

SPAC Meeting

Indian Institute of Technology, Kanpur
Proposal for a New Course for Postgraduate studies

1. Course No: SPA 626
2. Course Title: Space Environments and Space Systems
3. Per Week Lectures: 3(L), Tutorial: 0 (T), Laboratory: 0 (P), Additional Hours[0-2]:0 (A), Credits (3*1+2*T+P+A):9, Duration of Course: Full Semester
4. Proposing Department/IDP : Space, Planetary & Astronomical Sciences & Engineering (SPASE)
5. Proposing Instructor(s): Rohit Sharma and Soumyabrata Chakrabarty
Other faculty members interested in teaching the proposed course:
6. Course Description:

A. Objectives: This course aims to provide the students the exposure to understand different aspects of the space environment, including space weather, space climate, space debris and how these impact on spacecraft design, terrestrial infrastructure systems and will enable students to explore particular topics at a deeper level.

B. Contents (preferably in the form of 5 to 10 broad titles):

S No.	Broad Title	Topics	No. of lectures
1	Introduction	Space weather definition; solar activity, solar wind, solar flare, coronal mass ejection, effects of solar activity on our earth, magnetosphere, magnetic storm and magnetic substorm, spacecraft systems and its orbits, classification of space environments for a spacecraft.	5
2	Neutral particles environment	Neutral gas flow around a spacecraft, earth's atmosphere, pressure variation with altitude, planetary atmospheres, aerodynamic force; contamination, erosion by atomic oxygen, glow, particle impacts on spacecraft, scattering of EM	5

3	Plasma Environment	The geomagnetic field, the external and disturbance fields; low earth orbit, polar orbits, the geosynchronous plasma environment; spacecraft-plasma interactions, spacecraft surface charging and current collection, current sources to a spacecraft, spacecraft-plasma interactions, spacecraft surface charging and current collection, current sources to a spacecraft, current from the ambient plasma, photoelectric currents, backscattered and secondary electrons, effect of magnetic fields on current collection, artificial current and charge sources; general probe theory; the thin-sheath limit the thick-sheath limit, spacecraft potentials, barrier potentials, potentials, anomalies, and arcing on geo-spacecraft.	8
4	Macroscopic particle environment	The physics of macroscopic particles, cometary meteoroids, asteroidal meteors, space debris.	3
5	Radiation Environment:	Electromagnetic radiation, electromagnetic radiation at radio frequencies, visible and infrared, UV, EUV, and X-rays; energetic particle radiation; trapped radiation, cosmic rays, solar proton events, radiation interactions with matter, single-particle interactions, photon interactions, charged-particle interactions, neutron interactions.	6
6	Spacecraft induced Environments	Spacecraft outgassing; chemical thrusters; plasma thrusters; the space radiation environment; solar-array degradation.	3
7	Spacecraft operations	Spacecraft charging; single event upsets; spacecraft drag; space radiation, radiation hazards to satellite electronic systems; radiation due to heavy ions, radiation charging of dielectric materials; particulate interactions: particle impacts on spacecraft scattering of EM radiation from particles, environmental effects of space systems.	7
8	Mission Planning and Safety	Coupling, victim, spacecraft radiation hardening, test and evaluation, design guidelines, material selection, wiring and cable shields and their bonding	3

C. Pre-requisites: Not Applicable.

D. Short summary for including in the Courses of Study Booklet: The hazardous interactions between the space environment and the orbiting spacecraft may lead to the degradation of spacecraft and its subsystem performance and possibly even may lead to the loss of the spacecraft itself. This course aims to provide the students with the introduction to the understanding of different aspects of the space environment, including space weather, space climate, space debris and how these impact on spacecraft design, human and robotic spaceflight, terrestrial infrastructure systems and will enable students to explore a particular topic at a deeper level. Emphasis is laid on problem solving techniques and design guidelines

that will provide the student with an understanding of how space environment effects may be minimized through proactive spacecraft design.

7. Recommended books:

Textbooks:

- Hastings, D., & Garrett, H. 'Spacecraft-Environment Interactions', (Cambridge Atmospheric and Space Science Series). Cambridge: Cambridge University Press, 1996.
- Vincent L. Pisacane, 'The Space Environment and Its Effects on Space Systems', Second Edition, American Institute of Aeronautics and Astronautics, Inc, 2008.
- Alan C. Tribble, 'The Space Environment: Implications for Spacecraft Design', Princeton University Press, Princeton New Jersey, 2003.
- Thomas F Tascione, 'Introduction to the Space Environment', 2nd Edition, Krieger Publishing, Florida, 1994.
- Shu T. Lai, 'Fundamentals of Spacecraft Charging: Spacecraft Interactions with Space Plasmas' Princeton University Press, 2012.

Reference Books:

- Volker Bothmer, Ioannis A. Daglis, 'Space Weather: Physics and Effects', Springer Berlin, Heidelberg, 2007
- Yohsuke Kamide Abraham C.-L. Chian, 'Handbook of the Solar-Terrestrial Environment', Springer Berlin Heidelberg New York, 2007
- George V. Khazanov, 'Space Weather Fundamentals', CRC Press Taylor & Francis Group, 2006.

8. Any other remarks:

Dated: 25.12.2023 Proposer: Soumyabrata Chakrabarty

Dated: _____ DUGC/DPGC Convener: _____

The course is approved / not approved

Chairman, SUGC/SPGC

Dated: _____

*Obhejjeel
20/12/23*

PGDesk-IITK-DOAA

From: dpgc_ssa <dpgc_ssa@iitk.ac.in>
Sent: 18 June 2024 09:59
To: Spgc; courses@iitk.ac.in; Pgdesk
Subject: Fwd: [acadstaff] New PG course proposal from Department of SPASE

Dear Prof Mohapatra.

We have floated this course on April 16th 2024. There are some revisions. I am attaching the revised proposal for this course. I request your office to please assign a course number for this course since we want to offer it in the upcoming semester.

Best Wishes

Sharvari

----- Original Message -----

Subject:[acadstaff] New PG course proposal from Department of SPASE
Date:2024-04-16 16:46
From:dpgc_ssa <dpgc_ssa@iitk.ac.in>
To:Acadstaff <acadstaff@lists.iitk.ac.in>, Pkjain <pkjain@iitk.ac.in>

Dear All,

Please find a new course proposal by Prof. Soumyabrata Chakrabarty at the link below. Please send your comments to dpgc_ssa@iitk.ac.in and pkjain@iitk.ac.in

<https://iitk.ac.in/doaa/data/NewCourses/Course-proposal-SPAXXX-Space-Environments-and-Space-Systems.pdf>

Best Regards

DPGC Convener

SPASE.

SSA

o/c scem
27/0/24


**INDIAN INSTITUTE OF TECHNOLOGY KANPUR
POSTGRADUATE OFFICE**

No. A(P)/IITK/course approval/
August 27, 2024

The Convener, DPGC
Departments of AE/SEE/CHE/SPASE
IIT Kanpur

I am directed to communicate the concurrence of the SPGC (2023-24) in its 10th meeting held on 15/07/2024 for the approval of new PG course proposal. After detailed discussion the following courses were approved.

Course No	Title	Credits	Instructor	SPGC Decision
SPA626	Space Environments and Space Systems	3-0-0-0-(9)	Dr. Rohit Sharma Dr. Soumyabrata Chakrabarty	Approved
AE631	Multidisciplinary Design Optimization	2-0-3-0-(9)	Dr. Prabhat Hajela, Dr. Pradeep Moise	Approved
AE632	Structural Vibration and Control	(3-0-0-0-9)	Dr Tanmay Mathur Dr Dipak Giri	Approved
AE651	System Identification Techniques for Aerial Vehicles	3-0-0-0-(9)	Dr. Subrahmanyam Saderla	Approved
SEE618	Heating, Ventilation, and Air-conditioning of Buildings	3-0-0-0-(9)	Dr. Aakash Chand Rai	Approved
CHE669	"Chemical Kinetics: Reaction Rate Theories and Rare-Event Simulations	3-0-0-0-(9)	Dr. Vishal Agarwal	Approved


Assistant Registrar
Academic Affairs
R

CC: OARS (DOAA Office) For necessary action

MINUTES
FOR THE 10th MEETING OF THE SENATE POSTGRADUATE COMMITTEE (2023-24) TO
BE HELD ON July 15, 2024 () AT 11:00 AM
DOAA CONFERENCE ROOM (208), ACADEMIC AFFAIRS BUILDING

Members present:

Prof(s): P M Mohite (AE), Vishal Agarwal (CHE), Chinmoy Kolay (CE) Abheejeet Mohapatra (EE) ,T H Syed (ES), Sukumar Vellakkal in place of Vasudha Jain (ECO), R Sengupta in place of Feroz Hassan (HSS), Amit Shukla (DoMS), Santanu De (ME), Shikhar Misra in place of Sudhanshu S Singh (MSE), Sudhanshu Shekhar in place of Subhajit Dutta (MATH), Sharvari Nadkarni Ghosh (SPASE), Aakash Chand Rai in place of Lallu Chandra(SEE).

Members Absent: Prof(s), Suresh Kumar (BSBE), Ark Verma (CGS), Ashis Kumar Patra (CHM), J Ramkumar (DES), Shilpi Gupta (PSE), Piyush Rai (CSE), Sri Sivakumar (MSP), Pankaj Wahi (NET), Sagar Chakrabarty (PHY)

Student representative:

Shivam Nigam (19112264), Harsha Prasad (21106270)

Item requiring SPGC Approval:

a) Conversion from MSR/MTech to PhD Program:

S.No	Roll No	Name	Dept	Prog	Supervisor and DPGC Recommendation	SPGC Recommendation /Decision
01-	21106008	Ankit Sinha	MSE	MTech	DPGC not Recommended	Not Recommended
02-	231010086	Vineet Anand Bedarman	AE	MTech	Recommended	Recommended and reported to Senate
03-	22105091	Tushar Jain	ME	MTech	Recommended	Already approved via email on 17-06-2024)- only for SPGC minutes

*Students has completed course and CPI requirement as per clause 4.6 of PG Manual

b) New course approval :-

Course No	Title	Credits	Instructor	SPGC Recommendation /Decision
SPA626	Space Environments and Space Systems	3-0-0-0-(9)	Dr. Rohit Sharma Dr. Soumyabrata Chakrabarty	Approved
AE631	Multidisciplinary Design Optimization	2-0-3-0-(9)	Dr. Prabhat Hajela, Dr. Pradeep Moise	Approved
AE632	Structural-Vibration and Control	(3-0-0-0-9)	Dr Tanmay Mathur Dr Dipak Giri	Approved
AE651	System Identification Techniques for Aerial Vehicles	3-0-0-0-(9)	Dr. Subrahmanyam Saderla	Approved
SEE618	Heating, Ventilation, and Air-conditioning of Buildings	3-0-0-0-(9)	Dr. Aakash Chand Rai	Approved
CHE669	*Chemical Kinetics: Reaction Rate Theories and Rare-Event Simulations	3-0-0-0-(9)	Dr. Vishal Agarwal	Approved

Abheejeet Mohapatra