

Proposal of

Dual Degree B.Tech + M.Tech in Mathematics and Computing Programme

**In place of
Five year M. Tech in Mathematics and Computing
as suggested by
CRC and UCIC**

**Department of Mathematics
IIT Delhi
February 2015**

Proposal for Dual Degree B.Tech + M.Tech in Mathematics and Computing Programme of Mathematics Department

1. Framework of the B. Tech + Dual Degree (B. Tech + M. Tech) Programme in Mathematics and Computing

A. Objective

Mathematics and computing do possess a very longstanding relationship. While mathematics focuses more on abstract concepts and ideas, computing focuses more on concrete concepts. Modern computing demands development and application of varieties of rigorous mathematical techniques, ranging from solving complicated differential equations to statistical analysis of large scale data and drawing inference from there; from finding optimized solutions under different constraints, to stochastic modeling of potentially volatile market conditions, etc. All these however can be achieved only if one has strong background of rigorous mathematics.

The Mathematics Department at IIT Delhi has played a pioneering role in bringing Mathematics and computing together by successfully running the 5-year integrated M.Tech in Mathematics and computing Program for about two decades. As per the recommendation of the CRC and UCIC, the Departmental Faculty Board (DFB) recommends that the following two programmes be offered by the Department (in place of the 5 year Integrated Mathematics and Computing program) and the intake for both the programmes will be through JEE.

(i) B. Tech in Mathematics and Computing (30 students)

(ii) Dual Degree B. Tech + M. Tech in Mathematics and Computing (18 students)

The objective of the undergraduate programme of the Department:

To build a broad-based theoretical background of Mathematical Sciences and practical training in computing, numerical methods, and mathematical/statistical modeling. Graduates of this programme will be ready for careers in research and development in software industries, financial institutions, and to develop a research-based career.

B. Framework

Taking into account the strength of the department and its experience in running a 5-year integrated M.Tech Programme in Mathematics and Computing, the Mathematics department proposes to offer a B. Tech in Mathematics and Computing (30 students) and a Dual Degree B. Tech + M. Tech in Mathematics and Computing (18 students). These programmes will have the desired depth and breadth within the extended view of mathematical sciences, and ample hands on experience of computational skills. These programmes will also address a broad range of applications within the field of Mathematics and Computing. The department will aim at covering all fundamental aspects of Mathematics and computing as its core component and will provide varieties of electives in order to enable a student to develop interest and hone the skills of different subareas of computational methods.

C. Proposed Credit Distribution:

(i) Credit structures of B. Tech in Mathematics and Computing

Total Credit: 168 (153 + 15 non graded core)
 (IC: 55 + PL EA/ES &BS: 12.5 + DC: 63.5 + DE: 12 + OC :10 =153)

1. **Institute Core** 55 credits
 - a. BS 22
 - b. EAS 18
 - c. HUSS 15
2. **Program Linked EA/ES & BS Courses: 12.5 credits (15 Maximum)**
 - a. CSL 201 Data Structures and Algorithms (CS) 5 (3-0-4) credits
 - b. EEL 201 Digital Electronics (EE) 4.5(3-0-3)credits
 - c. Principles of Electronic Material (from Physics) 3 (3-0-0) credits
3. **Department Core (DC)** 63.5 credits (55-70)
4. **Department Elective (DE)** 12 credits (10-25)
5. **Open Category Courses (OC)** 10 credits
6. **Non Graded Core Requirements** 15 credits

(ii) List of Department Core courses

	Course Number	Courses	L	T	P	C	Remarks
1	EEL 308	Computer Architecture	3	0	0	3	DC in MT5
2	EEP 308	Digital Systems Lab (Arch + Embedded)	0	0	3	1.5	DC in MT5
3	MTL 102	Differential Equations	3	0	0	3	New
4	MTL 103	Optimization Methods and Applications	3	0	0	3	DE in MT5
5	MTL 104	Linear Algebra and Applications	3	0	0	3	DC in MT5
6	MTL 105	Algebra	3	0	0	3	DE in MT5
7	MTL 106	Probability and Stochastic Processes	3	1	0	4	DC in MT5
8	MTL 107	Numerical Methods and Computations	3	0	0	3	DC in MT5
9	MTL 122	Real and Complex Analysis	3	1	0	4	DC in MT5
10	MTL 180	Discrete Mathematical Structures	3	1	0	4	DC in MT5
11	MTL 342	Analysis and Design of Algorithms	3	1	0	4	DC in MT5
12	MTL 458	Operating Systems	3	0	2	4	DC in MT5
13	MTL 783	Theory of Computation	3	0	0	3	New
14	MTL 390	Statistical Methods	3	1	0	4	DC in MT5
15	MTL 411	Functional Analysis	3	0	0	3	New
16	MTL712	Computational Methods for Differential Equations	3	0	2	4	New
17	MTL 782	Data mining	3	0	2	4	DE in MT5
18	MTP 290	Computing Laboratory	0	0	4	2	DC in MT5
19	MTD 421	B.Tech. Project (BTP)	0	0	8	4	
	Total Credits					63.5	

(iii) List of Department Electives

SN	Course Number	Course Name	L	T	P	Total Credits
1	CSL374	Computer Networks	3	0	3	4.5
2	CSL728	Compiler Design	3	9	3	4.5
3	EEL375	Embedded Systems	3	0	0	3
4	EEL703	Computer Networks	3	0	0	3
5	EEL706	Soft Computing	3	0	0	3
6	EEL707	Multimedia systems	3	0	2	4
7	EEL708	Information Retrieval	3	0	0	3
8	EEL709	Pattern Recognition	3	0	0	3
9	EEL715	Image Processing	3	0	2	4
10	EEL754	Computer Graphics	3	0	2	4
11	EEL758	Intelligent and Knowledge Based Systems	3	0	0	3
12	EEL804	Computer Vision	3	0	0	3
13	EEL806	Scientific Visualization	3	0	0	3
14	MTD 350	Mini Project	0	0	6	3
15	MTL 145	Number Theory	3	0	0	3
16	MTL246	Combinatorics	3	0	0	3
17	MTL260	Boundary Value Problems	3	0	0	3
18	MTL 270	Measure Integral and Probability	3	0	0	3
19	MTL 415	Parallel Algorithms	3	0	0	3
20	MTL 265	Mathematical Programming Techniques	3	0	0	3
21	MTL 773	Wavelets and Applications	3	0	0	3
22	MTL 775	Programming Languages	3	0	0	3
23	MTL 776	Graph Algorithms	3	0	0	3
24	MTL 781	Finite Element Theory and Applications	3	0	0	3
25	MTL 765	Parallel Computing	3	0	0	3
26	MTL 766	Multivariate Statistical Methods	3	0	0	3
27	MTL 768	Graph Theory	3	0	0	3
28	MTL 704	Numerical Optimization	3	0	0	3
29	MTL 710	Database Management Systems	3	0	2	4
30	MTL 717	Fuzzy Sets and Applications	3	0	0	3
31	MTL 720	Neurocomputing and Applications	3	0	0	3

32	MTL 731	Introduction to Chaotic Dynamical systems	3	0	0	3
33	MTL 732	Financial Mathematics	3	0	0	3
34	MTL 733	Stochastic of Finance	3	0	0	3
35	MTL 735	Advanced Number Theory	3	0	0	3
36	MTL 738	Commutative Algebra	3	0	0	3
37	MTL 739	Representation of Finite Groups	3	0	0	3
38	MTL 741	Fractal Geometry	3	0	0	3
39	MTL 742	Operator Theory	3	0	0	3
40	MTL 743	Fourier Analysis	3	0	0	3
41	MTL 744	Mathematical Theory of Coding	3	0	0	3
42	MTL 751	Symbolic Dynamics	3	0	0	3
43	MTL 754	Principles of Computer Graphics	3	0	0	3
44	MTL 755	Algebraic Geometry	3	0	0	3
45	MTL 756	Lie Algebras and Lie Groups	3	0	0	3
46	MTL 757	Introduction to Algebraic Topology	3	0	0	3
47	MTL 760	Advanced Algorithms	3	0	0	3
48	MTL 761	Basic Ergodic Theory	3	0	0	3
49	MTL 766	Probability and Computing	3	0	0	3
50	MTL 770	Combinatorial Optimization	3	0	0	3
51	MTL 785	Natural Language Processing	3	0	0	3
52	MTL 792	Modern Methods in Partial Differential Equations	3	0	0	3
53	MTL 793	Numerical Methods for Hyperbolic PDEs	3	0	0	3
54	MLL 794	Advanced Probability Theory	3	0	0	3
55	MTV 791	Special Module in Dynamical System	1	0	0	1

(iv) **Proposed Semester-wise scheduling of courses (Semester-I & II are IC)**

Se m	Lecture 1	Lecture 2	Lecture 3	Lecture 4	Lecture 5	Lecture 6	Practical	L-T-P C
I	MTL100/M TL 101 (3-0-0) (4)	EE/CS (3-0- 2) (4)	PH/CY (3-0-4) (4)	AML 110 (3-1-0) (4) /free	Language (0-0-2) (1) /None	Engg Vis/Prod. Rel (0-0-4) (2)		17
II	MTL 101/MTL 100 (3-1-0) (4)	CS/EE (3-0-2) (4)	CY/PH (3-0-4) (4)	Free/AML 110 (3-1-0) (4)	None/ Language (0-0-2) (1)	Prod. Rel/ Engg. Vis (0-0-4) (2)		17
III	CSL 201 (3-0-4) (5)	MTL 180 (3-1-0) (4)	PHL111 (3-0-0) (3)	ENV(2)	MTL104 (3-0-0) (3)	Hul-I (4)	Intro to Dept. (0- 0-2) (NC)	21
IV	MTL 122 (3-0-0) (3)	EEL 201 (3-0-3) (4.5)	MTL 103 (3-0-0) (3)	Bio (3-0-2) (4)		Hul-II (4)	MTP 290 (0-0-4) (2)	20.5
V	MTL 106(3-1-0) (4)	EEL 308 (3-0-0) (3)	MTL 105 (3-0-0) (3)	MTL 107 (3-0-0) (3)	MTL 342 (3-1-0) (4)	Hul-III (4)		21
VI	MTL 102 (3-0-0) (3)	MTL 782 (3-0-2) (4)	MTL 390 (3-1-0) (4)	MTL 411 (3-0-0) (3)	E-I (3-0-0) (3)		EEL 308 (0-0-3) (1.5)	18.5
VII	MTL 712 (3-0-2) (4)	MTL 783 (3-0-0) (3)	E-II (3)	MTL 458 (3-0-2) (4)	OC1 (3/4)	Hul-IV(3)		20/21
VIII	OC2 (3/4)	OC3 (3/4)	E-III (3)	E-IV (3)	BTP-I (0-0-8) (4)			16/18

- (v) **The proposed credit structures of Dual Degree B. Tech+ M.Tech in Mathematics and Computing.**

Total Credit: 202 (187 + 15 non graded core)

(IC: 55 + PL EA/ES & BS: 12.5 + DC: 59.5 + DE: 12 + OC : 10 + PC : 22 + PE: 16 =187)

- (vi) **PC courses**

Sl. No.	Course Code	Course Name	L	T	P	C
1	MTD 851	MTP-I	0	0	12	6
2	MTD 852	MTP-II	0	0	32	16
3	MTD 853*	MTP-I	0	0	8	4
4	MTD 854*	MTP-II	0	0	36	18
		Total Credits (* Either MAD 851 + MAD 852) or (MAD 853 + MAD 854)	0	0	44	22

- (vii) **PE courses: Same as the list of DE courses as given in (iii). Note that PE courses have to be 700 or above level courses.**

- (viii) **Proposed Semester-wise scheduling of courses (Semester-I & II are IC) for Dual degree B.Tech+ M.Tech Tech in Mathematics and Computing.**

Se m	Lecture 1	Lecture 2	Lecture 3	Lecture 4	Lecture 5	Lecture 6	Practical	L-T-P C
I	MTL 100/ MTL 101 (3-1-0) (4)	EE/CS (3-0-2) (4)	PH/CY (3-0-4) (4)	AML 110 (3-1-0) (4) /free	Language (0-0-2) (1) /None	Engg Vis/ Prod. Rel (0-0-4) (2)		17
II	MTL 101/ MTL 100 (3-1-0) (4)	CS/EE (3-0-2) (4)	CY/PH (3-0-4) (4)	Free/AML 110 (3-1-0) (4)	None/ Language (0-0-2) (1)	Prod. Rel/ Engg. Vis (0-0-4) (2)		17
III	CSL 201 (3-0-4) (5)	MTL 180 (3-1-0) (4)	PHL111 (3-0-0) (3)	ENV(2)	MTL104 (3-0-0) (3)	Hul-I (4)	Intro to Dept. (0-0-2)(NC)	21
IV	MTL 122 (3-0-0) (3)	EEL 201 (3-0-3) (4.5)	MTL 103 (3-0-0) (3)	Bio (3-0-2) (4)		Hul-II (4)	MTP 290 (0-0-4) (2)	20.5
V	MTL 106 (3-1-0) (4)	EEL 308 (3-0-0) (3)	MTL 105 (3-0-0) (3)	MTL 107 (3-0-0) (3)	MTL 342 (3-1-0) (4)	Hul-III (4)		21
VI	MTL 102 (3-0-0) (3)	MTL 782 (3-0-2)(4)	MTL 390 (3-1-0) (4)	MTL 411 (3-0-0) (3)	E-I (3-0-0) (3)		EEP 308 (0-0-3) (1.5)	18.5
VII	MTL 712 (3-0-2) (4)	MTL 783 (3-0-0) (3)	E-II (3)	MTL 458 (3-0-2) (4)	OC1 (3/4)	Hul-IV(3)		20/21
VIII	OC2 (3/4)	OC3 (3/4)	E-III (3)	E-IV (3)	E-V (3)			15/17
IX	E-VI (3)	E-VII (3)	E-VIII (3)	E-IX (4)			MTP-I (0-0-12) (6)	19
X							MTP-II (0-0-32) (16)	16

Head, Mathematics

Appendix

Changes made in MT4/MT6 (B.tech and Dual Degree) from MT5 (Five year Integrated M.Tech) :

1. MAL 122 real and Complex analysis was in BS course. As new BS courses are approved by Senate, this course has been moved to Departmental core.
2. Two new courses (i) Differential equations and (ii) Computational Methods for Differential Equations are introduced in DC in place of the course (a) Differential Equations: Theory and Methods
3. Functional Analysis is introduced in place of Topology and Functional Analysis.
4. Linear algebra and applications is introduced in place of Linear Algebra Course
5. Algebra is now moved from DE to DC
6. Theory of Computation is newly included in DC

Summary: Essentially two new courses are added in DC (one from Applied Mathematics, and one from Computing)

Courses that are moved from DC to DE or are removed:

1. Computer Graphics: both EEL and MAL Numbers are included.
2. Image Processing: only EEL Number is included.
3. Colloquium, MAN 150, MAT 450: are removed as per Institute Guideline.

Conclusion: Out of 153 credits, changes are only 8 credits (introduction of two new courses in DC and moving two courses to DE), which is 5.16 % only in compared to the existing Five year M. Tech in Mathematics and Computing Program. So the character of the program remains the same. As per the recommendation of the CRC and UCIC, Department of Mathematics is modifying the 5 year integrated in Mathematics and Computing program into a B. Tech and a Dual Degree B. Tech + M. Tech in Mathematics and Computing Program.