University of the West of Scotland
Module Descriptor

Session: 2022/23

Title of Module: Thin Film Processes & Principles (Physical)			
Code: PHYS11011	**SCQF Level: 11** (Scottish Credit and Qualifications Framework)	**Credit Points: 20**	**ECTS: 10** (European Credit Transfer Scheme)
School:	School of Computing, Engineering and Physical Sciences		
Module Co-ordinator:	Des Gibson		

Summary of Module

The module offers advanced study at Level 11 of the physical processes and equipment used in the growth of thin films. It is suitable for all Level 11 students with an undergraduate science/engineering related degree, and is a core module for students enrolled on the Masters in Advanced Thin Film Technologies programme at UWS. The module is intended to teach fundamental principles in the physical processes deposition of thin films, relevant to a broad range of applications.

The module also includes practical classes, which will enable students to put into practice the principles covered in the lectures. Part of the practical element is laboratory based (e.g. lab session to various physical based thin film deposition processes including thermal evaporation, electron beam and sputtering).

- A brief outline of the syllabus is given below.
- - Gas kinetics (vapours & gases, Maxwell Boltzmann distribution, ideal gas laws, units of measurement, Knudsen equation, mean free path, transport properties)
- - Vacuum technology (pump selection & gas handling, contamination sources, pressure measurement)
- - Substrate surfaces & thin film nucleation (atomic view of substrate surfaces, thermodynamic aspects of nucleation, kinetic processes in nucleation & growth)
- - Evaporation (physics of evaporation, film uniformity & purity, evaporation hardware, evaporation processes)Sputtering (plasmas, DC excitation & frequency effects, electrodeless excitation, DC, AC, reactive, magnetron, plasma etching)
- Electron beam deposition (electron gun hardware & operation, plasma assisted processes, glancing angle deposition) Epitaxy (mechanisms of epitaxial film growth, epitaxy of compound semiconductors, high and low temperature methods for epitaxial growth)
- The Graduate Attributes relevant to this module are given below. Academic: Critical thinker; analytical; inquiring; knowledgeable; digitally literate; problem solver; autonomous; incisive; innovative. Personal: Effective communicator;

influential; motivated Professional: Collaborative; research-minded; enterprising; ambitious; driven

Module Delivery Method

Face-To-Face	Blended	Fully Online	HybridC	HybridO	Work-based Learning
✓					

Face-To-Face
Term used to describe the traditional classroom environment where the students and the lecturer meet synchronously in the same room for the whole provision.
Blended
A mode of delivery of a module or a programme that involves online and face-to-face delivery of learning, teaching and assessment activities, student support and feedback. A programme may be considered "blended" if it includes a combination of face-to-face, online and blended modules. If an online programme has any compulsory face-to-face and campus elements it must be described as blended with clearly articulated delivery information to manage student expectations
Fully Online
Instruction that is solely delivered by web-based or internet-based technologies. This term is used to describe the previously used terms distance learning and e learning.
HybridC
Online with mandatory face-to-face learning on Campus
HybridO
Online with optional face-to-face learning on Campus
Work-based Learning
Learning activities where the main location for the learning experience is in the workplace.

Campus(es) for Module Delivery

The module will **normally** be offered on the following campuses / or by Distance/Online Learning: (Provided viable student numbers permit)

Paisley:	Ayr:	Dumfries:	Lanarkshire:	London:	Distance/Online Learning:	Other:
✓						

Term(s) for Module Delivery

(Provided viable student numbers permit).

Term 1	✓	Term 2		Term 3	

Learning Outcomes: (maximum of 5 statements)

On successful completion of this module the student will be able to:
L1. L1. Understand the advanced physics principles underlying physical vapour deposition processes.

L2. L2. Understand the advanced hardware and control required to implement physical vapour deposition processes. L3. L3. Ability to specify physical deposition processes in relation to thin film performance requirements, specifications and transferable skills. L4. L4. Operational and production awareness of physical vapour deposition in relation to process throughput, yield, equipment preventative maintenance.	
Employability Skills and Personal Development Planning (PDP) Skills	
SCQF Headings	During completion of this module, there will be an opportunity to achieve core skills in:
Knowledge and Understanding (K and U)	SCQF Level 11. At the end of this module, participants will be able to: L1. Understand the advanced physics principles underlying physical vapour deposition processes. L2. Understand the advanced hardware and control required to implement physical vapour deposition processes. L3. Ability to specify physical deposition processes in relation to thin film performance requirements, specifications and transferable skills. L4. Operational and production awareness of physical vapour deposition in relation to process throughput, yield, equipment preventative maintenance.
Practice: Applied Knowledge and Understanding	SCQF Level 11. SCQF Level 11. 1. Critical understanding of physical thin film deposition processes, principles and concepts 2. Critical understanding of required physical thin film deposition processes in relation to required thin film properties 3. Extensive, detailed and critical knowledge and understanding of implementation and required equipment/ control of physical film deposition processes 4. Critical awareness of operational/ production issues associated with physical thin film deposition processes 5.Ability to define required advanced physical thin film deposition processes in relation to end applications.
Generic Cognitive skills	SCQF Level 7. SCQF Level 11. 1. Apply critical analysis, evaluation and synthesis to issues which are at the forefront of, or informed by, developments at the forefront of physical thin film deposition processes, hardware and control. 2. Identify, conceptualise and define new and abstract problems and issues related to the inherent difficulty of 3. Critically review, consolidate and extend knowledge, skills practices and thinking in physical thin film deposition 4. Understand the complex multi-parametric nature of physical thin film deposition processes, hardware and control and professionally implement best practice research and/ or design of experiments for cost effective implementation.
Communication, ICT and Numeracy Skills	SCQF Level 11. SCQF Level 11. 1. Communicate effectively with peers, senior colleagues and specialists.

	2. Use a range of advanced thin film design, project management, design of experimental softwares to support and enhance cost effective implementation and effectiveness of physical thin film deposition processes 3. Undertake critical evaluations of physical thin film deposition related numerical and graphical data for the purpose of enhancing process efficiency and effectiveness.	
Autonomy, Accountability and Working with others	SCQF Level 10. SCQF Level 11. 1. Exercise substantial autonomy and initiative in professional and equivalent activities 2. Take responsibility for own work (i.e. independent learner) 3. Take responsibility for a significant range of resources beyond minimum requirements 4. Demonstrate leadership and/or initiative and make an identifiable contribution to change and development (i.e. flipped classroom environment) 5. Practise in ways which draw on critical reflection on own work and within team working	
Pre-requisites:	Before undertaking this module the student should have undertaken the following:	
	Module Code:	**Module Title:**
	Other:	
Co-requisites	**Module Code:**	**Module Title:**

* Indicates that module descriptor is not published.

Learning and Teaching	
Learning Activities During completion of this module, the learning activities undertaken to achieve the module learning outcomes are stated below:	**Student Learning Hours** (Normally totalling 200 hours): (Note: Learning hours include both contact hours and hours spent on other learning activities)
Lecture/Core Content Delivery	20
Tutorial/Synchronous Support Activity	10
Laboratory/Practical Demonstration/Workshop	6
Independent Study	164
	200 Hours Total

Indicative Resources: (eg. Core text, journals, internet access)
The following materials form essential underpinning for the module content and ultimately for the learning outcomes: Donald L Smith (2004), Thin Film Deposition – Principles & Practice, McGraw-Hill John F.O`Hanlon (2009), A Users Guide to Vacuum Technology, Wiley H.K Pulker, Coatings on Glass(1984), Thin Film Science and Technology 6, Elsevier Krisna Seshan, Handbook of Thin Film Deposition, (2014, 3rd edition), Elsevier-Verlag Berlin Heidelberg Hartmut Frey, Hamid Khan, Handbook of Thin Film Technology (2008), Springer-Verlag Berlin Heidelberg Helmut Frey, Relevance of Vacuum Technology for Thin Film Coating (2015), Springer-Verlag Berlin Heidelberg
(**N.B. Although reading lists should include current publications, students are advised (particularly for material marked with an asterisk*) to wait until the start of session for confirmation of the most up-to-date material)

Engagement Requirements
Students are academically engaged if they are regularly engaged with timetabled on-campus and online teaching sessions, asynchronous online learning activities, course-related learning resources, and complete assessments and submit these on time. Please refer to the Academic Engagement and Attendance Procedure at the following link: Academic Engagement and Attendance Procedure

Supplemental Information

Programme Board	Physical Sciences
Assessment Results (Pass/Fail)	No
Subject Panel	Physical Sciences
Moderator	David Hutson
External Examiner	D Faux
Accreditation Details	IoP & IET (to be sought when available)
Changes/Version Number	2.04 None

Assessment: (also refer to Assessment Outcomes Grids below)
Continuous assessment mark from scheduled class tests – three class tests spaced approximately two weeks apart and a final online test (50%)

The continuous assessment mark will be the average of all test marks. Failure to attend a class test will result in a mark of 0 (zero).

Coursework assignment – Mini-project assessment (four off) (50%)
Penalties for late submission:
Failure to meet the submission date will be penalised with 10% of the mark being deducted for work submitted up to one week late, with a mark of zero recorded thereafter.

Formative assessment: (1) peer-assessed teamwork and (2) short essays on specific topics

The formative assessments must each receive “pass” to achieve final degree.

Requirements for a pass:
To pass students must attain an average module mark of 50%.
Reassessment arrangements
To be reassessed by re-examination and/or re-submission of coursework. Students are required to contact the School to confirm re-sit arrangements

Mini-project report (50%)

(N.B. (i) **Assessment Outcomes Grids** for the module (one for each component) can be found below which clearly demonstrate how the learning outcomes of the module will be assessed.
(ii) An **indicative schedule** listing approximate times within the academic calendar when assessment is likely to feature will be provided within the Student Handbook.)

Assessment Outcome Grids (Footnote A.)

Component 1

Assessment Type (Footnote B.)	Learning Outcome (1)	Learning Outcome (2)	Learning Outcome (3)	Learning Outcome (4)	Weighting (%) of Assessment Element	Timetabled Contact Hours
Class test (written)	✓	✓	✓	✓	50	0

Component 2

Assessment Type (Footnote B.)	Learning Outcome (1)	Learning Outcome (2)	Learning Outcome (3)	Learning Outcome (4)	Weighting (%) of Assessment Element	Timetabled Contact Hours
Dissertation/ Project report/ Thesis	✓	✓	✓	✓	50	0
Combined Total For All Components					100%	0 hours

Footnotes
A. Referred to within Assessment Section above
B. Identified in the Learning Outcome Section above

Note(s):

1. More than one assessment method can be used to assess individual learning outcomes.
2. Schools are responsible for determining student contact hours. Please refer to University Policy on contact hours (extract contained within section 10 of the Module Descriptor guidance note).
   This will normally be variable across Schools, dependent on Programmes &/or Professional requirements.

Equality and Diversity
The programme team have considered how the programme meets the requirements of potential students irrespective of age, disability, political belief, race, religion or belief, sex, sexual orientation, social background or any other protected characteristic. Students/participants with special needs (including additional learning needs) will be assessed/accommodated and any identified barriers to particular groups of students/participants discussed with the Enabling Support Unit (for further details, please refer to the UWS Equality, Diversity and Human Rights policy). Further guidance is available from CAPLeD, Student Services, School Disability Co-ordinators or the University's Equality and Diversity Co-ordinator. UWS Equality and Diversity Policy
(N.B. Every effort will be made by the University to accommodate any equality and diversity issues brought to the attention of the School)