would be available Branch Electives requirement would be applicable

Updated Syllabus / Topics

	Topics
Maths-1	#1: Real numbers, Sequences, Series, Limit, Continuity, Mean value Theorems, Linear Approximation (10 hours) #2: Power Series, Taylors theorem, Approximation to Polynomials (6 hours) #3: Reimann Integral, Integral Calculus (7 hours) #4: Space Coordinates, Polar coordinates, Cylinders, Quadric surfaces, volume, area, length, Continuity, Differentiability, Partial derivatives (9 hours) #5: Double, Triple integrals, and Jacobians (3 hours) #6: Introduction to first order Differential Equations (7 hours)
Maths-2	#1: Matrices, and various Matrix Operations (8 hours) #2: Vector Spaces, and its related concepts (11 hours) #3: Properties of Eigen values, and eigen vectors (10 hours) #4: Complex Analysis (10 hours) #5: Introduction to 2nd order differential equations (3 hours)
Maths-3	Probability and Statistics
Physics	#1: Integral theorems: Gauss divergence theorem, Greens theorem, Stokes theorem, and related topics. #2: Simple harmonic motion and wave motion #3: Electromagnetics #4: Part of Quantum Mechanics: Schroedinger equation, harmonic oscillator, & basic quantum gates. #5: Euler-Lagrange equation; principle of least action, generalized coordinates & generalized momenta, writing the Lagrangian of a system.

Integrated M.Tech. Course Proposal Template

Course Name	Mobile Computing
Course Branch	Select one from the following: (Place X appropriately) X – ECE CSE
Course Proposer Name(s)	Prof. Debabrata Das
Course Instructor Name(s)	Prof. Debabrata Das and Prof. Jyotsna Bapat
Course Type *(Select one)*	Select one from the following: (Place X appropriately) X – Core Elective Special Topics Elective* ** 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) Level 1 Elective Level 2 Elective
Course Category *(Select one)*	Select one from the following: (Place X appropriately) Basic Sciences X – Branch Core (CSE / ECE): ECE Elective Engineering Science and Skills HSS/M Miscellaneous
Credits (L:T:P) **(Lecture : Tutorial : Practical)**	(Place X appropriately) 3 – Lecture (1hr = 1 credit) 0 – Tutorial (1hr = 1 credit) 2 – Practical (2hrs = 1 credit) **Total Credits: 4**
Grading Scheme	Select one from the following: (Place X appropriately) X – 4-point scale (A,A-,B+,B,B-,C+,C,D,F) Satisfactory/Unsatisfactory (S / X)
Pre-Requisites *(where applicable, specify exact course names)*	
It is a core course. Without pre-requisite it can be delivered.	
Course Description *A brief description of the course*	

Template Version Number	1.4
Template update date	30 May 2017

With the improvements in wireless technology over the last decade, mobile devices are finding a place in our day-to-day lives in ways beyond imagination. Initially designed to support voice and data, but with the advent of social, economic and immersive use cases, the expectation for coverage and capacity in cellular network has increased many folds. In addition to above expectations, the IoT and personal-computational devices are becoming more pervasive as well as complex. The applications requirements over communication network are rapidly more demanding (with respect to QoS and reliability, etc.). Moreover, the network over which the data traverses are becoming more heterogeneous (devices crosses through different versions of cellular networks (3G-4G-5G and futuristic 6G) and WiFi). These above requirements lead to complicated systems of convergence, which are challenging to study and build. Due to huge demand from customers/users, many companies are working to solve problems related to it.

One way to solve above complex problems this course will focus on concepts of existing architectures (topology + protocols) till 4G cellular network and find out technologies envisioned for better mobility as well as QoS for 5G networks. Furthermore, this course will cover important aspects which makes our complicated applications to work by signaling, secured authentication, hand off, and multimedia-data transportation architecture for heterogeneous networks for convergence.

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. The student have understanding of Radio Access Network (RAN) and Core Network (CN) architecture of Cellular network version 2G, 2.5G, 3G, 4G, 5G.
2. Control Signaling in Cellular network.
3. Voice and Data Path as well as protocol stack under standing in above Cellular networks.
4. Secured authentication of users equipment (Mobile) and IoT devices
5. Mobility hand off
6. 5G's Ultra Reliable and low Latency (URLLC), Massive IoT (mIoT) and Enhanced Mobile Broadband (eMBB) control and data channel protocols.

Course Content

The Mobile Computing curriculum will majorly focus on 4G and 5G Cellular Radio Access Network (RANs), Core Network (CN) elements, protocol stacks, signaling, authentication and mobility. To understand above, one need fundamental understanding of 2G, 2.5G, 3G architectures and basic signaling (SS7, SIP).

1. Introduction to Mobile computing (1Hr and 30 mins.)

- What is Mobile computing? What are the challenges faced as an wireless network and mobility over homogeneous as well as heterogeneous networks? What are the fundamental things this course will cover and why?

- Migration of Cellular Network from Circuit Switched to Packet Switched

2. Introduction to GSM Architecture (3-Hrs)

- GSM Architecture: BSC, MSC, HLR. VLR, AUC, EIR

- Hand off in 2G network

- Fundamental functionalities of GSM network Frame Structure of GSM : a) Multi Frame b) Super Frame c) Hyper Frame (d) Burst Structure

- Logical channels
  TCH/C, TCH/H, BCCH, FCCH, SCH, PCH, RACH, AGCH, SDCCH
  FACCH/F, FACCH/H, SACCH
- Location of Mobile
- Base Station and SIM
- Paging Procedures
- Registration Types and Security

3. Signaling Concepts (3 Hours)
   - Signaling System 7 (SS7) architecture and functions

   - 2G Signaling

4. Synchronization of User equipment and Cellular network (3 Hours)
   - how to detect there is a cell, followed by cell search,

   - Cell and PLMN camping (Use case level - Signal Bar, Operator name on screen, followed by Data Icon on-screen)

5. Voice and Data Architectures on Cellular Network (12 Hours)
   - GPRS (2.5G) architecture and protocol stacks understanding from circuit switching to packet switching between cellular network and Internet;

   - Major elements of GPRS architecture
- Radio Requirements of GPRS
- GPRS Reference points and signaling Layers
- Access Point Name, Interconnection to other GPRS networks of other operators and roaming, Managing, the private Dynamic IP addresses for mobiles and NAT

   - 3G Architecture and protocols

- 4G network architecture and protocol stacks, understanding of complete packet switching in cellular network

- 4G Evolved packet core (EPC) elements functions

- 4G communication frame structure (RACH for registration and followed by Data flow)

6. Signaling in 4G network - SIP functionalities. (6 hours)
   - SIP entities (Forking proxies, redirect servers)
   - Message format
   - The SIP request and response – (assignment can be given on Tracing Call Flows, using Ethereal and Seagull)

- Extending SIP -CPL and CCXML

- SIP State Call control machine (can be given assignments too)
- SDP
- BICC (ISUP) state machine and call control explanation
- Media Control:
  - SIP and H.323
  - H324M
- 4G all the Uplink and Downlink control channels and its functions

7. 5G network (6 hours and 30mins)
- 5G network RAN and CN architecture
- Next Generation Core (NGC) elements and its function
- Enhanced Mobile Broad Band (eMBB) protocols
- Massive IoT (mIoT) requirements and protocols
- Ultra Reliable and Low Latency Communication (URLLC) Protocols

8. Macro and Micro Mobility. (4 Hrs and 30 mins)
- Handoff functions in 5G network for Macro Mobility
- Handoff techniques for micro-mobility in 5G

9. Security used in 5G networks (3 hours)
-Steps of Security used for UE/IoT device to register in 5G

Assessments / Grading: Weightage Given below

1. Midterm Exam = 30%
2. Final Exam = 40%
3. Class Test = 10%
4. Assignments/Project = 20%

Text Book / References

1. The GSM Evolution – Mobile Packet Data Services, Peter Stuckmann, Wiley.
2. From GSM to LTE-Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband, By Martin Sauter, 3rd Edition, Wiley Publication;
3. 3GPP standard Releases 8 to 16 (This will Cover 4G)
4. GSM, GPRS and 3G Technical Standards from ITU
5. 3GPP 5G standard (Evolving till date)

List of Electives

Updated on: May 1, 2020

S. No	Elective name	Specialization
1.	Advanced Visual Recognition	AIML
2.	Artificial General Intelligence	AIML
3.	Artificial Intelligence	AIML
4.	Automatic Speech Recognition	AIML
5.	Deep learning for Automatic Speech Recognition	AIML
6.	Digital Image Processing	AIML
7.	Geographical Information Systems	AIML
8.	Machine Learning	AIML
9.	Maths for ML	AIML
10.	Multi-agent systems	AIML
11.	Natural Language Processing	AIML
12.	Network Science for the web	AIML
13.	Neural Networks and Reinforcement Learning	AIML
14.	Optimization, Learning and Cognition-2	AIML
15.	Optimization, learning, and Cognition	AIML
16.	Probabilistic Graphical Models	AIML
17.	Robotics	AIML
18.	Visual recognition	AIML
19.	Advanced Qualitative Research Methods	DT
20.	Cyberspace, Globalization, and Location	DT
21.	Digital Platforms: Technology and Business Components	DT
22.	Digital Sociology	DT
23.	Dynamics of the Information Technology Industry	DT
24.	E-Governance Application Design	DT
25.	Human Computer Interaction	DT
26.	Information and Communication Technology Policy and Regulation	DT
27.	Privacy in the Digital Age	DT
28.	Social Complexity and Systems Thinking	DT
29.	Social Media Communication	DT
30.	Techno-economics of networks	DT
31.	Technology and Development	DT
32.	Technology and Society	DT
33.	The City	DT
34.	The Web and the Mind	DT
35.	Advanced Computer Networks	NC
36.	Advanced Cyber Security	NC
37.	Cyber security – Fundamentals and Techniques	NC
38.	Internet of Things	NC
39.	Mathematical Analysis of Networks	NC
40.	Network Security	NC
41.	Networking and Communication	NC
42.	Software Defined Network and Network Function Virtualization	NC

S. No	Elective name	Specialization
43.	Wireless Access Networks	NC
44.	Wireless Communication	NC
45.	Simulation and Modeling of Data using High Performance Computing	GEN
46.	Nonlinear dynamics / Dynamical systems theory	GEN
47.	Advanced Algorithms	TSCD
48.	Advanced Computer Graphics	TSCD
49.	Advanced Data Visualization	TSCD
50.	Algorithms	TSCD
51.	Approximation Algorithms	TSCD
52.	Computational Geometry	TSCD
53.	Computer Graphics	TSCD
54.	Computing on Private Data	TSCD
	Cryptographic Engineering	TSCD
56.	Data Modeling	TSCD
57.	Data Visualization	TSCD
58.	Design Patterns and Enterprise system development	TSCD
59.	Discrete Mathematics and Computability	TSCD
60.	Foundations of Cryptography	TSCD
61.	Graph Theory	TSCD
62.	OOAD UML and Intro to Web 2.0	TSCD
63.	Privacy-Preserving Machine Learning	TSCD
64.	Program Analysis for Software Engineering	TSCD
65.	Programming Languages	TSCD
66.	Software production engineering	TSCD
67.	Software Systems & systems software	TSCD
68.	Software systems / Software Engineering	TSCD
69.	Software Testing	TSCD
70.	Topological Data analysis	TSCD
71.	Advanced Analog Design	VLSI
72.	Advanced ARM architectures	VLSI
73.	Analog Circuits and Systems	VLSI
74.	Analog CMOS VLSI Design	VLSI
75.	ASIC design	VLSI
76.	Device Driver Development	VLSI
77.	Digital CMOS VLSI Design	VLSI
78.	Functional Verification of SOCs	VLSI
79.	High level synthesis and optimization of Digital Circuits	VLSI
80.	Microprocessor and microcontrollers	VLSI
81.	Processor Architecture	VLSI
82.	RTOS	VLSI
83.	System design with FPGA	VLSI
84.	Testing and Design for Testability	VLSI
85.	Virtual machines	VLSI
86.	VLSI Subsystem	VLSI

ANNEXURE 2

Modifications proposed to the MSc (Digital Society) curriculum structure (18-April-2020)

The MSc (Digital Society) curriculum was modified in June 2018 based on recommendations of the MSc (Digital Society) Program Review Committee 2017. In the modified curriculum, a 4-credit core course on Research Methods was introduced to replace the earlier courses on Quantitative Methods and Qualitative Methods. This was done to accommodate the reduction in overall programme credits from 76 to 66. Based on the experience of offering the Research Methods course to the 2018 and 2019 batches, it is now felt that the reduction in credits for an important core course on methods has not been received well by both the students and the instructors. Both the groups have expressed the need to devote more time to the various topics on qualitative and qualitative methods that gets covered in the Research Methods course, so as to better prepare them for the specialization electives in the subsequent semesters. This aspect was discussed in two meetings among a few MSc (Digital Society) instructors (copied here) during March and April 2020.

It is now recommended that the 4-credit Research Methods course give way to two 4-credit core courses to focus on qualitative methods and quantitative methods respectively. The course proposals for these new core courses to be introduce in the MSc (Digital Society) curriculum is attached.

To incorporate the change, the following modifications will have to be made to the course sequencing and distribution of core/elective courses:

1. The modified list/sequence of courses will be as follows:

Program Orientation (2 weeks, 2 courses, 0 credits)
Programming Foundations (Satisfactory/Unsatisfactory) Social Science Foundations (Satisfactory/Unsatisfactory)
Term 1 (15 weeks, 18 credits, 5 core courses)
Digital Components of a Connected Society (4) Application Development for a Connected Society [1](2) Qualitative Research Methods (4) Quantitative Data Analysis for Public Policy (4) Technology and Society (4)
Term 2 (15 weeks, 16 credits, 4 core courses)
Technology in Development (4) ICT Policy and Regulation (4) Social Complexity and Systems Thinking (4) Human Computer Interaction (4)

[1] *Those with prior experience in building systems may choose to take the Enterprise Software Development course in lieu of this course.*

Term 3 (15 weeks, 16 credits, 4 electives)
Electives I, II, III, IV (4x4)
Term 4 (26 weeks, 16 credits)
Thesis/Internship (16)
Total Credits 66

This table will replace the existing Table 1 on page 4 of the Curriculum Structure document.

2. The credit distribution between the different components of the programme will be modified as follows:

	Proposed Credits	**%**
Core courses	34	51.5
Elective course credits	16	24.2
Internship/Thesis credits	16	24.2
Total credits requirement for M.Sc. (Digital Society)	**66**	**100**

This table will replace the existing Table2 on page 4 of the Curriculum Structure document.

Course Name	**Quantitative Data Analysis for Public Policy (QDAPP)**
Term	Term I (Aug-Dec)
Instructor(s)	V. Sridhar & Amit Prakash
Course credits	4
Pre-requisite(s)	None
Semester	MScDT – I Semester (Core); MTech – III Semester (Elective); IMTech – VII/IX Semester (Elective)

Course overview and objectives

As data from various facets of life ranging from individuals, communities, societies, industry and government become ubiquitous and available, careful analysis of such data Is becoming relevant. At the same time, regulators and policy makers are also using data from various sources to make informed decisions on important regulatory and policy issues. It is in this context that this course lays the foundation of data analysis for public policy. The course covers various techniques and methodologies in data life cycle including capturing and collecting data, transforming data for public consumption, and analyzing data. Further the course will also involve tools and methodologies on using data for public policy decisions in the area of Information and Communication Technologies.

Course calendar

Week	Topics
1-2	**Probability and Statistics** Probability theory overview - Probability law— Interpretation of probability, Axioms of probability, Conditional probability, Prior/Posterior probability Descriptive analysis – Units of analysis and variables, Level of measurement, Frequency distribution and graphical representation, Central tendency, Dispersion, Distributional shape Distribution theory – Discrete and Continuous random variables, Binomial distribution, Normal distribution

3-4	**Sampling and Surveys** Inference and Errors in Surveys: Constructs, measurement, response, observational gap, measurement error, processing error, sampling error etc. Target Population and Sampling Frames: Coverage properties of sampling frames, common target populations and their frame issues, coverage error Sample Design and Sampling Error: Simple random sampling, cluster sampling, stratified sampling Questions and Answers in Surveys: Cognitive processes in answering questions, problems associated with encoding, misinterpretation, judgement etc. in answering questions, guidelines for writing good questions
5-7	**Inferential Statistics and Measures of Association** Point estimation, Confidence intervals/levels, Hypothesis testing, One-sample/Two-sample tests: z-test, Student's T-test Cross-Tabulation and Chi-squared test, Correlation analysis Comparison of Means of control and treatment groups, within group and across group means, testing for means, one and two-way ANOVA tests, taxonomy of ANOVAs: ANCOVA, MANOVA, MANCOVA, Omnibus and post-hoc tests, Bonferroni adjustments in post-hoc tests
8	**Design of Experiments** Need for experiment design, comparison of experiments and sampling, taxonomy of Design of Experiments (DoE), Full and Fractional Factorial Design, Randomized Control Tests (RCTs), Types of RCT designs., Randomized Block Design. Matched Pair Design
9	**Introduction to Public Data Sets and Policy Dimensions** NSSO, NFHS datasets on employment, household expenditure, healthcare etc. and research reports and policy briefs based on these datasets
10	**Data Transformation for Public Use** Anonymization of data, pseudonymization, de-anonymization, k-anonymity, t-closeness, differential privacy Data visualization basics and techniques

11-14	**Data Analysis: Linear Regression** Simple linear regression using OLS, parameter estimation, parameter confidence intervals and hypothesis testing, test for model fit, dummy variable regression for categorical variables, Type I and Type II errors and implications Logistic Binomial Regression, relation to classification, odd's ratio, interpretation of estimators **Regression diagnostics**: Multicollinearity: Variance Inflation Factor test, Heteroscedasticity: Breusch Pagan and White'sTest; tests and corrections for the same; **Panel data regression**, Pooled OLS, Fixed Effect and Random Effect models, test for model fit, Hausman Test for FEM vs. REM **Time series regression,** tests for stationarity: Unit Root Test, test for auto and serial correlation: Durbin Watson test, Auto Regressive Integrated Moving Average (ARIMA) models, estimation of p and q using Auto Correlation and Partial Auto Correlation Functions
15	**Advanced Topics** Dual causality and Simultaneous Equation Models SEM), 2 and 3 stage least square estimation techniques for SEM Log-Log and Log-Lin regression models and estimator interpretations
16	**Group Project Presentations**

Data sources to be analyzed during the course

Public data sets available from CRAN libraries, World Development Indicators (WDI); World Integrated Trade Solution Data (WITS); National Sample Survey Office, India; Central Statistical Office, India; Bureau of Labour Statistics (U.S.); International Labour Organization; Federal Communications Commission, U.S.; MySpeed and MyCall data from Telecom Regulatory Authority of India; Uber Movement Database; Facebook Open Data; Dvara Research household finance data

Grading

To help anchor the concepts more firmly, student groups will be assigned a semester long project that involves collection of data, anonymizing the data, building statistical and simulation models using the data and create data based public policy briefs. The groups will put all these together in the form of a consultant report to be presented. For data analysis

there will be periodic assignments dealing with various data sets and involve model specification and implementation using R or Python.

The different components of the grading are described below:

Component	Marks
Quizzes/ Assignments	**20%**
Group Project:	
Stage 1 – Data presentation	5%
Stage 2 – Data analysis	5%
Final Poster Presentation	10%
Project Total	**20%**
Mid Term Exam	**30%**
End Term Exam	**30%**
Total	***100%***

Text books and references

- Amemiya, T. (1994). Introduction to statistics and econometrics. Harvard University Press.
- Fung, B. C., Wang, K., Fu, A. W. C., & Philip, S. Y. (2010). Introduction to privacy-preserving data publishing: Concepts and techniques. Chapman and Hall/CRC.
- Groves, R. M., Fowler Jr, F. J., Couper, M. P., Lepkowski, J. M., Singer, E., & Tourangeau, R. (2011). Survey methodology. John Wiley & Sons.
- Gujarati, D. N. (2009). Basic econometrics. Tata McGraw-Hill Education.
- Hanneman, R. A., Kposowa, A. J., and Riddle, M. D. (2013), Basic statistics for social research. John Wiley & Sons, San Francisco.
- James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). *An introduction to statistical learning* (Vol. 112, p. 18). New York: Springer.
- Levin R., and Rubin, D. (1998). Statistics for management (7th Edition), Pearson.

Course Name	Qualitative Research Methods
Course Branch	M.Sc. (Digital Society)/ IMTech/ MTech
Course Proposer Name(s)	Preeti Mudliar
Course Instructor Name(s)	Preeti Mudliar
Course Type	Core (for MScDT)
Course Level	Level 2
Credits (L:T:P) **(Lecture : Tutorial : Practical)**	4
Grading Scheme	A,A-,B+,B,B-,C+,C,D,F

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

None

Course Description

This course will 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 observations and interview techniques the students will be trained in analyzing and presenting the different forms of data collected through these methods.

Course Outcomes

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

The student is expected to UNDERSTAND:

- the purpose of qualitative methods and their relevance to a research question
- the ethical concerns in the conduct of research
- different data collection methods
- qualitative data analysis methods

The student is expected to DO:
Design, implement and write a qualitative research project

Course Content

- Theme 1 – Method Matters
    - Why do methods matter?

- Constructing knowledge –
    - Science and Social Science
    - Historical perspectives
- Qualitative methods – What? Why? When? When not?
- Research Concepts – I
    - Measurements, Conceptualisation, Operationalisation, Variables
- Research Concepts – II
    - Asking Questions
    - Introduction to Literature Review

- Theme 2: Doing Things
    - Research Ethics
    - Ethical issues in digital research
    - Designing a Research Plan
    - Sampling
- Theme 3: Tools of the Trade
    - Field Observations
    - Field Notes
    - Interviews
    - Diary studies
    - Ethnography
    - Autoethnography
    - Fieldwork for the Digital (Internet based research)
    - Remote fieldwork (e.g. online interviews, user studies)
- Theme 4: Reflexivity: Identities and Positionalities
    - Situating yourself on the Field
    - Researchers and their Gaze
- Theme 5: Making Sense: Data Analysis and Writing
    - Transcribing data
    - Coding and analysis
    - Writing

Grading Scheme
• Literature review and research design: 20% • Offline interview and observation exercise: 20% • Online Interview and user interaction exercise: 20% • Final paper: 40%