Minutes of the 32nd Senate meeting of IIIT-D held on 30th March, 2016 at 03.30PM in the Senate Room, B-wing, R&D Building, Okhla Industrial Estate, Phase-III, New Delhi-110020

Following members were present:

- Prof. Pankaj Jalote - Chairman
- Dr. Kaushik Saha - External Member
- Prof. Dheeraj Sanghi - Ex-Officio Internal Member
- Prof. G.S. Visweswaran - Ex-Officio Internal Member
- Dr. Vinayak Nayak - Ex-Officio Internal Member
- Dr. Anubha Gupta - Ex-Officio Internal Member
- Dr. Angshul Majumdar - Internal Member
- Mohd. S. Hashmi - Internal Member
- Dr. Sujay Deb - Internal Member
- Mr. Ashwani Kumar Kansal - Secretary
- Ms. Shreya Singh - UG Students' Representative

Special Invitees:

- Dr. Pushpendra Singh - Faculty-IIITD
- Prof. Anand Srivastava - Faculty-IIITD
- Dr. Anuradha Sharma - Faculty-IITD
- Dr. Rajiv Raman - Faculty-IIITD
- Prof. Samaresh Chatterji - Faculty-IIITD
- Dr. Puneet Goyal - Faculty-IIITD
- Mr. K.P. Singh - Incharge, Academic
- Ms.Sheetu Ahuja - AM -Academics
- Mr. Ashutosh Brahma - JM (Academic)
- Ms. Anshu Dureja - JM (Academic)
- Ms. Priti Patel - JM (Academic)

THITYY SECOND (32nd) MEETING OF SENATE OF IIIT-DELHI
(held on 30th March, 2016)

MINUTES OF THE MEETING

General

32.1 Opening remarks of the Chairman.

The Chairman welcomed all to the meeting. Thereafter, agenda items were taken up for discussions.

32.2 Confirmation of minutes of the 31st meeting of the Senate held on 1.12..2015

Since there were no comments, the minutes of the 31st meeting of the Senate held on 1.12.2015 were confirmed.

32.3 To consider End of Semester Summary Report (Monsoon 2015)

Chairman, Senate apprised the members of the various activities of academics undertaken during previous semester as detailed in the semester summary report (Monsoon 2015) placed at Appendix-I. The Senate noted the same with satisfaction with the following observations :

i) Parents of the students found deficient in academic and attendance should be informed immediately after the mid-semester examination.
ii) With this data we should be able to track the past records of students' performance in future years
iii) Measures should be taken to check the lowering performance of the students in consultation with the counsellor subject to maintaining confidentiality rules.
iv) For M.Tech. students the faculty should be requested to provide the grade after mid-sem examination in order to keep a watch on the weak students. A meeting with M.Tech. Coordinator should be arranged to know the reasons / difficulties being faced by them.
v) Take measures to support the weak students as well as encourage the excelling students

32.4 Approval of Academic Calendar for Summer Semester 2016

The Senate approved the Academic Calendar for Summer Semester 2016 placed at Appendix-II

32.5 Approval from AICTE

Registrar apprised the members of the present status regarding submission of application for extension of existing programs as well as for new programs for the Academic year 2016-17. The details of existing programs as well as new programs are as under:

Already Approved Programs	**Approved Strength**	**New Programs**	**Approved Strength**
BTech(IT)	100	BTech(ECE)	60
MTech(CSE)	25	MTech(VLSI)	24
MTech(ECE)	24	MTech(Bio Informatics)	24
MTech(IT)	25		
MTech(Mobile Tech)	24		

The Senate noted the above position.

32.6 Approval from NBA for Accreditation of PG programs

Registrar informed that we applied for Accreditation of MTech(CSE) and MTech(ECE) programs and the application has been found in order. We have been asked to deposit the fees and the matter is under process.

UG ISSUES

32.7 Bonus Marks for BTech Admissions in 2016

Chairman, Senate apprised the members of the background of the proposal for giving bonus marks to the candidates applying for BTech admission 2016. The Senate appreciated the basic principle of making admission criteria more broad based and giving weight to other achievements. After detailed deliberations the Senate agreed to the proposal to add/include some more areas of achievements as per details placed at Appendix-III. It agreed that Chairman Senate, DOAA, and Registrar will revise some of the criteria to make it more precise and then recommend them to the Board of Governors for approval.

32.8 To consider increase in intake of B. Tech. programs

Chairman, Senate apprised the members of the proposal to fix/increase the intake of B.Tech. programs for Academic year 2016-17 as under:

Program	Existing 2015-16	Increased intake 2016-17
CSE	110	110
ECE	70	80
CS & Applied Mathematics	-	60
DASA	12	25
KM	1	1
	193	276

The Senate noted that from next academic year there will be two sections of classes for some of the courses starting at 8.00 a.m.

Internal distribution of seats among SC/ST/OBC/GEN will be as per percentage of reservations already approved by the Board. The reservation for CW (5%) and PH (3%) will be made out of the seats available for various categories mentioned above.

After detailed deliberations the Senate agreed to the above proposal and recommended the same to the Board of Governors for approval.

32.9 To consider a proposal to start a new B.Tech. (CS+Maths) program

Chairman, Senate introduced the proposal (Appendix-IV) for starting a new B.Tech. program (Computer Science & Applied Maths). Thereafter, Dr. Rajiv Raman who coordinated in formulating the program presented the salient features of the new B.Tech. program. During discussions he also answered some of the queries made by the members. After detailed deliberations the Senate agreed to the proposal for starting a new **B.Tech. program in Computer Science and Applied Mathematics**, with an intake of 60. The Senate also authorized the Chairman, Senate to frame/approve regulation for this new program on similar lines as that of existing B.Tech. CSE and report to the next meeting of the Senate for ratification.

32.10 To consider recommendation of the UGC to allow a BTech student to do "extra credits".

Chairman, Senate apprised the members of the earlier decision of the Senate taken at its 31st meeting held on 1.12.2015 to allow a BTech student to do "extra credits" beyond 152 credits required for completion of B.Tech. requirement, and for N extra credits done, allow worst grades in N credits, with a maximum limit of 8 credits, to be not counted towards CGPA computation. Thereafter, Dr. Anubha Gupta, Chairperson, UGC explained the methods recommended by UGC for calculating the CGPA. After detailed deliberations the Senate agreed to the following recommendation of the UGC made at its 5th meeting held on 30th December,2015 for calculating the CGPA:

Method: (Automatically decide which extra credits to be not counted in CGPA)

- For CGPA computation at the end of 6th semester, baseline credits will be 116 (equal to 29 full courses including OC). If a student has done N credits more than 116, then for CGPA computation the following will be done:

- The worst grades in courses totaling M credits will be "removed", where M= min{8, N}.

- CGPA will be computed based on the remaining credits. It is to be noted that since OC's are with S/X Grades, although they will be included in baseline 116 credits, they will not be counted in CGPA. e.g. If a student has done 120 credits including OC of 4 credits, CGPA will be computed from best grades corresponding to 112 credits.

- For CGPA computation at the end of 7th semester, baseline credits will be 136.

General Rules:

- SGPA computation will remain the same for each semester.

- CGPA computation will remain the same for first 5 semesters, even if a student has done "extra credits."

32.11 To report discontinuation of streams in UG programs

Chairman, Senate informed that as per decision taken by the Senate at its 31st meeting held on 1.12.2015 the streams in UG programs have been discontinued. Accordingly, the streams will not be shown in the Transcript although guidance on streams will be available on the website for information of the students. The Senate noted the same for information.

32.12 To consider recommendation of the UGC to allow the UG students to repeat (Improvement) of a particular course

Chairman, Senate apprised the members of the following recommendation of the UGC taken at its 6th meeting held on 20.1.2016:

> "Chair UGC presented the issue raised by Student Senate regarding repeat of a course completed with pass grade. After detailed discussion, UGC recommended that improvement in a particular course may be allowed, but only the latest Grades (may be lower) in that course will be considered for CGPA computation. Also all attempts in that course will be recorded in the respective semester transcripts. This matter needs approval at the Senate level."

After detailed deliberations the Senate agreed to the recommendation of allowing the repeat of a course, but agreed that the best grade be counted for CGPA computation. The Senate, however, made it clear that a repeat course will not be permitted to be dropped after mid-semester examination.

32.13 **To consider regulations regarding Engineering Science courses**

Chairman, Senate apprised the members of the observation made by the UGC at its 6th meeting held on 20.1.2016 seeking clarification with regard to Engineering Science courses. It was noted that the UG curriculum as approved by Senate has one course slot for Engineering Science course for CSE students in the two semesters in their 2nd year. However, UG Regulations do not state requirement for the same.

The following was agreed:
For these slots, a CSE student must do (i) TOC or a Maths course of 200 level or above (e.g. Math III or Math IV), and (ii) must do a CB or ECE course at 200 level or above. CSE regulations may be amended suitably for this, and it should apply starting from the 2015 batch also.

PG ISSUES

32.14 To report the status of Regular and Rolling PhD Admissions

The Senate noted following Ph.D. admissions:

Students selected through Rolling Admissions			
S.No	Name	Discipline	Date of joining
1	Vijay Gahlawat	ECE	09.10.2015
2	Payal Garg	ECE	01.01.2016
3	Vanika Singhal	ECE	04.01.2016

4	Siddhant Jain	CSE	11.01.2016
5	Naina Gupta	CSE	05.01.2016
6	Nalla Ananda kumar	CSE	04.01.2016

Students selected through Direct Admissions			
1	Prawendra Kumar	ECE	01.01.2016
2	Niharika Agrawal	ECE	01.01.2016
3	Vipin Kumar	ECE	01.01.2016
4	Ravneet Kaur Chawla	ECE	01.01.2016
5	Divya Sachdeva	CSE	01.01.2016
6	Srikanth Baride	CSE	01.01.2016
7	Anupriya Tuli	CSE	01.01.2016
8	Pravin Nagar	CSE	04.01.2016

32.15 To consider a proposal to start Ph.D. in Mathematics

Chairman, Senate introduced the proposal to start Ph.D. program in Mathematics from the Academic Year 2016-17. He informed that regulation for this program will remain the same as for Ph.D. program in general. The eligibility criteria will be same as for Ph.D. in CSE/ECE disciplines with one additional requirement as follow:

> "Essential qualification (for Mathematics students)- JRF from either UGC or CSIR or NBHM or GATE qualified."

For special requirements, if any, the details will be worked by the PGC in consultation with the concerned faculty/area experts. Dr. Anuradha Sharma (IITD) who attended the meeting as a special invitee answered the queries made by some of the members. After detailed deliberations the Senate approved the proposal for Ph.D. program in Mathematics. The faculty members of Mathematics will determine the areas in which PhD students are to be selected in each year.

32.16 To ratify the approval given by the Director ,Chairman, Senate

The Senate ratified the approval given by Chairman, Senate for adding the following provision in the 2015 regulation of M.Tech. (CB):

"**In electives, at most 4 credits of "Independent Study/Project" can be taken**".

32.17 Recommendation / Report by PGC:

The Senate approved the following clarification made by the PGC at its 12th meeting held on 13.1.2016 with regard to replacement of courses:

"Arising out of discussions the PGC with respect to its earlier recommendation (7th meeting held on 1.4.2015 vide item No.5) clarified that replacement up to two courses by PG student (M.Tech. and Ph.D.) will be allowed after publication of result provided it does not result in underload."

32.18 To consider a proposal to start PG program in Telecommunications Technology and Management by IIIT-D, IIML, and ALTTC

Chairman, Senate informed that Prof Anand Srivastava is coordinating the proposal to start a PG program in Telecommunications Technology and Management to be jointly run by IIIT-D, IIML, and ALTTC. The proposal is currently under discussions with the concerned institutions and a detailed proposal will be placed before the Senate for further deliberations in the due course.

32.19 To consider a proposal on PhD Supervisor change

Dean of Academic Affairs presented Guidelines for change of Ph.D. He also answered/clarified some of the points raised by the members. A few minor suggestions emerged during the discussions. It was agreed that, the guidelines along with suggested changes will be finalized by DOAA, PGC Chair, and the Director. The final guidelines are given in Appendix V.

The meeting ended with a vote of thanks to the Chair.

Appendix I

SEMESTER SUMMARY REPORT – MONSOON 2015

1. Summary of Courses Offered & Registrations

3 Days modules conducted

Batch	Specialization	Module	Performance will count towards	Faculty Coordinator	Date	Enrollments
BTech 2014	ECE	MATLAB	S&S	Dr Sanjit Kaul	27 July - 29 July	58
	CSE & ECE	Java	for CSE- AP, for ECE - ELD	Dr Chetan Arora	30 July - 1 Aug	147
BTech 2013	ECE	EDA Tools	Some Course in Monsoon 2015	Dr Sanjit Kaul	27 July - 29 July	23
		Java		Dr Chetan Arora	30 July - 1 Aug	3
	CSE	SE Workshop	SE (Course is compulsory for students planning to register for SE course in Monsoon 2015)	Mr Manish Sharotiya	29 July - 1 Aug	38
BTech 2012	ECE	Java	Some Course in Monsoon 2015	Dr Chetan Arora	30 July - 1 Aug	NIL
	CSE	SE Workshop	SE (Course is compulsory for students planning to register for SE course in Monsoon 2015)	Mr Manish Sharotiya	29 July - 1 Aug	NIL

Courses Offered

Total No. of Courses offered	68
No. of Core Courses Offered	12
No. of Elective Courses Offered	56
No. of New Courses Added	12
No. of 2 Cr Courses Offered	4
No. of Online Courses Offered	3 (2-CSE & 1-ECE)

No. of CSE Electives Offered	22
No. of ECE Electives Offered	13
No. of HSS Electives Offered	6
No. of BIO Electives Offered	3
No. of MTH Electives Offered	2
No. of ECO or MGT Electives Offered	2
No. of ENT, PHY, DES Electives Offered	3
No. of Electives Offered in Dual Discipline	5

Maximum Class Size for Elective Courses	162
Average Class Size for Elective Courses	38.5
No. of Elective Courses with 5 students or less	3
No. of Elective Courses with 100 students or more	4
No. of Late Drop applications received	65

Class strengths in Electives

No. of Students	No. of Courses
1-5	3
6-10	8
11-30	19
31-60	15
61-100	7
>100	4

List of courses with 5 or less students

Couse No.	Course Name	Credit
CSE531	Multiagent Systems	4
CSE749	Network Anonymity and Privacy	4
ECE556S	Multimedia Compression (2 credit - New)	2

BTech students registration for IP/IS/UR/BTP

No. of students registered for IP	73
No. of students registered for IS	8
No. of students registered for UR	10
No. of students registered for BTP	65

PhD students registration for IP/IS

PhD Students registered for IS	2

MTech Students registration for Project based courses

No. of students registered for Thesis	62
No. of students registered for Scholarly Paper	18
No. of students registered for Industrial Project	8
No. of students registered for Capstone Project	1
No. of students registered for Independent Project	5
No. of students registered for Independent Study	6

2. Summary of Attendance in Core Courses

Sno.	Name of the course	Less than 50%	Less than 70%	Less than 75%	Greater than 75%	Total Strength
1	Introduction to programming	15	49	62	149	211
2	Digital Circuits	8	27	49	149	198
3	Maths1	14	45	65	135	200
4	System Management	8	46	68	132	200
5	Communication skills	11	49	88	110	198
6	Discrete Mathematics	17	57	75	63	138
7	Embedded logic design	3	12	15	40	55
8	Advanced Programming	13	57	69	80	149
9	Signals & systems	22	40	47	23	70
10	Linear Circuits	4	11	13	21	34
11	Maths3	8	26	34	66	100
12	Operating Systems	23	52	59	80	139

List of Ist Year students with overall attendance less than equal to 60% and SGPA less than 6.5

Roll. No.	Name	Attendance Percentage for all courses	Sem 1 SGPA
2015059	MOHD AZHAR TAK	48.39	5.2
2015071	PIYUSH CHOUDHARY	59.20	4.5
2015079	ROHIT RAJ	42.74	4
2015110	UTSAV ROHILLA	60.00	5.2
2015111	VAIBHAV KASHYAP	58.87	5.2
2015125	AKASH WAGRATH	50.40	4
2015156	PARTH TIWARI	52.85	6
2015166	SACHIN KUMAR	55.65	2
2015176	SHIV SOORMA	57.60	2.4
2015192	VIVEK RAJORA	48.78	4.8

List of IInd Year students with overall attendance less than equal to 60% and SGPA less than 6.5

Roll No	Name	Attendance Percentage for all courses	SGPA
2013002	Aashanvit Sheoran	52.44	3.4
2013003	Abhishek Chaudhary	51.22	5.2
2013037	Gaurav Yadav	57.32	4.4
2013153	Sahil Sahil	33.33	2
2014016	Aniket Kadiyan	37.80	3.4
2014024	Ashutosh Nandan	52.44	3.4
2014034	Darvesh Kumar Punia	54.88	4.2
2014050	Ishan Pandita	37.80	6.4
2014054	Kunal Sharma	57.32	6
2014066	Nickey Kumar	58.54	5.25
2014087	Rishi Mohan	51.22	5.4
2014107	Sudhir Kumar	56.10	4
2014119	Vipin Chaudhary	57.32	5.6
2014123	Yash Mohan Sherry	32.93	6.2
2014151	Paurush Rathi	46.67	5
2014162	Siddhant Gandhi	43.70	4.6

3. Examination

Date of Moderation	7 Dec 2015
Date of Declaration of Results	11 Nov 2015
No. of I-grades at the time of declaration of result s	224
No. of Grade Changes done	12 (Approved:11, Not Approved: 1)
No. of Students who missed Invigilation Duty	2
Unauthorized absence from exams	12

4. Student Performance

BTech

Overall BTech student performance for Monsoon 2015

SGPA Range	2015		2014		2013		2012	
	CSE	ECE	CSE	ECE	CSE	ECE	CSE	ECE
<=5	7	11	11	7	12	3	3	0
>5<=7	36	27	42	13	36	14	26	9
>7<=8	26	17	28	5	34	9	19	7

>8<10	48	18	39	7	35	8	78	22
=10	4	0	3	0	0	0	6	0
Total	121	73	123	32	117	34	132	38
Average	7.6	6.86	7.23	6.34	7.18	7.03	8.25	8.15

Students with Backlogs

No. of Back Logs	Ist Year	IInd Year	IIIrd Year	IVth Year	Vth Year	Total
1	16	12	16	4	1	49
2	3	5	3		1	12
3		3	2			5
4	1		2			3
5	1	1	1	1		4

List of students whose SGPA for this sem is 2 or lesser than previous sem SGPA

1	2013133	Farheen Shah
2	2013170	Vishal Ranjan
3	2011103	Shivangi Mehra
4	2012042	Ishita Ahlawat
5	2012087	Rohan Kumar
6	2012113	Tavneet Singh
7	2012091	Shagun Beniwal
8	2012146	Mukul Gupta

List of students whose SGPA for this sem is 2 or more than previous sem SGPA

1	2014101	Shubham Maheshwari
2	2014148	Mohd Shoaib Iqbal
3	2014120	Vishisht Khilariwal
4	2014098	Shivam Rustogi
5	2013090	Saransh Nahar
6	2013078	Ritvik Agarwal
7	2013081	Rupam Patir
8	2013126	Aneesh Kumar
9	2013082	Sahil Babbar
10	2013014	Aneesh Dogra
11	2013051	Kartik Maji
12	2013103	Sidhant Tickoo
13	2013048	Karan Grover
14	2013012	Amya Rai
15	2013032	Deepanshu Arora
16	2013059	Mayank Vachher
17	2013100	Shubham Sharma
18	2012149	Prateek Singh
19	2012147	Nikita Singh
20	2012167	Udayan Tandon

Warning Letters sent for Attendance

No. of BTech students sent warning because of low attendance and poor performance in first year courses	28
No. of students sent warning because of low attendance and poor performance in second year courses	50

MTech

Overall MTech student performance for Monsoon 2015

CGPA Range	M.Tech Batch	
	2014	2015
>=8.00	67	42
6.00-8.00	26	59
<6.00	0	6

List of students with less than 6 CGPA

S.No	Roll No	Name	CGPA
1	MT15002	AASHISH GROVER	5
2	MT15019	HIMANSHU AGARWAL	5
3	MT15038	NAVEEN KUMAR PATIDAR	5.67
4	MT15047	PRIYANKA GUPTA	5.67
5	MT15053	RICHA GUPTA	5.67
6	MT15130	PARTHA PRATIM SAHA	5.67

Students on Semester Extension

S No.	Roll No.	Name	Reason
1	MT13003	Amit Semwal	Delayed due to Medical
2	MT13031	Adarsh Kumar Dubey	One Bucket Course Left and Not Yet defended Thesis(Not registered yet)
3	MT13043	Navin Agarwal	Defended Thesis late, will be graduated with 2015 batch
4	MT13046	Prabhat Ranjan	No response from student, Thesis component left
5	MT13047	Prasoon	Registered for Thesis
6	MT13063	Dibyendu Talukder	No response from student, Thesis component left
7	MT13073	Prabhat Mishra	Registered for Scholarly paper.

No. of MTech Thesis Defended and Industry Project/Capstone Project/Scholarly Paper submitted

S.No.	Course	Defense and Evaluation
1	Thesis	7
2	Scholarly Paper	3
3	Capstone Project	0
4	Industrial Project	8

PhD

Name of the students who put under warning				
S.No.	**Name**	**When**	**Reason**	**Status**
1	Monalisa Jena	Aug-15	Due to poor review	Warning revoke w.e.f. Jan 2016
2	Megha Gupta	Sep-15	Due to poor review	Follow up review is scheduled on 8th Feb, 2016
3	Rahul Bajpai	Oct-15	Due to poor review	Warning continue till the end of Winter Sem 2016
4	Shiju S.	Jun-15	Due to low CGPA	CGPA has improved thus , warning revoked in Dec 2015
5	Ankita Deo	Dec-15	Due to low CGPA	Warning continue till the end of Winter Sem 2016

Summary of Yearly Review July 2015

Rating	No. of Students	Remark
Excellent	6	
Good	50	
Average	7	
Below average	1	Academic Warning has been issued
Poor	2	
Total	66	

SNo.	Item	Aug	Sep	Oct	Nov	Dec	Total
1	No. of Comprehensive done	**5**			**1**	**10**	**16**
2	No. of Fellowships awarded	**14**		**4**			**18**
3	No. of Thesis Defended	**2**					**2**
4	No. of Students who were on semester Leave during the semester	**1**					**1**

Highest Grade Info:

No. of Students who got A+ grades

Batch--->	2015		2014		2013		2012		Total
Program	**Course**	**No. of Students who got A+**	**Course**	**No. of Students who got A+**	**Course**	**No. of Students who got A+**	**Course**	**No. of Students who got A+**	
BTech	IP	7	AP	4	DSP	1	AN	2	
	DC	2	DM	2	DCS	1	CMOS	1	
	SM	1	OS	2			BTP	3	

			Theatre	1			CMP	1	
							CG	1	
							DMG	2	
							VLSI	1	
							SCM	2	
							IEA	1	
							ISC	2	
							LO	1	
							MC	2	
							MAD	1	
							NS	1	
							NLE	1	
							Phy	1	
							PA	1	
							SSIOT	2	
							T&S	1	
	Total	**10**		**9**		**2**		**27**	**48**
MTech	OOPD	1							
	Total	**1**							**1**
PhD	CMP	1			SSIOT	1			
	SSIOT	1							
	RS	1							
	Total	**3**				**1**			**4**

List of Students who got A+ Grade				
Roll No.	**Name**	**Pogram**	**Course Name**	**No. of A+ Grades**
2012016	Alakh Dhruv Chopra	BTech/CSE	Linear Optimization, Modern Algorithm Design	2
2012020	Anisha Agrawal	BTech/CSE	Non Linear Editing	1
2012029	Ayush Goel	BTech/CSE	Compilers	1
2012039	Harkirat Singh Lamba	BTech/CSE	Technology and Society, Physics	2
2012044	Juhi Jetwani	BTech/CSE	Introduction To Spatial Computing	1
2012050	Kriti Pandey	BTech/CSE	Effective Supply Chain Management for E-Commerce Businesses	1
2012056	Mansi Vijh	BTech/CSE	Effective Supply Chain Management for E-Commerce Businesses	1
2012059	Megha Arora	BTech/CSE	Data Mining	1

2012062	Mrinal Kachhara	BTech/CSE	Advanced Networks	1
2012064	Neeraj Kumar	BTech/CSE	Network Security	1
2012075	Prasant Chidella	BTech/CSE	Introduction To Spatial Computing, Smart Sensing for Internet of Things	2
2012082	Pulkit Arora	BTech/CSE	Introduction to Economic Analysis, Mobile Computing	2
2012088	Sarthak Ahuja	BTech/CSE	Computer Graphics	1
2012108	Sukrit Kalra	BTech/CSE	Advanced Networks	1
2012122	Abhinav Jadon	BTech/ECE	Smart Sensing for Internet of Things	1
2012131	Ayush Verma	BTech/CSE	Data Mining	1
2012139	Inderdeep Singh	BTech/ECE	BTech Project	1
2012141	Magus Verma	BTech/CSE	Mobile Computing	1
2012155	Rajat Kashyap	BTech/ECE	BTech Project	1
2012160	Shreya Singh	BTech/ECE	Digital VLSI Design, Analog CMOS Design, BTech Project	3
2012163	Shuktika Jain	BTech/CSE	Program Analysis	1
2013146	Parth Shrivastava	BTech/ECE	Digital Signal Processing	1
2013165	Tanay Kabra	BTech/ECE	Digital Communication Systems	1
2014004	Adesh Pandey	BTech/CSE	Advanced Programming	1
2014006	Agam Singh Bajaj	BTech/CSE	Theatre Appreciation	1
2014012	Ambar Pal	BTech/CSE	Discrete Mathematics	1
2014038	Divam Gupta	BTech/CSE	Advanced Programming	1
2014041	Gursimran Singh	BTech/CSE	Advanced Programming	1
2014089	Rounaq Jhunjhunu Wala	BTech/CSE	Advanced Programming	1
2014096	Satyam Kumar	BTech/CSE	Discrete Mathematics	1
2014098	Shivam Rustogi	BTech/CSE	Operating Systems	1
2014099	Shrey Bagroy	BTech/CSE	Operating Systems	1
2015039	Hasan Kamal	BTech/CSE	Introduction to Programming	1
2015050	Lamha Goel	BTech/CSE	Introduction to Programming	1
2015051	Luv Sharma	BTech/CSE	Introduction to Programming	1
2015069	Parth Mittal	BTech/CSE	Introduction to Programming	1
2015076	Rishabh Garg	BTech/CSE	Introduction to Programming	1
2015101	Siddharth Sundar	BTech/CSE	Introduction to Programming, Digital Circuits, System Management	3
2015120	Abhinav	BTech/ECE	Introduction to Programming	1

	Khattar			
2015184	Tushar Kataria	BTech/ECE	Digital Circuits	1
MT15032	MAURYA KAVITA DINESH	MTech (CSE)/IS	Object Oriented Programming and Design	1
PhD1307	Haroon Rashid	PhD/CSE	Smart Sensing for Internet of Things	1
PhD15005	Dhriti Khanna	PhD/CSE	Compilers	1
PhD15102	Gade Narayana Sri Harsha	PhD/ECE	Smart Sensing for Internet of Things	1
PhD15105	Shelly Vishwakarma	PhD/ECE	Radar Systems	1

5. Summary of TA/RA Work

MTech

Sl.No.	Particulars	Numbers
1	Total Number of M.Tech TA	180
2	Total TA with Satisfactory Performance	173
3	Total TA with unsatisfactory Performance	7

PHD

Month	Total No. of Students	No. of students with Attendance less than 75%	No. approved leaves/ Advisor confirmations	No. of students for whom Fellowship was Deducted
Sep-15	48	8	8	0
Oct-15	48	13	13	0
Nov-15	48	8	6	2

6. Admissions PhD

Rolling Admissions (Aug - Dec 2015)

For the month	No. of students selected through rolling	Date of joining	Name of Student	Remark
Sep-15	3	10/06/2015	Surbhi Arora	
		Jan-16	Vanika Singhal	
		Jan-16	Vijay Ghalawat	Sponsored
Oct-15	1	17/11/2015	Aakarsh Malhotra	

Nov-15	1	Jan-16	Nalla Anadakumar	Sponsored
Dec-15	1	Jan-16	Siddhant Jain	
Total	**6**			

7. Student Interactions & Meetings Conducted

Interactions with Students

Group of Students	Date of Interaction	Agenda
All Students	3 & 4 Aug 2015	Course Registration Guidance
BTech 2013 Batch	17 & 18 Sep 2015	Guidance on Importance & type of skills that are important
BTech 2014 Batch	7 & 10 Sep 2015	
BTech 2015 Batch	08-Sep-15	
PhD	08-Sep-15	Regular Interaction
MTech CSE	8-Oct-15	Regular Interaction
MTech ECE	9-Oct-15	Regular Interaction

UGC/PGC Meetings done

Item	Nos.
UGC Meetings	3
PGC Meetings	4

No. of Open House sessions conducted during the semester

8. Other Statistics

No. of International /National conference attended by students

Programme	No. of National Conferences attended	No. of International Conferences attended
BTech	0	0
MTech	10	0
PhD	5	8

No. of students who have withdrawn from the Programme

Programme	No. of Withdrawals
BTech	5
MTech	10
PhD	1

No. of Students who were on semester Leave during the semester

Programme	Nos

BTech	1
MTech	0
PhD	1

No. of non-degree visiting students

Sl.No.	Particulars	Nos.
1	Number of Applications	3
2	Number of Selected Applications	0

Counsellor Visits

Item Name	Aug	Sep	Oct	Nov	Dec	Total
No. of Visits	**6**	**8**	**9**	**8**	**0**	**31**

Appendix II

Semester Schedule for Summer Term 2016

S.No.	Event	From Date	Day	To Date	Day
1	Pre-registration	30/04/2016	Saturday	06/05/2016	Friday
2	Registration	11/05/2016	Wednesday	13/05/2016	Friday
3	Commencement of classes	16/05/2016	Monday		
5	Mid-Semester Examination	06/06/2016	Monday	08/06/2016	Wednesday
6	Last date for Late Drop (for Instructor driven courses)	15/06/2016	Wednesday		
7	End –Sem. Examination	6/07/2016	Wednesday	9/07/2016	Saturday
8	Moderation meeting	12/07/2016	Tuesday		
9	Grades to reach UG/PG Section	13/07/2016	Wednesday		
10	Verification of Grades	14/07/2016	Thursday		
11	Announcement of Grades (tentative)	16/07/2016	Saturday		

Monsoon Semester 2016

S.No.	Event	Date	Day
1	3 Day Modules	28/07/2016-30/07/2016	Thursday-Saturday
2	First Day of the Class	01/08/2016	Monday

Appendix III

Astronomy Olympiad		
Marks	**Stages**	**Numbers**
0	Stage 1: Appeared for NSEA 2015 or 2016	
6	Stage 2:Represented your region and appeared for INAO 2015 or 2016 (Hold certificate of INAO merit)	300
10	Stage 3: Selected for attending training camp (OCSC)for selection of Indian team for IAO (INAO Awardees)	30
National Sports Federation		
0	Participated in School Level	
0	Participated in Inter school Level	
6	Represented State in U19 or U17 Category in any of the 25 High priority / priority games as defined by SGFI under the National Sports Federation of India (Certificate should not be issued before 2013)	
INSPIRE Award Scheme		
0	Recipient of Inspire Awards under Scheme for Early Attraction of Talent (SEATS)	
0	Recipient of Inspire Internship under Scheme for Early Attraction of Talent (SEATS)	
0	Recipient of Inspire Scholarship under Scheme for Scholarship for Higher Education (SHE)	
National Level Exhibition & Project Competition (NLEPC) under 'INSPIRE' Programme of DST		
6	Participated in National Level Exhibition & Project Competition (NLEPC) in last 5 Years	1000
10	Recipient of Gold/Silver/Bronze/Consolation Award in National Level Exhibition & Project Competition (NLEPC) in last 5 Years	60 Students
IGNITE Award under National Innovation Foundation		
0	Submitted Idea / Proposal for National IGNITE Awards	
10	Recipient of Award under National IGNITE Awards in last 5 years	30
IRIS National Science Fair		
0	Submitted Idea/Proposal for IRIS National Science Fair	
6	Selected for National Fair(4 Day Fair) in class IX to XII	100
10	Recepient of Grand Award for participation in International Science Eng Fair(ISEF) in class IX to XII	20

Appendix IV

Mathematics and Computing at the IIIT-D

Background

IIIT Delhi proposes to start an undergraduate degree program in Mathematics and Computing along the lines of a similarly named course at many leading universities. The increasing use of sophisticated mathematical tools and techniques in tandem with computational tools in several areas such as computational finance, biology, e-commerce, weather forecasting, and data science motivates the need for such a program that will produce graduates with computational skills as well as the ability to use sophisticated mathematical concepts and tools in order to tackle these problems.

The Math and Computing program at IIIT-D aims to be a broad-based program with a small set of core courses and many electives, enabling students to build a program most suitable for them. For example, It is possible for a student of this program to complete the requirements necessary to appear for the PhD Mathematics entrance exam conducted by the UGC-CSIR, or build a specialization in Data Science.

This document outlines the post-conditions, syllabus and requirements of the program followed by a detailed description of the courses. The appendix provides a comparison between the BSc Math program at Delhi University, and our BTech program.

Post-conditions

1a. Understanding foundational topics in mathematics.
1b. Understanding of theoretical foundations and limits of computing.
2. Ability to abstract and rigorously model and analyse a variety of problems using appropriate mathematical or computational concepts.
3a. Ability to design and implement algorithms and data structures for efficiently solving new problems.
3b. Ability to use and apply mathematical and statistical techniques and tools to solve problems.
4. Remaining come from the BTech CSE objective.

Proposed curriculum

The BTech program at IIIT-D follows a philosophy of having a small set of core-courses, allowing students significant flexibility in designing their curriculum and specialization.The curriculum at IIIT-D requires a student to complete 152 credits, equivalent to 38 full courses. Of these 38 courses, about 22 courses are core courses, and the rest are elective courses.

In the BTech in Math and Computing, owing to the larger scope, the required or core courses are larger. We propose a sequence of 26 core courses, with 11 math courses, 8 CS courses, 3 ECE courses and 4 HSS courses. Table 1 gives the list of core courses in the program.

	Math	CS	ECE	HSS
Sem I	Linear Algebra [+matlab]	System Mgmt. Intro. to Prog.	Digital Circuits	HSS
Sem II	Prob and Stat.	Data Struct & Alg.	Basic Electronics IED	HSS
Sem III	Multivariate Calc.(separate course?) Discrete Math (Math Version)	Computer Organization+OS		HSS
Sem IV	ODE/PDE +[numerical methods.?] Abstract Algebra I [+magma]	Anal. Des.Algorithms ToC		HSS
Sem V	Analysis I (earlier) Probability & Random Processes			
Sem VI	Statistical Inference Optimization			

Possible additions to the CS Core curriculum: Operating Systems, Software Engineering.

Semester-wise View

- Here **Bold** indicates Core courses. These are required courses for all students in the program.
- The first year courses are common across disciplines.
- The courses are color-coded: Blue: Math, Brown: CS, Black:Other, Green: Elective.

Semester I	Semester II
Math I: Linear Algebra **System Management.** **Introduction to Programming** **Digital Circuits** **HSS**	**Math II: Probability and Statistics** **Data Structures and Algorithms** **Basic Electronics** **IED** **HSS**
Semester III	**Semester IV**
Math III: Mutivariate Calculus **Discrete Math** **Elective 1 [Number Th, AP, Physics,Signals & Sys.] (?)** **Computer Organization[CO+OS]** **HSS**	**Math IV: ODE/PDE** **Abstract Algebra** **Analysis and Design of Algorithms** **Theory of Computing** **Env. Studies (2cr.)** **TCOM (2cr.)**
Semester V	**Semester VI**
Elective 2 [Real Analysis, Numerical Methods] **Probability and Random Processes** Elective 3 Elective 4 Elective 5	**Optimization/Linear Optimization** **Statistical Inference** Elective 6 Elective 7 Elective 8
Semester VII	**Semester VIII**
Elective 9 Elective 10 Elective 11 Elective 12	Elective 13 Elective 14 Elective 15 Elective 16

Structure of Elective Courses:

The course structure allows a student sufficient flexibility in the choice of elective courses and thus structure the program to their interest. In choosing electives however, the following rules must be followed.

- **Elective 1**: This elective in **Semester III** can be used as a student to get a glimpse into various disciplines that she may choose to pursue in later semesters. It is therefore recommended that this course be one of the following:
    - Elementary Number Theory
    - Advanced Programming
    - Introduction to Physics
    - Signals and Systems

Note that a choice made in this semester is not an exclusive one. These courses will be available to the student in later semesters.

- **Elective 2:** This elective in **Semester V** is a choice between
    - Real Analysis
    - Numerical Methods.

It is strongly advised that a student do both courses. However, a student with an interest in pursuing a position in the industry could choose numerical methods in place of Real Analysis. One of the reasons for moving Numerical Methods out of ODE/PDE was that faculty teaching the courses felt it was impossible to do justice to both. With a hard limit on the number of core courses, it was felt that making a choice between Real Analysis and Numerical methods was the only reasonable option.

- A student choosing to do a BTP can register for a minimum of 8 credits and a maximum of 16 credits,i.e., 2-4 courses. This would leave the student with 10-12 elective courses to choose from.
- At most two of the electives can be used for IP/IS.
- Among the elective courses, at most two courses can be *free* electives, i.e., courses outside of Math or CSE.
- Among the remaining CSE/Math electives, a student must ensure that she does at least three courses from either discipline.

Streams

In order to allow students to make informed choices about elective courses, we propose a set of streams - which is a sequence of at least three courses.

Streams are merely suggestive, and there is no compulsion on the part of the student to follow a sequence. The streams and courses listed below are some possibilities. They may change based on the availability of faculty and student interest.

Stream	Courses
Pure Mathematics	Analysis II, Functional Analysis, Abstract Algebra II, Graph Theory
Algebra and Computation	Algebra II, Coding Theory, Algebra and Computation, Information Theory
Algorithms and Complexity	Modern Algorithm Design, Randomized Algorithms, Approximation algorithms, Complexity Theory, Quantum Computing, Information Theory, Fourier analysis and applications.
Optimization	Linear Optimization, Convex Optimization, Combinatorial Optimization, Game Theory, Algorithmic Game Theory, Supply Chains, Reliability and Performance Analysis
Statistics and Data Science	Statistical Computations, Machine Learning, Pattern Recognition, Random Networks, Big Data Analytics, Statistical Computing, Data Mining, Estimation Theory, Regression, Sampling, Information Theory
Biology	Molecular Biology and Biochemistry, Algorithms in Computational Biology, Systems Biology
Economics	Introduction to Economic Analysis, Applied Econometric Analysis, Game Theory
Applied Mathematics	Mechanics, Physics, Fluid Mechanics and Computational Fluid Dynamics

Possible Sequences

The tables below give suggested sequences a student might pursue. These are only indicative of some of the possibilities, and are not meant to be prescriptive.

The tables below need editing.

Optimization

Semester V	Semester VI
Analysis I **Probability and Random Processes** Applied Linear Algebra	**Statistical Inference** **Optimization** Graph Theory
Semester VII	**Semester VIII**
Game Theory Combinatorial Optimization Linear Optimization	Approximation Algorithms Convex Optimization

Algorithms and Theory

Semester V	Semester VI
Analysis I **Probability and Random Processes** Modern Algorithm Design Fourier Analysis and applications in CS	Graph Theory **Optimization** **Statistical Inference** Complexity Theory
Semester VII	**Semester VIII**
Combinatorial Optimization Quantum Computation Topics in Modern Cryptography	Coding Theory Approximation Algorithms/Advanced Algorithms Information Theory

Data Science

Semester V	Semester VI
Analysis I **Probability and Random Processes** Applied Linear Algebra	Graph Theory **Optimization** **Statistical Inference** Statistical Computation
Semester VII	**Semester VIII**
Graphs and Networks Machine Learning Elective 4 IP/IS/BTP	Big Data Analytics Engineering Optimization Elective 6 Elective 7 IP/IS/BTP

Pure Mathematics

Semester V	Semester VI
Analysis I **Probability and Random Processes** Combinatorics	Graph Theory **Optimization** **Statistical Inference** Topology
Semester VII	**Semester VIII**
Abstract Algebra II Complex Analysis	Analysis II Differential Geometry

Minor in Mathematics

Computer Science and Electrical Engineering require increasingly sophisticated mathematical tools, and a minor in mathematics is a popular choice offered at several universities. A minor at IIIT-D requires students to do 5 courses and a BTech project in the particular topic. For example, IIT Bombay offers a minor in mathematics consisting of the following courses:

Minor in Math:
Real Analysis, Basic Algebra, Complex Analysis, Topology and Fourier Analysis and Applications.

Minor in Statistics:
Probability Theory, Statistical Inference, Regression Analysis, Applied Stochastic Processes, Introduction to Derivative Pricing.

We could consider offering a minor program along these lines.

Course Descriptions

Math I:(MTH100) Linear Algebra

Contents: This first level math course covers basics of linear algebra including vector spaces, matrix algebra, linear transformations, eigenvalues and eigenvectors, orthogonality, properties of symmetric matrices, positive definite matrices, and SVD. The course is developed with an aim to provide a strong foundation in linear algebra which will be used in the subsequent curriculum by both CS and ECE students. Time permitting, some applications of linear algebra in engineering disciplines will be introduced. The course also attempts to increase the mathematical maturity of students by introducing proofs and mathematical rigour.

Contents: Systems of linear equations, row reduction and echelon forms, matrix equation of the form Ax = b, invertibility of matrices, Vector spaces and subspaces, linear dependence/independence, dimension, span, applications. Fundamental subspaces. Linear transformation, rank. Matrix of linear transformation, effect of change of basis, Similarity transformation. Algebra of linear transformations. Determinants, properties of determinants, Eigenvalues and eigenvectors, diagonalization of a matrix, eigenvectors and linear transformations, complex eigenvalues. Orthogonality and least squares, inner product, length, orthogonal projections, Gram-Schmidt orthogonalization, QR decomposition. Symmetric matrices and Quadratic forms, diagonalization of symmetric matrices, positive definite matrices, SVD, application to image processing.

Recommended Textbooks:

1. David Lay: Linear Algebra and Its Application, 3rd (Indian Edition), Pearson.
2. Strang: Linear Algebra and Its Applications, 4th Edn, Cengange.
3. Lipschutz: Linear Algebra, Schaum's Outline Series.
4. Hoffman & Kunze: Linear Algebra, Pearson.
5. Axler: Linear Algebra Done Right, Springer. (Advanced)

Math II: (MTH201) Probability and Statistics

Post conditions:

- Will be able to summarize and visualize Data
- Will be able to model simple real world problems in terms of probability and statistics.
- Will be able to analyze relationship between separate datasets
- Will be able to analyze cause-effect relationship for multi-variate data.

Brief Description: The course is intended as a balanced introduction to basic probability and statistical applications for a mixed audience of ECE and CS students. The course will start with examples of data collection in various science/engineering areas as motivation and proceed to highlight the role of a) probability models for data and their b) statistical analysis. The mix of probability concepts and data analysis methods will be mediated by use of statistical computation as a-glue.

Contents: Presentation of data, Frequency Distributions, Measures of central tendency,Probability Theory, Measures of Dispersion,Set Theory, Permutations, etc.,Random Variables,Theoretical Distributions,Correlation and Regression,Parameter Estimation,Sampling Theory, Advanced Topics (classification / multi-variate regression)

Recommended Textbooks:

1. Sheldon Ross: Introduction to Probability and Statistics for Engineers and Scientists, Elsevier/Acad. Press, 4th Edition.

Discrete Mathematics: Math version

This course is meant to be an introduction to discrete mathematics with a focus on fewer topics, and more emphasis on rigour. Topics include Logic, Combinatorics, and Graph Theory and proofs and proof techniques in these areas.

Recommended Textbooks:

1. Discrete Mathematics, Elementary and Beyond, L. Lovasz, J. Pelikan, K. Vesztergombi
2. An Invitation to Discrete Mathematics, J. Matousek, J. Nesetril

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Math III: Mulitvariate Calculus

Maths IV: (MTH204) ODE/PDE

Post conditions: At the end of the course, the student will be able to:

- Solve ordinary and partial differential equations analytically
- Model physical systems using ODEs/PDEs, obtaining an analytical solution where possible
- Interpret results of ODE/PDE models

Course description: This is the first course in differential equations (ordinary and partial) to be taken by students in their second year of undergraduate studies. The primary focus of the course will be on learning how to solve linear second order ODEs (homogeneous as well as non-homogeneous) and PDEs (wave, heat and Laplace) using different methods. The course will also extend to systems of linear ordinary differential equations including a discussion on qualitative methods for nonlinear systems.

Weekly schedule:

Week	Topics	Assignments/Labs (6-7 hrs)
1	Review of first order ODEs (self study plus homework with doubts/quesries to be addressed during tutorial session), Second order homogeneous linear ODEs with emphasis on equations with constant coefficients.	HW1
2	Modeling (free oscillations), Euler Cauchy equation, Existence and Uniqueness for homogeneous linear equations, Wronskian, Introduction to nonhomogeneous equations.	HW2
3	Solution by undetermined coefficients, solution by variation of parameters, Modeling (forced oscillations, electric circuits).	HW3
4	Series solutions, Legendre's equation, Frobenius method, Bessel's equation.	HW4
5	Sturm-Liouville problems, orthogonal functions, orthogonal eigenfunction expansions.	HW5

6	Laplace transform, transforms of derivatives and integrals, differentiation and integration of transforms, Convolution, Partial fractions.	HW6
7	Introduction to higher order linear differential equations, Systems of differential equations, Phase plane, Critical points, Stability.	HW7
8	Nonhomogeneous linear systems, Qualitative methods for nonlinear systems.	HW8
9	Introduction to partial differential equations, first order PDEs, mathematical classification of second order PDEs, characteristics.	HW9
10	Wave equation (hyperbolic): Using separation of variables and Fourier series, D'Alembert's solution, Two dimensional wave equation: rectangular membrane (double Fourier series), circular membrane (Fourier-Bessel series).	HW10
11	Heat equation (parabolic): Solution by Fourier series, solution by Fourier integrals and transforms.	HW11
12	Laplace equation (elliptics): In cartesian coordinates, In cylindrical and spherical coordinates, Solution using a Fourier-Legendre series.	HW12
13	Applications of ordinary and partial differential equations in Electronics and Communication Engineering (contributions by different faculty members in the stream).	HW13

Recommended Textbooks:

1. Advanced Engineering Mathematics" by Erwin Kreyszig.
2. Differential Equations with Applications and Historical Notes" by George F. Simmons.

Abstract Algebra I

Contents: Formal properties of integers, equivalence relations, congruences, rings, homomorphisms, ideals, integral domains, fields; Groups, homomorphisms, subgroups, cosets, Lagrange's theorem ,normal subgroups, quotient groups, permutation groups; Groups actions, orbits,stabilizers, Cayley's theorem, conjugacy, class equation, Sylow's theorems and applications; Principal ideal domains, Euclidean domains, unique factorization domains, polynomial rings; Characteristic of a field, field extensions, algebraic extensions, separable extensions, finite fields, algebraically closed field, algebraic closure of a field.

Recommended Textbooks:

1. I. N. Herstein, Topics in Algebra, Wiley, 2004.
2. J. B. Fraleigh, A First Course in Abstract Algebra, Addison Wesley, 2002.
3. Algebra: M. Artin (1991) Prentice Hall

Analysis I

Contents: Real Numbers, least upper bound property, sequences, convergence, suprema and infima, Bolzano-Weierstrass theorem, limsup, liminf, limit points, subsequences, Infinite series, rearrangement of series, tests for convergence, Functions on R, continuous functions, intermediate value theorem, Heine Borel Theorem, uniform continuity, Differentiation on R^n, definition of total derivative, L'Hospital rule, local maxima and minima, inverse function theorem, implicit function theorem, Riemann integration, basic properties, Riemann integrability of continuous functions, fundamental theorem of Calculus. Pointwise and uniform convergence of sequences of functions, uniform convergence and continuity, Weierstrass approximation theorem, Uniform convergence of series of functions, Weierstrass M-test, convergence of integrals and derivatives of sequences of functions, Introduction to power series and analyticity.

Recommended Textbooks:

1. Analysis I & II: T. Tao, TRIM Series (2006)
2. Principles of Mathematical Analysis: W. Rudin (1976)
3. Mathematical Analysis: T.M. Apostol (1974)
4. Introduction to Real Analysis: R. G. Bartle and D. R. Sherbert (2011)
5. Methods of Real Analysis: Goldberg (1976) Wiley

Numerical Methods : Gets added to ODE/PDE

Contents: Errors; Iterative methods for nonlinear equations; Polynomial interpolation, spline interpolations; Numerical integration based on interpolation, quadrature methods, Gaussian quadrature; Initial value problems for ordinary differential equations - Euler method, Runge-Kutta methods, multi-step methods, predictor-corrector method, stability and convergence analysis; Finite difference schemes for partial differential equations - Explicit and implicit schemes; Consistency, stability and convergence; Stability analysis (matrix method and von Neumann method), Lax equivalence theorem; Finite difference schemes for initial and boundary value problems (FTCS, Backward Euler and Crank-Nicolson schemes, ADI methods, Lax Wendroff method, upwind scheme).

Recommended Textbooks:

1. D. Kincaid and W. Cheney, Numerical Analysis: Mathematics of Scientific Computing, 3rd Ed., AMS, 2002.
2. G. D. Smith, Numerical Solutions of Partial Differential Equations, 3rd Ed., Calrendorn Press, 1985.
3. K. E. Atkinson, An Introduction to Numerical Analysis, Wiley, 1989.
4. S. D. Conte and C. de Boor, Elementary Numerical Analysis - An Algorithmic Approach, McGraw-Hill, 1981.
5. R. Mitchell and S. D. F. Griffiths, The Finite Difference Methods in Partial Differential Equations, Wiley, 1980.

Statistical Inference

Contents: Reduction of data, sufficient statistics, minimal sufficient statistics, Neyman factorization theorem, complete statistics, exponential families. Ancillary statistics, Basu's theorem. Estimation of real and vector parameters. Method of moments and maximum likelihood, Bayes' estimation. Methods of evaluating estimators, Cramer-Rao Inequality, Fisher Information, Rao-Blackwell theorem, Lehmann-Scheffe theorem. Testing of hypotheses, likelihood Ratio tests, Bayesian tests, error probabilities, P-values, power function, most powerful tests, Neyman-Pearson lemma, uniformly most powerful tests, monotone likelihood ratio. Confidence intervals, construction of confidence intervals, one-sided confidence intervals and their relation with UMPtests, pivotal quantities, Bayesian intervals. One and two way analysis of variance, F- statistics and their null distributions.

Recommended Textbooks:

1. Statistical Inference: George Casella, R. L. Berger (2002) Cengage Learning
2. All of Statistics, A Concise Course in Statistical Inference (Springer Texts in Statistics): Larry Wasserman (2004) Springer
3. Linear Statistical Inference and its Applications: C. R. Rao (2001) Wiley
4. Parametric Inference: B. K. Kale (1999) Narosa 5. An Introduction to Probability and Statistics: V. K. Rohatgi, A. K. Md. Saleh (2000) Wiley

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Probability and Random Processes

Contents: The Probability Space, Events, properties of probability measures, independence, Bayes' formula, Kolmogorov 0-1 law. Random variable, distribution functions, examples of discrete and continuous distributions, joint distributions, independence of random variables, Borel-Cantelli lemmas. Limit theorems: Weak/Strong Law of Large numbers, Central limit theorem. Conditional probability, Martingales, Stopping time, Azuma's inequality, Doob's inequality. Discrete time discrete space Markov chain, Chapman-Kolmogorov equation, classification of states, and limit theorems.

Recommended Textbooks:

1. Introduction to Probability Models: S. M. Ross (2014) Academic Press
2. Introduction to the Theory of Probability and its Applications, Vol. 1: W. Feller (2008) Wiley
3. Introduction to Stochastic Processes: P. G. Hoel, S. C. Port and C.J. Stone (1986) Waveland Press Inc.
4. G. R. Grimmett and D. R. Stirzaker, Probability and Random Processes, Oxford University Press, 2001.

Optimization: Revisit to make it an optimization rather than OR course

Prerequisites: Linear Algebra, Probability and Statistics, Mulitvariate Calculus

Post-Conditions:

• The student will be able to model problems as optimization problems and use existing solvers to solve them.
• The student will be able understand the concept of duality.
• The student will understand basic techniques involved in solving discrete as well as continuous optimization problems.
• The student will learn about conditions of optimality in various settings.
• The student will understand basic queueing systems and simulation.

Course Description:
This is the foundational course in the optimization stream. The course focuses on modeling and usage of tools to solve optimization problems arising in several domains with a focus on applications in Computer Science and Electrical Engineering. Topics covered include linear and non-linear programming, discrete optimization including network flows, duality theory, conditions for optimality, queueing theory, dynamic programming and heuristic methods, and using modeling tools such as AMPL, GAMS as well as solvers such as CPLEX, GLPK, CVX, etc. The course is useful to get

a glimpse of the power and utility of optimization methods. A student completing this course could take courses on linear optimization, engineering optimization, etc. that deal more with the geometry and algorithms underlying these tools.

Recommended Textbooks:

1. Operations Research, Hamdy A. Taha
2. Introduction to Operations Research, Hiller, Lieberman
3. A gentle introduction to Optimization, B. Guenin, J. Konnemann, L. Tuncel
4. Model Building in Mathematical Programming, H. Paul Williams

Elective Courses

Graph Theory

Contents: The Basics: graphs, paths and cycles, connectivity, trees and forests, bipartite graphs, contraction and minors, Euler tours, Hamilton Cycle. Matching and Covers: Maximum bipartite matching algorithms, Konig's Theorem, Independent Set. Cuts and Connectivity: 2-connected Graphs, Menger's theorem; Network Flow: Max-flow Min-cut and the Ford-Fulkerson algorithm. Planar Graphs: drawing, Euler's formula, Kuratowski's theorem, plane duality. Coloring: coloring maps and planar graphs, coloring vertices, coloring edges. Cayley graph, Spectrum of a graph.

Recommended Reading: 1. Introduction to Graph Theory: D.B. West (1996) Prentice Hall

Recommended Textbooks:

1. Introduction to Graph Theory: D.B. West (1996) Prentice Hall
2. Graph Theory: F. Harary (1969) Addison-Wesley
3. Modern Graph Theory: B. Bollobas (2008) Springer
4. Graph Theory: R. Diestel (2006) Springer
5. Graphs: C. Berge (1989) North-Holland
6. Graph Theory and its Applications: J.L. Gross and J. Yellen (2006) CRC Press
7. A First Course in Graph Theory and Combinatorics: S. M. Cioaba, M. Ram Murty (2009) Hindustan Book Agency

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Linear Optimization(LO)

Prerequisites: Optimization, or linear algebra

Post-Conditions:

• Students will be able to model problems as linear optimization problems and use existing solvers to solve them.

• students will understand and the basics of polytopes and the geometry behind linear programming.

• Students understand the concept of duality in the context of linear programming and its applications.

• Students understand algorithms for solving linear programs, such as simplex, interior point, and ellipsoid method, etc.

• Students will understand the use of linear programming in combinatorial optimization.

Course Description:

While the world is inherently non-linear, perhaps the most widely used optimization techniques are linear optimization. This course aims to give students a good understanding of the foundations of linear optimization and its applications in various fields. The focus is on the beautiful geometry and algorithms underlying linear optimization, and its varied applications. Topics include polyhedral theory, duality, algorithmic techniques such as simplex, interior point methods, ellipsoid method and applications in combinatorial problems such as network flows, as well as in integer programming as well as extensions of linear programming such as semi-definite programming.

Books:

• Main: Introduction to Linear Optimization, Bertsimas and Tsitsiklis

• Reference: Theory of Linear of Integer Programming, Alexander Schrijver

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Appendix

A Comparison between the BTech Math and Computing Program, and the requirements of a BSc MathematicsprogramatDelhiUniversity.

The BSc Mathematics program at Delhi University comprises of the following Core Courses. For each core course, we present the appropriate course in the BTech Math and Computing program. The table below shows that our BTech program provides sufficient coverage compared to the BSc program at Delhi University.

DU BSc. Math	IIIT-D Math and Computing
Calculus	None (background assumed)
Algebra	Contents covered in DM and Math - I
Real Analysis	Real Analysis
Differential Equations	Partly covered in Math IV: ODE/PDE
Theory of Real Functions	Partly covered in Real Analysis
Group Theory - I	Covered in Algebra I
Multivariate Calculus	Multivariate Calculus
Partial Differential Equations	Partly covered in Math IV (ODE/PDE)
Reimann Integration and Series of Functions	Analysis - II
Ring Theory and Linear Algebra - I	Partly covered in Algebra - I and Algebra - II
Metric Spaces	Partly covered in Real Analysis
Group Theory - II	Partly covered in Real Analysis and Analysis - II
Complex Analysis	Complex Analysis
Ring Theory and Linear Algebra - II	Partly covered in Analysis -II

Departmental Electives at DU

Numerical Methods	Numerical Methods

Mathematical Modeling and Graph Theory	Graph Theory, Linear Optimization, Optimization (except for some applications of differential equations), Probability and Random Processes
C++ Programming	Advanced Programming (and other courses)
Math Finance	
Discrete Mathematics	Discrete Mathematics
Cryptography and Network Security	Several Courses in Cryptography
Probability and Statistics	Probability and Statistics + several courses
Mechanics	
Number Theory	Number Theory
Bio-Mathematics	Several Courses in Biology
Linear Programming and Theory of Games	Linear Optimization, Game Theory
Applications of Algebra	

Appendix V

Guidelines for Change of PhD Supervisor at a Late Stage

Guiding PhD students by a supervisor is one of the longest and strongest associations between a student and faculty. It is based on mutual trust and respect, in which a student expects the supervisor to protect his/her interests, and supervisor expects high quality research work. While change of supervisor at early stages is not uncommon and there is a standard process for it, sometimes, due to various reasons, the student-supervisor relationship is formally terminated even at a late stage. This note aims to provide some guidelines if the change of supervisor happens at a late stage when some research has been already done. The guidelines are based on:

- It will be assumed that all research work done by the student and supervisor before the termination of student-supervisor relationship was being done towards the PhD thesis of the student, unless both agree for some work that it was done for some other purposes and was not meant to be included in the thesis.
- Rights of supervisor and student regarding authorship and publications, and rights of supervisor for using the past-works (e.g. for building upon it, using as project deliverables, having another student work on it, etc) and of student for using the past-works (e.g. towards his/her PhD degree) should be protected.

Guidelines

A. Change of supervisor at a late stage of the student's PhD should be avoided and all attempts should be made to take the relationship to its logical conclusion – namely submission of the thesis. The possibility of having the past supervisor continue as a co-supervisor should also be explored. Change of supervisor at a late stage should happen only as the last resort.

B. If the student continues in the Institute with some other supervisor and does not want to use previous work (e.g., start on a new problem), then this is like the normal change of supervisor, which can follow existing process.

C. If the student continues in the Institute with some other supervisor and wishes to use some of the past works in his/her thesis, the following steps will be taken:
    a. A meeting shall be called between the previous supervisor, new supervisor and the student. They may invite any other faculty member as well. If they can reach an agreement on use of previous work and role of previous supervisor (including, for example, him/her remaining as a co-supervisor without being an examiner for the thesis), that agreement will be recorded and followed.
    b. If the meeting does not result in any agreement, then in the final thesis certificate, contribution of the previous supervisor will be explicitly recorded (e.g., it may be stated that Prof. X was supervisor from date1 to date2, and Prof. Y from date2). If the previous

work included in the thesis is substantial, the previous supervisor can also ask to be a co-supervisor, without any administrative rights and without being an examiner for the PhD thesis.

D. If the student leaves the Institute, and wishes to use past work in his/her thesis and continue with some supervisor in another university/institute, he/she may seek permission through the new university/institute for use of these works. Institute will take a view based on IP protection and approval of the previous supervisor.

E. If the supervisor leaves the Institute, then possibility of him/her continuing as a supervisor or co-supervisor should be explored. If such an arrangement is not possible or fails for any reason, the student can use the previous work in the thesis. In this case, it will be explicitly recorded in the final thesis certificate that the outgoing faculty member was the supervisor from Date1 to Date2.

F. Other cases not covered by the above, or any exceptions to the above, or any disputes in implementing these guidelines, will be brought to the PGC, which will advise the Senate, which will take the final view.