



On

SATELLITE COMMUNICATION SYSTEMS

(27/03/2022 to 20/04/2022)

<u>Sponsored by:</u> Scheme for Promotion of Academic and Research Collaboration (SPARC)	<u>Organized by:</u> Department of Electronics and Communication Engineering, NIT Tiruchirappalli, India	<u>Collaboration with:</u> National Research Tomsk Polytechnic University, Russia
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About SPARC:

Scheme for Promotion of Academic and Research Collaboration (SPARC) is a Ministry of Human Resource Development (MHRD), GOI initiative to improve research ecosystem in India. It supports national premier educational institutions by facilitating academic and research collaborations between Indian institutions and the best and selected institutions across the world's 28 nations. It encourages international faculty, Indian institution visits and long-term stays to teach courses and conduct workshops for the benefit of Indian researchers and students in the selected research area.

About TPU- Russia:

The Tomsk Polytechnic University (TPU), Russia is ranked at 387 in QS world rank and is ranked as 10th in Russia. It has 277th place in the world in the direction of "Engineering and Technology" as of QS ranking and 201-250 place in the world in the discipline "Engineering: mechanics, aviation, production" and Chemistry. TPU is the first engineering school in Russia's Far East to open doors in 1896. Today TPU is one of Russia's leading public research universities with focus on applied science and technology. TPU is a research university with a strong tradition of excellence in the areas of physics, applied engineering, and electronics engineering. Recently, we added nanotechnologies and alternative energy to our research portfolio. Tomsk Polytechnic's annual research budget of \$30 million ranks second among technical and engineering schools in the country. Roughly 10% of funding comes from outside Russia; we rank second to none in this category.

Key Resource Person:

Prof. DUSHANTHA NALIN K JAYAKODY,



(S'09, M'14, SM' 18) received the Ph. D. degree in Electronics, Electrical, and Communications Engineering, from the University College Dublin, Ireland in 2014. He received his MSc degree in Electronics and Communications Engineering from the Department of Electrical and Electronics

Engineering, Eastern Mediterranean University, Turkey in 2010 (under the University full graduate scholarship). From 2014 - 2016, He was a Postdoc Research Fellow at the Institute of Computer science, University of Tartu, Estonia and Department of Informatics, University of Bergen, Norway. From 2016, he is a Professor at the

School of Computer Science & Robotics, National Research Tomsk Polytechnic University (TPU), and Russia. Prof. Jayakody has published over 120 international peer reviewed journal, conference papers and books. His research interests include PHY and NET layer prospective of 5G communications technologies such as NOMA for 5G etc, Cooperative wireless communications, device to device communications, LDPC codes, Unmanned Ariel Vehicle etc. Prof. Jayakody is a Senior Member of IEEE and he has organized or co-organised more than 20 workshops and special sessions of various IEEE conferences. He also served as chair, session chair or technical program committee member for various international conferences, such as IEEE PIMRC 2013-2019, IEEE WCNC 2014-2018, IEEE VTC 2015-2018 etc. He currently serves as an Area Editor the Elsevier Physical Communications Journal, MDPI Information journal and Wiley Internet of Technology Letters. In his career, so far, he has attracted nearly 6M \$ research funding. Also, he serves as a reviewer for various IEEE Transactions and other journals.

Eligibility:

The programme is open to all UG, PG, PhD. Scholars and Faculty members

Course Coordinators:

- ❖ Dr. P. Muthuchidambaranathan, Professor, ECE Dept.
- ❖ Dr. G. Lakshmi Narayanan, Professor, ECE Dept.
- ❖ Dr. G. Thavasi Raja, Assistant Professor, ECE Dept.

Registration:

No Registration fees

Last date of Registration 25.03.2022

To Register click on the below link :

<https://forms.gle/QY2LknAtAHCe1nCU8>

For any clarifications, please contact:

Mr. Jithin M George, Mobile: 9037176122

Mail id: sparc5gnitt@gmail.com

Course Outline

Name of course: SATELLITE COMMUNICATION SYSTEMS (12 Lectures)
Course level: PG (any year)
Instructor: Prof. Dushantha Nalin K. Jayakody
Teaching Assistants : Dr. Rajkumar Samikkannu (TPU) & Anandpushparaj P. (NIT- T)
Discipline: Electronics & Electrical Engineering/ Telecommunications Engineering
Lecture hours: 12 hrs
Pre-requisites: Module on Digital Communications

Course Description:

The constant evolution of satellites has boosted the development of numerous advanced services. From the IP protocol, globally accepted as the network protocol that enabled the convergence and integration of different technologies, to the need for new mechanisms to provide higher speeds and capacities, this UC addresses the challenges of satellites (geo-location, positioning and image and video capture systems), with special emphasis on telecommunications. These aspects are in objectives (i) and (ii) and are covered by contents (1) and (2). One of the main functional requirements imposed by network scenarios is related to requirements in terms of the degree of mobility of devices and users involved, as well as coverage in regions not covered by cellular environments. Regardless of the location and type of movement of the devices, the constant change in the location of users should not prevent communication or affect the quality of service. These aspects are directly related to the type of propagation used and the link budget analysis, and are transcribed in objectives (iii) and (iv), being covered by content (3) and (4). The dimensioning of satellite communications that meet current and future requirements, namely the development of systems that mitigate the constraints caused by the fading experienced in SATCOM and the new satellite switching and routing systems, are related to objectives (iv) and (v), being covered by the contents (5), (6) and (7).

Intended Learning Outcome

- (i) Knowledge of the main aspects related to satellite communications (SATCOM), geo-location, positioning and image, and video capture systems, in particular the technologies and protocols for wireless networks used in this environment.
- (ii) Mastery of the types of orbits used in satellite constellations, and the associated physical analysis.
- (iii) Knowledge of the propagation models associated with satellite communications and link budget analysis.
- (iv) Ability to evaluate, design and develop new satellite communication products, protocols, and services.
- (v) Critical analysis of current limitations and future challenges in satellite communications

Lecture Hrs – 12 (27/03/2022 to 20/04/2022)

Course Contents

Topic	Contents
1	Fundamentals and evolution of satellite communications, as well as geo-location, positioning and image and video capture systems
2	GEO, MEO, LEO and HEO constellations. Physical analysis of these types of orbits. Systems currently in operation.
3	Study of the propagation models used in SATCOM: direct, reflected, diffracted and dispersed radio. The multipath effect. Types of fading experienced in SATCOM. Rice model. SATCOM frequency bands.
4	SATCOM link budget analysis and C/N calculation. Relationship with Eb/N0 calculation. Calculation of the probability of error for the various modulation schemes. Error Control Systems used in satellites.
5	Application of MIMO, transmission techniques (ex: OFDM and DSSS) and high order modulations (ex: 64_QAM) to SATCOM.
6	VSAT networks with on-board Routing and/or Switching
7	Creation of a transponder and ground station. The control stations. Placing a satellite in orbit.

Note: 2 Practical sessions and one tutorial.

Assessment

- By attendance 30%
- Module project 40%
- Quizzes/Tutorial 30%

Recommended Reading:

Ha, Tri T., (1990), Digital Satellite Communications, 2nd edition, McGraw-Hill Communications Series, New York.
Marques da Silva, M., (2016), Cable and Wireless Networks: Theory & Practice, CRC Press, 1st edition, FL, USA.
D. Roddy (2006), Satellite Communications, McGraw-Hill, New York.
B. Carlson (1986), Communication Systems, 3rd Ed., Mc Graw Hill, New York.