AP-15
Senate/Agenda/2012-13/2nd/27.09.2012

Sh. V K Misra
Pl. ask for enclosure.

INDIAN INSTITUTE OF TECHNOLOGY KANPUR
4242

Secretary Senate
Kindly put up for the consideration of Senate.
Shandi
14-8-12

Date: August 14, 2012

Chairman, Senate
IIT Kanpur

Sub: Minutes of the 3rd EPC meeting held on June 8, 2012.

Dear Sir,

Please find enclosed herewith a copy of the Minutes of the 3rd EPC meeting held on June 8, 2012 for your kind perusal and necessary action.

With kind regards,

Sincerely,

A. Upadhyaya
Convener, EPC

Enclosures: As above.

2012
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कुलसचिव कार्या०/Registrar's Office

AP-16
Senate/Agenda/2012-13/2nd/27.09.2012

Minutes of the 3rd EPC Meeting held on June 8, 2012

Members Present:
Prof. S.G. Dhande (Chairman, EPC), Prof. Rajiv Sinha (Chairman, SPGC), Prof. Sumit Ganguly (Acting Chairman, SUGC), Professor V. Shankar (special invitee), Karanveer Singh (student representative), and Dr. Anish Upadhyaya (Convenor, EPC)

Agenda Item Discussed: Report on the Sub-Committee on B.Tech. Program in Engineering Sciences

Minutes:

EPC discussed the recommendations of the senate-approved sub-committee that was constituted (vide letter no. DIR/IITK/2012/00-30 dt. 31.3t.12, by the Director) to look into various aspects related to the implementation of the proposed B.Tech. program in 'Engineering Sciences.'

1. The committee feels that the Engineering Sciences is a well-conceived, niche' programme. In particular, the Track I curriculum *(Energy, Environment and Climate)* is a novel concept. However, the EPC also examined the proposed course curriculum under the track '*Geosciences*,' and it was felt that a significant portion of courses in this track can be included in 'Track I' and the committee may consider renaming it to '*Energy, Environment and Earth Sciences*'.

2. The EPC members present expressed their reservations on the structure of the Track-II (*Mechanics*) and felt that course should have the novelty and should be framed in a way so that that it becomes truly interdisplinary. Furthermore, modeling and synthesis should be intrinsic parts of any Engineering Sciences curriculum and this should be reflected in the proposed curriculum of Track II *(Mechanics)*.

3. The EPC agrees with the recommendations of the committee regarding the eligibility requirement for the student to switch over to the Engineering Sciences program. It was also suggested that the institute should conduct an open house/orientation programme for the first and second year UG students so as to enable them to make informed decisions regarding opting for this branch.

4. EPC agrees with the committee's recommendation of limiting the number of seats for each track to 10 in the initial years.

5. EPC endorses the administrative structure proposed by the committee. It however emphasized that the success of this program requires the sustained involvement of committed faculty members.

6. Notwithstanding the existing branch change rules, EPC feels that for this program the option for opting for this branch should be given after four semesters as well.

(S.G. Dhande)
Chairman, EPC

(Anish Upadhyaya)
Convenor, EPC

AP-17
Senate/Agenda/2012-13/2nd/27.09.2012

From:
V Shankar
Professor
Department of Chemical Engineering
IIT Kanpur

To:
Chairman – Senate
IIT Kanpur

Convener, Senate EPC
Kindly review in EPC and forward it with the comments to Senate.
Shanki
22-5-12

Dear Sir,

(Cc: DD, DoAA, Dte)

Sub: Report of the sub-committee on **B.Tech program in Engineering Sciences**

A senate-approved committee was formed (vide letter no. DIR/IITK/2012/00-30, dated March 31, 2012, by the Director) to look into various aspects related to implementation of the proposed "Engineering Science" program. The committee, chaired by Prof. C. S. Upadhyaya, met several times and the report drafted by the committee is attached herewith for your kind perusal. Prof. C. S. Upadhyaya is currently out of station, and he has asked me to submit the report.

Thanks very much for your kind attention.

Sincere regards,

V Shankar

EPC

AP-18
Senate/Agenda/2012-13/2nd/27.09.2012

Engineering Sciences Program

A senate approved committee was formed to look into various aspects related to implementation of the proposed "Engineering Science" program. A committee was formed vide letter no. DIR/IITK/2012/00-30, dated March 31, 2012, by the Director. The committee comprised of the following members:

(a) Dr. CS Upadhyay (AE, Convener), (b) Dr. S Guha (CE), (c) Dr. H Karnick (CSE), (d) Dr. N Mishra (Math. & Stat.), (e) Dr. V Shankar (ChE), (f) Dr. S. Mahesh (AE/ME) and (g) Dr. A Banerjee (EE).

The terms of reference of the committee were:

(1) Propose complete curriculum for the B. Tech. program in Engineering Science, including semester-wise template.
(2) Propose requirements, if any, for switching to Engineering Science program.
(3) Propose number of seats (if any constraint is proposed) for the program.
(4) Propose administrative structure (like DUGC) of the program.
(5) Propose changes to branch change rules, if required.
(6) Propose any other changes to UG Manual, if required.

The committee met several times to discuss the templates and other issues desired. The following are the recommendations of the committee:

ITEM 1:

(1) The detailed templates for the two tracks – **Energy Environment and Climate (EEC); Mechanics (MCH)** - have been prepared, as per the senate approved format. These templates are included as Appendix I.
(2) Another proposal for a track in Geosciences, as submitted by the Geosciences group of Civil Engineering, is added for reference of the senate. The committee felt that the terms of reference does not include this track, and hence the senate should opine on offering it or not.

ITEM 2:

(1) A student can change to the Engineering Science program, as per the standard norms of branch change. However, since this program does not have any initial intake (only via branch change) a CPI criterion should be added. **The minimum CPI for eligibility should be 7.0 for General category and 6.5 for OBC, SC/ST.**
(2) No other constraints on eligibility is required.

ITEM 3:

(1) As a first step, it is proposed that the program should have 10 seats in each of the tracks, i.e. total of 20 seats.
(2) The number of seats maybe increased in future, depending on response to this program and availability of laboratory infra-structure.

ITEM 4:

The program will function like any undergraduate department, with the following structure:

(1) **Program Coordinator:** The program coordinator should be the current Head of one the participating departments, i.e. Aerospace, Mechanical, Chemical, Civil, Physics. The selection of the coordinator will be by rotation. The coordinator will be appointed for a two-year term.
(2) **Program Undergraduate Committee (PUGC):** This will have the coordinator as a member, the previous coordinator as an ex-officio member, and one representative from each of the participating departments (i.e. AE, ME, ChE, CE, Phy.). Further,
   (a) One of the members will be chosen as the convener by the PUGC.
   (b) The PUGC will look after all undergraduate academic issues related to the program and function like the DUGC of any department.
   (c) The PUGC will be charged with the added responsibility of advising the students on academic matters, e.g. course selection, etc.
   (d) The convener of the PUGC will represent this program in the SUGC.
(3) The program should be provided with a dedicated office-space: office for Coordinator; space for meetings of PUGC and program library; small seminar room (30 seater).
(4) Dedicated office staff is required at the following levels: (a) 1 Superintendent (or Junior Superintendent), (b) 1 assistant, (c) 1 junior assistant.
(5) For proper functioning of the program, a budget should be allocated to the program, in line with the existing departments.

ITEM 5:

The committee felt that the standard branch-change rules, as applicable to all UG programs, should be adopted. The only exception is that the student should have a minimum CPI of 7.0 at the end of second semester or the fourth semester (in case of 2nd year branch change).

ITEM 6:

The UG manual requires the following changes:

(a) Item 1.2 requires addition of PUGC, with the structure as given above.
(b) Annexure 1 will require the CPI requirement for Engineering Sciences to be added as an exception, i.e. minimum CPI for general candidates should be 7.0 and 6.5 for OBC, SC and ST applicants.
(c) Annexure 1 (item A, 3) The strength constraint should be waived for Engineering Sciences. Only the upper limit of ten per track will be enforced.

(d) Annexure 1 (item B, 2) should specify the same CPI requirement, i.e. minimum of 7.0 for general; and 6.5 for OBC, SC and ST should be enforced.
(e) In Annexure 2, the course template of Engineering Science should be added.

ANY OTHER ITEMS:

The geosciences group of the Civil Engineering department has proposed another track on "Engineering Geosciences". The committee felt that discussion on this track was not in the terms of reference of the committee. However, the committee has agreed to communicate the document to the senate for discussion. The document is attached as Appendix II.

CS Upadhyay | S Guha | H Karnick | N Mishra

V Shankar | S Mahesh | A Banerjee

APPENDIX I

Energy, Environment and Climate Program in Engineering Science

Summary Sheet

Course Group	Group Code[1]	EEC Credits	EEC % of Total
HSS (excluding Management, comm. Skills etc)	HSS	49	11.5
Science (including electives)	S	81	19.0
Engineering Science (ESc, ESO)	ES	61	14.3
Technical Arts	TA	21	4.9
Management + PE + Comm Skills + Foreign Language	MPCFL	10	2.3
Department Core (Mandatory)	DC	123	28.9
Department Elective	DE	36	8.5
Open Elective	OE	45	10.6
Total		**426**	**100**

[1]These codes have been used in the template to identify the credit contributions.

ESO/SO Structure:

ESO 201, ESO 204, ESO 208, MSO 201, MSO 203b

Program Laboratory Credits: 16

Is UGP2 or UGP2 & UGP3 compulsory: UGP2 & UGP3 compulsory

TRACK 1: Energy, Environment and Climate (EEC) Template for B.Tech. Program

First Semester			Second Semester		
S: MTH 101 (C)	3-1-0-0	11	S: MTH 102	3-1-0-0	11
S: PHY 103	3-1-0-0	11	S: PHY 102	3-1-0-0	11
S: CHM 101 (Lab)	0-0-3-0	03	S: PHY 101 (Lab)	0-0-3-0	03
TA: TA 101	2-0-3-0	09	ES: ESC 101	3-1-3-0	14
S: LIF 101	2-0-0-0	06	S: CHM 102	2-1-0-0	08
HSS: ENG 112/HSS-1 (Level 1)	3-1-0-0	11	MPCFL: PE102	0-0-3-0	03
MPCFL: PE101	0-0-3-0	03			
	Total	54		Total	50
Third Semester			Fourth Semester		
ES: ESO201: Thermodynamics	3-1-0-0	11	ES: ESC 201: Electronics	3-1-3-0	14
ES: ESO204: Fluid Mechanics	3-1-0-0	11	S: MSO201: Prob. & Stat	3-1-0-0	11
S: MSO 203b (PDE)	3-1-0-0	06	HSS: HSS-3 (Level 2)	3-0-0-0	9
HSS: HSS-2 (Level 1)	3-1-0-0	11	DC-2: CE 412: Wat. & WW Dsgn.	3-0-2-0	11
DC-1: CE 211 Env. Qual.&Poll.	3-0-3-0	12	TA: TA 202 (ME)	1-0-3-0	06
TA: TA 201 (MSE)	1-0-3-0	06			
MPCFL: Composition (Web)	0-0-2-0	02			
	Total	59		Total	51
Fifth Semester			Sixth Semester		
ES: ESO208: Numerical Methods	3-1-0-0	11	DC-6: ME 301 EnergySystems I	2-0-0-0	06
DC-3: ME 341: Heat & Mass Tr.	3-0-1-0	10	DC-7:EEC 321: Climate	3-0-0-0	09
DC-4:ESO203Intro. Electrical Eng	3-1-0-0	11	DC-8:EEC322: EEC Lab	1-0-6-0	09
DC-5:EEC311: Theory Combustion	3-0-0-0	9	HSS: HSS-5 (Level 2)	3-0-0-0	09
HSS:HSS-4 (Level 2)	3-0-0-0	9	OE-1		09
MPCFL: Comm. Skills	0-0-2-0	02	OE-2/DE-1		09
			UGR-1 (Optional): EEC 323		04
	Total	52		Total	51-55
Seventh Semester			Eighth Semester		
C-9: ME 401Energy systems II	3-0-1-0	10	DC-11:EEC 421: Alt. Energy	3-0-0-0	09
DC-10: EEM 606: Air Pollution	3-0-0-0	09	DE-3/OE-3		09
OE-2/DE-1		09	DE-4		09
DE-2		09	OE-4		09
DE-3/OE-3		09	OE-5		09
DC-12: UGR-2: EEC 411		09	DC-13: UGR-3: EEC422		09
			UGR-4 (Extra Credit): EEC 423		06
	Total	55		Total	54-60

List of Compulsory Courses for EEC

Course	L-T-P-A	Credits	Present Status in the parent departments and action reqd
CE 211: Environmental Quality and Pollution	3-0-3-0	12	Compulsory course for CE BTech, offered in the odd sem
CE 412: Water Supply and Wastewater Disposal System	3-0-2-0	11	DE for CE BTech (in Basket A), it will always be offered in the even sem.
ME 341: Heat and Mass Transfer	3-0-1-0	10	Compulsory course for ME BTech, offered in the odd sem
ESO 203:Introduction to Electrical Engineering	3-1-0-0	11	An ESO course that is offered in both odd and even sem.
EEC 311: Theory of Combustion	3-0-0-0	9	Proposed new course. Contents similar to existing AE 753 and/or ME 744 which are not regularly offered. Need to be sanctioned with an UG number an offered regularly in the odd sem.
ME 301: Energy Systems I	2-0-0-0	6	Compulsory course for ME BTech, offered in the even sem
EEC 321: Introduction to Climate and Climate Change	3-0-0-0	9	Proposed new course.
EEC 322: Energy Experiments	1-0-6-0	9	Proposed new course.
EEC 323: Introduction to Research (optional)		4	Proposed new course. It is an optional reading course.
ME 401: Energy Systems II	3-0-1-0	10	Compulsory course for ME BTech, offered in the odd sem
EEM 606: Air Pollution and Control	3-0-0-0	9	An elective for EEM MTech, always offered in the odd sem, need to give an UG number in CE or EEC.
EEC 421: Alternative Energy	3-0-0-0	9	Proposed new course.
EEC 411: UG Research I		9	Proposed UG Research course
EEC 422: UG Research II		9	Proposed UG Research course
EEC 423: UG Research III (Extra Credit)		6	Proposed UG Research course

Program Elective Basket

The four DE's have to be chosen from the following courses. Some more courses may be added from time to time.

PH 304: Introduction to Atmospheric Science
EEM 603: Ecological and Biological Principles and Processes in Environment
NT 602: Nuclear and Reactor Physics
EE330 Power Systems
EE 360: Power Electronics

CE 414: River Engineering
ME 401N: Energy Systems II
ME 402: Power Systems
EEM 613: Atmospheric Physics and Chemistry
CE 442: Physical and Environmental Geology
CE 717: Groundwater Hydrology and Pollutant Transport
EEM 609: Fate and Transport of Contaminants in Natural Systems
ME 690: Alternative Fuels and Advances in IC Engines
NT 611: Nuclear Power Engineering I
AE 650: Applied Combustion
AE 653: Thermal Turbo-machines
ECO 341: Environmental Economics and Policy
ART 405: Architecture and Environmental Design
ART 406: Environmental Design & Ethics
ECO 442: Energy Economics

Course Contents for the Suggested New Courses

EEC 311: Theory of Combustion, (3-0-0-0), 9 credits

Content same as AE 753.

EEC 321: Introduction to Climate and Climate Change, (3-0-0-0), 9 credits

Introduction: Climate in the Spotlight; The Spectrum of Scientific Opinions, introduction to physics and chemistry of atmosphere. The Earth's Natural Greenhouse Effect, Radiative Balance, importance of water, Greenhouse Gases: Role of carbon dioxide and methane, major uncertainties; anthropogenic CO2 Emissions, concerns of developed and developing countries.

The Earth's carbon reservoirs: biogeochemistry, atmospheric carbon reservoir, breathing of Gaia, missing CO2 sink, carbon cycling. Some examples: physical carbon pump, biological carbon pump, marine carbon cycle, terrestrial carbon cycle.

Climate and Weather: The Earth's climate machine, global wind systems, trade winds and the Hadley cell, westerlies, importance of monsoon rains, occurrence of seasons.

Clouds, Storms and Climate: Cloud Formation and Climate, Introduction to Global Ocean Circulation; El Niño and the Southern Oscillation, and its Effects.

Outlook for the Future: Introduction to Climate Change, Advances in Computer Modeling

EEC 322: Energy Experiments (1-0-6-0), 9 credits

Experiments in dynamics of machines related to energy generation (Components of existing ME 371)

Experiments in Energy Conversion (Components of existing ME 471N)

Experiments in circuits, control systems and power systems (Components of existing EE 380 and EE381)4

Unit Operations in Heat and Mass Transfer (Components of existing CHE 391)

Chemical Reactors, Process Dynamics and Control (Components of existing CHE 492)

Characterization of a two-stage axial fan (AE propulsion Lab.)

Cascade analysis of a turbine stage (AE propulsion Lab.)

Cascade analysis of a compressor stage (AE propulsion Lab.)

Performance analysis and emission estimates in a continuous combustion unit (AE propulsion Lab.)

Performance analysis of a 2 shaft gas turbine unit (AE propulsion Lab.)

EEC 421: Alternative Energy, (3-0-0-0), 9 credits

Origin of energy sources: Energy, progress and economics; Origin of renewable sources: Energy cycles of earth

Solar radiation: Direct and scattered radiation, energy content, Variability

Wind energy: Kinetic energy and power, variability

Ocean waves: Wave spectra, power density, tides, rivers and hydropower and sustainability

Geothermal energy: Region specific resources, power densities

Biological potential and other sources: Photosynthesis, salinity differences

Energy conversion: Thermodynamics and irreversible thermodynamics in energy conversion, Photovoltaic conversion, Turbines, Thermoelectric/thermionic conversion, Electrochemical conversion; Conversion of solar radiation via solar thermal methods; Conversion of wind and wave energy; Chemical, electrochemical, photochemical and electrochemical conversion strategies

Renewable energy storage: Using latent heat, phase change, flywheels, pumped hydro, compressed gas, batteries

Energy distribution: Heat pipes, power electronics simulations, load structure, life cycle analysis, break even analysis

TRACK 2: Engineering Science (Mechanics) Template for B.Tech. Program

First Semester			Second Semester		
S: MTH 101 (C)	3-1-0-0	11	**S:** MTH 102	3-1-0-0	11
S: PHY 102/ PHY 103	3-1-0-0	11	**S:** PHY 103 / PHY102	3-1-0-0	11
S: PHY101/CHM 101 (Lab)	0-0-3-0	03	**S:** CHM 101 / PHY 101 (Lab)	0-0-3-0	03
TA/SC: {TA101+LIF101}/ESC101	{2-0-3-0+2-0-0-0}/3-1-3-0	14	**ES:** ESC 101/ {TA 101+LIF101}	3-1-3-0/{2-0-3-0+2-0-0-0}	14
HSS: ENG 112/HSS-1 (Level 1)	3-1-0-0	11	**S:** CHM 102	2-1-0-0	08
MPCFL: PE101	0-0-3-0	03	**MPCFL:** PE102	0-0-3-0	03
	Total	**53**		**Total**	**50**

Third Semester			Fourth Semester		
ES: ESC201 (electronics)	3-1-3-0	14	**HSS:** HSS-2 (Level 1)	3-1-0-0	11
SO-1: MSO202a (complex) + MSO203b (PDE)	3-1-0-0	11	**SO-3:** ESO208 (num. meth)	3-1-0-0	11
ESO-2: ESO209 (dynamics)	2-1-0-0	08	**DC: DEPT:** MCH201 (= ESO201, thermodynamics)	3-0-2-0	11
DEPT : MCH204 (= ESO204, fluid mech)	3-0-0-0	09	**DC: DEPT:** MCH202 (= ESO202, mech. of solids)	3-0-0-0	09
TA: TA201(MSE)/TA202 (ME)	0-0-2-0	02	**DC:DEPT:** AE251 (measurement lab)	2-0-2-0	08
MPCFL: Composition (Web)	0-0-2-0	02	**TA:** TA202 (ME)/ TA201(MSE)	1-0-3-0	06
	Total	**46**		**Total**	**56**

Fifth Semester			Sixth Semester		
ESO-3: ESO205 (materials)	3-1-0-0	14	**DC: DEPT:** PHY306/SE312	3-0-0-0	09
DC: DEPT: MCH394 (=SE394, continuum mech.)	3-0-0-0	09	**HSS-4:** HSS (Level 2)	3-0-0-0	09
DC: DEPT: ME341 (heat & mass transfer)	2-0-2-0	08			
DC: DEPT: ME353 (vibration)	3-1-2-0	11	**DE-1:**	3-0-0-0	09
UGP1 (optional)	0-0-4-0	04	**DC: DEPT:** Any course from the fluids basket	3-0-0-0	09
DC:DEPT: AE351 (structures, fluid mech. lab)	0-0-4-1	05	**UGP2/OE/DE**	0-0-9-0/ 3-0-0-0	09
MPCFL: Comm. Skills	0-0-2-0	02	**DC: DEPT:** Any course from the solids basket	3-0-0-0	09
	Total	**49**		**Total**	**54**

Seventh Semester			**Eighth Semester**		
DE-2: Any course from the bio-/geomechanics basket	3-0-0-0	09	**HSS-4**: Level 2	3-0-0-0	09
DC: DEPT: CHE391 (unit ops. lab.)	1-0-3-0	08	**DE: DEPT :** course from any program basket	3-0-0-0	09
DE: DEPT: Any program elective	3-0-0-0	09	**DE-2:** Any course from the geo-/biomechanics basket	3-0-0-0	09
OE-5:	3-0-0-0	09	**DE-1:** course from any program basket	3-0-0-0	09
UGP3/OE/DE:	0-0-0-9/3-0-0-0	09	**OE-6:**	3-0-0-0	09
			UGP4 (optional):	0-0-0-9	09
	Total	**44**	**OE-4**	3-0-0-0	09
				Total	**54**

1. Courses constituting the various baskets are listed below.
2. If a course from the biomechanics basket is taken as DE-2 in the seventh semester, a course from the geomechanics basket is required to be taken in the eighth semester as DE-2, and vice-versa.

List of courses in Engineering Science (Mechanics) Undergraduate Program

All courses related to the undergraduate programs in engineering science (mechanics) including compulsory courses, departmental electives are listed below

Compulsory Courses

L-T-P-A	Credits	Title	Number
3-0-2-0	11	Thermodynamics	MCH201
3-0-0-0	09	Mechanics of solids	MCH202
3-0-0-0	09	Fluid mechanics and rate processes	MCH204
2-0-2-0	08	Experiments in Aerospace Engineering I	AE251
2-0-2-0	08	Heat and mass transfer	ME341
3-1-2-0	11	Vibrations	ME353
0-0-4-1	05	Experiments in Aerospace Engineering II	AE351
3-0-0-0	09	Continuum mechanics	MCH394
1-0-3-2	08	Unit operation lab I	CHE391
3-0-0-0	09	Order and chaos	PHY306/SE312

Pogram Core/Elective courses in the fluid mechanics basket

No more than one course listed against each thematic title may be taken.

L-T-P-A	Credits	Title	Number
3-1-0-0	11	Statistical mechanics	SE316
3-0-0-0	09	Microscale thermal sciences	SE381

3-0-0-0	09	Molecular fluid mechanics	SE395/ME637/AE747
3-1-0-0	11	Incompressible aerodynamics	AE 211
3-0-0-0	09	Compressible aerodynamics	AE311
3-0-0-0	09	Boundary layer theory	AE481
3-1-0-0	11	Computational fluid dynamics	AE453/AE615/AE622/ME634
3-0-0-2	11	Transition and turbulence	AE617/AE625/AE621/ME647/PHY672
3-0-0-0	09	Introduction to tribology	ME355
3-0-0-0	09	Hydrodynamic instabilities (New)	MExxx

Program core/elective courses in the solid mechanics basket

No more than one course listed against each thematic title may be taken.

L-T-P-A	Credits	Title	Number
3-0-0-0	09	Aerospace structural analysis-I	AE670
3-0-0-0	09	Aeroelasticity	AE676
3-0-0-0	09	Introduction to finite element methods	AE675/ME425/ME623/SE363
3-0-0-0	09	Random vibrations	AE683/ME628
33-0-0-0	09	Theory of elasticity	ME321/ME622
3-0-0-0	09	Structural vibrations	AE678/ME626
3-0-0-0	09	Mechanics of soft matter/Contact mechanics (New)	CHE678/MExxx
3-0-0-0	09	Experimental stress analysis	ME671
3-0-0-0	09	Theory of plasticity	ME721
3-0-0-0	09	Fracture and fatigue	ME728
3-0-0-0	09	Wave propagation in solids	ME723

Program core/elective courses in the biomechanics basket

L-T-P-A	Credits	Title	Number
3-0-0-0	09	Biomechanics	BSE314
3-0-0-0	09	Evolution of biological machines	BSE441
3-0-0-0	09	Intro biophysics	PHY309/SE303
3-0-0-0	09	Natural nanomachines	PHY314
3-1-0-0	11	Physics of biomaterials: structure and design	SE304
3-0-0-0	09	Biosystems	SE334
3-0-0-0	09	Biological fluid dynamics (New)	MCH412

Program core/elective courses in the geomechanics basket

L-T-P-A	Credits	Title	Number
3-0-0-0	09	Earth systems	SE397
3-0-0-0	09	Atmosphere and environment	SE389
3-0-0-0	09	Introduction to earthquake engineering	CE423
3-0-0-0	09	Constitutive modeling of soils	CE434
3-0-0-0	09	Earth system processes	CE640
3-0-0-0	09	Geological hazards	CE642
3-0-0-0	09	Atmospheric physics	PHY304/PHY670
3-0-0-0	09	Granular materials	ME725

Other program elective courses

No more than one course listed against each thematic title may be taken.

L-T-P-A	Credits	Title	Number
3-0-0-0	09	Space mechanics	AE641/AE642/ME650/ME660
3-0-0-0	09	Optimization methods in engineering design	ME 442
3-0-0-0	09	Classical mechanics	PHY401/ME652
3-0-0-0	09	Special and general relativity	PHY407
3-0-0-0	09	Variational calculus	ME624
3-0-0-0	09	Hamiltonian mechanics and symplectic algorithms	ME726

Optional and Extra Credit Courses

L-T-P-A	Credits	Title	Number
0-0-0-9	09	UG Project I (Extra Credits)	MCH398
0-0-0-9	09	UG Project II (Extra Credits)	MCH399
0-0-0-9	09	UG Project III (Extra Credits)	MCH498
0-0-0-9	09	UG Project IV (Extra Credits)	MCH499

ARC Guidelines for Percentage Credit Allocation in Academic Programme vis-à-vis Program Proposal

Course Group	Group Code[3]	MCH Credits (Min)	MCH, % of Total	ARC Reco, % of Total
HSS (excluding Management, comm. Skills etc)	HSS	40	9.8	10
Science (including electives)	S	86[1]	21.2	20
Engineering Science (ESC, ESO)	ES	50	12.3	10
Technical Arts	TA	16	3.9	5
Management + PE + Comm Skills + Foreign Language	MPCFL	10	2.5	5
Department Core (Mandatory)	DC	105	25.9	25
Department Elective	DE	54[2]	13.3	10
Open Elective	OE	45[2]	11.1	15
Total		**406**	**100**	**100**

[1]Does not include electives. Impossible to include as the students are free to choose them according to their wish.
[2]Minimum credits. May increase depending on the courses chosen by the student. UGP2/OE/DE in the sixth semester and UGP3/OE/DE in the seventh semester have been counted under OE.
[3]These codes have been used in the template to identify the credit contributions.

Appendix II

Proposal for 4-year B.Tech. Program in Engineering Geosciences

Geoscience is a truly interdisciplinary science which requires input from various disciplines namely, physics (earth processes), chemistry (earth materials), biology (fossil records and paleobiology), mathematics (numerical modeling of earth systems) and engineering (engineering materials, geoengineering). In recent years, the curriculum of geosciences across the world has become much more broad-based encompassing the entire earth system namely land, atmosphere, hydrosphere and biosphere. In other words, we are moving towards an 'earth system' approach. In India, our geosciences curriculum has not responded to these changes and we have therefore failed to respond to the technical and professional needs of the society.

The Indian Institute of Technology Kanpur has been involved in geosciences related activities for over two decades. A post-graduate programme in Engineering Geosciences has been in operation for the last twenty five years under the auspices of the Civil Engineering Department. We also have a very active research group at IIT Kanpur with expertise in traditional as well as applied geosciences. Apart from the Engineering Geosciences Group, the expertise in the environmental engineering, water resources engineering, geoinformatics, earthquake engineering, geotechnical engineering and chemical sciences can also be effectively utilized for developing a sound undergraduate pogramme in geosciences and to produce the much desired manpower to take up the challenges for the sustainable development of the society and the country.

The proposed B.Tech. programme in Geosciences will utilize a number of professional courses across the different departments in terms of basic sciences, HSS and electives. A number of new courses have also been proposed as a part of this new programme. While we already have the expertise for some of these, we will need new faculty to teach some of the courses such as geophysics, geohydrology, structural geology etc. A distribution of the courses and units under different groups of courses is shown in Table 1 and a template for the programme is shown in Table 2. Table 3 shows the details of the core courses and suggested electives for the Geosciences programme.

Table 1. Distribution of courses and credits

Course Group	Group Code	Total credits (Min)	% of total credits	ARC recommendation (% of total credits)
HSS (excluding Management, comm.skills etc)	HSS	49	11.9	10
Science (including electives)[1]	S	75	18.2	20
Engineering Science (Esc, ESO etc.)	ES	61	14.8	10
Technical Arts	TA	21	5.1	5
Management + PE + Comm Skills +	MPCFL	10	2.4	5

Foreign Language				
Core courses (Mandatory)	DC	102	24.8	25
Electives[2]	DE	40	9.7	10
Open Electives[2]	OE	54	13.1	15
Total		412	100	100

1- Does not include electives.
2- Minimum credits; may increase depending on the courses chosen by the student.

Table 2. Course Template for 4-year B.Tech. Program in Engineering Geosciences

First Semester			**Second Semester**		
S:MTH 101 (C)	3-1-0-0	11	S:MTH 102	3-1-0-0	11
S:PHY 103	3-1-0-0	11	**S:PHY 102**	3-1-0-0	11
S:CHM 101 (Lab)	0-0-3-0	03	S:PHY 101 (Lab)	0-0-3-0	03
TA: TA 101	2-0-3-0	09	**ES:**ESC 101	3-1-3-0	14
S:LIF 101	2-0-0-0	06	S:CHM 102	2-1-0-0	08
HSS:ENG 112/HSS-1 (Level 1)	3-1-0-0	11	**MPSFL:**PE 102	0-0-3-0	03
MPCFL : PE 101	0-0-3-0	03			
	Total	**54**		**Total**	**50**
Third Semester			**Fourth Semester**		
ES: ESC 201:Electronics	3-1-3-0	14	**HSS:**HSS-2 (Level 1)	3-1-0-0	11
ES: ESO-1 : Mechanics of Solids	3-1-0-0	11	S:SO-3: Prob. & Stat	3-1-0-0	11
ES: ESO-2: Fluid Mechanics	3-1-0-0	11	**DC-2:** Earth Materials and Resources	2-0-2-0	08
DC-1: CE322: Introduction to Earth Sciences	3-0-0-0	09	**DC-3:** Structural geology	3-0-2-0	11
TA: TA 201 (MSE)	1-0-3-0	06	**DC-4:** Earth's surface processes	3-0-0-0	09
MPCFL: Composition (web)	0-0-2-0	02	**TA:**TA 202 (ME)	1-0-3-0	06
	Total	**54**		**Total**	**54**
Fifth Semester			**Sixth Semester**		
ES: ESO-3: Numerical Methods	3-1-0-0	11	**DC-10:** Resource exploration methods	2-0-2-0	08
DC-5: CE331: Geoinformatics	3-0-2-0	11	**DC-11:** Earth's history	3-0-0-0	09
DC-6: Mineralogy & Crystallography	2-0-2-0	08	**DC-12:** Geohydrology	2-0-0-0	06
DC-7: Principles of Geophysics	2-0-2-0	08	DC-13: Field Geology Part - II	2-0-0-0	06
DC-8: Geochemistry	2-0-0-0	06	**HSS:** HSS-3 (Level 2)	3-0-0-0	09
DC-9: Field Geology Part-1	2-0-0-0	06	**OE-1**	3-0-0-0	09
MPCFL : Comm Skill	0-0-2-0	02	**OE-2**	3-0-0-0	09
	Total	**52**		**Total**	**56**
Seventh Semester			**Eighth Semester**		
OE-3		06	**DE - 4**		06-11
DE-1		06-11	**DE -5**		06-11
DE -2		06-11	**OE-5**	3-0-0-0	09
DE -3		06-11	**OE-6**	3-0-0-0	09
OE-4	3-0-0-0	09	**HSS:**HSS-5 (Level 2)	3-0-0-0	09
HSS:HSS-4 (Level 2)	3-0-0-0	09			
	Total	**51-57**		**Total**	**45-58**

Table 3: List of courses

A. Compulsory courses

Title	L-T-P-A	Credits	Remarks
DC-1: Introduction to Earth sciences	3-0-0-0	09	Existing course (CE322)
DC-2: Earth Materials and Resources	2-0-2-0	08	New course, expertise available
DC-3: Structural geology	3-0-2-0	11	New course, expertise available
DC-4: Earth's surface processes	3-0-0-0	09	New course, expertise needed
DC-5: Geoinformatics	3-0-2-0	11	New course, expertise available
DC-6: Mineralogy & Crystallography	2-0-2-0	08	Existing course (CE331)
DC-7: Principles of Geophysics	2-0-2-0	08	New course, expertise available
DC-8: Geochemistry	2-0-0-0	06	New course, expertise needed
DC-9: Field Geology Part-1	2-0-0-0	06	New course, expertise available
DC-10: Resource exploration methods	2-0-2-0	08	New course, expertise available
DC-11: Earth's history	3-0-0-0	09	New course, expertise needed
DC-12: Geohydrology	2-0-0-0	06	New course, expertise available
DC-13: Field Geology Part - II	2-0-0-0	06	New course, expertise needed

B. Electives

MSE 201: Thermodynamics & Phase equilibria	3-1-0-0	11	Existing course
ME 301: Energy Systems I	2-0-0-0	06	Existing course
ECO312: Econometric practice	3-1-0-0	04	Existing course
ECO341: Environmental Economics and policy	3-1-0-0	04	Existing course
CE 351: Soil mechanics	2-0-2-0	08	Existing course
CE 361: Engineering hydrology	2-0-0-0	06	Existing course
CE422: Physical and Environmental Geology	3-0-0-0	09	Existing course
CE 431: Advanced measurements techniques	3-0-0-0	09	Existing course
ECO442: Energy Economics	3-1-0-0	04	Existing course
CE451: Application of geotechnical engineering	3-0-0-2	11	Existing course
CE 462: Hydraulic and hydrologic design	3-1-0-0	11	Existing course
ECO543: Environmental Impact Assessment	3-1-0-0	04	Existing course
DE: Paleoecology and paleoenvironments	3-0-0-0	09	New course
DE: Geodynamics and plate tectonics	3-0-0-0	09	New course
UG Research I	0-0-0-9	09	Research based
UG Research II	0-0-0-9	09	Research based
Other PG courses as available from time to time			

In summary, the salient features of this programme are:

- This offers a programme in the engineering sciences stream which is different from the one in basic sciences and aims to truly integrate the engineering and science-based courses.
- This programme includes electives from several departments with an attempt to bring in multi-disciplinarity
- This programme includes a large number of courses with hand-on lab exercises aimed at providing practical experience. This also includes two field-based courses aimed at observing the earth's processes and providing an exposure to real-life problems.
- Apart from the academic merit, this programme will impart knowledge about the planet on which we live and will prepare a breed of students who will be better prepared for the optimal exploitation of earth's limited resources.