Tentative schedule online/hybrid course “Analytics for Photovoltaics” at FU Berlin, WS 2021/22

Date	Time/Location	Lecture	Seminar
Tuesday 19.10.2021	10:15 – 12:00 Hybrid via Zoom	**1.1** General introduction to the course, general introduction to topic Renewable Energy (RE) **1.2** General introduction to analytics	
Friday 22.10.2021	10:15 – 12:00 Hybrid via Zoom	**2.1** Solar radiation, black body radiation **2.2** Introduction to PV	
Tuesday 26.10.2021	10:15 – 12:00 Hybrid via Zoom	**3.2** Introduction to PV **3.2** Introduction to PV: Shockley-Queisser limit	
Tuesday 26.10.2021	12:15 – 14:00 Hybrid via Zoom		**S 1.1** Introduction to the Seminar „Analytics for PV” and discussion **S 1.2** Introduction to the Seminar „Analytics for PV” and discussion
Friday 29.10.2021	10:15 – 12:00 Hybrid via Zoom	**4.1** Introduction to PV **4.2** Electrical measurements, Lock-in amplifier	
Tuesday 02.11.2021	10:15 – 12:00 Hybrid via Zoom	**5.1** Semiconductors: Density of states, doping **5.2** Fermi Level, effective mass	
Tuesday 02.11.2021	12:15 – 14:00 Hybrid via Zoom		**S 2.1** Fundamental electrical characterization of thin-film solar cells

			S 2.2 Discussion: Lock-in amplifier
Friday 05.11.2021	10:15 – 12:00 Hybrid via Zoom	**6.1** Semiconductors: Bands, mobility, **6.2** Measurement of conductivity & Hall effect	
Tuesday 09.11.2021	10:15 – 12:00 Hybrid via Zoom	**7.1** Semiconductors: Optical properties (direct and indirect bandgap) **7.2** Semiconductors: Radiative and non-radiative recombination, Auger recombination	
Tuesday 09.11.2021	12:15 – 14:00 Hybrid via Zoom		**S 3.1** Absorption and photocurrent spectroscopy (Photothermal Deflection Spectroscopy (PDS) and Constant Photocurrent Methods (CPM)) **S 3.2** Discussion of homework
Friday 12.11.2021	10:15 – 12:00 Hybrid via Zoom	**8.1** Light management, Yablonovitch limit **8.2** Measurement of absorption and reflection	
Tuesday 16.11.2021	10:15 – 12:00 Hybrid via Zoom	**9.1** Semiconductors: Defects **9.2** pn junction	
Tuesday 16.11.2021	12:15 – 14:00 Hybrid via Zoom		**S 4.1** Photoluminescence spectroscopy and its application to PV materials **S 4.2** Discussion of homework
Friday 19.11.2021	10:15 – 12:00 Hybrid via Zoom	**10.1** pn junction **10.2** Capacitance of pn junction	

Tuesday 23.11.2021	10:15 – 12:00 Hybrid via Zoom	**11.1** Silicon Solar Cells (multicrystalline Si) **11.2** Silicon Solar Cells (monocrystalline Si)	
Tuesday 23.11.2021	12:15 – 14:00 Hybrid via Zoom		**S 5.1** Transient optoelectronic characterization: Charge extraction and transient photovoltage methods **S 5.2** Discussion of homework
Friday 26.11.2021	10:15 – 12:00 Hybrid via Zoom	**12.1** Non-coherent light sources **12.2** Non-coherent light sources	
Tuesday 30.11.2021	10:15 – 12:00 Hybrid via Zoom	**13.1** Laser **13.2** Laser	
Tuesday 30.11.2021	12:15 – 14:00 Hybrid via Zoom		**S 6.1** Time resolved THz spectroscopy for charge carrier mobility measurements **S 6.2** Discussion of homework
Friday 03.12.2021	10:15 – 12:00 Hybrid via Zoom	**14.1** Detectors **14.2** Monochromator	
Tuesday 07.12.2021	10:15 – 12:00 Hybrid via Zoom	**15.1** X-ray radiation **15.2** X-ray radiation	
Tuesday 07.12.2021	12:15 – 14:00 Hybrid via Zoom		**S 7.1** Electroluminescence analysis of solar cells **S 7.2** Discussion of homework
Friday 10.12.2021	10:15 – 12:00	**16.1** X-ray sources	

	Hybrid via Zoom	**16.2** Synchrotron	
Tuesday 14.12.2021	10:15 – 12:00 Hybrid via Zoom	**17.1** Synchrotron **17.2** Synchrotron spectroscopy	
Tuesday 14.12.2021	12:15 – 14:00 Hybrid via Zoom		**S 8.1** Capacitance Spectroscopy: CV profiling, DLTS **S 8.2** Discussion of homework
Friday 17.12.2021	10:15 – 12:00 Hybrid via Zoom	**18.1** Disorder induced effects **18.2** Thin film Si solar cells	
Tuesday 04.01.2022	10:15 – 12:00 Hybrid via Zoom	**19.1** EPR spectroscopy: Introduction, spin counting **19.2** EPR spectroscopy: Bloch sphere, relaxation	
Tuesday 04.01.2022	12:15 – 14:00 Hybrid via Zoom		**S 9.1** EPR spectroscopy: defect analysis of solar cell materials **S 9.2** Discussion of homework, Demo of EPR
Friday 07.01.2022	10:15 – 12:00 Hybrid via Zoom	**20.1** EPR spectroscopy: Magnetic interaction, line shapes, g tensor **20.2** EPR spectroscopy: Introduction to pulsed EPR, FID, inv. recovery echoes	
Tuesday 11.01.2022	10:15 – 12:00 room 1.3.21 T1	**21.1** NMR spectroscopy **21.2** NMR spectroscopy	

Tuesday 11.01.2022	12:15 – 14:00 Hybrid via Zoom		**S 10.1** Transient optoelectronic Characterization: Charge extraction and transient photovoltage methods **S 10.2** Discussion of homework
Friday 14.01.2022	10:15 – 12:00 Hybrid via Zoom	**22.1** Grain boundaries: Classification, Seto model **22.2** Grain boundary characterization (SEM, EBSD,)	
Tuesday 18.01.2022	10:15 – 12:00 Hybrid via Zoom	**23.1** Grain boundary characterization (EDX, WDX,) **23.2** CIGS and CdTe thin film solar cells	
Tuesday 18.01.2022	12:15 – 14:00 Hybrid via Zoom		**S 11.1** Scanning probe spectroscopy on thin film materials for solar cells **S 11.2** Discussion of homework
Friday 21.01.2022	10:15 – 12:00 Hybrid via Zoom	**24.1** III-V materials and multi junction solar cells **24.2** III-V materials and multi junction solar cells	
Tuesday 25.01.2022	10:15 – 12:00 Hybrid via Zoom	**25.1** Vibrational spectroscopy: Introduction **25.2** Vibrational spectroscopy: Raman and Infrared spectroscopy	
Tuesday 25.01.2022	12:15 – 14:00 Hybrid via Zoom		**S 12.1** Accessing elemental distributions in thin film materials for solar cells (SIMS, GD-OES, AES, atom probe) **S 12.2** Discussion of homework

Friday 28.01.2022	10:15 – 12:00 Hybrid via Zoom	**26.1** Hybrid Solar Cells: Organic molecules, vibronic states, OPV **26.2** Hybrid Solar Cells: Organic molecules, vibronic states, OPV	
Tuesday 01.02.2022	10:15 – 12:00 Hybrid via Zoom	**27.1** Third Generation PV: Concepts, Up Conversion **27.2** Third Generation PV: Singlet Fission Lecturer: Rowan MacQueen (HZB)	
Tuesday 01.02.2022	12:15 – 14:00 Hybrid via Zoom		**S 13.1** Fourier-transform infrared spectroscopy (FTIR) and application to PV materials **S 13.2** Preparation for oral examination
Friday 04.02.2022	10:15 – 12:00 Hybrid via Zoom	**28.1** Time resolved PL, fs spectroscopy, Pump and probe, fs-2PPE **28.2** Time resolved PL, fs spectroscopy, Pump and probe, fs-2PPE Lecturer: Rowan MacQueen (HZB)	
Tuesday 08.02.2022	10:15 – 12:00 Hybrid via Zoom	**29.1** Scanning probe techniques (STM, AFM, SNOM) **29.2** Elemental distribution profiling: Mass spectroscopy, SIMS, RBS, ERDA	
Tuesday 08.02.2022	12:15 – 14:00		**S 14.1** X-rays and neutron diffraction

	Hybrid via Zoom		**S 14.2** Discussion of homework
Friday 11.02.2022	10:15 – 12:00 Hybrid via Zoom	**30.1** Surface/interface analysis: UPS, XPS, **30.2** Surface/interface analysis: XES, XRF, XAS, (NEXAFS, EXAFS), inverse PES	
Tuesday 15.02.2021	10:15 – 12:00 Hybrid via Zoom	**31.1** Quantum dot solar cells **31.2** Hybrid solar cells: Dye and perovskites SC	
Tuesday 23.02.2020	12:15 – 14:00 Hybrid via Zoom		**S 15.1** X-ray and inverse photoemission: core level spectra, electronic band alignment and density of states spectroscopy in PV materials **S 15.2** Preparation for oral examination
Thursday/Friday 17.02/18.02.2022	10:15 – 18:00 Hybrid via Zoom or EMIL@HZB	**Oral Examination**	