UNIVERSITY OF KERALA

Four Year Under Graduate Programme

(UoK FYUGP)

Syllabus

Major Discipline: PHYSICS

University of Kerala

Senate House Campus, Palayam, Thiruvananthapuram- 34, Kerala, India

May 2024

CONTENTS

1. BOARD OF STUDIES

1. Dr. Prabitha V. G., Govt. College for Women, Thiruvananthapuram, (Chairperson)
2. Dr. P.R. Biju, Mahatma Gandhi University, Kottayam, (Expert)
3. Dr. Bijini B. R., VTMNSS College, Dhanuvachapuram, (Member)
4. Dr. Hysen Thomas, Christian College, Chengannoor, (Member)
5. Dr. Anilkumar K. M., M.S.M College, Kayamkulam, (Member)
6. Dr. Sajesh Sasidharan, Sree Narayana College, Sivagiri, Varkala, (Member)
7. Mr. Viji V. R., University College, Thiruvananthapuram, (Member)
8. Dr. Renju R. Krishnan, St. Xavier's College, Thumba, (Member)
9. Dr. Vikas L. S., Govt. Arts College, Thiruvananthapuram, (Member)
10. Dr. Sibi K. S., University of Kerala, Kariavattom, Thiruvananthapuram, (Member)

2. CONTRIBUTORS

1. Dr. J. Binoy. Govt. College for Women, Thiruvananthapuram, (Academic Council Member)
2. Dr. Prince P. R., University College, Thiruvananthapuram, (Faculty)
3. Dr. Padma Kumar H., Mahatma Gandhi College, Thiruvananthapuram, (Faculty)
4. Prof. N.V Unnikrishnan, School of Pure and Applied Physics, M G University (Subject Expert)
5. Dr. N. Shaji, Department of physics, CUSAT, (Subject Expert)
6. Dr. Abhilash Kumar R G, Govt. College Ambalappuzha , (Subject Expert)
7. Sri. Muhammed Rishad K P, International School of Photonics, CUSAT, (Subject Expert)
8. Dr. Rajeshmon V. G., St. Paul's College, Kalamassery , (Subject Expert)
9. Dr. Anjana P.S., All Saint's College, Thiruvananthapuram
10. Dr. D. Sajan, Bishop Moore College, Mavelikkara
11. Mr. Srijith S., Sree Narayana College, Kollam
12. Mrs. Biji M. S., Govt. Arts College, Thiruvananthapuram
13. Mr. Syam Kumar S. U., N.S.S. College, Nilamel
14. Dr. Deepa V., Mahatma Gandhi College, Thiruvananthapuram
15. Dr. Mahesh S K, N. S. S. College, Pandalam
16. Miss. Devi R. Nair, University College, Thiruvananthapuram
17. Dr. Veena Suresh Babu , All Saints' College, Thiruvananthapuram
18. Mrs. Gayathri V., Shree Vidhyadhiraja College of Arts & Science, Karunagappally
19. Dr. Rajesh S R, S D College, Alappuzha

20. Dr. Rajesh S, Mar Ivanios College (Autonomous), Thiruvananthapuram
21. Dr. Arun Aravind, Bishop Moore College, Mavelikkara
22. Dr. Veena Gopal S., Christ Nagar College , Maranalloor
23. Dr. Sasanka Kumar S., T.K.M.M. college Nangiarkulangara, Harippad
24. Dr. Malu Somaraj, Sree Narayana College, Cherthala
25. Dr. Mohammed Salim M., T.K.M. College of Arts and Science, Kollam
26. Dr. Morris Marieli Antoinette, St. Joseph's College for Women, Alappuzha
27. Dr. Krishnakumar K., S.G. College, Kottarkkara
28. Dr. Anshad A., T.K.M. College of Arts and Science, Kollam
29. Dr. Sachin P C, Fathima Matha National College (Autonomous), Kollam
30. Dr. Indulal, S.G. College, Kottarakkara
31. Dr. Nisha N G, Govt. College for Women, Thiruvananthapuram
32. Dr. Jisha V T, Christian College Kattakkada
33. Dr. Rakesh Chandran S B, SD College, Alappuzh

3. PREFACE

The Kerala University Four-Year Undergraduate Programme (FYUGP) in Physics marks a major shift in the field of higher education in Kerala, allowing students to learn according to their interests. The FYUGP in Physics is an outcome-based program that allows students the flexibility and freedom to attain their desired learning outcomes in Physics. The program is primarily multidisciplinary in nature, allowing students to explore the interaction between physics and other fields of study. This approach broadens students' perspectives and helps them realize how different areas of knowledge are interconnected. The current three-year undergraduate curriculum has been totally revamped, with a shift from a teacher-centric to a student-centric approach.

The FYUGP in Physics consists of three different types of courses: (i) discipline-specific core courses (DSC), (ii) discipline-specific elective courses (DSE), and general foundation courses. General foundation courses have three divisions: multi-disciplinary courses (MDC), value addition courses (VAC), and skill enhancement courses (SEC). The students have the flexibility to change their major or minor at the end of the second semester from the broad list of courses provided by the university. Students who choose Honours with Research can carry out a research project in their core or elective areas of study in the fourth year. Capstone courses are offered in the seventh semester. The program offers a variety of elective courses from which students can choose according to their interests. It offers students the opportunity to choose from a variety of academic and vocational paths. Students are exposed to a variety of learning contexts rather than simply memorizing and rote learning knowledge. The syllabus is aimed at stimulating critical thinking, developing problem-solving skills, and increasing creativity.

The FYUGP in Physics includes wide introductory foundation courses in Physics, paving the way for advanced-level Physics courses. Students are introduced to and thoroughly explore advanced-level physics topics in order to prepare them for research-level activities. FYUGP pedagogy is primarily activity-oriented. The practicals in the syllabus provide students with hands-on experience, allowing them to better comprehend and apply physics ideas in real-world scenarios. The syllabus adheres to globally competitive standards of knowledge and skills in physics, allowing students to be equipped with the competencies required by global industries. Internships in firms and reputable institutes will prepare students for employment and make them aware of industry-academic connections. It is believed that this program will provide students with a solid foundation in the discipline while exposing them to cutting-edge developments in the field.

The multidisciplinary and holistic nature of the program is believed to equip students with the skills and knowledge necessary for success in a rapidly changing environment.

4. GRADUATE ATTRIBUTES

Graduate attributes bridge the gap between academia and the real world, fostering lifelong learning and meaningful contributions. They denote the skills, competencies and high-level qualities that a student should acquire during their university education. Apart from gathering content knowledge, these attributes go beyond the assimilation of information to its application in various contexts throughout a graduate's life. It aims in inculcating the art of critical thinking, problem solving, professionalism, leadership readiness, teamwork, communication skills and intellectual breadth of knowledge. The University of Kerala envisages to pave the path in guiding the student's journey to shape these attributes uniquely, making them integral to personal growth and success in various spheres of life. The University strives to ensure that these graduate attributes are not just checkboxes, but they play a pivotal role in shaping the students into capable, compassionate and responsible individuals with a high degree of social responsibility.

5. PROGRAMME OUTCOMES (PO)

No.	Programme Outcomes (POs)
PO-1	**Critical thinking** ○ analyze information objectively and make a reasoned judgment ○ draw reasonable conclusions from a set of information, and discriminate between useful and less useful details to solve problems or make decisions ○ identify logical flaws in the arguments of others ○ evaluate data, facts, observable phenomena, and research findings to draw valid and relevant results that are domain-specific
PO-2	**Complex problem-solving** ○ solve different kinds of problems in familiar and no-familiar contexts and apply the learning to real-life situations ○ analyze a problem, generate and implement a solution and to assess the success of the plan

	○ understand how the solution will affect both the people involved and the surrounding environment
PO-3	**Creativity** ○ produce or develop original work, theories and techniques ○ think in multiple ways for making connections between seemingly unrelated concepts or phenomena ○ add a unique perspective or improve existing ideas or solutions ○ generate, develop and express original ideas that are useful or have values
PO-4	**Communication skills** ○ convey or share ideas or feelings effectively ○ use words in delivering the intended message with utmost clarity ○ engage the audience effectively ○ be a good listener who are able to understand, respond and empathize with the speaker ○ confidently share views and express himself/herself
PO-5	**Leadership qualities** ○ work effectively and lead respectfully with diverse teams ○ build a team working towards a common goal ○ motivate a group of people and make them achieve the best possible solution. ○ help and support others in their difficult times to tide over the adverse situations with courage
PO-6	**Learning 'how to learn' skills** ○ acquire new knowledge and skills, including 'learning how to learn skills, that are necessary for pursuing learning activities throughout life, through self-paced and self-directed learning ○ work independently, identify appropriate resources required for further learning ○ acquire organizational skills and time management to set self-defined goals and targets with timelines ○ inculcate a healthy attitude to be a lifelong learner

PO-7	**Digital and technological skills** ○ use ICT in a variety of learning and work situations, access, evaluate, and use a variety of relevant information sources ○ use appropriate software for analysis of data ○ understand the pitfalls in the digital world and keep safe from them
PO-8	**Value inculcation** ○ embrace and practice constitutional, humanistic, ethical, and moral values in life including universal human values of truth, righteous conduct, peace, love, nonviolence, scientific temper, citizenship values ○ formulate a position/argument about an ethical issue from multiple perspectives ○ identify ethical issues related to work, and follow ethical practices, including avoiding unethical behaviour such as fabrication, falsification or misrepresentation of data, or committing plagiarism, and adhering to intellectual property rights ○ adopt an objective, unbiased, and truthful actions in all aspects of work

6. PROGRAMME SPECIFIC OUTCOMES (PSO)

No.	Programme Specific Outcomes (PSO)
PSO-1	Discuss the fundamental laws, basic concepts in physics and prioritise the core knowledge in the major premises of Physics and their interconnections
PSO-2	Apply the principles of Physics and mathematical tools to analyse and solve numerical and conceptual problems in various domains, as well as formulate equations and models for describing different physical theories and phenomena.
PSO-3	Analyse concepts in space science, nanoscience and nanotechnology, atmospheric science, electronics, forensic science, energy physics, and medical physics to establish a seamless integration with industry, research and academic institutions
PSO-4	Discover a multidisciplinary perspective to recognise synergies between disciplines such as arts and sports, environmental science, history, economics, data analysis, artificial intelligence, archeophysics, geology, archaeology, history and administer

	a strong understanding of interconnected topics by integrating concepts and methodologies.
PSO-5	Administer a general awareness, skills in programming, operating systems, computer hardware and software, scientific writing, optical fibre technology, PCB making and design, photographic optics, electrical device knowledge, and devise and troubleshoot basic household appliances for fostering self employability
PSO-6	Evaluate the effectiveness and weaknesses of modern electronics, communication systems and address global concerns such as the energy crisis and natural disasters, to provide innovative solutions
PSO-7	Apply theoretical knowledge and practical skills to perform experiments in lab, solve real-world challenges and practice ethical standards in scientific research and industrial environments.

7. COURSE STRUCTURE

7.1 COURSE CATEGORY CODES

Sl No	Name of Course	Course Category Code
1	Ability Enhancement Course	AEC
2	Multi-Disciplinary Course	MDC
3	Discipline Specific Core	DSC
4	Discipline Specific Elective	DSE
5	Value Addition Course	VAC
6	Skill Enhancement Course	SEC

7.2 FOUR YEAR UG PROGRAM IN PHYSICS

Semester	Course	Credit	Academic Level	No. of courses in each semester	Minimum credit to be earned in each semester
I	**DSC1 – A1**	4	100-199	6	21
	DSC2 – B1	4			
	DSC3 – C1	4			
	AEC1 - English	3			
	AEC2 – Other Language	3			
	MDC1	3			
II	**DSC4 – A2**	4	100-199	6	21
	DSC5 – B2	4			
	DSC6 – C2	4			
	AEC3 - English	3			
	AEC4 – Other Language	3			
	MDC2	3			

III	**DSC7 – A3**	4	200-299	6	22
	DSC8 – B3	4			
	DSC9 – C3	4			
	DSE1 – A2	4			
	MDC3 – KS	3			
	VAC1	3			
IV	**DSC10 – A4**	4	200-299	6	21
	DSC11 – A5	4			
	DSE2 – A2	4			
	SEC1	3			
	VAC2	3			
	VAC3	3			
INTERNSHIP		2			2
V	**DSC12 – A6**	4	300-399	6	23
	DSC13 – A7	4			
	DSC14 – A8	4			
	DSE3 – A3	4			
	DSE4 – A4	4			
	SEC2	3			
VI	**DSC15 – A9**	4	300-399	6	23
	DSC16 – A10	4			
	DSC17 – A11	4			
	DSE5 – A5	4			
	DSE6 – A6	4			
	SEC3	3			

VII	**DSC18# - A12**	3	400-499	6	24
	DSC19# - A13	3			
	DSC20@ - B/C	3			
	DSC21@ - B/C	4			
	DSC22@ - B/C	4			
	DSE7# – A7	4			
VIII	**DSC23$**	4	400-499		8+12
	DSC24$	4			
	INTERNSHIP PROJECT / RESEARCH PROJECT	12			

 # - Advanced Level Course

@ - 300 - 399 Level Course

$ - Online Mode

8. SYLLABUS INDEX

MAJOR DISCIPLINE: PHYSICS

(**Click Course Code / Page No to view the detailed syllabus)

Semester: 1

L — Lecture, T — Tutorial, P — Practical

Semester: 2

Course Code	Title of the Course	Type of the Course	Credit	Hours / Week	Hours Distribution / Week			Page No
					L	T	P	
UK2DSCPHY100	Foundation Course in Physics-II	DSC	4	5	3	0	2	79
UK2DSCPHY101	Electricity, Magnetism and Acoustics	DSC	4	5	3	0	2	85
UK2DSCPHY102	Optics and Thermodynamics	DSC	4	5	3	0	2	92
UK2DSCPHY103	Modern Physics	DSC	4	5	3	0	2	99
UK2MDCPHY100	Archaeo Physics	MDC	3	3	3	0	0	105
UK2MDCPHY101	Basics of Artificial Intelligence	MDC	3	3	3	0	0	111
UK2MDCPHY102	Beyond the Sky	MDC	3	3	3	0	0	117
UK2MDCPHY103	Foundations in Forensic Science	MDC	3	3	3	0	0	122
UK2MDCPHY104	Medical Physics	MDC	3	3	3	0	0	128

Semester: 3

Course Code	Title of the Course	Type of the Course	Credit	Hours / Week	Hours Distribution / Week			Page No
					L	T	P	
UK3DSCPHY200	Basic Electronics	DSC	4	5	3	0	2	133
UK3DSCPHY201	Digital Electronics and Datascience	DSC	4	5	3	0	2	139
UK3DSCPHY202	Solid State Physics and Spectroscopy	DSC	4	5	3	0	2	146
UK3DSCPHY203	Heat, Magnetism and Geophysics	DSC	4	5	3	0	2	152

UK3DSCPHY204	Light, Electricity and Emerging energy sources	DSC	4	5	3	0	2	158
UK3DSEPHY200	Fundamentals of Earth - Atmosphere System	DSE	4	4	4	0	0	166
UK3DSEPHY201	Circuit Elements and Network Theorems	DSE	4	4	4	0	0	172
UK3DSEPHY202	Basics of Nanoscience and Nanotechnology	DSE	4	4	4	0	0	177
UK3DSEPHY203	Fundamentals of Astrophysics	DSE	4	4	4	0	0	183
UK3DSEPHY204	Introduction to Medical Physics	DSE	4	4	4	0	0	189
UK3DSEPHY205	Mathematical tools for Physics	DSE	4	4	4	0	0	195
UK3DSEPHY206	Computer Hardware and Operating System	DSE	4	4	4	0	0	201
UK3VACPHY200	Energy crisis, Sustainability and Management	VAC	3	3	3	0	0	206
UK3VACPHY201	Introduction to laboratory safety measurements	VAC	3	3	3	0	0	215
UK3VACPHY202	The history of physics and its influence on society	VAC	3	3	3	0	0	221

Semester: 4

Course Code	Title of the Course	Type of the Course	Credit	Hours / Week	Hours Distribution / Week			Page No
					L	T	P	
UK4DSCPHY200	Classical Dynamics	DSC	4	5	3	0	2	230
UK4DSCPHY201	Electromagnetics and Transient Currents	DSC	4	5	3	0	2	238
UK4DSEPHY200	Atmospheric Thermodynamics (*AP)	DSE	4	5	3	0	2	246
UK4DSEPHY201	Basic digital principles and applications (*EL)	DSE	4	5	3	0	2	254
UK4DSEPHY202	Synthesis of Nanomaterials (*NS)	DSE	4	5	3	0	2	259
UK4DSEPHY203	Solar Terrestrial Physics (*AP)	DSE	4	5	3	0	2	266
UK4DSEPHY204	Physical Aspects of Diagnostics	DSE	4	5	3	0	2	273
UK4DSEPHY205	C++ Programming for Physics	DSE	4	5	3	0	2	282
UK4DSEPHY206	Fibre Optic communication	DSE	4	5	3	0	2	288
UK4SECPHY200	Basic Instrumentation Skills	SEC	3	4	2	0	2	295
UK4SECPHY201	Wiring and Electrical Devices	SEC	3	4	2	0	2	301
UK4VACPHY200	Introductory course on physics in financial market	VAC	3	3	3	0	0	308
UK4VACPHY201	Research and Publication Ethics	VAC	3	3	3	0	0	314
UK4VACPHY202	Disaster management	VAC	3	3	3	0	0	320
UK4INTPHY200	Capstone Internship	INT	2	2	-	-	-	-

Semester: 5

Course Code	Title of the Course	Type of the Course	Credit	Hours / Week	Hours Distribution / Week			Page No
					L	T	P	
UK5DSCPHY300	Optics	DSC	4	5	3	0	2	326
UK5DSCPHY301	Quantum Mechanics - I	DSC	4	4	4	0	0	333
UK5DSCPHY302	Thermodynamics & Statistical Mechanics	DSC	4	5	3	0	2	339
UK5DSEPHY300	Dynamics of the Atmosphere	DSE	4	4	4	0	0	347
UK5DSEPHY301	Transistor Amplifier circuits and Oscillators	DSE	4	4	4	0	0	354
UK5DSEPHY302	Characterization of Nano Materials	DSE	4	4	4	0	0	359
UK5DSEPHY303	Solar and Plasma Physics	DSE	4	4	4	0	0	364
UK5DSEPHY304	Physical Aspects of Therapeutics	DSE	4	4	4	0	0	369
UK5DSEPHY305	Forensic Physics	DSE	4	4	4	0	0	375
UK5DSEPHY306	Research Methodology	DSE	4	4	4	0	0	381
UK5SECPHY300	Optics in Digital Photography	SEC	3	3	3	0	0	385
UK5SECPHY301	Programming in Java	SEC	3	3	3	0	0	393
UK5SECPHY302	Programming in Python	SEC	3	3	3	0	0	401

Semester: 6

UK6SECPHY301	PCB Making and Designing	SEC	3	3	3	0	0	490
UK6SECPHY302	Scientific writing	SEC	3	3	3	0	0	496
UK6SECPHY303	Computer Hardware and Assembling	SEC	3	3	3	0	0	502

Semester: 7

Course Code	Title of the Course	Type of the Course	Credit	Hours / Week	Hours Distribution / Week			Page No
					L	T	P	
UK7DSCPHY400	Advanced Mathematical Physics	DSC	4	4	4	0	0	508
UK7DSCPHY401	Quantum Mechanics-II	DSC	4	4	4	0	0	514
UK7DSEPHY400	Weather Analysis and Forecasting	DSE	4	4	4	0	0	519
UK7DSEPHY401	Environmental Sustainability of Nanomaterials	DSE	4	4	4	0	0	526
UK7DSEPHY402	Frontiers of Space Science, Technology and Programming	DSE	4	4	4	0	0	533

Semester: 8

Course Code	Title of the Course	Type of the Course	Credit	Hours / Week	Hours Distribution / Week		
					L	T	P
UK8CIPPHY400	Capstone Internship	CIP	12	-	-	-	-
UK8RPHPHY400	Research Project	RPH	12	-	-	-	-

ADDITIONAL ELECTIVE COURSES- RECOMMENDED EXCLUSIVELY FOR INTER DISCIPLINARY MAJOR PATHWAY

Course Code	Title of the Course	Type of the Course	Credit	Hours / Week	Hours Distribution / Week			Page No
					L	T	P	
Semester 3								
UK3DSEPHY207	Electrodynamics	DSE	4	5	3	0	2	539
Semester 5								
UK5DSEPHY307	Modern Optics	DSE	4	5	3	0	2	547
Semester 6								
UK6DSEPHY308	Atomic and Molecular Spectroscopy	DSE	4	4	4	0	0	554
Semester 7								
UK7DSEPHY403	Mathematical Physics	DSE	4	4	4	0	0	561

9. DSC COURSES FOR PHYSICS MAJOR IN BRIEF

SEM	Course code	Course Name
1	UK1DSCPHY100	Foundation Course in Physics-I
2	UK2DSCPHY100	Foundation Course in Physics-II
Compulsory courses for Physics major		
3	UK3DSCPHY200	Basic Electronics
4	UK4DSCPHY200	Classical Dynamics
4	UK4DSCPHY201	Electromagnetics and Transient Currents
5	UK5DSCPHY300	Optics
5	UK5DSCPHY301	Quantum Mechanics - I
5	UK5DSCPHY302	Thermodynamics & Statistical Mechanics
6	UK6DSCPHY300	Atomic & Molecular Physics
6	UK6DSCPHY301	Nuclear & Particle Physics
6	UK6DSCPHY302	Solid State Physics

10. SPECIALIZATION STREAMS

10.1: STREAM CODE

Physics offers five different specialisation streams in elective (DSE) courses. Out of the trial required DSE courses a student is studying, if the students take any four courses from a particular stream the student is eligible to get specialisation title in their degree.

Sl No	Stream Code	Stream
1	AP	Atmospheric science
2	EL	Electronics
3	NS	Nanoscience and Nanotechnology
4	SP	Space Physics
5	MP	Medical Physics

10.2: COURSE CODE FOR SPECIALIZATION STREAM

(Minimum of any four from each stream is compulsory for getting specialization in that particular stream)

Sem	AP	EL	NS	SP	MP
3	UK3DSEPHY200	UK3DSEPHY201	UK3DSEPHY202	UK3DSEPHY203	UK3DSEPHY204
4	UK4DSEPHY200	UK4DSEPHY201	UK4DSEPHY202	UK4DSEPHY203	UK4DSEPHY204
5	UK5DSEPHY300	UK5DSEPHY301	UK5DSEPHY302	UK5DSEPHY303	UK5DSEPHY304
6	UK6DSEPHY300	UK5DSEPHY301	UK6DSEPHY302	UK6DSEPHY303	UK6DSEPHY304
7	UK7DSEPHY400		UK7DSEPHY401	UK7DSEPHY402	

11. PRACTICALS

A minimum of 5 experiments to be performed from Part A and a minimum of 1 experiment to be performed from part B during a semester.

12. TEACHER CONTENT

20% of both theoretical (fifth module in each course (*marked)) and practical components (Part B (*marked)) can be changed by the faculty with the prior approval of BoS (pass) Physics.

13. FIELD TRIP / STUDY TOUR

A field trip or study tour should be conducted during the third year, and the report can be submitted at the end of the sixth semester. Students are directed to visit a research institute / science museum / observatory / industrial institute / factory, and a scientifically prepared handwritten study tour report must be submitted by each student.

14. DETAILED SYLLABUS

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK1DSCPHY100**				
Course Title	**FOUNDATION COURSE IN PHYSICS-I**				
Type of Course	**DSC**				
Semester	**I**				
Academic Level	**100 - 199**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites	-				
Course Summary	This course discusses basic foundation concepts in Physics. Simple mathematical tools required for understanding Physical concepts are discussed in the first module. Motion of objects is explained on the basis of Newton's laws followed by the discussion on work and energy. Study on rotational dynamics reveals the concept of angular momentum and its significance in rigid bodies. The discussion on oscillations will help to understand simple harmonic motion and its applications in pendulum.				

BOOKS FOR STUDY:

1. Introduction to Electrodynamics, David J Griffiths, Prentice Hall
2. Sear and Zemansky's University Physics With Modern Physics, Hugh D Young, Roger A Freedman, Addison -Wesley, 13TH EDITION, 2012.
3. Introduction to Mechanics, Daniel Kleppner and Robert Kolenkow Second Edition, Mc Graw Hill Education, 2017.
4. Mechanics, J C Upadhyaya, Ramprasad Publications
5. Principles of Physics 10^{th} Edition, Robert Resnick, Jearl Walker, David Halliday, Wiley, 2014.

BOOKS FOR REFERENCE:

1. Mechanics: H. S. Hans and S. P. Puri, TMH, 2ndEdn.
2. Properties of matter: Brijlal and Subramaniam, S. Chand & Co.,2004
3. Principles of Physics: P.V. Naik, PHI,

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**LANGUAGE OF PHYSICS (Book 1: Chapter 1)**	**9**	
	1	Vector algebra - vector operations, component form, triple products,	3	1
	2	Gradient, the operator ∇, the divergence, the curl, product rules	4	1
	3	Integral calculus: line, surface and volume integrals	1	1
	4	Gauss's divergence theorem and Stokes's theorem (statements only)	1	1
II		**LAWS OF MOTION (Book 2: Chapter 4 & 8)**	**9**	
	5	Newton's first law, law of inertia - Inertial frame of reference	2	2
	6	Newton's second law- Mass and Force	1	2
	7	Mass and weight- Variation of g with location, measuring mass and weight	2	3,5
	8	Newton's third law	1	2
	9	Momentum and impulse - Newton's second law in terms of Momentum, The impulse-momentum theorem	2	2
III		**DYNAMICS OF MOTION- WORK AND ENERGY (Book 2: Chapter 6 & 7)**	**9**	
	10	Work, Kinetic energy and work - energy theorem	1	2,5
	11	Work and energy with varying forces- Straight line motion, Motion along a curve, Power	2	2,5
	12	Gravitational Potential energy, elastic Potential energy	3	2

	13	Conservative and non-conservative forces, Law of Conservation of energy	2	3,5
	14	Force and potential energy	1	2,5
IV	**DYNAMICS OF ROTATION AND ANGULAR MOMENTUM (Book 2, Book 3 and Book 4)**		**9**	
	15	Torque, Angular acceleration, Rigid body rotation about a moving axis	4	2
	16	Combined translation and rotation-energy relations, rolling without slipping. Rolling friction, work and power in rotational motion (Book2: Chapter 10)	4	4,5
	17	Angular momentum of a particle, fixed axis rotation-Moment of Inertia (ring, Disc, Stick), The Parallel axis theorem, dynamics of fixed axis rotation	3	4,5
V*	**UNDERSTANDING OSCILLATIONS (Book 6, Book 2)**		**9**	
	18	Simple Harmonic motion, Energy in Simple Harmonic motion (Book6, Chapter 15)	3	6
	19	mass on a spring - oscillation of two particles connected by a spring (Book 2, Chapter 9)	2	6
	20	compound pendulum - interchange ability of suspension and oscillation points-collinear points-conditions for maximum and minimum periods (Book 2, Chapter 9)	4	6

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Compound Bar Pendulum – Symmetric	6
2	Compound Bar Pendulum – Asymmetric.	6
3	Determination of moment of inertia of fly wheel	4, 6
4	Helical spring- Spring constant	2, 6

5	Show that the period of oscillation of a simple pendulum is independent of the mass of the bob used.	6
6	Establish the relationship between length and period of a simple pendulum.	6
Part B* – At least One Experiment to be performed		
7	Inclined plane - determine the downward force, along an inclined plane	1, 2
8	Concurrent forces - determination of unknown mass	1, 2
9	Concurrent forces - parallelogram law verification	1, 2

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss the basic mathematical tools used to manipulate vectors and associated problems	U, Ap	1, 2, 4
CO-2	Recall Newton’s laws of motion and describe basic concepts related to objects in motion like momentum, inertia, work, energy and simple harmonic motion.	R, U	1, 2
CO-3	Use the basic ideas of Newtonian mechanics to evaluate dynamics of objects in detail.	R, U	1, 2
CO-4	Describe the concept of moment of inertia and use it to objects having different shapes	R, U, Ap	1, 2, 7
CO-5	Solve numerical problems related to motion of objects	U, Ap	1, 2
CO-6	Relate the concept of simple harmonic motion with periodic movement of objects	U, Ap	1, 2, 7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: FOUNDATION COURSE IN PHYSICS-I

Credits: 3:0:1 (Lecture:Tutorial:Practical)

CO No.	CO	PSO / PO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Discuss the basic mathematical tools used to manipulate vectors and associated problems	PSO 1, 2, 4/ PO 1, 2	U, Ap	F, C	L	P
CO-2	Recall Newton's laws of motion and describe basic concepts related to objects in motion like momentum, inertia, work, energy and simple harmonic motion.	PSO 1, 2/ PO 1, 2	R, U	F, C	L	-
CO-3	Use the basic ideas of Newtonian mechanics to evaluate dynamics of objects in detail.	PSO 1, 2/ PO 1, 2	R, U	F, C	L	-
CO-4	Describe the concept of moment of inertia and use it to objects having different shapes	PSO 1, 2/ PO 1, 2	R, U, Ap	F, C, P	L	P
CO-5	Solve numerical problems related to motion of objects	PSO 1, 2, 7/ PO 1, 2	U, Ap	F, C	L	-

CO-6	Relate the concept of simple harmonic motion with periodic movement of objects	PSO 1, 2, 7/ PO 1, 2, 3, 6	U, Ap	F, C, P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	3	2	-	1	-	-	-	1	3	-	-	-	-	-	-
CO-2	3	1	-	-	-	-	-	2	2	-	-	-	-	-	-
CO-3	3	2	-	-	-	-	-	2	3	-	-	-	-	-	-
CO-4	2	1	-	-	-	-	-	1	2	-	-	-	-	-	-
CO-5	2	3	-	-	-	-	1	2	3	-	-	-	-	-	-
CO-6	2	2	-	-	-	-	2	3	2	1	-	-	2	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	-	-	✓
CO-6	✓	✓	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK1DSCPHY101**				
Course Title	**PRINCIPLES OF DYNAMICS**				
Type of Course	**DSC**				
Semester	**I**				
Academic Level	**100 - 199**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites	1. The students should have undergone a course in physics during their higher secondary curriculum 2. The students should have a basics understanding of motion 3. The students should have basic ideas physical quantities and units				
Course Summary	This course aims to present the basics of mechanics in an easily understandable way. The course begins with an introduction to kinematics which includes the properties of vectors, motions and Newton's laws. The second module comprises the basic ideas of momentum and collisions and discusses the concept of conservation. The basic ideas of circular motion is explained with a few examples in the third module. The work, energy, force and the concept of angular momentum are introduced in the fourth module. The last module includes the elementary ideas of central force.				

BOOKS FOR STUDY:

1. Physics for scientists and engineers with Modern Physics, 7th Edition, Serway & Jewett,
2. College Physics 2e, OpenStax
3. University Physics, 13 th Edition, Hugh D. Young, Roger A. Freedmann, A. Lewis Ford, Pearson 2012.
4. An Introduction to Mechanics, D. Kleppner & R. Kolenkow, 2/e, Cambridge University Press.

BOOKS FOR REFERENCE:

1. Principles of Physics, 10/e, Walker, Halliday & Resnick, International Student Version, Wiley
2. Basic Physics, Kenneth W Ford, World Scientific Publishing Co. Pvt. Ltd., 2016

WEB RESOURCES:

1. https://archive.org/details/basicph_current/mode/2up (Basic Physics: Principles and Concepts, Avijit Lahiri)

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	**INTRODUCTION TO KINEMATICS (Book :1 - Chapter: 2, 3,4; Book : 2- Chapter: 2,3,4; Book : 3; Chapter: 1-5)**		**9**	
	1	Vectors, Properties of vectors - cross product and dot product, scalar product and Vector product, Divergence and Curl	3	1
	2	Motion in One Dimension - Position, Velocity and speed, acceleration, freely falling objects	2	2
	3	Motion in two Dimension - position, velocity and acceleration vectors, projectile motion, circular motion	2	2
	4	Newton's laws of motion, Application of Newton's laws - Particles in equilibrium, Dynamics of particles, Frictional Force	2	2
II	**Linear Momentum, Impulse and Collisions (Book :1 - Chapter: 9; Book : 2- Chapter: 8)**		**9**	
	5	Linear momentum, Conservation of linear momentum	2	3
	6	Impulse - momentum theorem	2	3
	7	Collisions, Collisions in one dimension and two dimensions,	2	3
	8	Elastic and inelastic collisions, concept of centre of mass, rocket propulsion	3	3
III	**Circular Motion (Book 1, Chapter 4, Chapter 6)**		**9**	
	9	The Particle in Uniform Circular Motion	2	4

	10	Tangential and Radial Acceleration	1	4
	11	Newton's Second Law for Particle in Uniform Circular Motion	3	4
	12	Non Uniform Circular Motion	3	4
IV	**Angular Momentum (Book :1 - Chapter: 8, 11; Book : 2- Chapter: 10, Book:3 - Chapter 9,10)**		**9**	
	13	Work done by a constant force and varying force, work–kinetic energy theorem, potential energy	2	4
	14	Conservative and non-conservative forces, conservative forces and potential energy	2	4
	15	Angular Momentum, Conservation of Angular Momentum, Torque	2	4
	16	Angular momentum of rotating rigid object	1	4
	17	Gyroscopic Effects: Vector Aspects of Angular Momentum	2	4
V*	**Central Force (Book 4, Chapter 10)**		**9**	
	18	Central Force Motion as a One- body Problem	2	5
	19	Consequences of Conservation of Angular Momentum	2	5
	20	Consequences of Conservation of Energy	1	5
	21	The Effective Potential	1	5
	22	The Formal Solution for Central Force Motion	3	5

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Least Count of instruments - Screw Gauge, Vernier Callipers, Spectrometer, traveling microscope	6
2	Screw Gauge - To find the thickness of a scale and radius of wire	6
3	Vernier Callipers - To find the breadth of a scale and the diameter of a small spherical/cylindrical body	6

4	The moment bar - To determine the weight of a bar/scale	6
5	Concurrent Forces - To find the weight of a body using parallelogram law of vectors	6
6	Viscosity - To find the Coefficient of viscosity- Continuous flow method using constant pressure head.	6
7	Viscosity- To find the Coefficient of viscosity- using Variable pressure head arrangement	6
8	To locate the points to given coordinates in space, measure the distance between two points in space and then to verify the distance using distance formula.	6
9	To find the distance of given point (in space) from a plane (passing through three non-collinear points) by actual measurement and also analytically	6
10	To study the third law of motion using two spring balances	6
Part B* – At least One Experiment to be performed		
11	Surface Tension - To find the surface tension of water by capillary rise method	6
12	The force of Friction - To determine the relationship between force of limiting friction and normal reaction and to find the coefficient of friction between a block and a horizontal surface	6
13	The inclined plane - To determine the downward force along the inclined plane acting on a trolly/roller	6
14	Surface Tension - To find the surface tension of water by capillary rise method	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify the basics of vectors and their properties	R	PSO-1
CO-2	Compare the motions in one and two dimensions and explain the newton's laws of motion and its applications	R, U	PSO-1
CO-3	Learn the physical and mathematical concepts of linear momentum, Impulse and Collisions	R, U	PSO-1
CO-4	Review the fundamental idea of work energy and force and recognize the concept of angular momentum	R, U	PSO-1

CO-5	Discuss the elementary ideas of central force	R, U	PSO-1
CO-6	Identify the methods to measure the radius of various objects and interpret the nature of various forces	U, Ap	PSO-2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: PRINCIPLES OF DYNAMICS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Identify the basics of vectors and their properties	PSO-1 PO-1	R	F	L	-
CO-2	Compare the motions in one and two dimensions and explain the newton’s laws of motion and its applications	PSO-1 PO-1, 2	R, U	F, C	L	-
CO-3	Learn the physical and mathematical concepts of linear momentum, Impulse and Collisions	PSO-1 PO-1, 2	R, U	F, C	L	-
CO-4	Review the fundamental idea of work energy and force and recognize the concept of angular momentum	PSO-1 PO-1, 2	R, U	F, C	L	-
CO-5	Discuss the elementary ideas of central force	PSO-1 PO-1	R, U	F, C	L	-
CO-6	Identify the methods to measure the radius of	PSO-2 PO-1	U, Ap	C, P		P

	various objects and interpret the nature of various forces					

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	1	-	-	-	-	-	-	2	-	-	-	-	-	-	-
CO-2	2	-	-	-	-	-	-	2	1	-	-	-	-	-	-
CO-3	1	-	-	-	-	-	-	2	2	-	-	-	-	-	-
CO-4	2	-	-	-	-	-	-	2	1	-	-	-	-	-	-
CO-5	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO-6	-	2	-	-	-	-	-	2	-	-	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	✓	-	-
CO-6	✓	-	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK1DSCPHY102**				
Course Title	**PROPERTIES OF SOLIDS**				
Type of Course	**DSC**				
Semester	**I**				
Academic Level	**100 - 199**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites	1. Students should have a basic understanding of states of matter and chemical bonding. 2. Students should be aware of basics of diamagnetic, paramagnetic, and ferro magnetic substances. 3. Students should know the fundamentals of heat, temperature, thermal expansion and heat transfer by conduction, convection and radiation. 4. Students should be familiar with foundation of semiconductor electronics.				
Course Summary	This course explores the fundamental properties of solids and their applications in semiconductor devices. Topics covered include magnetic properties, superconductivity, thermal properties, dielectric properties and semiconductor devices. Emphasis is placed on understanding the underlying concepts of physics governing these properties and their technological significance.				

BOOKS FOR STUDY:

1. Physics, Principles with Applications, Douglas C. Giancoli, Pearson Education Limited, 7^{th} Edition (2016).
2. Engineering Physics, G Aruldhas, PHI Learning Private Limited, New Delhi(2012).

3. Heat and Thermodynamics: Brijlal and Subramaniam, S. Chand &Co.

BOOKS FOR REFERENCE:

1. Concepts of Modern Physics, Arthur Beiser, Shobhit Mahajan, S Rai Choudhury, McGraw Hill Education (India) Private Limited (2017).
2. Solid State physics and Electronics, R K Puri, V K Babbar, S Chand & Company Ltd, (2008).
3. Solid State Physics, Dr R Asokamani, Eswar Press, Chennai, (2015).
4. Applied Solid State Physics, Rajnikant, Wiely India Pvt. Ltd. 92011)
5. Heat and Thermodynamics: M. Zeemansky, McGraw Hill, New Delhi (2007).
6. Heat and Thermodynamics: Rose C. McCarthy, The Rosen Publishing Group, Inc. NY,(2005)
7. Thermodynamics Kinetic Theory and Statistical Thermodynamics: F. W. Sears and G.
8. L. Salinger, Addison-Wesley Publishing Company, 3rd Edn. (1975).

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**MOLECULES AND SOLIDS (Book 1)**	**8**	
	1	Bonding in molecules, Potential Energy diagrams for molecules, Weak (Van der Waals) bonds – Protein synthesis,	2	1
	2	Bonding in solids	1	1
	3	Free electron theory of metals	2	1
	4	Band theory of solids, Semiconductors and doping, Semiconductor Diodes, LEDs, OLEDs, Transistors: Bipolar and MOSFETs, Integrated Circuits, 22-nm Technology	3	1,6
II		**MAGNETIC PROPERTIES (Book 2)**	**10**	
	5	Permeability and Susceptibility	1	2
	6	Origin of Magnetic Moment	1	1,6
	7	Classification of magnetic materials	2	2

	8	Curie Temperature, Weiss theory of Ferromagnetism	1	2
	9	Hysteresis loop	2	2
	10	Antiferromagnetism, Ferrimagnetism, Ferrites, Magnetic materials for information storage	3	2
III	**SUPERCONDUCTIVITY (Book 2)**		**8**	
	11	Introduction, Magnetic Properties, Meissner Effect	2	3
	12	Type I and type II superconductors – London Penetration depth	2	3
	13	Isotope Effect, BCS Theory, Cooper Pairs	2	3
	14	High temperature superconductivity, Applications	2	3
IV	**THERMAL PROPERTIES (Book 3)**		**10**	
	15	Coefficient of Thermal Conductivity, Thermometric Conductivity	1	4
	16	Thermal conductivity – Radial flow of heat, cylindrical flow	2	4,6
	17	Wiedemann – Franz Law	1	4
	18	Latent Heat of Fusion	1	4
	19	Laws of Fusion - Practical Applications	1	4
	20	Effect of Pressure and impurities on Freezing point,	1	4
	21	Thermoelectric effects – Seebeck, Peltier, Thomson effect and Thermo electric power	3	4
V*	**DIELECTRIC PROPERTIES (Book 2)**		**9**	
	22	Electric Dipole, Polarizability, Polarisation vector, Dielectric constant, Dielectric Susceptibility	2	5
	23	Dielectric polarisation- Electronic Polarisation, Ionic Polarisation, Orientation Polarisation, Space Charge Polarization, Total Polarisation	3	5

	24	Frequency dependence of Polarisation, Dielectric loss	2	5
	25	Ferroelectric Crystals, Piezoelectric Crystals- Applications	1	5
	26	Applications of dielectric materials	1	5

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Diode Characteristics (for Ge and Si diodes)	6
2	Zener diode characteristics: To (i) trace and construct the circuit (ii) to plot the V-I characteristicunder reverse biased condition and (iii) to calculate the dynamic resistance of the diode under reverse bias when conducting	6
3	Phase transition-determination of M.P of wax	6
4	Determination of thermal conductivity of rubber	6
5	Lee's disc-determination of thermal conductivity of a bad conductor	6
6	Circular coil- magnetization of a magnet	6
7	Absolute determination of m and Bh using box type and Searle's type vibrationmagnetometers	6
8	Searle's vibration magnetometer-comparison of magnetic moments	6
9	Potentiometer – Resistivity	6
Part B* – At least One Experiment to be performed		
10	Thermo emf-measurement of emf using digital multimeter	6
11	Determination of dielectric constant of a given material	6
12	Carey Foster's Bridge-Resistivity	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Differentiate various types of bonding in solids, describe the relationship between band structure and electrical properties and apply the principles of doping in the fabrication of semiconductor devices	U, Ap	PSO-1,2
CO-2	Illustrate and interpret the magnetic properties of materials and their theoretical underpinnings crucial for different applications	U, Ap	PSO-1,2
CO-3	Explain the principles of superconductivity, describe the properties of superconducting materials, and evaluate the wide range of applications of superconductivity	U, Ap	PSO-1,2
CO-4	Describe and apply the thermal conductivity principles of solids, analyse the latent heat of fusion and evaluate its applications and analyse the thermoelectric properties of solids	U, Ap, An	PSO-1,2
CO-5	Describe the principles governing dielectric materials and categorise different types of dielectric crystals and appraise their application.	U, Ap	PSO-1,2
CO-6	Experiment and infer conductivity and magnetic property measurements as well as semiconductor device characterization.	Ap, An	PSO-1,2, 7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: PROPERTIES OF SOLIDS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Differentiate various types of bonding in solids, describe the relationship between band structure and electrical properties and apply the principles of doping in the fabrication of semiconductor devices	PO 1, 2, 3, 4, 5, 8/ PSO – 1,2	U, Ap	C	L	-
CO-2	Illustrate and interpret the magnetic properties of materials and their theoretical underpinnings crucial for different applications	PO 1, 2, 3, 4, 6, 8/ PSO – 1,2	U, Ap	C	L	-
CO-3	Explain the principles of superconductivity, describe the properties of superconducting materials, and evaluate the wide	PO 1, 2, 3, 4, 8/ PSO – 1,2	U, Ap	C	L	-

	range of applications of superconductivity					
CO-4	Describe and apply the thermal conductivity principles of solids, analyse the latent heat of fusion and evaluate its applications and analyse the thermoelectric properties of solids	PO 1, 2, 3, 4, 5, 8/ PSO – 1,2	U, Ap, An	C	L	-
CO-5	Describe the principles governing dielectric materials and categorise different types of dielectric crystals and appraise their application.	PO 1, 2, 3, 4, 8/ PSO – 1,2	U, Ap	C	-	-
CO-6	Experiment and infer conductivity and magnetic property measurements as well as semiconductor device characterization.	PO 1, 2, 3, 4, 5, 6, 8/ PSO – 1,2,7	Ap, An	P	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	3	2	-	-	-	-	-	3	3	2	1	1	-	-	1
CO-2	3	3	-	-	-	-	-	3	3	2	1	-	1	-	1
CO-3	3	3	-	-	-	-	-	3	3	3	1	-	-	-	1
CO-4	3	3	-	-	-	-	-	3	3	3	1	1	-	-	1
CO-5	3	3	-	-	-	-	-	3	3	3	2	-	-	-	1
CO-6	3	3	-	-	-	-	3	3	3	3	3	3	3	-	3

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	✓	-	✓
CO-3	✓		-	✓
CO-4	-	✓	-	✓
CO-5	✓	-	-	-
CO-6	✓	-	✓	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK1DSCPHY103</td></tr>
<tr><td>Course Title</td><td colspan="5">INTRODUCTION TO MECHANICS AND ENERGY RESOURCES</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSC</td></tr>
<tr><td>Semester</td><td colspan="5">I</td></tr>
<tr><td>Academic Level</td><td colspan="5">100 - 199</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>3 Hrs</td><td>-</td><td>2 Hrs</td><td>5 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5"></td></tr>
<tr><td>Course Summary</td><td colspan="5">Knowledge about basic ideas of physical quantities, vectors, gravitation, rotational motion, energy resources and sound waves.</td></tr>
</table>

BOOKS FOR STUDY:

1. Principles of physics: Halliday and Resnick, tenth edition
2. Non-conventional energy sources: G D Rai, Khanna publishers 2008

DETAILED SYLLABUS: THEORY

<table>
<tr><th>Module</th><th>Unit</th><th>Content</th><th>Hrs</th><th>CO No</th></tr>
<tr><td rowspan="3">I</td><td colspan="2">Physical quantities and vectors
(Book 1)</td><td>9</td><td></td></tr>
<tr><td>1</td><td>Measuring things, the international system of units</td><td>1</td><td>1</td></tr>
<tr><td>2</td><td>Significant figures</td><td>1</td><td>1</td></tr>
</table>

	3	Vectors and scalars, components of a vector	1	1
	4	Unit vectors	1	1
	5	Addition of vectors	1	1
	6	Multiplication of vectors	2	1
	7	Vectors and the laws of physics	2	1
II	**Gravitation (Book 1)**		**9**	
	8	Newton's law of gravitation, gravitation and principle of superposition	2	2
	9	Gravitation near earth's surface, gravitation inside earth	2	2
	10	Gravitational potential energy	1	2
	11	Planets and satellites, Kepler's laws	2	2
	12	Satellite orbits and energy	2	2
III	**Energy resources (Book 2)**		**9**	
	13	Various forms of energy, renewable and conventional energy systems	2	3
	14	Solar energy, applications, merits and demerits	2	3
	15	Wind energy, applications, merits and demerits	2	3
	16	Biomass energy, merits and demerits	1	3
	17	Nuclear energy, fission and fusion and nuclear reactors	2	3
IV	**Rotational motion (Book1)**		**9**	
	18	Rotational variables, rotation with constant angular acceleration	2	4
	19	Relating the linear and angular variables	2	4
	20	Kinetic energy of rotation	1	4
	21	Calculating the rotational inertia	2	4

	22	Torque	1	4
	23	Newton's second law of rotation	1	4
V*	**Sound waves (Book 1)**		**9**	
	24	Sound waves, speed of sound waves, travelling sound waves	2	5
	25	Interference	2	5
	26	Intensity and sound level, sources of musical sound	2	5
	27	Beats, Doppler effect, supersonic speeds, shock waves	3	5

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Melde's string- frequency of tuning fork	6
2	Kater's pendulum-Acceleration due to gravity	6
3	Fly Wheel	6
4	Sonometer-frequency of A.C	6
5	Kundt's tube-determination of velocity of sound.	6
6	Symmetric bar pendulum – g	6
7	Compound Bar Pendulum – Asymmetric - g	6
8	Comparison of least counts of measuring instruments.	6
9	Evaluation of errors in simple experiments.	6
Part B* – At least One Experiment to be performed		
10	Program to find the dot product and cross product of vectors	6
11	Program to find the moment of inertia of regular bodies about various axes of rotation.	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Classify a physical quantity as a vector or scalar, identify number of significant figures in a value and practise problems involving vectors.	R, U, Ap	PSO-1,2
CO-2	Define Newton's law of gravitation and Kepler's laws and describe the principles behind the orbiting of planets and satellites.	R, U	PSO-1,2
CO-3	Identify the differences between conventional and renewable energy sources and classify an energy source as conventional or renewable	R, U	PSO-1,2,3
CO-4	Recognize and distinguish between variables in linear motion and rotational motion	R, U	PSO-1,2
CO-5	Identify types and properties of sound waves and describe characteristics of sound waves	R, U	PSO-1,2
CO-6	Describe and demonstrate simple experiments	U, Ap	PSO-7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: INTRODUCTION TO MECHANICS AND ENERGY RESOURCES

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Classify a physical quantity as a vector or scalar, identify number of significant figures in a value and practise	PO 1,3,4, 5,6,8 / PSO-1,2	R, U, Ap	F, C	L	-

	problems involving vectors.					
CO-2	Define Newton's law of gravitation and Kepler's laws and describe the principles behind the orbiting of planets and satellites.	PO 1,3,4, 5,6,8 / PSO-1,2	R, U	F, C	L	-
CO-3	Identify the differences between conventional and renewable energy sources and classify an energy source as conventional or renewable	PO 1,2, 3,4,5,6,8 / PSO-1,2,3	R, U	F, C	L	-
CO-4	Recognize and distinguish between variables in linear motion and rotational motion	PO 1,3,4, 5,6,8 / PSO-1,2	R, U	F, C	L	-
CO-5	Identify types and properties of sound waves and describe characteristics of sound waves	PO 1,3,5,6,8 / PSO-1,2	R, U	F, C	L	-
CO-6	Describe and demonstrate simple experiments	PO 1,2, 4,5,8 / PSO-7	U, Ap	F, C		P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	1	-	-	-	-	-	2	-	2	2	2	2	-	2
CO-2	2	2	-	-	-	-	-	2	-	3	2	2	2	-	3
CO-3	2	1	2	-	-	-	-	2	2	2	2	2	2	-	3
CO-4	2	1	-	-	-	-	-	2	-	2	3	2	2	-	2
CO-5	2	2	-	-	-	-	-	2	-	2	-	2	2	-	2
CO-6	-	-	-	-	-	-	3	2	2	-	3	2	-	-	2

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	-	✓	-	✓
CO-3	-	✓	-	✓
CO-4	-	✓	-	✓
CO-5	✓	-	-	-
CO-6	✓	-	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK1MDCPHY100</td></tr>
<tr><td>Course Title</td><td colspan="5">ELEMENTARY DATA ANALYSIS</td></tr>
<tr><td>Type of Course</td><td colspan="5">MDC</td></tr>
<tr><td>Semester</td><td colspan="5">I</td></tr>
<tr><td>Academic Level</td><td colspan="5">100 - 199</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>3</td><td>3 Hrs</td><td>-</td><td>-</td><td>3 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5"></td></tr>
<tr><td>Course Summary</td><td colspan="5">By the end of the course, students will have gained proficiency in collecting, analysing, and interpreting experimental data in Physics, preparing them for further studies or careers in scientific research or related fields. The course emphasizes hands-on experience with real-world datasets and practical applications, aiming to equip students with the ability to extract meaningful insights from experimental measurements.</td></tr>
</table>

BOOKS FOR STUDY:

1. Goon A. M., Gupta M. K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I& II, 8th Edn. The World Press, Kolkata.
2. Hogg, R.V., Tanis, E. A. and Rao J. M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.
3. Mood, A. M. Graybill, F. A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
4. Miller, Irwin and Miller, Marylees (2006): John E. Freund’s Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.

5. Vijay K. Rohatgi, A. K. Md. Ehsanes Saleh · 2011,An Introduction to Probability and Statistics, Wiley.
6. Curtis Frye, Microsoft Excel 2019 Step by Step- 250 Ways to a Calmer You ,2019, Microsoft.

BOOKS FOR REFERENCE:

1. K. F. Riley, M. P. Hobson and S. J. Bence, 2006, Mathematical Methods for Physics and Engineering Third Edition, Cambridge University Press.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Presentation of Data (Book:1, 4)**	**10**	
	1	Data: Quantitative and Qualitative, Attributes, Variables, Scales of Measurement- Nominal, Ordinal, Interval and Ratio.	2	1
	2	Presentation of Data by Tables and Diagrams- Tabular and Graphical, Including Bar Diagram, Histogram, Pie Chart, Frequency Polygon and Ogives.	3	1
	3	Bivariate data: Definition, Scatter Diagram	2	1
	4	Frequency Distributions for Discrete and Continuous Variables, Graphical Representation of a Frequency Distribution by Histogram and Frequency Polygon, Cumulative Frequency Distributions.	3	1
II		**Probability (Book: 2, 5)**	**10**	
	5	Introduction, Random Experiments, Sample Space, Events and Algebra of Events	3	2
	6	Definitions of Probability – Classical, Statistical, and Axiomatic.	2	2
	7	Conditional Probability, Laws of Addition and Multiplication, Independent Events	2	2
	8	Theorem of Total Probability, Bayes’ Theorem and its Applications.	3	2

III	**Statistical Methods (Book: 1, 3)**		**10**	
	9	Statistical Methods: Definition and Scope of Statistics, Concepts of Statistical Population and Sample.	2	1
	10	Central Tendency and its Measures: Arithmetic Mean, Median, Mode, Geometric Mean and Harmonic Mean, Quartile and Percentiles.	3	3
	11	Measures of Dispersion: Range, Skewness, Mean Deviation, Standard Deviation, Moments, Coefficient of Variation	3	3
	12	Standard Probability Distributions: Normal, Binomial and Poisson.	2	3
IV	**Introduction to Spreadsheet (Book: 6)**		**6**	
	13	Cell Reference – Entering Data, Formatting, Editing Data	1	4
	14	Using Formulas – Filters ,Sorting, Data Analysis, Pivot Tables	2	4
	15	Mathematical and Statistical Functions, Creating Charts (Pie Chart, Column Chart and Line Chart)	3	4
V*	**Hands On Training (Book: 6) Any Five.**		**09**	
	16	Using Spreadsheet, calculate the mean, median, and mode.	9	5
	17	Using Spreadsheet, calculate the range and standard deviation.		5
	18	Using Spreadsheet, compute standard deviation, range and skewness of the data.		5
	19	Using Spreadsheet, organize data in a list alphabetically, numerically or chronologically.		5
	20	Using Spreadsheet, plot Ohm’s law.		5
	21	Using Spreadsheet, create a formula to find the Income tax of an individual that contains nested functions.		5
	22	A worksheet contains names and marks in 3 subjects. Calculate total marks and construct 3D Pie chart for total marks.		5

	23	Using Spreadsheet, Construct 2D line chart for a given set of data.		5
	24	Using Spreadsheet, Construct 2D column chart for a given set of data.		5
	25	From the data given, using the most appropriate formulas and functions, (i). Calculate the total rainfall for the week and the year respectively. (ii). Find the lowest rainfall for the week and the year respectively. (iii). Find the highest rainfall for the week and the year respectively. (iv). Find the mean rainfall for the week and the year respectively.		5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Summarize the basics of data handling, various quantitative techniques involved and its presentation.	R, U	4
CO-2	Illustrate probability theory, its applications and enable them to analyse and make decisions in uncertain situations, and solve problems in diverse contexts.	R, U	4
CO-3	Administer the statistical methods of handling data.	R, U	4
CO-4	Develop the proficiency in utilizing formulas to conduct calculations and streamline tasks through automation.	U, Ap	4
CO-5	Interpret, apply and visualize data using Spreadsheet software, enabling them to make informed decisions and solve real-world problems efficiently.	U, Ap	4

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ELEMENTARY DATA ANALYSIS

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Summarize the basics of data handling, various quantitative techniques involved and its presentation.	PO 1,4/ PSO 4	U	F,C	L	-
CO-2	Illustrate probability theory, its applications and enable them to analyse and make decisions in uncertain situations, and solve problems in diverse contexts.	PO 1,2/ PSO 4	U	F,C	L	-
CO-3	Administer the statistical methods of handling data.	PO 1,2,4/ PSO 4	U	F,C	L	-
CO-4	Develop the proficiency in utilizing formulas to conduct calculations and streamline tasks through automation.	PO 1,2,6,7/ PSO 2,4	U, Ap	F,C,P	L	-
CO-5	Interpret, apply and visualize data using Spreadsheet software, enabling them to make informed decisions and solve real-world problems efficiently.	PO 1,2,6,7/ PSO 2,4	U, AP	F,C,P	L/T	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	-	-	-	2	-	-	-	1	-	-	2	-	-	-	-
CO-2	-	-	-	2	-	-	-	1	1	-	-	-	-	-	-
CO-3	-	-	-	2	-	-	-	1	1	-	2	--	-	-	-
CO-4	-	2	-	2	-	-	-	1	2	-	-	-	2	2	-
CO-5	-	2	-	2	-	-	-	1	2	-	-	-	2	2	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	-	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	✓	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK1MDCPHY101**				
Course Title	**ENVIRONMENTAL PHYSICS**				
Type of Course	**MDC**				
Semester	**I**				
Academic Level	**100 - 199**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 Hrs	-	-	3 Hrs
Pre-requisites					
Course Summary	Foster environmental consciousness among students by fostering an understanding of environmental issues and the interconnectedness of humanity and the environment, advocating for nature preservation and conservation, and promoting awareness of environmental laws and policies.				

BOOKS FOR STUDY:

1. Foundations of Environmental Physics : Understanding Energy Use and Human Impacts : Kyle Forinash, Island Press; 1st edition (2010)
2. Handbook of Electronic Waste Management: International Best Practices and Case Studies: Edited by Majeti Narasimha Vara Prasad, Sri Jayewardenepura, and Anwesha Borthakur, Butterworth-Heinemann 2020
3. Atmosphere, Weather and Climate:R.G. Barry, R. J. Chorley ;Routledge 8th edition (2003)
4. Climate Change: What The Science Tells Us: C. Fletcher; Wiley 1st edition
5. A textbook of Environmental Studies- E Bharucha - University Grants Commission, 2004

BOOKS FOR REFERENCE:

1. Environmental Science: Principles and Practice- R.C. Das and D.K. Behera - PHI Learning Pvt. Ltd (2008)
2. A textbook of Environmental Studies- S.Satyanarayan, S.Zade, S.Sitre and P.Meshram - Allied Publishers, New Delhi, 2009
3. The Physics of Monsoon: R. N. Kesavamoorthy and N. Sankar Rao, Allied Publications (1992)
4. The Physics of Atmosphere: J. T. Houghton, Cambridge University, 3rd Edition (2002)

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**ENVIRONMENT: A BASIC INTRODUCTION (Book 1 Chapter 1, 4; Book 2, Chapter 1)**	**9**	
	1	Overview of Environment	3	1
	2	Impact of Population on Environment- Water, Food, Waste, Pollution, Ozone Layer	3	1,2,3
	3	Radioactive Waste, Types of Contaminants in Electronic Waste.	3	1,3
II		**PHYSICS OF CLIMATE CHANGE (Book 3 Chapter 1, 13; Book 4, Chapter 1)**	**9**	
	4	Composition of the Atmosphere- Primary Gases - Greenhouse Gases- Reactive Gas Species-Aerosols	2	3
	5	Weather and Climate- Layers of the Atmosphere	1	3
	6	Global Circulation of the Atmosphere-Ocean Currents	2	3
	7	Global Warming and the Ocean- Warming Oceans- Phytoplankton- Acidifying Oceans	2	2,3
	8	The Global Energy Balance- The Greenhouse Effect	1	2,3
	9	Environmental Impacts of Climate Change- Sea Level- Snow and Ice	1	2,3
III		**ENVIRONMENTAL POLLUTION (Book 5 Unit 5)**	**9**	
	10	Pollution	1	1

	11	Air Pollution-Types and Sources of Air Pollution-Pollutants in the Atmosphere-Effects of Air Pollution on Living Organisms-Effects of Air Pollution on the Stratosphere-Ozone Depletion and its Effects	2	1,2,3
	12	Air Pollution in India-Air Quality Monitoring	1	1
	13	Water Pollution-Water Availability on the Planet-Point Sources of Pollution-Causes of Water Pollution-Groundwater Pollution	3	1,3
	14	Noise Pollution-Effects of Noise Pollution on Physical Health-Effects of Noise Pollution on Mental Health-Noise Control Techniques	2	1,3
IV	**ENVIRONMENTAL DEGRADATION (Book 5 Unit 4, 5)**		9	
	15	Soil Pollution-Causes of Soil Degradation-Problems with Pesticide Use-Excess Salts and Water	2	1,4
	16	Thermal Pollution-Sources-Effects	1	1
	17	Biodiversity-Genetic Diversity-Species Diversity-Ecosystem Diversity-Biogeographic Classification of India	3	4,3
	18	Threats to Biodiversity: Habitat Loss, Poaching of Wildlife, Man-Wildlife Conflicts	1	4
	19	Conservation of Biodiversity	2	4
V*	**WASTE MANAGEMENT AND ENVIRONMENTAL ACTS (Book 5 Unit 5, 6; Book 2 Chapter 1)**		**9**	
	20	Solid Waste Management: Causes, Effects, and Control Measures of Urban and Industrial Waste - Incineration-Vermi - Composting	2	5
	21	Treatment Strategies of E-waste – Recycling - Landfill Disposal - Biological Treatment - Advanced Methods	2	5
	22	Role of an Individual in Prevention of Pollution	1	5

	23	Environmental Laws and Constitutional Provisions to Control Pollutions in India-The Environment (Protection) Act- The Air (prevention and Control of Pollution) act- The Water (Prevention and Control of Pollution) Act- The Wildlife Protection Act- The Forest Conservation Act of 1980	4	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss an overview of the environment and the effect of population on it.	U	PSO-4
CO-2	Summarize the composition of the atmosphere and the effect of climatic change due to global variation in temperature.	U	PSO-3,4
CO-3	Describe different types of pollution and its effects on environment	U	PSO-1,2,3,4
CO-4	Understand biodiversity and examine major environmental degradation and propose control and prevention measures	R, U	PSO-4
CO-5	Understand various waste management methods and aware of policies and standards related to waste management and environmental protection	R,U	PSO-2,4,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ENVIRONMENTAL PHYSICS

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Discuss an overview of the environment and the	PO-1,8/ PSO-2,4	R, U	F, C	L	-

	effect of population on it.					
CO-2	Summarize the composition of the atmosphere and the effect of climatic change due to global variation in temperature.	PO-1,8/ PSO-3,4	U	F	L	-
CO-3	Describe different types of pollution and its effects on environment	PO-1,2,8/ PSO-1,2,3, 4	U	F,C	L	-
CO-4	Understand biodiversity and examine major environmental degradation and propose control and prevention measures	PO-1,8/ PSO-1,2,4,7	R, U	F,C	L	-
CO-5	Understand various waste management methods and aware of policies and standards related to waste management and environmental protection	PO-1,2,3,6, 8/ PSO-2,4,7	R,U	F	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	-	1	-	1	-	-	-	1	-	-	-	-	-	-	1
CO-2	-	-	2	2	-	-	-	1	-	-	-	-	-	-	2
CO-3	1	2	2	2	-	-	-	1	1	-	-	-	-	-	1
CO-4	1	1	-	2	-	-	1	1	-	-	-	-	-	-	1
CO-5	1	1	-	2	-	1	3	2	2	1	-	-		-	2

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	-	✓	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	-	-	✓
CO-5	✓	✓	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK1MDCPHY102**				
Course Title	**GREEN ENERGY**				
Type of Course	**MDC**				
Semester	**I**				
Academic Level	**100 - 199**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 Hrs	-	-	3 Hrs
Pre-requisites					
Course Summary	The course provides a comprehensive understanding of work, energy, and power fundamentals. It includes various forms of energy such as renewable and conventional systems like coal, oil and natural gas. It explores the impact of non-conventional energy sources on global warming and examines approaches to energy conservation and governmental policies. Moreover, this course also covers specific renewable energy sources like solar, wind, hydro, tidal, and wave energy. The course touches upon other energy sources, storage methods and provides a broad overview of energy systems and technologies.				

BOOKS FOR STUDY:

1. Energy Technology: S. Rao and Dr. B.B. Parulekar, Third edition, 2009.
2. Alternative Energy Resources, Green Energy and Technology, Efstathios E. (Stathis) Michaelides, Springer, 2012, DOI 10.1007/978-3-642-20951-2.
3. Non-Conventional Energy Sources, Sri. Shali Habibulla, State Institute of Vocational Education Directorate of Intermediate Education Govt. of Andhra Pradesh, Hyderabad, 2005.

4. Non-Conventional Energy Resources: G. D. Rai, Khanna Publishers, 2008.
5. Solar Energy Fundamentals and application: H.P. Garg and J. Prakash, Tata McGraw - Hill Publishing company Ltd., 1997.

BOOKS FOR REFERENCE:

1. Power Plant Technology: A. K. Wahil. 1993.
2. Solar energy: S. P. Sukhatme, Tata McGraw- Hill Publishing company Ltd.,1997.
3. Renewable Energy, Power for a sustainable future, Godfrey Boyle, 2004, Oxford University Press, in association with The Open University.
4. Solar Energy: Resource Assessment Handbook, Dr. P Jayakumar, 2009.
5. Wave and Tidal Energy Editor(s): Deborah Greaves, Gregorio Iglesias, First published:23 March 2018, DOI:10.1002/9781119014492, 2018 John Wiley & Sons Ltd.
6. Renewable Energy Resources: John Twidell and Tony Weir, Routledge Publishers ISBN: 978-1138782841.
7. Solar energy: G.D. Rai, Fifth edition, 1995.
8. Renewable Energy: Sources and Methods, Anne Elizabeth Maczulak, 2010.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	**INTRODUCTION (Book 1 Chapter 2, Book 2 Chapter 1, Book 3, Chapter 1)**		**9**	
	1	Fundamentals of Work, Energy and Power	1	1
	2	Various Forms of Energy - Renewable and Conventional energy Systems - Comparison - Coal, Oil and Natural Gas – Availability - Applications – Merits and demerits	2	1
	3	Impact Due to Non-Conventional Energy Sources – Global Warming	3	1
	4	Approaches to Energy Conservation - Energy Conservation Policies of Different Governmental Bodies	3	1
II	**SOLAR ENERGY (Book 1 Chapter 4, Book 3 Chapter 2)**		**9**	
	5	Solar Radiation Measurements (qualitative only), Solar Energy Collector, Principles of the Conversion of Solar Radiation into Heat	3	2

	6	Classification of Different Types of Solar Energy Collectors (qualitative ideas only) - Merits and Demerits	3	2
	7	Solar Energy Storage, Solar Heaters, Solar Cookers, Solar Green Houses	1	2
	8	Merits and Demerits of Solar Energy, Solar Cell Technology (basic principle only)	2	2
III	**WIND ENERGY (Book 1 Ch**apter **8,9, Book 2 Ch**apter **8, Book 3 Ch**apter **3)**		**9**	
	9	Basic Principles of Wind Energy Conversion, Merits and Demerits	3	3
	10	Basic Components of Wind Energy Conversion System	3	3
	11	Policies Related to Wind Energy in India, Applications of Wind Energy.	3	3
IV	**HYDRO, TIDAL AND WAVE ENERGY (Book 1 Ch**apter **18, Book 3 Ch**apter **5)**		**9**	
	12	Hydro-Resources, Hydro-Project- Types and Hydro-Conversion Technologies	2	4
	13	Tidal Resource, Tidal Power Conversion	3	4
	14	Wave Resource, Wave Energy Conversion	3	4
	15	Challenges to Sustainability	1	4
V*	**OTHER SOURCES OF ENERGY AND STORAGE (Book 1 Ch**apter **19, 20, Book 2 Ch**apter **12)**		**9**	
	16	Piezoelectric Energy Harvesting – Physics and Characteristics of Piezoelectric Effect, Piezoelectric Energy Applications	2	5
	17	Electromagnetic Energy Harvesting	2	5
	18	Oceans and Chemical Energy Resources	2	5
	19	Energy Storages - Primary and Secondary Cells –Fuel Cells (basics)	3	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identifying various forms of energy and the impacts of Non-Conventional Energy Sources	R, U	PSO-3,4.7
CO-2	Explain the principles conversion of solar energy into heat and classify various types of solar energy collectors	R, U	PSO-3,4.7
CO-3	Explain the principles of wind energy conversion and discuss the policies related to wind energy in India	R,U	PSO-3,4.7
CO-4	Explain the fundamental principles hydro resources and challenges to sustainability	R, U	PSO-3,4.7
CO-5	Differentiate between piezoelectric and electromagnetic energy harvesting methods	R,U	PSO-3,4.7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: GREEN ENERGY

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Identifying various forms of energy and the impacts of Non-Conventional Energy Sources	PO-1,2 /PSO-3,4.7	R, U	F, C	L	-
CO-2	Explain the principles conversion of solar energy into heat and classify various types of solar energy collectors	PO-1,2 /PSO-3,4.7	U	C	L	-

CO-3	Explain the principles of wind energy conversion and discuss the policies related to wind energy in India	PO-1,2 /PSO-3,4.7	U	C	L	-
CO-4	Explain the fundamental principles hydro resources and challenges to sustainability	PO-1,2 /PSO-3,4.7	R, U	F, C	L	-
CO-5	Differentiate between piezoelectric and electromagnetic energy harvesting methods	PO-1,2 /PSO-3,4.7	U	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	-	-	2	3	-	-	-	1	1	-	-	-	-	-	-
CO-2	-	-	2	3	-	-	-	1	1	-	-	-	-	-	-
CO-3	-	-	2	3	-	-	-	1	1	-	-	-	-	-	-
CO-4	-	-	2	3	-	-	-	1	1	-	-	-	-	-	-
CO-5	-	-	2	3	-	-	-	1	1	-	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	-	-	-	✓
CO-3	✓	✓	-	✓
CO-4	-	-	-	✓
CO-5	✓	✓	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK1MDCPHY103**				
Course Title	**PHYSICS IN ARTS AND SPORTS**				
Type of Course	**MDC**				
Semester	**I**				
Academic Level	**100- 199**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 Hrs	-	-	3 Hrs
Pre-requisites					
Course Summary	Focusses on the physical principles behind arts and sports, with the purpose of enabling the student to develop and optimize ideas on arts/music/photography and sports				

BOOKS FOR STUDY:

1. Physics in the Arts P. U. P. A. Gilbert and W. Haeberli (Elsevier) Revised Edition
2. The Physics of Sports A Textbook by David R. Heskett
3. Concepts in physics by H C Verma

BOOKS FOR REFERENCE:

1. Phyllotaxis, anthotaxis and semataxis Acta Biotheoretica Vol 14, 1961, pages 1-28. (Fibonacci series)
2. https://www.mathnasium.com/blog/14-interesting-examples-of-the-golden-ratio-in-nature (Fibonacci series)
3. https://science.howstuffworks.com/engineering/architecture/brunelleschis-dome.htm

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**INTRODUCTION (Book 1 Chapter 1, 2, 4) (Ref 1 & 2)**	**9**	
	1	Electromagnetic Spectrum, Refraction and Total Internal Reflection in Diamonds, Polarization	2	1
	2	Geometry in Architecture, Developments from Brunelleschi to Leonardo	2	2
	3	Light and Shadow in Nature, Fibonacci Series, Golden Ratio and Symmetry in Nature.	4	
	4	Human Visual System	1	2
II		**PHYSICS OF PAINTING & PHOTOGRAPHY (Book 1 Chapter 6, 7, 8 & 9)**	**9**	
	5	Primary Colours, Colour Triangle, Colour Sensitivity of the Eye	3	1
	6	Colour: Saturation, Brightness in Painting and Photography. Additive Color Mixing in Painting, Subtractive Primary Colors	3	1
	7	Camera - Focusing the Camera	1	3
	8	Parameters Affecting Quality of Photos: Exposure Time, Aperture, Depth of Field, *f* Number, Rule of Third	2	3
III		**PHYSICS OF MUSIC (Book 1 Chapter 10, 11 & 13)**	**9**	
	9	Periodic Oscillations, Simple Harmonic Motion, Damped Oscillations (qualitative) and Resonance.	3	1
	10	Build-up and Decay of Musical Tones, Resonators in Musical Instruments	2	2
	11	Beats and Harmony, Principle of Superposition, Sound Perception: Pitch, Loudness and Timbre, Loudness and Amplitude, Loudness and Frequency	4	3

IV	**PHYSICS IN SPORTS – I (Book 2 Chapter 1, 2 & 3)**		9	
	12	Newton's Laws of Motion, Concept of Velocity, Momentum, Force, Action and Reaction, Conservation of Momentum and Energy, Torque	4	1
	13	Damping, Friction, Rotation, Circular Motion, Gravitation, Projectile, Range of Projectile	3	2
	14	Catches, Throws, Thrust, Pressure	2	2
V*	**PHYSICS IN SPORTS - II (Book 2 Chapter 8, 9 & 10)**		**9**	
	15	Science Behind Various Sports -Basketball, Football, Javelin, Discus, Cricket Batting, Kicking of Football, Badminton, Swimming	2	4
	16	Science Behind the Design of Bats - Table Tennis, Cricket, Tennis	1	4
	17	Cricket Bowling- Magnus Effect, Spin Motion, Reverse Swing	2	4
	18	Throw- Shot Put Throw, Discus Throw and Javelin Throw	1	4
	19	Athletics - Physics of Running, Long jump, High Jump & Gymnastics	3	4

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss beauty and interconnectedness of the natural world and human understanding.	U, R	PSO-2,4
CO-2	Administer a solid foundation in the principles of light, color, for creative expression through photography and painting.	A, U, R	PSO-1, 2,4
CO-3	Explain the oscillatory phenomena and their relevance to	U, R	PSO-1, 2,4

	the production, transmission, and perception of sound.		
CO-4	Describe the application of physics principles to sports and athletics, enabling them to understand and enhance performance, design better equipment, and make informed decisions in coaching, training, and sports medicine.	U, R	PSO-1, 2,4

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: PHYSICS IN ARTS AND SPORTS

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Discuss beauty and interconnectedness of the natural world and human understanding.	PO-3,6/ PSO-2,4	U	F, C	L	-
CO-2	Administer a solid foundation in the principles of light, color, for creative expression through photography and painting.	PO-3,6/ PSO-1, 2,4	U	F, C	L	-
CO-3	Explain the oscillatory phenomena and their relevance to the production, transmission, and perception of sound.	PO-3,6/ PSO-1, 2,4	U, R	F, C	L	-
CO-4	Describe the application of physics	PO-3,6/ PSO-1,	U, R	F, C	L, T	-

	principles to sports and athletics, enabling them to understand and enhance performance, design better equipment, and make informed decisions in coaching, training, and sports medicine.	2,4				

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	-	1	-	3	-	-	-	-	-	1	-	-	1	-	-
CO-2	3	1	-	3	-	-	-	-	-	1	-	-	1	-	-
CO-3	3	1	-	3	-	-	-	-	-	2	-	-	1	-	-
CO-4	3	1	-	3	-	-	-	-	-	1	-	-	2	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	-	-	-	✓
CO-2	-	-	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	✓	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK1MDCPHY104**				
Course Title	**PHYSICS OF EVERYDAY APPLIANCES**				
Type of Course	**MDC**				
Semester	**I**				
Academic Level	**100 - 199**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 Hrs	-	-	3 Hrs
Pre-requisites					
Course Summary	"This course provides a basic exploration of the physical principles underlying everyday appliances and technologies. From the basics of electronics and electricity to modern communication technology, students will gain a comprehensive understanding of how various devices work, their impact on energy consumption and efficiency."				

BOOKS FOR STUDY:

1. Louis A Bloomfield – "How things works – The physics of everyday life" - 5-th Edition - Willy Publications (2013)
2. Eric Kleinert - "Trouble shooting and repairing major appliances" Third Edition - McGraw Hills companies (2013)
3. Disseminating Star Labelling in Household Appliance (DISHA) Operational Manual, Bureau of Energy Efficiency

BOOKS FOR REFERENCE:

1. Edison's Electric Light: The Art of Invention (Johns Hopkins Introductory Studies in the History of Technology)
2. LED Lighting: A Primer to Lighting the Future, Sal Cangeloso
3. "The Physics of Everyday Things: The Extraordinary Science Behind an Ordinary Day" by James Kakalios
4. "Optics" by Eugene Hecht

WEB REFERENCES

1. https://www.energy.gov/articles/history-light-bulb
2. Energy_efficient_Ceiling_fans_using_BLDC_motors-A_practical_implementation - Dr Mahesh Rao (https://www.researchgate.net/profile/Mahesh-Rao-8/publication/325922681_Energy_efficient_Ceiling_fans_using_BLDC_motors-A_practical_implementation/links/5b2c7dcfa6fdcc8506bc8680/Energy-efficient-Ceiling-fans-using-BLDC-motors-A-practical-implementation.pdf)
3. Induction stoves: An option for clean and efficient cooking in Indonesia – Tiandho, Yuant etal 2020 (doi:10.1088/1757-899X/1034/1/012068)

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Lighting Devices (Ref Web Link -1, Book-1 section 13.2-13.3, Book 3)**	**9**	
	1	History of light bulbs	1	1
	2	Discharge lamps, fluorescent lamps - mercury, metal-halide, and sodium lamps	3	1
	3	Light-emitting diodes- working of led	2	1
	4	Lasers - types of lasers	1	1
	5	Need for saving energy - bee standards & labelling	2	1
II		**Mirrors, Lenses, and Camera (Book-1, section 14.1)**	**7**	
	6	Introduction to mirrors and lenses, real images - focusing and lens diameter	2	2

	7	Focal lengths and f-numbers - improving the quality of a camera lens - the viewfinder and virtual images	2	2
	8	Image sensors - limit of resolution	2	2
	9	Eyes and eye glasses	1	2
III	**Heat Transfer and Cooling Systems (Book-1, section 7.1, 8.2, 8.1)**		**11**	
	10	Woodstoves -thermal conductivity, conduction, convection, radiation, heat capacity	1	3
	11	Microwave ovens – speed, frequency, and wavelength in electromagnetic waves - polar and nonpolar molecules - working of ovens	2	3
	12	Induction stoves - basic principles	2	3
	13	Automobiles - using thermal energy: heat engines – the internal combustion engine, efficiency	3	3
	14	Air conditioners - pumping heat against its natural flow - how an air conditioner cools the indoor air - how an air conditioner warms the outdoor air	3	3
IV	**Other Domestic Appliances (Book-1, section 9.1, 9.2, Web Link-2)**		**9**	
	15	Clocks- working - time and space, natural resonance, simple harmonic motion, frequency, period, amplitude	3	1
	16	Musical Instruments: sound; music; vibrations in strings, air, surfaces, fundamental and higher-order modes; harmonic and nonharmonic overtones; sympathetic vibration; standing and traveling waves; transverse and longitudinal waves.	5	1
	17	BLDC Motors - features, applications (Fan, Pump)	1	1
V*	**Hands on Training (Book-2, Chapter 6 & 7)**		**9**	
	18	(Any five experiments to be done) 1. Soldering technique 2. Electric tester	9	4

		3. Checking the continuity of electrical components in simple circuits using multimeter 4. Assembling/replacing of fuse wire in household devices 5. Familiarization of resistor, capacitor, diode, transformer 6. One lamp controlled by one switch - soldering 7. One lamp controlled by two switch - soldering 8. Led bulb/tube light making, and troubleshooting 9. Finding the focal length of lens 10. Making of simple electrical extension boards 11. Electric earthing system 12. Energy auditing of devices		

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Summarize the basics of lighting technology, domestic appliances including proficiency in energy efficiency standards and labelling programs established by the Bureau of Energy Efficiency (BEE)	R, U	PSO-1, 4,6
CO-2	Understand the working of optical systems and imaging devices such as camera.	R, U	PSO-1, 2,3,4
CO-3	Discuss basic knowledge of heat transfers and technology in common appliances.	R, U	PSO-1, 4
CO-4	Administer practical skills through hands-on experiments, including soldering, circuit construction etc.	R, U, Ap	PSO-3,6,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: PHYSICS OF EVERYDAY APPLIANCES

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Demonstrate a comprehensive understanding of lighting technology.	PO 4,7/ PSO-1, 4,6	U	F, C	L	P
CO-2	Understand the working of optical systems and imaging devices such as camera.	PO 4,7/ PSO-1, ,2,3,4	R, U	F, C, P	L/T	P
CO-3	Develop basic knowledge of heat transfers and technology in common appliances.	PO 4,7/ PSO-1,4	R, U	F, C, P	L	-
CO-4	Develop fundamental Knowledge of electronics and electricity and also to develop practical skills through hands-on experiments, including soldering, circuit construction etc.	PO 3,4,7/ PSO-3,67	R, U, A	F,C,P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	-	-	3	-	3	-	-	-	-	1	-	-	1	-
CO-2	2	3	3	3	-	-	-	-	-	-	1	-	-	1	-
CO-3	2	-	-	3	-	-	-	-	-	-	1	-	-	1	-
CO-4	-	-	3	-	-	3	3	-	-	1	1	-	-	3	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	✓	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK2DSCPHY100</td></tr>
<tr><td>Course Title</td><td colspan="5">FOUNDATION COURSE IN PHYSICS-II</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSC</td></tr>
<tr><td>Semester</td><td colspan="5">II</td></tr>
<tr><td>Academic Level</td><td colspan="5">100 - 199</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>3 Hrs</td><td>-</td><td>2 Hrs</td><td>5 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">-</td></tr>
<tr><td>Course Summary</td><td colspan="5">This course discusses the basic concepts required to learn advanced physics courses. The concept of error and precision emphasises the importance of numbers when expressing the magnitude of a quantity. Discussion on waves basic features of waves and its expression. Basic concepts of fluids helps us to understand application level problems like venturi meter and aeroplane wings. The discussion on elasticity gives an idea about different elastic moduli.</td></tr>
</table>

BOOKS FOR STUDY:

1. Principles Of Physics 10th Edition, Robert Resnick Jearl Walker, David Halliday, Wiley, 2014.
2. Sear and Zemansky’s University Physics With Modern Physics, Hugh D Young, Roger A Freedman, Addison -Wesley, 13TH EDITION, 2012.
3. College Physics 2e, PAUL PETER URONE, ROGER HINRICHS, Openstax, 2022
4. Elements of Properties of Matter: D.S. Mathur, S. Chand Publications,2014

BOOKS FOR REFERENCE:

1. Mechanics: J. C. Upadhyaya and Ram Prasad, S. Chand Publications, 2017
2. Mechanics: H. S. Hans and S. P. Puri, TMH, 2ndEdn.
3. Properties of matter: Brijlal and Subramaniam, S. Chand & Co.,2004
4. Principles of Physics: P.V. Naik, PHI, 2010
5. Principles Of Physics 10th Edition, Robert Resnick Jearl Walker, David Halliday, Wiley, 2014.

WEB REFERENCE

1. https://www.owlnet.rice.edu/~labgroup/pdf/Error_analysis.htm
2. https://faraday.physics.utoronto.ca/PVB/Harrison/ErrorAnalysis/

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**PRECISION IN PRACTICE (Web 1, Web 2)**	**9**	
	1	Significant figures (Web 1)	1	1
	2	Absolute and relative error (Web 1)	1	1
	3	Systematic error (Web 1)	1	1
	4	Random error, estimating random errors (Web 1)	1	1
	5	Propagation of errors (Web 1)	2	1
	6	Precision and accuracy (Web 2)	2	1
	7	Error bars and graphical representation (Web 2)	1	1
II		**PHYSICAL WORLD OF WAVES (Book1: Chapter 16)**	**9**	
	8	Types of waves – Mechanical, Electromagnetic and matter waves, Transverse and longitudinal waves	1	2
	9	Amplitude, phase, wavelength, wave number, period , frequency, angular frequency, phase constant, Speed of a travelling wave	2	2
	10	Wave Speed on a stretched string, energy and power of a wave travelling along a string	2	2

	11	Wave equation	1	2
	12	The principle of Superposition of waves	1	2
	13	Standing waves and resonance(qualitative idea)	2	2
III	**FLUID STATICS (Book 3: Chapter 11)**		**6**	
	14	Cohesion and adhesion of liquids, surface tension - pressure inside a bubble, capillary action	4	3
	15	Pressure in the body: Blood pressure, pressure in eye, Pressure Associated with the Lungs, Other Pressures in the Body: Spinal Column and Skull- Bladder Pressure- Pressures in the Skeletal System	2	3
IV	**FLUID DYNAMICS (Book 2: Chapter 12 and Book 3: Chapter 12)**		**12**	
	16	Fluid flow-streamline and turbulent flow, continuity equation (Book 2: Chapter 12)	2	3
	17	Bernoulli’s equation -derivation, venturi meter, lift on an aeroplane wing (Book 2: Chapter 12)	4	3
	18	Viscosity and Laminar Flow; Poiseuille’s Law, Motion of an Object in a Viscous Fluid (Book 3: Chapter 12)	4	3
	19	Molecular Transport Phenomena: Diffusion, rate and direction of diffusion, Osmosis and Dialysis - Diffusion across Membranes (Book 3: Chapter 12)	2	3
V*	**BEAUTY OF DEFORMATION AND RESTORATION (Book1, Book4)**		**9**	
	20	Condition for equilibrium, Centre of Gravity (Book1: Chapter 11)	1	4
	21	Stress, Strain, and Elastic Moduli- Hook’s law, Tensile stress and strain, Bulk Stress and Strain, Shear Stress and Strain (Book1: Chapter 11)	2	4
	22	bending of beams, bending moment, cantilever, Beams supported at its ends and loaded in the middle (Book 4: Chapter 12)	3	4

	23	Twisting couple on a cylindrical rod or wire, work done in twisting a wire, torsion pendulum (Book 4: Chapter 12)	3	4

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		CO No
Sl No	**Name of Experiment**	
1	Uniform bending—Y- optic lever method	4
2	Non-uniform bending-Y-Optic lever & telescope	4
3	Rigidity modulus –Static torsion	4
4	Torsion pendulum I- By Torsional oscillations.	4
5	Torsion pendulum I- By Equal masses.	4
6	Viscosity-Continuous flow method using constant pressure head.	3
7	Viscosity-Variable pressure head arrangement	3
8	Surface tension-Capillary rise.	3
Part B* – At least One Experiment to be performed		
9	Evaluation of errors in simple experiments.	1
10	Experiment to demonstrate random error, by taking dimensions of a small rectangular object using Vernier calliper and evaluate the volume of the object	1
11	Comparison of least counts of measuring instruments.	1
12	Uniform Bending- determination of Y using pin and Microscope	4
13	Determination of the viscosity of fluid using Stoke’s method.	3

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss the basics of error analysis and use it in expressing physical quantities.	U, Ap	1, 2, 7

CO-2	Identify the basic concepts of waves and its mathematical expression to understand periodic wave motion	R, U	1, 2
CO-3	Observe physical concepts of fluids in rest and motion, to relate them with real world examples	R, U	1, 2, 7
CO-4	Cite Hook's law and apply it to calculate the elastic moduli of beams and rods.	U, Ap	1, 2, 7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: FOUNDATION COURSE IN PHYSICS-II

Credits: 3:0:1 (Lecture:Tutorial:Practical)

CO No.	CO	PO/ PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Discuss the basics of error analysis and use it in expressing physical quantities.	PSO 1, 2, 7/ PO 1, 2	U, Ap	F, C, P	L	P
CO-2	Identify the basic concepts of waves and its mathematical expression to understand periodic wave motion	PSO 1, 2, 7/ PO 1, 2	R, U	F, C	L	
CO-3	Observe physical concepts of fluids in rest and motion, to relate them with real world examples	PSO 1, 2, 7/ PO 1, 2	R, U	F, C, P	L	P
CO-4	Cite Hook's law and apply it to calculate the elastic moduli of beams and rods.	PSO 1, 2, 7/ PO 1, 2	U, Ap	F, C, P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	2	-	-	-	-	2	1	1	-	-	-	-	-	-
CO-2	3	1	-	-	-	-	-	2	2	-	-	-	-	-	-
CO-3	3	2	-	-	-	-	3	2	2	-	-	-	-	-	-
CO-4	3	2	-	-	-	-	3	3	3	-	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	-	✓	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK2DSCPHY101</td></tr>
<tr><td>Course Title</td><td colspan="5">ELECTRICITY, MAGNETISM AND ACOUSTICS</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSC</td></tr>
<tr><td>Semester</td><td colspan="5">II</td></tr>
<tr><td>Academic Level</td><td colspan="5">100 - 199</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>3 Hrs</td><td>-</td><td>2 Hrs</td><td>5 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5"></td></tr>
<tr><td>Course Summary</td><td colspan="5">This course provides a comprehensive understanding of fundamental principles and Phenomenon of electricity, magnetism, and acoustics. This course enables to identify and explain chemical, thermal and magnetic effect of electric current, analyses and solves electrical circuits with dc and ac source.</td></tr>
</table>

BOOKS FOR STUDY:

1. Brijlal and Subramaniam, Electricity and Magnetism, S. Chand & Co, New Delhi (2016)
2. R. Murugeshan, Electricity and Magnetism, S. Chand & Co, New Delhi (2016)
3. Textbook of Sound, D.R.Khanna and R.S. Bedi, Atmaram and sons, 1969.
4. A Text Book of Sound, N.Subrahmanyam and BrijLal, Vikas Publishing House - Second revised edition,1995.
5. Yarwood and Wittle; Experimental Physics for Students, Chapman & Hall Publishers.
6. A text book of practical physics, S. Viswanathan & Co., Chennai. Press.

BOOKS FOR REFERENCE:

1. David J Griffith,1997, Introduction to electrodynamics,2ND EDITION, New Delhi, Prentice Hall of India Pvt.Ltd.
2. Electricity and Magnetism -E.M.Pourcel, Berkley Physics Cource, Vol.2 (Mc Grraw-Hill)
3. Hugh D. Young and Roger A. Freedman, Sears & Zemansky's University Physics with Modern Physics,14th Edition (2015)
4. Fundamentals of Acoustics" by Lawrence E. Kinsler, Austin R. Frey, Alan B. Coppens

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	**INTRODUCTION TO KINEMATICS (Book :1 - Chapter: 2, 3,4; Book : 2- Chapter: 2,3,4; Book : 3; Chapter: 1-5)**		**11**	
	1	Electric charge and its properties	1	1
	2	Coulomb's Law -Electric intensity	1	1
	3	Electric field and electric field lines	1	1
	4	Gauss law- Electric field intensity due to a Uniformly charged sphere.	1	1
	5	Electrical potential–Equipotential surfaces	1	1
	6	Ohms law- Current density, Electric resistivity and Conductivity	1	1
	7	Kirchoff law of circuit analysis – Maxwell Bridge	2	1
	8	Carey–Foster Bridge – theory – temperature coefficient of resistance, Potentiometer – theory	3	1
II	**Magnetic Effect of Electric Current (Book: 1,2)**		**10**	
	9	Magnetic flux and magnetic induction ,Relation connecting B.M and H, Magnetic susceptibility and permeability	2	2
	10	Biot Savart law- magnetic induction at a point due to a straight conductor carrying current	2	2
	11	magnetic induction at a point on the axis of a circular coil carrying current	2	2
	12	Amperes circuital law-magnetic field inside a long solenoid	2	2
	13	Lorentz force on a moving charge- direction of force	1	2

	14	Torque on a current loop in a uniform magnetic field.	1	2
III	**Thermal and Chemical Effects of Electric Current (Book: 1,2)**		**06**	
	15	Thermoelectricity – Seebeck effect- laws of thermo e.m.f	2	3
	16	measurement of thermo e.m.f. using potentiometer	1	3
	17	Peltier effect and Peltier coefficient	1	3
	18	Thomson effect and Thomson coefficient	1	3
	19	Faraday's laws of electrolysis	1	3
IV	**AC and DC circuits (Book: 1,2)**		**09**	
	20	EMF induced in a coil rotating in a magnetic field	1	4
	21	Peak, average and RMS values of AC voltage and current	1	4
	22	j operator method –use of j operator in the study of AC circuits	1	4
	23	Resistance in an AC Circuit-Inductance in an AC circuit. Capacitance in an AC circuit-	2	4
	24	AC through an inductance and capacitance in series	1	4
	25	AC through an capacitance and resistance in series	1	4
	26	Growth and decay of current in LC and CR circuits with d.c.voltages	2	4
V*	**Ultrasonics and Acoustics (Book: 3,4)**		**09**	
	27	Ultrasonics	0.5	5
	28	Production – Piezoelectric crystal method - Magnetostriction method	2	5
	29	Properties and Applications of Ultrasonics	1.5	5
	30	Acoustics of building – Reverberation- Sabine's Reverberation formula	2	5
	31	Factors affecting acoustics of building- Sound distribution in an auditorium-	2	5
	32	Requisites for good acoustics.	1	5

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		CO No
Sl No	**Name of Experiment**	
1	Deflection and vibration magnetometer- M and Bh	2,6
2	Circular coil- magnetization of a magnet	2,6
3	Searle’s vibration magnetometer-comparison of magnetic moments	2,6
4	Potentiometer-Resistivity	1,6
5	Thermo-emf-measurement of emf using Potentiometer	5,6
6	Carey Foster“s bridge – Measurement of unknown resistance of wire	1,6
7	Carey Foster’s Bridge-Temperature coefficient of resistance	1,6
8	To study the frequency response of a series RC circuit	4,6
9	Sonometer-frequency of A.C	4,6
10	Melde’s string-Frequency of fork	6
Part B* – At least One Experiment to be performed		
11	Verification of Ohms Law	1,6
12	Circular coil-dipole moment	2,6
13	Potentiometer – EMF of a thermocouple	3,6
14	To study the frequency response of a series LC circuit	4,6
15	Kundt’s tube-determination of velocity of sound.	6

COURSE OUTCOMES

CO No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discover the fundamental concepts of electric charge and electric fields. Use it and solve basic electric circuit problems using Ohm's Law and Kirchhoff's Laws.	U, Ap	PSO-1,2

CO-2	Review Biot and Savart’s law and Ampere’s circuital law to describe and explain the generation of magnetic fields by electrical currents.	U, Ap	PSO-1,2
CO-3	Identify the basics Thermocouple effects	U	PSO-1,2
CO-4	Discuss the concepts of AC and DC circuits and solves electrical circuits with dc and ac source.	U, Ap	PSO-1,2
CO-5	Compare the different methods of producing ultrasonic waves and associate the theories used in building acoustics.	U	PSO-1,2
CO-6	Develop practical skills and understanding experimental setups in the context of the relevant physical principles of Electricity, Magnetism and Acoustics.	U,Ap	PSO - 1,3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ELECTRICITY, MAGNETISM AND ACOUSTICS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Discover the fundamental concepts of electric charge and electric fields. Use it and solve basic electric circuit problems using Ohm's Law and Kirchhoff's Laws.	PO-1/ PSO-1,2	U, Ap	C	L	-
CO-2	Review Biot and Savart’s law and Ampere’s circuital law to describe and explain the generation of magnetic fields by electrical currents.	PO-1/ PSO-1,2	U, Ap	C	L	-

CO-3	Identify the basics Thermocouple effects	PO-1/ PSO-1,2	U	F, C	L	-
CO-4	Discuss the concepts of AC and DC circuits and solves electrical circuits with dc and ac source.	PO-1/ PSO-1,2	U, Ap	C	L	-
CO-5	Compare the different methods of producing ultrasonic waves and associate the theories used in building acoustics.	PO-1/ PSO-1,2	U	F, C	L	-
CO-6	Develop practical skills and understanding experimental setups in the context of the relevant physical principles of Electricity, Magnetism and Acoustics.	PO-1,6/ PSO - 1,3	U, Ap	C, P		P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	2	-	-	-	-	-	2	-	-	-	-	-	-	-
CO-2	2	2	-	-	-	-	-	2	-	-	-	-	-	-	-
CO-3	2	2	-	-	-	-	-	2	-	-	-	-	-	-	-
CO-4	2	2	-	-	-	-	-	2	-	-	-	-	-	-	-

CO-5	2	2	-	-	-	-	-	2	-	-	-	-	-	-	-
CO-6	2	-	2	-	-	-	-	2	-	-	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	-	-	✓
CO-5	✓	✓	-	-
CO-6	✓	✓	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK2DSCPHY102</td></tr>
<tr><td>Course Title</td><td colspan="5">OPTICS AND THERMODYNAMICS</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSC</td></tr>
<tr><td>Semester</td><td colspan="5">II</td></tr>
<tr><td>Academic Level</td><td colspan="5">100 - 199</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>3 Hrs</td><td>-</td><td>2 Hrs</td><td>5 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">1. Students should know the fundamentals of ray optics such as reflection, refraction and total internal reflection.
2. Students should be aware of wavefront, Huygen’s Principle and coherent sources.
3. Students should be familiar with Thermal equilibrium, Zeroth law and first law of thermodynamics
4. Students should know the basics mathematics of permutations, combinations, logarithm, and Sterling’s approximation</td></tr>
<tr><td>Course Summary</td><td colspan="5">1. Introduces theory of different optical phenomena.
2. Aims to provide the basic concepts of thermodynamics, the first and the second law of thermodynamics, heat engine, entropy, and the change in entropy during reversible and irreversible processes.
3. Gain the basic knowledge about the fundamentals of Statistcal Mechanics.
4. Provides a platform to observe and analyse different optical phenomena through practical sessions.</td></tr>
</table>

BOOKS FOR STUDY:

1. Optics, Dr. N Subrahmanyam Brijlal, Dr M N Avadhanulu, S Chand and Company Ltd (2020).
2. Heat and Thermodynamics and Statistical Mechanics: Brijlal , Subramaniam, P S Hemne, S. Chand &Co (2021).

BOOKS FOR REFERENCE:

1. Optics, Ajoy Ghatak, McGraw Hill, New Delhi (2020).
2. Heat and Thermodynamics: M. Zemansky, McGraw Hill, New Delhi (2007).
3. Physics, Principles with Applications, Douglas C. Giancoli, Pearson Education Limited, 7^{th} Edition (2016).
4. Concepts of Modern Physics, Arthur Beiser, Shobhit Mahajan, S Rai Choudhury, McGraw Hill Education (India) Private Limited (2017).
5. Sear and Zemansky's University Physics With Modern Physics, Hugh D Young, Roger A Freedman, Addison -Wesley, 13TH EDITION, 2012.
6. Heat and Thermodynamics: D. S. Mathur, S. Chand & Sons, New Delhi (1995)
7. College Physics 2e, Paul Peter Urone, Roger Hinrichs, Openstax, 2022.
8. Principles Of Physics 10th Edition, Robert Resnick Jearl Walker, David Halliday, Wiley, 2014.
9. Statistical Mechanics, Sathyaprakash, Kedar Nath Ram Nath, Delhi, Edn (2021).
10. Thermal and Statistical Mechanics: S. K. Roy, New Age International- 2001

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**GEOMETRIC OPTICS (Book 1)**	**7**	
	1	Light – Electromagnetic theory and Quantum theory, Dual nature	1	2
	2	Reflection – Laws, Refraction – Laws	2	1
	3	Refractive index, optical path,	1	2
	4	Dispersion	1	2
	5	Fermat's principle, Rectilinear propagation of light	2	1,2

II	**WAVE OPTICS (Book 1)**		**15**	
	6	Interference - Principle of superposition.	2	1
	7	Young's double slit experiment, bright and dark fringes, fringe width	2	2
	8	Interference in thin films – due to reflected light, Colours in thin films, Applications.	2	2
	9	Newtons rings	2	2
	10	Diffraction - Fresnel and Fraunhofer Diffraction	1	2
	11	Diffraction from a Single slit, Double slit (Qualitative), Plane transmission grating (Qualitative).	3	2
	12	Polarisation – polarised and unpolarised light	1	2
	13	Types of Polarisations	2	2
III	**THERMODYNAMICS (Book 2)**		**9**	
	14	Thermodynamic Systems, Thermodynamic Equilibrium, Work done during volume changes, Internal energy and first law of Thermodynamics	2	1,3
	15	Thermodynamic processes –Quasistatic, Isothermal, Adiabatic, reversible, and irreversible, Cyclic process, Isobaric and Isochoric (Basic ideas)	3	3
	16	Carnot's Ideal Heat engine	2	3
	17	Second law of thermodynamics – Clausius and Kelvin - Planck statements, Refrigerator	2	1,3
IV	**ENTROPY (Book 2)**		**5**	
	18	Change of entropy – Reversible process, irreversible processes and physical concept	2	3
	19	T -S diagram	2	3
	20	Principle of increase of entropy - Heat Death of universe	1	3
V*	**STATISTICAL MECHANICS (Book 2)**		**9**	
	21	Statistical Basis – Probability, Principle of equal A priory	1	1,4

	22	Macrostates and Microstates, Phase space	2	4
	23	Statistical Ensembles – Microcanonical, Canonical, Grand Canonical	2	4
	24	Maxwell - Boltzmann statistics - Energy distribution – Derivation	2	4
	25	Need of Quantum statistics, Maxwell - Boltzmann statistics, Bose - Einstein statistics, Fermi - Dirac statistics – Comparative study only	2	4

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Liquid Lens – optical constants of given lens	5
2	Liquid lens – Refractive Index of given liquid	5
3	Spectrometer – A, D and n of a solid prism	5
4	Spectrometer – Dispersive power and Cauchy’s constants	5
5	Spectrometer – Grating normal Incidence	5
6	Spectrometer – Hollow Prism Refractive Index of given liquid	5
7	Spectrometer – i-d Curve	5
8	Newton’s Rings – Reflected system	5
9	To determine angular spread of He-Ne laser using plane diffraction grating	5
Part B* – At least One Experiment to be performed		
10	Air wedge – Diameter of a wire	5
11	To determine the wavelength of a laser source using diffraction of a single slit	5
12	To determine the wavelength of a laser source using diffraction of double slits	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Explain the fundamental laws of Optics, Thermodynamics and Statistical Mechanics.	U	PSO – 1,2
CO-2	Illustrate the basic principles and describe the applications of geometric optics, wave optics, and polarization	U, Ap	PSO –1,2
CO-3	Identify the basic concepts in thermodynamics and entropy, enabling them to evaluate physical processes and systems governed by these principles.	U, Ap, E	PSO – 1,2
CO-4	Define phase space, microstate, macrostate, ensemble and describe different statistical distributions	U, Ap	PSO – 1,2
CO-5	Inculcate experimental skills and apply optical principles to analyse and interpret experimental data through laboratory experiments	U, Ap, An	PSO – 1,2,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: OPTICS AND THERMODYNAMICS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Explain the fundamental laws of Optics, Thermodynamics and Statistical Mechanics.	PO 1,2,3,4,5,6,7,8 / PSO – 1,2	U	F, C	L	-
CO-2	Illustrate the basic principles and describe the applications of geometric optics, wave optics, and polarization	PO 1,2,3,4,5,6,7,8/ PSO – 1,2	U, Ap	F, C	L	-

CO-3	Identify the basic concepts in thermodynamics and entropy, enabling them to evaluate physical processes and systems governed by these principles.	PO 1,2,3,4,5,6,7,8/ PSO – 1, 2	U, Ap, E	F, C	L	-
CO-4	Define phase space, microstate, macrostate, ensemble and describe different statistical distributions	PO 1,2,3,4,5,6,7,8/ PSO – 1, 2	U, Ap	F, C	L	-
CO-5	Inculcate experimental skills and apply optical principles to analyse and interpret experimental data through laboratory experiments	PO 1,2,3,4,5,6,7,8 /PSO – 1,2,7	U, Ap, An	C, P	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	3	3	-	-	-	-	-	3	3	1	2	-	1	-	1
CO-2	3	3	-	-	-	-	-	3	3	2	2	1	2	-	1
CO-3	3	3	-	-	-	-	-	3	2	2	1	1	2	-	1
CO-4	3	3	-	-	-	-	-	2	1	2	1	1	1	-	1
CO-5	3	3	-	-	-	-	3	3	3	3	2	2	3	2	2

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	✓	-	✓
CO-3	-	✓	-	✓
CO-4	✓	-	-	-
CO-5	-	-	✓	-

University of Kerala

Discipline	**PHYSICS**
Course Code	**UK2DSCPHY103**
Course Title	**MODERN PHYSICS**
Type of Course	**DSC**
Semester	**II**
Academic Level	**100 - 199**

Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites	-				
Course Summary	Knowledge about basic ideas of quantum mechanics, number systems, logic gates, atom models nuclear properties, radioactivity and crystallography.				

BOOKS FOR STUDY:

1. Modern Physics – R.Murugeshan, S.Chand & Co. Ltd.
2. Principles of Electronics – V.K.Mehta

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Quantum Mechanics (Book 1)**	**9**	
	1	Inadequacies of classical physics, experimental evidences	2	1
	2	Quantum theory Planck's hypothesis, foundation of quantum mechanics	2	1
	3	Wave function and probability density	1	1
	4	Schrödinger equation-time dependent and time independent	2	1
	5	Particle in a potential box	2	1

II	**Digital electronics (Book 2)**		**9**	
	6	Number systems – binary, octal and hexadecimal and their interconversions	3	2
	7	Binary arithmetic, 1's compliment and 2's compliment arithmetic	3	2
	8	Basic logic gates	2	2
	9	Universal logic gates	1	2
III	**Atom models (Book 1)**		**9**	
	10	Bohr atom model	1	3
	11	Space quantization and spin of electrons	2	3
	12	Vector atom model	3	3
	13	Pauli's exclusion principle	1	3
	14	Periodic table	2	3
IV	**Atomic nucleus (Book 1)**		**9**	
	15	Basic properties of nuclei	1	4
	16	Nuclear force	1	4
	17	Mass defect and binding energy	2	4
	18	Radioactivity and law of radioactive decay	2	4
	19	Half-life and mean life	1	4
	20	Measurement of radioactivity, radiocarbon dating	2	4
V*	**Crystallography (Book 1)**		**9**	
	21	Crystalline and amorphous solids, Crystal structure-crystal lattice and translation vectors	2	5
	22	Unit cell, symmetry operations	2	5
	23	Types of lattices, lattice directions and planes	2	5
	24	X-ray crystallography-diffraction of x -rays, Bragg's law, x-ray crystallography, powder diffraction method.	3	5

DETAILED SYLLABUS: PRACTICALS

Sl No	Name of Experiment	CO No
Part A – At least 5 Experiments to be performed		
1	Carey Foster's bridge - Resistivity	6
2	Potentiometer- Resistivity	6
3	Diode Characteristics (for Ge and Si diodes)	6
4	Half wave rectifier-Measurement of ripple factor with and without filter capacitor	6
5	Full wave rectifier- Measurement of ripple factor with and without filter capacitor	6
6	Logic gates- OR and AND-To verify the truth tables of OR and AND gates using diodes.	6
7	Logic gate- NOT-To verify the truth tables of NOT gate using a transistor	6
8	Conversion of galvanometer into ammeter and calibration using digital Multimeter	6
9	Conversion of galvanometer into voltmeter and calibration using digital Voltmeter.	6
10	Potentiometer-Calibration of ammeter	6
Part B* – At least One Experiment to be performed		
11	Program to convert hexadecimal to decimal number, decimal to hexadecimal number, binary to hexadecimal numbers and hexadecimal to binary numbers	6
12	Program to find the result of binary addition and subtraction.	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Outline the evolution of quantum mechanics and explain the basic concepts of quantum mechanics	R, U	PSO-1,2
CO-2	Practise the conversion binary numbers to octal and hexadecimal, solve problems using binary arithmetic and define and compare logic gates	R, U, Ap	PSO-1,2

CO-3	Describe and summarize vector atom model	R, U	PSO-1,2
CO-4	State properties of a nucleus and explain radioactivity	R, U	PSO-1,2
CO-5	Identify types of crystal lattices and explain principle and applications of X-ray diffraction	R, U	PSO-1,2
CO-6	Describe and demonstrate simple experiments	U, Ap	PSO-7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: MODERN PHYSICS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Outline the evolution of quantum mechanics and explain the basic concepts of quantum mechanics	PO-1/ PSO-1,2	R, U	F,C	L	-
CO-2	Practise the conversion binary numbers to octal and hexadecimal, solve problems using binary arithmetic and define and compare logic gates	PO-1, 2, 3/ PSO-1,2	R, U, Ap	F,C	L	-
CO-3	Describe and summarize vector atom model	PO-1/ PSO-1,2	R, U	F,C	L	-
CO-4	State properties of a nucleus and explain radioactivity	PO-1, 2/ PSO-1,2	R, U	F,C	L	-
CO-5	Identify types of crystal lattices and explain principle and	PO-1, 2/ PSO-1,2	R, U	F,C	L	-

	applications of X-ray diffraction					
CO-6	Describe and demonstrate simple experiments	PO-1, 2, 3/ PSO-7	U, Ap	F,C		P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-
CO-2	2	2	-	-	-	-	-	2	3	2	-	-	-	-	-
CO-3	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-
CO-4	2	1	-	-	-	-	-	2	2	-	-	-	-	-	-
CO-5	2	2	-	-	-	-	-	2	1	-	-	-	-	-	-
CO-6	-	-	-	-	-	-	3	2	2	1	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	-	✓	-	✓
CO-3	-	✓	-	✓
CO-4	-	✓	-	✓
CO-5	✓	-	-	-
CO-6	✓	-	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK2MDCPHY100**				
Course Title	**ARCHAEOPHYSICS**				
Type of Course	**MDC**				
Semester	**II**				
Academic Level	**100 - 199**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 Hrs	-	-	3 Hrs
Pre-requisites					
Course Summary	The course provides a comprehensive overview of archaeology's core elements and its relationship with physics. Students will gain insights into the nature of archaeological data and develop proficiency in various methods for analysing and interpreting this data. Furthermore, the course explores the principles governing digital tools in archaeology and their practical applications. By the end of the course, students will develop a comprehensive knowledge about archaeology, from its theoretical foundations to its real-world computational applications, facilitating a deeper appreciation of the discipline's interconnections to various other disciplines.				

BOOKS FOR STUDY:

1. Archaeology: Principles and methods K Rajan; Manoo Pathippakam (2002)
2. https://www.archaeological.org/pdfs/education/Arch101.2.pdf
3. Digital Geoarchaeology New Techniques for Interdisciplinary Human-Environmental Research; Christoph Siart, Markus Forbriger, Olaf Bubenzer (eds.); Springer (2018)

4. Modern Physics; R Murugeshan, Kiruthiga Sivaprasath, 17th Edition, S Chand & Company (2014)

BOOKS FOR REFERENCE:

1. Introducing Archaeology, Robert James Muckle and Stacey L. Camp; University of Toronto Press ,Third Edition (2021)
2. Archaeology in Practice (A Student Guide to Archaeological Analyses), Balme, Jane and Alistair Paterson ;John Wiley and Sons Inc.(2014)
3. Modern Physics, R.A. Serway, C. J. Moses, C. A. Moyer; 3rd edition, Thomson (2005)

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	**Introduction to Archaeology (Book 1: Chapter1; Book 2; Book 3: Chapter 1)**		**9**	
	1	Archaeology: Definition and Scope; Goals of Archaeology; Archaeology and Physics	2	1
	2	Types of Archaeology	1	1
	3	The Process of Archaeology (Excavation, Data Collection and Recording, Laboratory and Conservation, Interpretation, Publication)	2	1
	4	Techniques and Tools (Excavation, Survey and Mapping)	2	1
	5	Introducing the Concept of Digital Geoarchaeology	2	1
II	**Basics of Radioactivity (Book 4, Chapter 27, 31)**		**9**	
	6	Introduction to the Nucleus	1	2
	7	Natural Radioactivity-Alpha, Beta and Gamma Rays-Properties of Alpha, Beta and Gamma Rays	2	2
	8	Soddy Fajan’s Displacement Law- Natural Radioactive Series	1	2
	9	Law of Radioactive Disintegration-Half-Life	2	2
	10	Units of Radioactivity	1	2
	11	Radioactive Dating	2	2

III	**Radioactive Dating Techniques (Book 1: Chapter 13)**		**9**	
	12	Dating Methods in Archaeology, Dating System, Relative Dating and Absolute Dating Techniques	2	3
	13	Radiocarbon Dating-Principle, Sample, Collection of Sample, Limitations	3	3
	14	Thermo-Luminescence Dating	1	3
	15	Potassium-Argon Dating; Uranium Series Dating; Fission Track Dating	2	3
	16	Archaeomagnetism, Dendrochronology	1	3
IV	**Digital Archaeology (Book 3: Chapter 11, 14)**		**9**	
	17	LiDAR Basics	1	4
	18	LiDAR in Geo-Archaeology - Principles of Capturing 3D Geo-Data with LiDAR- Advantages and Drawbacks- Typical Workflow for LiDAR, Data Capturing and Processing	3	4
	19	Geophysical Methods	1	4
	20	Ground Penetrating Radar, Electromagnetic Induction Methods, Electrical Resistance Techniques, Magnetic Methods, Acoustic Procedures	4	4
V*	**Activities (Any five)**		9	
	21	Museum visits & reports	9	5
	22	Handling of artefacts		5
	23	Registration and documentation of artefacts		5
	24	Presentation and discussions by students		5
	25	Estimate the energy loss of different ions in water and carbon, using SRIM/TRIM etc simulation		5
	26	Simulation study (using SRIM/TRIM or any other software) of radiation depth in materials		5
	27	Comparison of interaction of H like ions in given medium (Carbon/Water) using simulation software (SRIM etc).		5

	28	Estimate the energy loss of different ions in water and carbon, using SRIM/TRIM etc simulation		
	29	Simulation study (using SRIM/TRIM or any other software) of radiation depth in materials		
	30	Comparison of interaction of H like ions in given medium (Carbon/Water) using simulation software (SRIM etc).		

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the basic concepts of Archaeology, the sources, the methodology and its relations with Physics	R,U	PSO-1,4
CO-2	Understand basics of radioactivity	R,U	PSO-1
CO-3	Understand and identify various methods of dating	U	PSO-1,2,4,7
CO-4	Understand the principles of digital tools for archaeology	U	PSO-2,4,7
CO-5	Understand about the Museums and the Artefacts and Utilize the computational tools to estimate energy loss of ions in different media.	U,Ap	PSO-2,4,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ARCHAEOPHYSICS

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Introduction to basic concepts of Archaeology, the sources, the methodology and its relations with Physics	PO 1/ PSO 1,4	R,U	F,C	L	-
CO-2	Understand basics of	PO 1/ PSO	R,U	F	L	-

	radioactivity	1				
CO-3	Understand and identify various methods of dating	PO 1,6/ PSO 1,2,4,7	U	F,C	L	-
CO-4	Understand the principles of digital tools for archaeology	PO 6/ PSO 2,4,7	U	C	L	-
CO-5	Understand about the Museums and the Artefacts. Familiarize with computational tools to estimate energy loss of ions in different media.	PO 1,2,3,4,6,8 / PSO 2,4,7	U, Ap	F,P	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	1	-	-	2	-	-	-	1	-	-	-		-		-
CO-2	1	-	-	-	-		-	1	-	-	-		-		-
CO-3	1	2	-	1	-	-	2	1	-	-	-		2		-
CO-4	-	1	-	1	-	-	1	-	-	-	-		1		-
CO-5	-	2	-	2	-	-	2	1	2	1	1		3		1

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	-	✓	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	-	-	✓
CO-5	✓	✓	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK2MDCPHY101**				
Course Title	**BASICS OF ARTIFICIAL INTELLIGENCE**				
Type of Course	**MDC**				
Semester	**II**				
Academic Level	**100 - 199**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 Hrs	-	-	3 Hrs
Pre-requisites	1. Basic knowledge in calculus, probability, and statistics 2. Proficiency in any programming language will be an added advantage				
Course Summary	This course provides a foundational introduction to Artificial Intelligence (AI) tailored for students with minimal or no background in information technology. The aim is to introduce key concepts, applications, and implications of AI in a user-friendly manner, making it accessible to non-IT students.				

BOOKS FOR STUDY:

1. Russell, Stuart Jonathan, Norvig, Peter, Davis, Ernest. Artificial Intelligence: A Modern Approach. United Kingdom: Pearson, 2010.
2. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, PHI Learning, 2014
3. Vinod Chandra S. S. and Anand Hareendran S. Artificial Intelligence and Machine Learning, PHI Learning Private Limited,2014.
4. Elaine Rich and Kevin Knight, “Artificial Intelligence”, Tata McGraw Hill
5. https:/nptel.ac.in/courses/106105077
6. https://nptel.ac.in/courses/106106126

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Introduction to Artificial Intelligence (Book : 1, 4)**	**8**	
	1	Concept of AI, History, Current Status and Scope	1	1
	2	Intelligent Agents and Environments	1	1
	3	Problem Formulations	1	1
	4	Review of Tree and Graph Structures	1	1
	5	State Space Representation	1	1
	6	Search Graph	1	1
	7	Search Tree	2	1
II		**Knowledge Representations and Search Algorithms (Book : 2, 3)**	**9**	
	8	Definition of Knowledge	1	3
	9	Representation and Organization of Knowledge	1	3
	10	Random Search, Search with Closed and Open List	1	3
	11	Depth First Search	1	3
	12	Breadth First Search	1	3
	13	Heuristic Search, A* Algorithm	2	3
	14	Concepts of Game Playing, Expert Systems	2	3
III		**Machine Learning (Book : 2, 3)**	**10**	
	15	History of Machine Learning, Types of Problems in Machine Learning	1	1
	16	Machine Learning Paradigms- Supervised learning	2	1
	17	Semi-Supervised and Unsupervised Learning Methods	2	2
	18	Reinforcement Learning	1	2

	19	Association Learning and Market Basket Analysis	2	2
	20	Concepts of Computer Vision and Nature Inspired Computing	2	2
IV	**Performance Measures (Book : 01)**		**9**	
	21	Classification of Performance Measures	1	4
	22	Precision and Recall	2	4
	23	Accuracy, F-Measure and Receiver Operating Characteristic Curve (ROC)	2	4
	24	Area Under Curve (AUC)	1	4
	25	Bootstrapping	1	4
	26	Cross Validation and Ensemble Methods	2	4
V*	**Ethical Considerations and Applications in AI (Online Resource : 5, 6)**		**9**	
	27	Discussion on Bias, Fairness, and Transparency in AI	1	5
	28	Privacy Concerns and Responsible AI Practices	2	5
	29	Exploring AI Applications in Non-Technical Domains Like AI in Healthcare, Finance and Education	2	5
	30	Showcasing User-Friendly AI Tools and Platforms	2	5
	31	Case studies: Weather Predictions, Self-driving cars.	2	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss Machine learning concepts	R, U	4
CO-2	Distinguish supervised, unsupervised and reinforcement learning concepts	R, U	4
CO-3	Contrast various search algorithms, such as uninformed search (breadth-first search, depth-first search) and informed search (heuristic search, A* algorithm), to solve problems in artificial	R, U	2,4

	intelligence and other related fields		
CO-4	Discuss real life problems using appropriate machine learning models and evaluate the performance measures	R, U	2,4
CO-5	Explain the ethical implications of various AI technologies and applications across diverse domains such as healthcare, finance, autonomous vehicles, and social media.	R, U	4,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: BASICS OF ARTIFICIAL INTELLIGENCE

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Discuss Machine learning concepts	PO-1,6 PSO-4	R, U	F,C	L	-
CO-2	Distinguish supervised, unsupervised and reinforcement learning concepts	PO-1,6 PSO-4	R, U	F,C	L	-
CO-3	Contrast various search algorithms, such as uninformed search (breadth-first search, depth-first search) and informed search (heuristic search, A* algorithm), to solve problems in artificial intelligence and other related fields	PO-6,7 PSO-2,4	R, U	F,C	L	-
CO-4	Discuss real life problems using	PS-3,6,7 PSO-2,4	R, U	C,P	L	-

	appropriate machine learning models and evaluate the performance measures					
CO-5	Explain the ethical implications of various AI technologies and applications across diverse domains such as healthcare, finance, autonomous vehicles, and social media.	PO-6,7,8 PSO-4,7	R, U	C, P	L/T	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	-	-	-	2	-	-	-	1	-	-	-	-	2	-	-
CO-2	-	-	-	2	-	-	-	1	-	-	-	-	2	-	-
CO-3	-	1	-	2	-	-	-	-	-	-	-	-	2	2	-
CO-4	-	1	-	2	-	-	-	-	-	1	-	-	2	2	-
CO-5	-	-	-	2	-	-	2	-	-	-	-	-	2	2	2

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	-	✓	-	✓
CO-5	✓	✓	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK2MDCPHY102</td></tr>
<tr><td>Course Title</td><td colspan="5">BEYOND THE SKY</td></tr>
<tr><td>Type of Course</td><td colspan="5">MDC</td></tr>
<tr><td>Semester</td><td colspan="5">II</td></tr>
<tr><td>Academic Level</td><td colspan="5">100 - 199</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>3</td><td>3 Hrs</td><td>-</td><td>-</td><td>3 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5"></td></tr>
<tr><td>Course Summary</td><td colspan="5">This course provides a comprehensive overview of astronomy, covering foundational concepts such as the scientific method and observational techniques. Students explore topics ranging from the formation of the solar system to the evolution of stars and galaxies. By the end of the course, students will have a deeper understanding of the cosmos and its wonders, from the smallest planets to the largest galaxies.</td></tr>
</table>

BOOKS FOR STUDY:

1. Astrophysics: Stars and Galaxies, K. D. Abhayankar - University Press 2001
2. An Introduction to Astrophysics, Baidyanadh Basu – PHI Learning Private Limited 2010
3. Introduction to Astronomy and Cosmology – Ian Morison, Wiley 2008
4. Modern Physics, R Murugeshan and Kiruthiga Sivaprasath, S. Chand & Company Pvt. Ltd. 2014
5. From Dust to Life: The Origin and Evolution of our Solar System, John Chambers and Jacqueline Mitton, Princeton University Press 2017\

BOOKS FOR REFERENCE:

1. An Introduction to Modern Astrophysics – Carroll & Ostlie, Latest Edition
2. Weinberg, S. The First Three Minutes: A Modern View of The Origin Of The Universe (Basic Books, 1993)
3. Minding the Heavens by Leila Belkora
4. The Amateur Astronomer by Sir Patrick Moore

WEB REFERENCES

1. https://science.nasa.gov/solar-system/
2. https://spaceplace.nasa.gov/
3. A brief history of the big bang theory (https://www.worldscientific.com/doi/pdf/10.1142/9789811229442_0001)

DETAILED SYLLABUS: THEORY

<table>
<tr><th>Module</th><th>Unit</th><th>Content</th><th>Hrs</th><th>CO No</th></tr>
<tr><td rowspan="5">I</td><td colspan="2">Introduction to Astronomy
(Book 1 - Chapter 1,3 & 4)</td><td>9</td><td></td></tr>
<tr><td>1</td><td>Introduction –Importance of Astronomy</td><td>1</td><td>1</td></tr>
<tr><td>2</td><td>Methods of Astronomy and Astrophysics –The Scientific Method - Scope of Astronomy</td><td>2</td><td>1</td></tr>
<tr><td>3</td><td>Brightness Measurement
1. Magnitude Scale
2. Measurement of Apparent Luminosity
3. Corrections for Observed Magnitudes</td><td>3</td><td>1</td></tr>
<tr><td>4</td><td>Distance Measurement
1. Measurement of Distances Within Solar System
2. Method of Parallax
3. The Method of Luminosity Distance</td><td>3</td><td>1</td></tr>
<tr><td rowspan="3">II</td><td colspan="2">Observational Astronomy
(Book 1 - Chapter 19, Web Link -1,2)</td><td>10</td><td></td></tr>
<tr><td>5</td><td>Optical Photometry and Spectroscopy, Astronomical Instruments - Optical Telescopes, Radio Telescopes, Space Telescopes - Hubble Space Telescope</td><td>6</td><td>2</td></tr>
<tr><td>6</td><td>Night Sky
1. Stars and Planets in Night Sky
2. Comets and Meteors</td><td>4</td><td>2</td></tr>
</table>

		3. Familiarization with Common Constellations 4. Eclipses 5. Phases of the Moon		
III	**Solar System** **(Book-3, Chapter 2 & 3, Book-2, Chapter-5, Web Link-1,3)**		**9**	
	7	Formation of the Solar System	2	3
	8	The Sun –Photosphere - Chromosphere - Solar Corona – Prominences – Sunspots and Solar Cycle- Solar Flares	4	3
	9	The planets of the Solar System - Kuiper Belt – Oort Cloud	3	3
IV	**Stellar Evolution** **(Book-3, Chapter 7, Book-4, Chapter -78)**		**8**	
	10	Classification of Stars 1. Spectral Types of Stars - The Harvard Classification System 2. Hertzsprung—Russell Diagram	1	4
	11	Stellar Evolution - Low Mass Stars: 0.05–0.5 Solar Masses, Mid Mass Stars: 0.5–~8 Solar Masses, High Mass Stars in the Range 8 Solar Masses	5	4
	12	White Dwarfs - Chandrasekhar Limit, Neutron Stars, Black Holes, Supernova Explosion	2	4
V*	**Galaxies and Beyond** **(**Book-2 Chapter 21, 22, Book-3 Chapter 8 & 9**)**		**9**	
	13	Milky Way Galaxy - Size, Shape and Structure of the Milky Way	1	5
	14	Hubble Classification of Galaxies, Expanding Universe	2	5
	15	Big Bang Models of the Universe, The Cosmic Microwave Background	3	5
	16	Extrasolar Planetary Systems, Habitable Planets	3	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understanding the Foundations of Astronomy	R, U	PSO-1,2,3

CO-2	Exploring Observational Astronomy	U, Ap	PSO-1,2,3
CO-3	Understand the constituents and formation of the solar system	R, U	PSO-1,2,3
CO-4	Understanding Stellar Evolution	R, U	PSO-1,2,3
CO-5	Exploring Galaxies and Cosmology	R, U	PSO-1,2,3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: BEYOND THE SKY

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Understanding the Foundations of Astronomy	PO 1,4,8/ PSO 1,2,3	R, U	F, C	L	-
CO-2	Exploring Observational Astronomy	PO 1,2,4,6/ PSO 1,2,3	U, Ap	F, C, P	L	-
CO-3	Understand the constituents and formation of the solar system	PO 2,4/ PSO 1,2,3	R, U	F,C	L	-
CO-4	Understanding Stellar Evolution	PO 4/ PSO 1,2,3	R,U	F,C	L	-
CO-5	Exploring Galaxies and Cosmology	PO 4,8/ PSO 1,2,3	R,U	F,C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	3	3	3	-	-	-	-	-	1	-	1	-	-	-	3
CO-2	3	3	3	-	-	-	-	1	1	-	1	-	2	-	-
CO-3	3	3	3	-	-	-	-	-	1	-	1	-	-	-	-
CO-4	3	3	3	-	-	-	-	-	-	-	1	-	-	-	-
CO-5	3	3	3	-	-	-	-	-	-	-	2	-	-	-	3

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	-	-	-	✓
CO-3	-	-	-	✓
CO-4	✓	-	-	✓
CO-5	✓	✓	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK2MDCPHY103**				
Course Title	**FOUNDATIONS IN FORENSIC SCIENCE**				
Type of Course	**MDC**				
Semester	**II**				
Academic Level	**100 - 199**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 Hrs	-	-	3 Hrs
Pre-requisites					
Course Summary	The "Foundations in Forensic Science" course is a comprehensive and interdisciplinary exploration of key areas in forensic investigation. Through this course, students can delve into the fundamental principles and techniques essential to modern forensic science. Beginning with an overview of forensic science's role in crime investigation, students progress to mastering crime scene management, evidence collection, and preservation. They then explore the analysis of various types of physical evidence and their forensic significance. The course culminates in a study of firearms and their crucial role in criminal investigation.				

BOOKS FOR STUDY:

1. Criminalistics: An Introduction to Forensic Science, Richard Saferstein, (12/e), Pearson Education Inc.
2. Forensic Science in Criminal Investigation and trials, Dr. BR.Sharma, (4/e), Universal Law Publishing Co. Pvt. Ltd.

BOOKS FOR REFERENCE:

1. Crime Investigation, Paul L Kirk, Wiley
2. Solving Crimes with Physics, Carla Miller Nozigia, Mason Crest Publishers
3. Beginners Forensic Science, Dr. C. Hegde & Dr. R. Shekhar, Himalaya Publishing House.
4. Crime Scene Forensics: A Scientific Method Approach, Robert C Shaler, CRC Press
5. Fundamentals of Forensic Science, Max M. Houck & Jay A. Siegel, Elsivier Science.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Science in Criminal Justice System [sec 1,2,4,5 Book 1: Chapter 1; sec 3 Book 2: Chapter 1]**	**9**	
	1	Definition and Scope of Forensic Science	1	1
	2	History and Development of Forensic Science	1	1
	3	Basic principles of Forensic Science	2	1
	4	Services of Criminal Laboratories - Basic Services Provided by Full Service Crime laboratories, Optional Services Provided by Full Service Crime Laboratories.	2	1
	5	Functions of Forensic Scientist - Analysis of Physical Evidence, The Importance of Physical Evidence, Determining Admissibility of Evidence, Providing Expert Testimony.	3	1
II		**The Crime Scene [Book 1: Chapter 2]**	**9**	
	6	Processing the Crime Scene - Securing and Isolating the Crime Scene, Recording the Crime Scene, Conducting a Systematic Search for Evidence.	5	2
	7	Collecting and Packaging of Physical Evidence - Collecting Physical Evidence, Handling Evidence, Packaging Evidence.	2	2
	8	Maintaining the Chain of Custody - Obtaining Standard/Reference Samples, Submitting Evidence to the Laboratory.	1	2
	9	Ensuring the Crime Scene Safety	1	2
III		**Physical Evidence [Book 1: Chapter 3 (sec 10 & 11), Chapter 4 (sec 12)]**	**9**	
	10	Common Types of Physical Evidence	1	3

	11	The Significance of Physical Evidence -Identification, Comparison, Individual Characteristics, Class Characteristics, Assessing the Value of Physical Evidence, Cautions and Limitations in Dealing with Physical Evidence.	5	3
	12	Crime Scene Reconstruction - Principles of Crime- Scene Reconstruction, Personnel Involved in Reconstruction.	3	3
IV	**Micro-Traces [Book 2: Chapter 17]**		**9**	4
	13	Importance	1	4
	14	Nature -Plant Materials, Dust, Fibres, Polymers, Minerals, Glass, Paint, Soil, mMaterials of Animal Origin.	1	4
	15	Location - The Culprit, Victim, Crime Scene, Weapon, Vehicle, Location, Techniques.	1	4
	16	Collection - Handpicking, Taping, Tacuuming, Dissolving and Washing, Scraping.	1	4
	17	Forensic Problems	1	4
	18	Evaluation -Tools and Techniques, Microscopy, Micro Chemical Tests, X-ray Diffraction, Micro-FTIR Spectroscopy.	2	4
	19	Example of a Specific Trace Evidence - Glass - Importance, Nature, Location, Evaluation.	2	4
V*	**Firearms [Book 2: Chapter 9]**		**9**	
	20	Importance	1	5
	21	Nature - Firearms, Firearm Parts, Classifications, Single Shot Firearms, Repeaters, Ammunition, The Firing Process.	5	5
	22	Location - The Victim, the Culprit, the Scene of Occurrence, the Firearm, the Ammunition.	3	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe the services of a typical comprehensive crime laboratory and forensic scientist in a criminal justice system	R, U	PSO 2, 3

CO-2	Describe the various measures taken while securing, recording and searching the crime scene as well as describe the proper techniques for packaging common types of physical evidence.	R, U	PSO 2, 3
CO-3	Summarize the common types and significance of physical evidence encountered at crime scenes as well as the principles of crime scene reconstruction.	R, U	PSO 2, 3, 6
CO-4	Demonstrate the physical evidence related to crimes involving microtraces.	R, U	PSO 2,3, 7
CO-5	Demonstrate the physical evidences related to crimes involving firearms.	R, U,	PSO 2,3, 7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: FOUNDATIONS IN FORENSIC SCIENCE

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Describe the services of a typical comprehensive crime laboratory and forensic scientist in a criminal justice system	PO- 1 PSO - 2, 3	R, U	F, C	L/T	-
CO-2	Describe the various measures taken while securing, recording and searching the crime scene as well as describe the proper techniques for packaging common types of physical evidence.	PO- 1, 3, 6 PSO - 2, 3	R, U	F, C	L/T	-
CO-3	Summarize the common types and significance of	PO- 1, 2, 3, 6	R, U	F, C, P	L/T	-

	physical evidence encountered at crime scenes as well as the principles of crime scene reconstruction.	PSO - 2, 3				
CO-4	Demonstrate the physical evidence related to crimes involving microtraces.	PO- 1, 2,3, 6 PSO - 2, 3, 7	R, U	F, C, P	L/T	-
CO-5	Demonstrate the physical evidences related to crimes involving firearms.	PO- 1, 2, 6 PSO - 2, 3, 7	R, U	F, C	L/T	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	-	1	1	-	-	-	-	1	-	-	-	-	-	-	-
CO-2	-	2	1	-	-	-	-	2	-	1	-	-	2	-	-
CO-3	-	3	1	-	-	-	-	3	2	2	-	-	2	-	-
CO-4	-	3	3	-	-	-	2	1	3	1	-	-	2	-	-
CO-5	-	3	3	-	-	-	2	1	3	-	-	-	2	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	-	-	✓
CO-4	✓	-	-	✓
CO-5	✓	✓	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK2MDCPHY104**				
Course Title	**MEDICAL PHYSICS**				
Type of Course	**MDC**				
Semester	**II**				
Academic Level	**100 - 199**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 Hrs	-	-	3 Hrs
Pre-requisites	-				
Course Summary	The course deals with the physical phenomenon revolving around the biological systems				

BOOKS FOR STUDY:

1. Biophysics, Vasantha Pattabhi N Goutham, Kluwer Academic Publishers, Newyork, Boston
2. 'HEAT TRANSFER APPLICATIONS IN BIOLOGICAL SYSTEMS', Liang Zhu University of Maryland Baltimore County, Baltimore, Maryland
3. "The Physics of radiation Therapy" by Faiz M Khan, Edn 3, Lippincott Williams and Wilkins.
4. Essentials of Biophysics: P. Narayanan, 2nd Edn. New Age publishers

BOOKS FOR REFERENCE:

1. A text book of biophysics: R. N. Roy, New central book agency Kolkata.
2. Introduction to Biophysics, Pranab Kumar Banerjee, S. Chand&co, NewDelhi
3. Elementary bio physics, P. K. Srivastava, Narosa publishing house, NewDelhi

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Origin and Evolution of Life (Book 1 Chapter 1 & Chapter 14)**	**9**	
	1	Prebiotic Earth	1	1
	2	Theories of Origin and Evolution of Life	2	1
	3	Cell Components – Proteins -Nucleic Acids	2	1
	4	Atoms and Ions, Molecules Essential for Life	2	1
	5	Heat Transfer in Biomaterials: Heat Transfer Mechanism, The Heat Equation, Joule Heating of Tissue	2	2
II		**Energy pathways in Biology (Book 1 Chapter 3 & Chapter 11)**	**9**	
	6	Free Energy, Coupled Reactions, Group Transfer Potential, Photosynthesis Photosystem, Photophosphorylation and Carbon Fixation	3	2
	7	Oxidation, Glycolysis, The Krebs Cycle, The Respiratory Chain, Diffusion, Osmosis, Osmotic Pressure, Osmoregulation	2	2
	8	Surface Tension, Dialysis, Adsorption, Viscosity	2	1
	9	Thermal Conduction, Colloids, Sedimentation.	2	1
III		**Biomechanics (Book 1 Chapter 12)**	**5**	
	10	Striated Muscles, Contractile Proteins, Mechanical Properties of Muscles, Contraction mechanism, Role of Ca 2+ions	2	1
	11	Bio Mechanics of Cardio Vascular System Blood Pressure	1	1
	12	Electrical Activity During the Heart Beat-Electro Cardiography	2	1
IV		**Physics of Radiotherapy (Book 3 Chapter 2, 3,4)**	**13**	
	13	Overview of Modern Radiotherapy Techniques, Need and Necessity of Quality Assurance Programme in Radiotherapy.	3	2
	14	Physical Principles of X-Ray Diagnosis - Interactions of X-Rays with Human Body, Differential Transmission of X-Ray Beam	4	3
	15	Beam Therapy and Brachytherapy	2	3

	16	Overview of Digital Subtraction Radiography and Mammography	2	3
V*		**Absorption and Fluorescence Spectroscopy (Book 3 Chapter 5, 6, 7)**	**9**	
	17	Electromagnetic Spectrum, Properties of Electromagnetic Radiations	1	4
	18	Concept and Types of Spectroscopies	1	4
	19	Absorption Spectrum, Energy Characteristics of Spectrum	1	4
	20	Fundamental Laws of Photometry: Beer's Law	2	4
	21	Principles of fluorescence, Colorimeter, Spectrophotometer & Spectro Fluorophotometer	2	4
	22	Ultrasound, CT, MRI Scanners (Basic Ideas Only)	2	4

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Interpret the fundamentals of physics adds values on biological systems	R, U	PSO-1,2, 3
CO-2	Explain models of biological system dealing with transport phenomena.	R, U	PSO-1,2
CO-3	Administer experimental techniques for making correct and appropriate use of a range of scientific equipment used in biological systems	R, U, Ap	PSO-1,2,3
CO-4	Analyse the biologic system by making use of experimental techniques in physics	R, U, An	PSO-3,6,

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: MEDICAL PHYSICS

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Understand and interpret the fundamentals of	PO-1,2 PSO-1	U	F, C	L	-

	physics adds values on biological systems					
CO-2	Explain models of biological system dealing with transport phenomena.	PO-1,2 PSO-1	U	P	L	-
CO-3	Study experimental techniques for making correct and appropriate use of a range of scientific equipment used in biological systems	PO-1,3 PSO-1, 2	U, R	C, P	L, T	-
CO-4	Evaluate the biologic system by making use of experimental techniques in physics	PO-2,3 PSO-1, 3	U, R	F, C, P	L, T	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	1	-	-	-	-	-	-	2	2	--	-	-	-	-	-
CO-2	1	-	-	-	-	-	-	2	2	-	-	-	-	-	-
CO-3	1	1	-	-	-	-	-	2	-	2	-	-	-	-	-
CO-4	1	-	2	-	-	-	-	-	2	2	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	✓	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK3DSCPHY200**				
Course Title	**BASIC ELECTRONICS**				
Type of Course	**DSC**				
Semester	**III**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites					
Course Summary	This course aims to familiarise the electronic components, their characteristics and applications. It also helps to understand the linear IC 741 and its mathematical operations.				

BOOKS FOR STUDY:

1. Principles of Electronics: V. K. Mehta and Rohit Mehta, S. Chand Ltd.,2020 Edition
2. Basic Electronics-Solid State: B. L. Theraja, S. Chand Ltd. 2005
3. Basic Electronics: Devices, circuits and IT fundamentals: Santiram Kal, PHI, 2010

BOOKS FOR REFERENCE:

1. Electronic Devices and Circuit theory: Robert Boylestad & Louis Nashelski, PHI,5th Edn.
2. Electronic Fundamentals & Applications: John D Ryder, PHI, 4thEdn.
3. Introduction to semiconductor materials and Devices, M.S Tyagi, Wiley India (2005)
4. Electronic circuits; Analysis and Design, Donald Neamen, Mc Graw Hill Education India (Third Edition)

5. Operational Amplifiers and Linear integrated circuits, R. A Gayakwad, Prentice Hall India (Fourth Edition 2015)
6. Digital Principles and Applications, Donald P Leach and Albert Paul Malvino, The Mc Graw Hill Company, Sixth Edition

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	**Diodes and Transistors (Book 2: Chapter 13, 15, 18 & 19)**		**9**	
	1	P-N Junction Diode - Characteristics, Zener diode, Zener diode as Voltage regulator	2	1
	2	Rectification: Halfwave, Full wave-Centre tap, Bridge rectifiers (Derivations not required), RC Filter circuit, Dual power supply	3	1, 6
	3	BJT-Theory of BJT operation and Configurations	2	1
	4	CB and CE characteristics and Gain parameters	2	2
II	**Transistor Amplifiers (Book 1: Chapter 8, 9, 10 & 11)**		**9**	
	5	Need for biasing and stabilization, stability factor-Thermal Runaway (Basic ideas only)	1	2, 6
	6	Selection of Operating point- ac and dc Load lines	2	2
	7	Collector feedback; base resistor and potential divider methods (CE configuration only)	2	2
	8	BJT amplifiers - analysis of CE amplifier (frequency response, band width, impedance and gain)	2	2, 6
	9	Multi stage Amplifiers- RC and Transformer coupled amplifiers	2	2
III	**Feedback Circuits (Book 2: Chapter 25 & 28)**		**9**	
	10	Feedback principles – Negative feedback - advantages of negative feedback	2	3
	11	Forms of negative feedback (Series and shunt)	1	3
	12	Positive feedback - Barkhausen criterion for oscillations	2	3
	13	Principle of Sinusoidal oscillation	1	3
	14	Hartley Oscillator, Colpitt’s Oscillator and RC phase shift oscillator (derivations not required)	3	3,6

IV	**Operational Amplifiers (Book 1: Chapter 25)**		**9**	
	15	Differential amplifier- Common mode and Differential signals	2	4
	16	Voltage gain in Differential amplifiers- CMRR	1	4
	17	Concept of Virtual Ground, Ideal Op Amp and its features- Familiarising IC 741 Op Amp	1	4
	18	Inverting and Non inverting Amplifiers	2	4
	19	Op Amp Applications: Voltage follower, Adder, Subtractor	2	4,6
	20	Op Amp Applications: Integrator-Differentiator	1	4, 6
V*	**Logic Gates and Boolean Algebra (Book 2: Chapter 33 & 34)**		**9**	
	21	Positive and Negative logic- Basic Logic gates (OR, AND and NOT)	2	5, 6
	22	De Morgan’s theorem, Bubbled gates, Universal gates and XOR gates	3	5
	23	Laws of Boolean Algebra-Equivalent circuits (Solving simple circuits only)	2	5
	24	Adders and Subtractors	2	5

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	**PN junction Diode (Ge & Si) characteristics**-To draw the characteristic curves of a PN junction diode and to determine its ac and dc forward resistances.	6
2	**Full wave (centre tapped) rectifier**-To construct a full wave rectifier using junction diode and to calculate the ripple factor with and without shunt filter	6
3	**Bridge rectifier**-To construct a bridge rectifier using junction diodes and to calculate the ripple factor with and without shunt filter	6
4	**Zener diode as a voltage regulator**-To construct a voltage regulator using Zener diode and to study its line regulation and load regulation.	6

5	**Transistor CE characteristics-**To draw the characteristic curves of a transistor in the CE configuration and determine the current gain, input impedance and output impedance	6
6	**OP amp. IC741- Inverting amplifier-**To construct an inverting amplifier using IC741 and determine its voltage gain	6
7	**OP amp. IC741- Non-inverting amplifier -** To construct a non-inverting amplifier using IC741 and determine its voltage gain	6
8	**Logic Gates** (AND, OR and NOT) using Diodes and Transistor	6
Part B* – At least One Experiment to be performed		
9	**Dual power supply-**To construct a dual power supply using bridge rectifier and measure the output voltages for different pair of identical load resistors	6
10	**Single stage CE amplifier-** To construct a single stage CE transistor amplifier and study its frequency response (designing not required).	6
11	**RC Phase shift oscillator (**using transistor**)**	6

<u>COURSE OUTCOMES</u>

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Familiarize solid-state devices for rectification	U, R, Ap	1
CO-2	Understand different amplifier circuits	U, Ap	1
CO-3	Understand positive and negative feedback circuits	U	1
CO-4	Understand the concept and applications of operational amplifiers.	U, Ap	1
CO-5	Familiarise digital electronics principles	U, R	1
CO-6	Fabrication of elementary electronic circuits	Ap	3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: BASIC ELECTRONICS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Familiarize solid-state devices for rectification	PO1/ PSO1	U, R, Ap	F, C	L	-
CO-2	Understand different amplifier circuits	PO1/ PSO1	U, Ap	C	L	-
CO-3	Understand positive and negative feedback circuits	PO1/ PSO1	U	C	L	-
CO-4	Understand the concept and applications of operational amplifiers.	PO 1/ PSO1	U, Ap	F, C	L	-
CO-5	Familiarise digital electronics principles	PO 1/ PSO 1	U, R	F, C	L	-
CO-6	Fabrication of elementary electronic circuits	PO 1/ PSO 3	Ap	P	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	-	-	-	-	-	-	2	-	-	-	-	-	-	-
CO-2	2	-	-	-	-	-	-	2	-	-	-	-	-	-	-
CO-3	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO-4	1	-	-	-	-	-	-	2	-	-	-	-	-	-	-

CO-5	2	-	-	-	-	-	-	2	-	-	-	-	-	-	-
CO-6	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-

Correlation Levels:

Level	**-**	**1**	**2**	**3**
Correlation	**Nil**	**Slightly / Low**	**Moderate / Medium**	**Substantial / High**

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	✓	✓
CO-3	✓	-	-	✓
CO-4	✓	-	-	✓
CO-5	✓	-	-	-
CO-6	✓	-	-	✓

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK3DSCPHY201**				
Course Title	**DIGITAL ELECTRONICS AND DATASCIENCE**				
Type of Course	**DSC**				
Semester	**III**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites	-				
Course Summary	This course introduces the fundamental concepts of Digital and Computational Methods in Physics. The first module comprises of the introduction to various number systems and codes. The idea of digital logic gates are introduced in the second module. The third module incorporates Boolean Laws and Theorems along with the concept Karnaugh Maps. The basics of data science which includes the types, collection pre-processing etc are discussed in fourth module. Fifth module explains the various data analysis and analytic techniques				

BOOKS FOR STUDY:

1. DIGITAL PRINCIPLES AND APPLICATION Albert Paul Malvino , Donald P Leach 7th Edition , Tata McGraw Hill Education Private limited
2. 2. Digital Electronics_ Principles and Applications, Roger L. Tokheim, Patrick E. (2021, McGraw-Hill Education)
3. 3. A Hands-On Introduction to Data Science- Chirag Shah - Cambridge University Press (2020)

BOOKS FOR REFERENCE:

1. Albert P. Malvino, Jerald A. Brown - Digital Computer Electronics (1993, McGraw-Hill)
2. Anil K. Maini - Digital Electronics. Principles, Devices and Applications [messy] (2007, Wiley)
3. Basics of Digital Electronics , Banani Ghosh, CRC Press, 2024
4. Electronics. Analog and Digital , Barun Raychaudhuri, Cambridge University Press, 2024
5. Ozdemir, Sinan - Principles of Data Science_ Learn the techniques and math you need to start making sense of your data (2016, Packt Publishing)
6. Sinan Ozdemir - Principles of Data Science_ A beginner's guide to essential math and coding skills for data fluency and machine learning-Packt Publishing Pvt Ltd (2024)

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Number Systems and Codes (Book 1: Chapter 5)**	**9**	
	1	Binary Number System	1	1
	2	Binary-to-decimal Conversion, Decimal-to-binary Conversion, BCD	2	1
	3	Octal Numbers-Conversions , Hexadecimal Numbers-Conversions	3	1
	4	The ASCII Code, The Excess-3 Code, The Gray Code	1	1
	5	Error Detection and Correction	2	1
II		**Digital Logic Gates (Book 2: Chapter 3)**	**9**	
	6	The AND Gate, The OR Gate ,The Inverter and Buffer	2	2
	7	The NAND Gate, The NOR Gate,	2	2
	8	The Exclusive OR Gate, The Exclusive NOR Gate	2	2
	9	The NAND Gate as a Universal Gate ,The NOR Gate as a Universal Gate	2	2
	10	Gates with More Than Two Inputs	1	2
III		**Combinational Logic Circuits (Book 1: Chapter 3)**		
	11	Boolean Laws and Theorems	2	3

	12	Sum-of-Products Method	1	3
	13	Truth Table to Kamaugh Map, Kamaugh Simplifications	3	3
	14	Don't-care Conditions	1	3
	15	Product-of-sums Method, Product-of-sums Simplification	2	3
IV	**Introduction to Data Science (Book 3: Chapter 1 & 2)**		**9**	
	16	Introduction- Data Science, Relation to other fields	1	4
	17	Data Types	2	4
	18	Data Collections	3	4
	19	Data Pre-processing	3	4
V*	**Data Analysis and Data Analytics (Book3: Chapter 3)**		**9**	
	20	Descriptive Analysis- Variables, Frequency Distribution, Measures of Centrality, Dispersion of a Distribution	4	5
	21	Diagnostic Analytics- Correlations	3	5
	22	Predictive Analytics, Prescriptive Analytics	1	5
	23	Exploratory Analysis, Mechanistic Analysis	1	5

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Familiarising different logic gates using 74XX series	6
2	Construction and Verification of the truth tables of AND gate using diodes	6
3	Construction and Verification of the truth tables of OR gate using diodes	6
4	Construction and Verification of the truth tables of NOT gates using transistors	6
5	Construction and Verification of the truth tables of AND gate using IC’s	6

6	Construction and Verification of the truth tables of OR gate using IC’s	6
7	Construction and Verification of the truth tables of NOT gate using IC’s	6
8	Construction and Verification of the truth tables of NAND gate using IC’s	6
9	Construction and Verification of the truth tables of NOR gate using IC’s	6
10	Verification of Demorgan’s theorem for 2 variables	6
Part B* – At least One Experiment to be performed		
11	Familiarising different logic gates using 74XX series	6
12	Construction and Verification of the truth tables of AND gate using diodes	6
13	Construction and Verification of the truth tables of OR gate using diodes	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss the conversion of different types of number system and codes	U	PSO 1,3,6
CO-2	Realize the concepts of digital logic gates and its applications	U	PSO 1,3,6
CO-3	Use DeMorgan's theorems to create equivalent circuits and to simplify complex logic circuits using fundamental Boolean algebra laws, make Karnaugh maps and Entered variable maps and use them to simplify Boolean expressions.	U	PSO 1,3,6
CO-4	Distinguish different Data types, major data sources, and formats and to perform basic data cleaning and transformation	U, Ap	PSO 1,2
CO-5	Discuss Various forms of data analysis and analytics techniques.	U	PSO 1,2
CO-6	Construct and verify the working of various digital logic gates using diode/transistors and IC’s	Ap, An	PSO 7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: DIGITAL ELECTRONICS AND DATASCIENCE

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Discuss the conversion of different types of number system and codes	PO 1/ PSO 1,3,6	U	F, C	L	-
CO-2	Realize the concepts of digital logic gates and its applications	PO 1/ PSO 1,3,6	U	C	L	-
CO-3	Use DeMorgan's theorems to create equivalent circuits and to simplify complex logic circuits using fundamental Boolean algebra laws, make Karnaugh maps and Entered variable maps and use them to simplify Boolean expressions.	PO 1/ PSO 1,3,6	U	C	L	-
CO-4	Distinguish different Data types, major data sources, and formats and to perform basic data cleaning and transformation	PO 1/ PSO 1,2	U, Ap	C	L	-
CO-5	Discuss Various forms of data analysis and analytics techniques.	PO 1/ PSO 1,2	U	C	L	-

CO-6	Construct and verify the working of various digital logic gates using diode/transistors and IC's	PO 6,7/ PSO 7	Ap, An	C,P	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	1	-	1	-		1	-	1	-	-	-	-	-	-	-
CO-2	2	-	2	-		2	-	2	-	-	-	-	-	-	-
CO-3	2	-	1	-		1	-	2	-	-	-	-	-	-	-
CO-4	2	1	-	-	-	-	-	2	-	-	-	-	-	-	-
CO-5	2	2	-	-	-	-	-	2	-	-	-	-	-	-	-
CO-6	-	-	-	-	-	-	2	-	-	-	-	-	2	2	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	-	-	✓
CO-5	-	✓	-	-
CO-6	✓	-	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK3DSCPHY202**				
Course Title	**SOLID STATE PHYSICS & SPECTROSCOPY**				
Type of Course	**DSC**				
Semester	**III**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites	1. Students should know the atom model 2. Students should be aware of different types of materials				
Course Summary	This course aims to provide the basic concepts of solid state physics and spectroscopy and make the students aware of some of the applications of spectroscopy.				

BOOKS FOR STUDY:

1. Physics for scientists and engineers with Modern Physics, 7th Edition, Serway & Jewett,
2. University Physics Vol.3, OpenStax
3. Modern Physics: R.Murugesan, S.Chand & Co.

BOOKS FOR REFERENCE:

1. Fundamentals of Molecular Spectroscopy: Banwell, TMH
2. Molecular Spectroscopy: G.Aruldhas, PHI, 2004

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Solid State Physics (Book 3)**	**9**	
	1	Types of molecular bonds- ionic bond, covalent bond, metallic bond, molecular bond, Hydrogen bond, Van der waal bond	2	1
	2	Crystal structure-crystal lattice and translation vectors	2	1
	3	Unit cell-symmetry operations point groups and space groups	2	1
	4	Types of lattices-lattice directions and planes, interplaner spacing-simple crystal structures	3	1
II		**Band Theory of Solids (Book 2, Sec. 9.5)**	**9**	
	5	Energy bands- Valence band , Conduction band, Energy Gap	1	2
	6	Classification of solids as conductors, semiconductors and insulators based on band theory	2	2
	7	Semiconductors and doping, break down mechanism	2	2
	8	Semiconductor devices- Junction diode, zener diode, light emitting and light absorbing diodes, Transistors, integrated circuits.	4	2
III		**Spectroscopy (Book 2 & 3)**	**9**	
	9	Atomic spectra, selection rule, Hydrogen spectrum	1	3
	10	X-ray spectrum, Moseley’s law	2	3
	11	Optical spectra- spectral terms and notations, selection rules	1	3
	12	Molecular spectra- origin and nature of molecular spectra	1	3
	13	Rotational spectra of diatomic molecules-rotational energy levels	2	3
	14	Diatomic vibrational spectra-vibrational energy levels	2	3
IV		**Spectroscopic Techniques (Book 3)**	**9**	
	15	EM Spectrum- UV, Visible, IR, Radio and microwave regions	1	4

	16	Principle of various spectrometers used in specific regions of EM spectrum	2	4
	17	Absorption spectroscopy, Emission spectroscopy	2	4
	18	Block diagram of absorption spectrometer	2	4
	19	Mass spectroscopy-qualitative ideas of ESR & NMR spectrometers.	2	4
V*		**Laser (Book 3)**	**9**	
	20	Interaction of light with matter, absorption, spontaneous emission, stimulated emission	2	5
	21	Principle of laser, population inversion, metastable states, pumping, light amplification,	2	5
	22	Types of Laser- Ruby laser, He-Ne laser, Semiconductor laser	4	5
	23	Application- Holography	1	5

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	LED characteristics: To (i) study the variations in resistance with varying current	6
2	Photo diode characteristics: To study the output characteristics of a photo diode	6
3	Half wave rectifier-Measurement of ripple factor with and without filter capacitor	6
4	Full wave rectifier- Measurement of ripple factor with and without filter capacitor	6
5	LED circuit design	6
6	Zener diode as a voltage regulator-To construct a voltage regulator using Zener diode and to study the output voltage variation (i) for different RL and (ii) for different input voltage with same RL.	6
7	Bridge rectifier-To construct a bridge rectifier using junction diodes and to calculate the ripple factor with and without shunt filter (10 readings for RL 100 to 5000).	6
Part B* – At least One Experiment to be performed		
8	To determine the Planck's constant using LEDs of at least 4 different colours	6

9	Bridge rectifier- Dual power supply-To construct a dual power supply using bridge rectifier and measure the output voltages for different pair of identical load resistors.	6
10	Transistor characteristics-CE-To draw the input and output characteristic curves of a transistor in the CE configuration	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe various molecular bonds and crystal structures	U	1
CO-2	Identify different types of solids and get basic knowledge about semiconductors and semiconductor devices	U	1
CO-3	Identify the basic concepts of atomic and molecular spectra.	U	1,2
CO-4	Differentiate various spectroscopic techniques and its applications	U, Ap	1
CO-5	Describe the fundamental knowledge about lasers	U	1
CO-6	Inculcate experimental skills and to interpret experimental data through laboratory experiments	U, Ap	1,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: SOLID STATE PHYSICS & SPECTROSCOPY

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Describe various molecular bonds and crystal structures	PO-1,3 PSO-1	U	F, C	L	-
CO-2	Identify different types of solids and get basic knowledge about semiconductors and	PO-1,3 PSO-1	U	F, C	L	-

	semiconductor devices					
CO-3	Identify the basic concepts of atomic and molecular spectra.	PO-1,3 PSO-1, 2	U	F, C	L	-
CO-4	Differentiate various spectroscopic techniques and its applications	PO-1,3 PSO-1	U, Ap	F, C	L	-
CO-5	Describe the fundamental knowledge about lasers	PO-1,3 PSO-1	U	F, C	L	-
CO-6	Inculcate experimental skills and to interpret experimental data through laboratory experiments	PO-1,2 PSO-1, 7	U, Ap	F, C, P		P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	-	-	-	-	-	2	-	1	-	-	-	2	-	-
CO-2	2	-	-	-	-	-	2	-	1	-	-	-	2	-	-
CO-3	2	1	-	-	-	-	2	-	1	-	-	-	2	-	-
CO-4	2	-	-	-	-	-	2	-	1	-	-	-	2	-	-
CO-5	2	-	-	-	-	-	2	-	1	-	-	-	2	-	-
CO-6	2	-	-	-	-	2	2	1	-	-	-		2	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	-	-	✓
CO-4	✓		-	✓
CO-5	✓	✓	-	
CO-6	-	-	-	✓

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK3DSCPHY203**				
Course Title	**HEAT, MAGNETISM AND GEOPHYSICS**				
Type of Course	**DSC**				
Semester	**III**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites	-				
Course Summary	Basic knowledge about physics of the earth, physics of atmosphere, magnetism of earth, transmission of heat and properties of magnetic materials.				

BOOKS FOR STUDY:

1. Fundamentals of Geophysics: William Lowrie, Cambridge University Press.
2. Modern Physics – R.Murugeshan, S.Chand & Co. Ltd

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Terrestrial physics (Book 1)**	**9**	
	1	The solar system	1	1
	2	Earth's structure-earth's size and shape, gravitation, gravitational field and gravitational potential	3	1
	3	Gravitational field and potential due to solid sphere	2	1
	4	The tides-tidal effect of sun. (Elementary ideas only)	1	1
	5	Earth quakes and seismographs. (Elementary ideas only)	2	1

II	**Atmospheric physics (Book 1)**		**9**	
	6	Atmospheric structure and composition	2	2
	7	Atmospheric pressure, density and temperature	2	2
	8	Measurement of air temperature	2	2
	9	Ionosphere and magnetosphere	3	2
III	**Earth's magnetism (Book 1)**		**9**	
	10	Earth's magnetism	1	3
	11	Elements of earths magnetism	2	3
	12	Cause of earth's magnetism	2	3
	13	Magnetic maps and their uses	2	3
	14	Magnetographs	2	3
IV	**Transmission of Heat (Book 2)**			
	15	Thermal conductivity and thermometric conductivity	2	4
	16	Weidmann and Franz law	1	4
	17	Energy distribution in the spectrum of black body and results	2	4
	18	Wien's displacement law, Rayleigh-Jeans law, their failure and Planck's hypothesis, Planck's law	2	4
	19	solar constant, its determination, temperature of sun	2	4
V*	**Magnetism (Book 2)**		**9**	
	20	Magnetic properties of matter, Magnetic vectors B.M and H	1	5
	21	Magnetic susceptibility and permeability	1	5
	22	Diamagnetism, Para-magnetism and ferromagnetism	3	5
	23	Electron theory of magnetism	3	5
	24	Domain theory of ferromagnetism	1	5

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		CO No
Sl No	**Name of Experiment**	
1	Specific heat-method of mixtures applying Barton's correction	6
2	Lee's disc- Thermal conductivity of cardboard	6
3	Deflection and vibration magnetometer- M and Bh	6
4	Circular coil- magnetization of a magnet	6
5	Thermo-emf-measurement of emf using digital multimeter.	6
6	Carey Foster's Bridge-Temperature coefficient of resistance	6
7	Circular coil-Study of earth's magnetic field using compass box.	6
8	Searle's vibration magnetometer-comparison of magnetic moments.	6
9	Phase transition-determination of M.P of wax.	6
10	Determination of thermal conductivity of rubber	6
Part B* – At least One Experiment to be performed		
11	Circular coil-Calibration of ammeter.	6
12	Potentiometer –Reduction factor of T.G	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe about solar system in general and describe earth in particular	R, U	PSO 1,2,3,4
CO-2	Describe and explain about earth's atmosphere	R, U	PSO 1,2,3,4
CO-3	Label and classify properties and causes of terrestrial magnetism	R, U	PSO 1,2,4

CO-4	Describe and explain the energy distribution in the spectrum of a black body and solve problems relating to it.	R, U, Ap	PSO 1,2
CO-5	List and classify paramagnetic, diamagnetic and ferromagnetic materials	R, U	PSO 1,2
CO-6	Describe and demonstrate simple experiments	U, Ap	PSO 7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: HEAT, MAGNETISM AND GEOPHYSICS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Describe about solar system in general and describe earth in particular	PO1,2,3, 4,5,6,8/ PSO 1,2,3,4	R, U	F,C	L	-
CO-2	Describe and explain about earth's atmosphere	PO1,2,3, 4,5,6,8/ PSO 1,2,3,4	R, U	F,C	L	-
CO-3	Label and classify properties and causes of terrestrial magnetism	PO1,3,4, 5,6,8/ PSO 1,2,4	R, U	F,C	L	-
CO-4	Describe and explain the energy distribution in the spectrum of a black body and solve problems relating to it.	PO1,3,4, 5,6,8/ PSO 1,2	R, U, Ap	F,C	L	-

CO-5	List and classify paramagnetic, diamagnetic and ferromagnetic materials	PO1,3,4, 5,6,8/ PSO 1,2	R, U	F,C	L	-
CO-6	Describe and demonstrate simple experiments	PO1,2,4, 5,8/ PSO 7	U, Ap	F,C	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	1	3	2	-	-	-	2	2	3	2	2	2	-	2
CO-2	2	2	2	2	-	-	-	2	2	2	2	2	3	-	2
CO-3	2	1	-	2	-	-	-	2	-	2	2	2	2	-	2
CO-4	2	1	-	-	-	-	-	2	-	2	2	2	2	-	2
CO-5	2	2	-	-	-	-	-	2	-	2	2	2	2	-	2
CO-6	-	-	-	-	-	-	3	2	3	-	2	2	-	-	2

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	-	✓	-	✓
CO-3	-	✓	-	✓
CO-4	-	✓	-	✓
CO-5	✓	-	-	-
CO-6	✓	-	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK3DSCPHY204</td></tr>
<tr><td>Course Title</td><td colspan="5">LIGHT, ELECTRICITY AND EMERGING ENERGY SOURCES</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSC</td></tr>
<tr><td>Semester</td><td colspan="5">III</td></tr>
<tr><td>Academic Level</td><td colspan="5">200 - 299</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>3 Hrs</td><td>-</td><td>2 Hrs</td><td>5 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">1. Light and its properties: frequency, wavelength, intensity
2. Basics of current electricity – Potential difference, electric current, Ohm’s law, dc& ac
3. Energy levels of atoms and molecules, chemical energy, semiconductor diode</td></tr>
<tr><td>Course Summary</td><td colspan="5">Introduce different types of basic sources and detectors of light and their working principle. Give a detailed idea of the working of LASER. Give introductory knowledge about optical instruments such as laser diodes, camera, telescope and compound microscope. The course also aims the understanding of the generation of dc and ac. In a comprehensive level, the trouble shooting in electric circuits is introduced. As a energy source of the future, solar energy and its successful use in various fields such as cooking, heating, cooling, distillation, pumping etc are introduced. The impact of solar energy and solar cells on the future of humankind is analyzed. Different thero-electric effects and their applications are discussed. Introductory ideas of fuel cells such as working principle, classification etc are discussed.</td></tr>
</table>

BOOKS FOR STUDY:

1. Light_ Introduction to Optics and Photonics, Judith Donnelly & Nicholas Massa, Photonics Media Press (2018) Second Edition
2. DC/AC Electrical Fundamentals, Dale R. Patrick, Stephen W. Fardo, Ray E. Richardson & Vigyan (Vigs) Chandra, River Publishers
3. Non-Conventional Energy Sources and Utilisation, R.K. Rajput , S. Chand & CO

BOOKS FOR REFERENCE:

1. A Text Book of Optics, Brijlal & N Subramanyam, S Chand & CO
2. Physics for Scientists and Engineers with Modern Physics (extended version) 2008, Paul A. Tipler & Gene Mosca, W. H. Freeman and Company
3. Non Conventional Energy Resources, B H Khan, Mc Graw Hill India, 2016

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Sources and detectors of light (Chapter 2 of Book 1)**	**9**	
	1	Natural Light Sources, Incandescent Light Sources, Fluorescent lamps, High Intensity Discharge (HID) Lamps, Low-Pressure Sodium Lamps, Flash Lamps and Arc Lamps, Light Emitting Diodes (LEDs)	4	1
	2	Detectors- Thermal Detectors, Quantum Detectors, Photo-emissive Detectors, Photoconductive Detectors	3	1
	3	Photodiodes, Photodiode Parameters	2	1
II		**Optical Instruments & Lasers (Chapter 8, 9 &10 of Book1)**	**9**	
	4	Simple Magnifier, The SLR Camera,	2	2
	5	Optical Telescopes, The Compound Microscope	2	2
	6	Laser - Emission and absorption of photons	1	3
	7	Basic laser components, energy transitions in laser action	2	3
	8	Semiconductor lasers (laser diodes)- Homo Junction , Hetro Junction Laser, Distributed Feedback Lasers	2	2,3

III	**Sources of DC & AC Electrical Energy (Chapter 8 &10 of Book2)**		**9**	
	9	Chemical Sources – Primary and Secondary Cells	2	4
	10	Battery Connections – Series , Parallel, Combination	1	4
	11	Light Sources, Heat Sources, Pressure Sources, Electro-Magnetic Sources	2	4
	12	AC Generator Basics	1	4
	13	Single Phase and Three Phase AC generators	2	4
	14	Analysis and Trouble shooting	1	4
IV	**Solar Energy Applications (Chapter 4 of book 3)**		**9**	
	15	Solar water heating, space heating, space cooling	2	5
	16	Solar distillation, solar pumping, solar air heaters and drying	2	5
	17	Solar cooking, solar furnace	2	5
	18	Solar green-houses and global warming, solar power plants	2	5
	19	Solar Photo Voltaic Cells (qualitative idea only)	1	5
V*	**Emerging Technologies (Chapter 9 of Book 3)**		**9**	
	20	Thermoelectric effect – Seebeck effect, Peltier effect, Thomson effect , Joule effect	1	6
	21	Thermoelectric generator – Construction and working, Thermoelectric materials and their selection, Advantages and disadvantages of thermoelectric power generator	2	6
	22	Thermionic generator/converter – Introduction, Thermionic generator, Desirable of Properties of Thermionic Converter Materials , Advantages, disadvantages/limitations and applications of thermionic converter	2	6
	23	Fuel cell: Advantages, disadvantages and applications of fuel cells	1	6

	24	Components and working theory of a fuel cell, Classification fuel cells, Requirements of electrolyte and electrode, Desirable characteristics of a fuel cell	2	6
	25	Hydrogen-oxygen fuel cell (hydrox cell)	1	6

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Experiment to determine the Wavelength of Sodium Light Using a Diffraction Grating/prism and Spectrometer	6
2	Determine and plot the characteristics of the light emitting diode in the forward-bias region, and to compare between different coloured diodes.	6
3	To study the VI Characteristics of Photodiode	6
4	Study the operating characteristics for a diode laser, including threshold current, output power versus current, and slope efficiency	6
5	Study diffraction by single slit	6
6	Study diffraction of by double slit	6
7	Determine the voltage and current by connecting 3 dry cells (a) Series (b) Parallel	6
8	Study the Characteristics of Thermistor	6
9	Study the Characteristics of Solar cell	6
10	To verify the relationship between the voltage, the electric field and the spacing of a parallel plate capacitor.	6
11	To verify superposition theorem/Thevenin's theorem/Norton's theorem/ Maximum power transfer theorem in a circuit	6
12	Set up simple circuits with resistors, capacitors, and/or inductors and use a multimeter to measure voltages, currents, and resistances at different points in the circuit.	6
Part B* – At least One Experiment to be performed		
11	To Calibrate the given thermistor with standard thermistor, hence to find the temperature of the unknown liquid.	6
12	Demonstration of Seebeck Effect and determination of Seebeck Coefficient and Figure of Merit	6

13	To measure the magnetic field at the centre of wire loops and along the axis of a coil and verify the analytical expressions.	6
14	To verify Ohm's law in a resistive circuit	6
15	To demonstrate Kirchhoff's laws in a circuit	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify different types of sources of light and light detectors discuss the working principle of basic optical instruments such as camera, telescope and microscope.	R, U	PSO-1,5
CO-2	Outline and describe the working principle of LASER and laser action in semiconductor diodes	R, U	PSO-1,5
CO-3	Describe dc & ac electric current and the electric circuits and practice trouble shooting of electric circuit at an understanding level.	U, Ap	PSO-1,2
CO-4	Explain and analyse usage, storage and importance of solar energy.	U, An	PSO-1,5
CO-5	Summarise and relate basic principles of emerging technologies of generation and storage of energy – Thermo-electric energy, thermionic energy, fuel cells	U, An	PSO-1,3
CO-6	Explain and demonstrate simple experiments	U, Ap	PSO-1,6,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: LIGHT, ELECTRICITY AND EMERGING lENERGY SOURCES

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Identify different types of sources of light and light detectors discuss the working principle of basic optical instruments such as camera, telescope and microscope.	PO1,2,3,4,6,7 / PSO-1,5	R, U	F, C	L	-
CO-2	Outline and describe the working principle of LASER and laser action in semiconductor diodes	PO1,2,3,4,6,7/ PSO-1,5	R, U	F, C	L	-
CO-3	Describe dc & ac electric current and the electric circuits and practice trouble shooting of electric circuit at an understanding level.	PO1,3,4,5,6,8/ PSO-1,2	U, Ap	F, C	L	-
CO-4	Explain and analyse usage, storage and importance of solar energy.	PO1,2,3,4,6,7/ PSO-1,5	U, An	F, C, P	L	-
CO-5	Summarise and relate basic principles of emerging technologies	PO1,2,3,4,6/ PSO-1,3	U, An	F, C	L	-

	of generation and storage of energy – Thermo-electric energy, thermionic energy, fuel cells					
CO-6	Explain and demonstrate simple experiments	PO1,2,3,4,5,6,7,8/PSO-1,6,7	U, Ap	F, C	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	3	-	-	-	2	-	-	2	3	2	2	-	2	3	-
CO-2	3	-	-	-	3	-	-	2	2	3	2	-	2	3	-
CO-3	3	2	-	-		-	-	2	-	2	2	2	2	-	2
CO-4	3	-	-	-	3	-	-	2	2	3	2	-	2	2	-
CO-5	3	-	3	-	-	-	-	2	3	2	3	-	2	-	-
CO-6	3	-	2	-	-	3	-	2	2	2	2	2	3	3	2

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	-	✓	-	✓
CO-3	-	✓	-	✓
CO-4	-	✓	-	✓
CO-5	✓	-	-	-
CO-6	✓	-	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK3DSEPHY200</td></tr>
<tr><td>Course Title</td><td colspan="5">FUNDAMENTALS OF EARTH-ATMOSPHERE SYSTEM</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSE</td></tr>
<tr><td>Semester</td><td colspan="5">III</td></tr>
<tr><td>Academic Level</td><td colspan="5">200 - 299</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 Hr</td><td>-</td><td>-</td><td>4 Hr</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">1. The student should have a general idea about Sun and planets, Elliptical orbits of planets, Tilt of axis of rotation.
2. The student should have a basic knowledge about evaporation and condensation.
3. The students must have observed the changes in daily weather conditions and the optical phenomena like rainbow, mirages.</td></tr>
<tr><td>Course Summary</td><td colspan="5">The course introduces the basics of Earth’s atmosphere which is an exact mixture of gases and heat/moisture conditions necessary to sustain life. It starts from the Sun-earth system and gives an understanding about the vertical structure of the atmosphere in terms of temperature, pressure, composition and ionisation. The second module deals with various phenomena associated with clouds and their formation. Different scales of winds and the cause of their generation are given in the third module. The fourth module details the causes of hazardous weather and climate change. Fifth module describes the physics behind the interesting natural phenomena in the atmosphere such as rainbows, mirages, halos etc.</td></tr>
</table>

BOOKS FOR STUDY:

1. The Atmosphere : An Introduction to Meteorology, Frederick K. Lutgens, Edward J Tarbuck, Dennis Tasa, Pearson., 2018

BOOKS FOR REFERENCE:

1. Basis of Atmospheric Science, A Chandrasekhar, PHI., 2010
2. Atmospheric Science: An Introductory Survey : John M Wallace and Peter V. Hobbs, Academic Press, 2nd Edition, 2006,
3. Essentials of Meteorology: An Invitation to the Atmosphere, C. Donald Ahrens, Cengage, 8th Edition, 2017.

DETAILED SYLLABUS:

Module	Unit	Content	Hrs	CO No
I		**Earth as a System – Atmosphere of the Earth (Book:1 – Chapter: 1)**	**12**	
	1	Planetary System	1	1
	2	Earth's motions – Rotation and Revolution, Seasons on the Earth	2	1
	3	Earth System – Geosphere, Atmosphere, Hydrosphere, Biosphere – Interactions between various spheres	1	1
	4	Composition of the Atmosphere- Major components, trace gases, variable components	2	1
	5	Vertical structure of the Atmosphere – Pressure and Temperature changes	2	2
	6	Planetary Boundary Layer – definition, nocturnal and diurnal conditions	2	2
	7	Charged and neutral atmosphere – Ionosphere and various layers	2	2
II		**Forms of Condensation and Precipitation (Book:1 – Chapter: 5)**	**12**	
	8	Cloud formation	2	3
	9	Cloud Classification, Cloud Varieties	2	3
	10	Aircraft contrails	2	3
	11	Types of fog	2	3
	12	Formation of precipitation	2	3
	13	Forms of precipitation – Rain, snow, glaze, hail	2	3

III	**Circulations and Winds (Book:1 – Chapter: 7)**		**12**	
	14	Wind and Air pressure, Temporal and spatial scales of atmospheric motion	1	3
	15	Local winds- Land and sea breezes, Mountain and Valley breezes	1	3
	16	Monsoons – Asian Monsoon	2	4
	17	Westerlies, Jet Streams	2	3
	18	Global winds and ocean circulation	2	3
	19	El Nino-La Nina-Southern Oscillation	2	4
	20	Cyclones, Tornados, Hurricanes	2	4
IV	**Hazardous Weather and Climate Change (Book:1 – Chapter: 9,10,11)**		**12**	
	21	Distinction between Weather and Climate	1	4
	22	Air Pollution, Sources of air pollution – anthropogenic and natural	2	5
	23	Acid Precipitation	1	4
	24	Natural causes of Climate Change- Plate tectonics, Volcanic Activity, Variation of Earth's Orbit, Solar Variability	2	5
	25	Human Impact on Climate Change- Rising CO_2 levels, Role of trace gases, Role of aerosols	2	5
	26	Ozone Depletion	1	5
	27	Green House effect, Enhanced Green House effect, Global Warming, Consequences of Global Warming	2	5
	28	IPCC, Adaptation and Mitigation	1	5
V*	**Optical Phenomena of the Atmosphere (Book:1 – Chapter: 16)**		**12**	
	29	Interaction of Light and matter – Scattering, Reflection, Refraction, Diffraction, Absorption	3	6
	30	Mirages, Rainbows, Glories	2	6
	31	Halos, Sundogs, Solar Pillars, Sub Sun	2	6
	32	Coronas, Iridescent Clouds	2	6
	33	Auroras, Airglow, Alpenglow, Afterglow	2	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Remember the basics of Sun Earth System	R	PSO-1,3
CO-2	Understand the vertical structure of the atmosphere	U	PSO-1,3
CO-3	Remember the phenomenon of cloud formation and understand the atmospheric circulation	R,U	PSO-1,3
CO-4	Understand various weather phenomenon	U	PSO-1,3
CO-5	Understand the changing climate, its causes and impact and apply adaptation and mitigation	U, Ap	PSO-1,3
CO-6	Remember the interaction of light and matter and Understand various optical phenomenon in the atmosphere	R,U	PSO-1,3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: FUNDAMENTALS OF EARTH-ATMOSPHERE SYSTEM

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Remember the Basics of Sun Earth System	PO1/ PSO-1,3	R	F	L	-
CO-2	Understand the vertical structure of the atmosphere	PO1/ PSO-1,3	U	F, C	L	-
CO-3	Remember the phenomenon of cloud formation and understand the atmospheric circulation	PO1/ PSO-1,3	R,U	F	L	-

CO-4	Understand various weather phenomenon	PO1/ PSO-1,3	U	C	L	-
CO-5	Understand the changing climate, its causes and impact and apply adaptation and mitigation	PO1/ PSO-1,3	U, Ap	C	L	-
CO-6	Remember the interaction of light and matter and Understand various optical phenomenon in the atmosphere	PO1/ PSO-1,3	R,U	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	1	-	1	-	-	-	-	1	-	-	-	-	-	-	-
CO-2	1	-	2	-	-	-	-	2	-	-	-	-	-	-	-
CO-3	1	-	1	-	-	-	-	2	-	-	-	-	-	-	-
CO-4	2	-	2	-	-	-	-	2	-	-	-	-	-	-	-
CO-5	2	-	2	-	-	-	-	2	-	-	-	-	-	-	-
CO-6	1	-	2	-	-	-	-	2	-	-	-	-	-	-	-

Correlation Levels:

Level	**-**	**1**	**2**	**3**
Correlation	**Nil**	**Slightly / Low**	**Moderate / Medium**	**Substantial / High**

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	✓	-	✓
CO-6	✓	✓	-	-

University of Kerala

Discipline	**PHYSICS**
Course Code	**UK3DSEPHY201**
Course Title	**CIRCUIT ELEMENTS AND NETWORK THEOREMS**
Type of Course	**DSE**
Semester	**III**
Academic Level	**200 - 299**

Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 Hrs	-	-	4 Hrs

Pre-requisites	
Course Summary	This course aims to get knowledge on basic electrical technology, network theorems, circuit analysis. It also helps to understand the ac circuit analysis and an idea regarding optoelectronic devices.

BOOKS FOR STUDY:

1. Basic Electronics Solid State: B. L. Theraja, S Chand & Company LTD.
2. Principles of Electronics, V K Mehta and Rohith Mehta, S Chand & Company LTD.
3. Basic Electronics: Devices, circuits and IT fundamentals: Santiram Kal, PHI, 2010

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	**Ohm's Law (Book 1, Chapter 1,2&3)**		**12**	
	1	Linear and non-linear Resistors, Resistor Colour code	2	1

	2	Resistor Types-Wire wound Resistors, Carbon composition Resistors, Carbon film Resistors, Metal film Resistors	2	1
	3	Resistive circuits, Series and Parallel Resistor circuits, Series aiding and Series opposing Voltages	2	2
	4	Proportional Voltage formula, Proportional Current formula, Series Voltage Dividers	2	2
	5	‘Open’ and ‘Short’ in Series, Parallel and Series –Parallel Circuits.	2	1,2
	6	Cells in series and parallel	2	1,2
II	**Inductors and Capacitors (Book 1, Chapter 5)**		**12**	
	7	Inductance, Inductor Types: Air core inductor, Iron-core Inductor, Ferrite-core Inductor	2	1
	8	Self-Induction, Mutual Induction, relation connecting self-inductance and mutual inductance	2	1
	9	Coefficient of Coupling, Inductors in Series or Parallel without M, series combination with M,	2	2
	10	Stray Inductance, Reactance offered by a Coil.	1	1
	11	Capacitance, Capacitors in Series and Parallel, Reactance offered by the Capacitor	2	1
	12	Type of Capacitors- Fixed Capacitors, Variable Capacitors	1	1
	13	Charging and discharging of a capacitor	2	1,2
III	**Network Theorems (Book 1, Chapter 4)**		**12**	
	14	Ideal constant Voltage Source, Ideal constant Current Source	2	1
	15	Kirchhoff’s Law	2	2
	16	Super position theorem	2	3
	17	Thevenin’s and Norton’s Theorem	4	3
	18	Maximum Power Transfer Theorem	2	3
IV	**Alternating Current (Book 1, Chapter 5)**		**12**	
	19	Type of alternating waveforms, Different values of sinusoidal voltage and current, Phase and Phase difference of A.C	2	1

	20	Non-sinusoidal waveform, Harmonics	1	1
	21	A.C through Resistor, Inductor, Capacitor	2	2
	22	L-R, R-C and LCR circuits	3	2
	23	Sharpness of resonance, Q-factor, Bandwidth	2	5
	24	Tuning of radio, Parallel LCR	2	5
V*	**Optoelectronic devices (Book 1, Chapter 16)**		**12**	
	25	Light Emitting Diode (LED) – theory, construction and applications	3	4,5
	26	Photo Emissive Devices	2	4
	27	Photomultiplier Tube	2	4
	28	Photovoltaic Devices – bulk type photoconductive cells	2	4,5
	29	Photodiodes – P-N junction photodiode – PIN photodiode – avalanche photodiode.	3	4,5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe basic electronic components	U	PSO-1
CO-2	Analyse Series and Parallel Networks	Ap, E	PSO-1, 2
CO-3	Understand the basic network theorems	U	PSO-1,2
CO-4	Familiarize the different semiconductor devices	U	PSO-1
CO-5	Understand the V-I characteristics of the circuits	Ap	PSO-1

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: CIRCUIT ELEMENTS AND NETWORK THEOREMS

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Describe basic electronic components	PO 1/ PSO 1	U	C	L	-
CO-2	Analyse Series and Parallel Networks	PO 1,2/ PSO 1,2	Ap, E	C	L	-
CO-3	Understand the basic network theorems	PO 1/ PSO 1,2	U	C	L	-
CO-4	Familiarize the different semiconductor devices	PO 1/ PSO 1	U	F	L	-
CO-5	Analyze the V-I characteristics of the circuits	PO 1,2/ PSO 1	Ap	P	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	1	-	-	-	-	-	-	1		-	-	-	-	-	-
CO-2	2	2	-	-	2	-	-	1	1	-	-	-	-	-	-
CO-3	2	2	-	-	-	-	-	1	-	-	-	-	-	-	-
CO-4	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO-5	1	-	-	-	-	-	-	1	1	-	-	-	-	-	-
CO-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	-	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	✓	-	-
CO-5	✓	✓	-	✓

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK3DSEPHY202**				
Course Title	**BASICS OF NANOSCIENCE AND NANOTECHNOLOGY**				
Type of Course	**DSE**				
Semester	**III**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 Hrs	-	-	4 Hrs
Pre-requisites	-				
Course Summary	Materials Structure and Bonding. Crystals and Imperfections in Solids, Electrical and Optical Properties of Materials, Generation of Nanoscience and Nanotechnology, Applications of Nanoscience and Nanotechnology for a Sustainable Future: Addressing Global Challenges				

BOOKS FOR STUDY:

1. Materials Science and Engineering: An Introduction, 10th Edition by William D. Callister Jr, David G. Rethwisc, Wiley (2018)
2. Textbook Of Nanoscience And Nanotechnology, B.S Murthy, P.Shankar. Baldev Raj,B.B.Rath , James Murday, Orient Blackswan, (2021)
3. Nanotechnology: Principles and Practices, Third Edition, by Sulabha K. Kulkarn (2014)
4. Introduction To Nanoscience And Nanotechnology By Chattopadhyay, PHI ,India

BOOKS FOR REFERENCE:

1. Fundamentals of Nanotechnology, CRC press, by G.L. Hornyak, J.J. Moone, H.F. Tihhale, J. Dutta
2. Nanotechnology Technology Revolution of 21st Century by Rakesh Rathi, published by S.Chand
3. Nanomaterials by A.K. Bandyopadhyay; New Age International Publishers.
4. Nanotechnology by Mark Ratner and Daniel Ratner, Pearson Education.
5. Nano Essentials- T.Pradeep, TMH

WEB REFERENCE

1. https://nptel.ac.in/courses/113/104/113104076/

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Materials Structure and Bonding**	**12**	
	1	Why Study Materials Science and Engineering? (Book1: Chapter 1)	1	1
	2	Arrangement of Atoms, Two-Dimensional Crystal Structures, Three-Dimensional Crystal Structures, Elementary ideas and examples of Three-Dimensional Crystals (Book1: Chapter 3)	3	1
	3	Planes in the Crystals, Crystallographic Directions, Reciprocal Lattice (Book1: Chapter 3)	3	1
	4	Atomic bonding in solids - bonding forces and energies (Book1: Chapter 2)	3	1
	5	Primary bonding - Ionic bonding, Covalent bonding (Book1: Chapter 2)	1	1
	6	Metallic bonding, Secondary bonding- van der Waals bonding (Book1: Chapter 2)	1	1
II		**Crystals and Imperfections in Solids**	**12**	
	7	Crystalline and non-crystalline materials -Single crystals, Polycrystals (Book1: Chapter 3)	2	2,3
	8	Atomic packing factors of FCC, BCC, Hexagonal close packed crystal structure (Book1: Chapter 3)	4	2,3
	9	Imperfection in solids – Point and line defects-Frenkel defect (Book1: Ch 4)	3	2,3
	10	Schottky defect-Burger vectors Vacancies, Interstitial (Book1: Ch 12)	3	2,3

III	**Electrical and Optical Properties of Materials**		**12**	
	11	Electrical Conductivity, Electronic and Ionic Conduction(Book1: Chapter 18)	2	4
	12	Energy Band Structures in Solids, Conduction in Terms of Band and Atomic Bonding Models, Electron Mobility (Book1: Chapter 18)	3	4
	13	Semiconductivity-Intrinsic Semiconduction, Extrinsic Semiconduction, Temperature Dependence of Carrier Concentration, Factors affect Carrier Mobility (Book1: Chapter 18)	3	4
	14	Optical Properties, Electromagnetic Radiation, Light Interactions with Solids (Book1: Chapter 21)	2	4
	15	Refraction , Reflection, Absorption, Transmission, Colour (Book1: Chapter 21)	2	4
IV	**Generation of Nanoscience and Nanotechnology**		**12**	
	16	Nano and Nature, Nanoscopic colours (Butterfly wings), Bioluminescence (Fireflies)	2	5
	17	Tribology in nature - Geckos Sticky feet, lotus-leaf effect. (Book3: Chapter 11)	2	5
	18	The development of nanoscale science: Size scale, Nanotechnology timeline, pre-18th Century; 19 th Century, 20th Century, 21 th Century	2	5
	19	Carbon age-New form of Carbon- Fullerenes, Bucky balls, Carbon Nanotubes (CNTs) , Multi walled CNTs (Book3: Chapter 11)	3	5
	20	Influence of nano over micro/macro, size effects and crystals, large surface to volume ration, surface effects on the properties, mechanical-physical-chemical properties,	3	5
V*	**Applications of Nanoscience and Nanotechnology for a Sustainable Future: Addressing Global Challenges (Book2: Chapter 4)**		**12**	
	21	Food and Agricultural Industry, Cosmetic and Consumer Goods,	4	6
	22	Energy ,Water treatment and Environment, Nano Medical Applications	4	6
	23	Textiles, Paints, Defence and Space Applications	4	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Explain the fundamentals of nanoscale systems and its physical, chemical, and electrical properties	U	PSO-1,2
CO-2	List and classify the fundamental crystal structure of the materials	R, U	PSO-2,3
CO-3	Outline the various defects occurs in materials	U	PSO-1,3
CO-4	Illustrate the electrical and optical properties of materials	Ap	PSO-3,4
CO-5	Illustrate the surface effects on mechanical-physical-chemical properties of materials	Ap	PSO-5
CO-6	Define and analyse the fundamental applications of nanotechnology and point out how it supports for a sustainable future in modern era	R, An	PSO-6,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: BASICS OF NANOSCIENCE AND NANOTECHNOLOGY

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Explain the fundamentals of nanoscale systems and its physical, chemical, and electrical properties	PO1,3,4,5 ,6,8/ PSO-1,2	U	F, C	L	-
CO-2	List and classify the fundamental crystal structure of the materials	PO1,2,3,4 ,5,8/ PSO-2,3	R, U	F, C	L	-
CO-3	Outline the various defects occurs in	PO1,2,3,4 ,6/ PSO-	U	F, C	L	-

	materials	1,3				
CO-4	Illustrate the electrical and optical properties of materials	PO1,2,3,4,6/ PSO-3,4	Ap	F, C	L	
CO-5	Illustrate the surface effects on mechanical-physical-chemical properties of materials	PO1,2,3,7/PSO-5	Ap	F, C	L	-
CO-6	Define and analyse the fundamental applications of nanotechnology and point out how it supports for a sustainable future in modern era	PO1,3,4,5,7,8/PSO-6,7	R, An	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	2	-	-	-	-	-	2	-	1	1	2	2	-	1
CO-2	-	2	1	-	-	-	-	1	2	2	1	2	-	-	2
CO-3	2	-	1	-	-	-	-	1	2	2	1	-	1	-	-
CO-4	-	-	3	2	-	-	-	2	2	1	1	-	1	-	-
CO-5	-	-	-	-	3	-	-	1	2	2	-	-	-	2	-
CO-6	-	-	-	-	-	2	2	1	-	2	2	2	-	1	1

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	-	✓	-	✓
CO-4	-	✓	-	✓
CO-5	-	✓	-	✓
CO-6	✓	-	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK3DSEPHY203**				
Course Title	**FUNDAMENTALS OF ASTROPHYSICS**				
Type of Course	**DSE**				
Semester	**III**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 Hrs	-	-	4 Hrs
Pre-requisites	1. Laws of motion, Familiarity with optics and light propagation 2. Knowledge of trigonometric functions and identities				
Course Summary	The course aims to give a fundamental concept of astronomy and astrophysics. This includes formation and evolution of stars and galaxies, basics of observational astronomy. On completion of the course, the student will get a comprehensive understanding of the fundamental principles and latest developments in astronomy and astrophysics.				

BOOKS FOR STUDY:

1. An Introduction to Astrophysics, Baidyanath Basu, PHI Learning Private Limited (2010)
2. Fundamentals of Astrophysics. Stan Owocki, Cambridge University Press, 2021
3. Astronomy, Andrew Fraknoi, David Morrison, and Sidney C. Wolff, XanEdu Publishing Inc; Second edition (2022)
4. Astronomy for Beginners, The introduction Guide to Space Cosmos Galaxies and Celestial Bodies, Sally R Ball ,Bluesource and Friends, 2019
5. Introduction to astronomy and cosmology, Ian Morison, Wiley
6. Introduction to Astronomy and Astrophysics, Pankaj Jain, CRC Press 2016

BOOKS FOR REFERENCE:

1. Astrophysics: Stars and Galaxies, K.D. Abhyankar, Universities Press (India) Limited (2001)
2. An Introduction to Modern Astrophysics, Bradley Carroll & Dale Ostlie Pearson Addison-Wesley, 2007
3. Modern Physics- R. Murugeshan, Kiruthika Sivaprasath (2007), S.Chand & Company Ltd
4. Introduction to Space Science – Robert C Hymes (1971), John Wiley & Sons Inc.
5. Introduction to Cosmology- J. V. Narlikar (1993), Cambridge University Press

RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]:

1. A Beginner's Guideto Workingwith Astronomical Data, Markus Possel (1905.13189v2.pdf (arxiv.org))
2. https://www.secretsofuniverse.in/basics-of-astrophysics-sou/

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	**Introduction to Astronomy & Astrophysics (Book 3: Chapter 2 & 3)**		**12**	
	1	Ptolemy's model of Universe – Copernican and Galilean contributions, Branches of Astronomy	3	1
	2	Laws of planetary motion: Tycho Brahe's observations, Kepler's laws	5	1
	3	Cosmology: Expansion of the Universe - redshifts , The Big Bang and the expanding universe; dark matter and dark energy, Hubble's law	4	1
II	**Stellar Astrophysics (Book 2: Part 3)**		**12**	
	4	Celestial coordinates, Astronomical distances- Parallaxes and Parsec, Electro-magnetic spectrum, Magnitude & Types, Color, Luminosity, Color-Magnitude Diagram,	3	2
	5	Formation of stars, Estimation of Star Formation Rate	3	2
	6	Stellar evolution, White dwarfs, Supernova explosion, Neutron stars,Chandrasekhar limit, Black holes	3	2
	7	Spectral classification of stars: The Harvard classification,Yerkes Classification, M-K classification, Hertzsprung Russel diagram	3	2

III	**Galaxies (Book 2: Part 4)**		**12**	
	8	Galaxy types: Spiral, Elliptical, Dwarf, Galaxy formation	4	3
	9	Our Galaxy- Galactic structure- Galactic rotation	4	3
	10	Cepheid variables as standard candle for distances to external Galaxies, Role of Galaxy Collisions, Galactic redshift and Hubble's law	4	3
IV	**Solar system (Book 1: Chapter 5)**		**12**	
	11	Formation of solar system: Nebular hypothesis, Evolution of protoplanetary disks	4	4
	12	Growth of solid bodies, Formation of Terrestrial and Giant planets	3	4
	13	Physical characteristics of planets in solar system	2	4
	14	Familiarization of solar system objects: Satellites, Asteroid belt, Kuiper belt, Comets and Meteorites, Search for extrasolar planets	3	4
V*	**Observational Techniques in Astronomy (Book 1: Chapter 1, E-content - 1)**		**12**	
	15	Imaging techniques: photography, CCD imaging	3	5
	16	Data Acquisitionin optical, infrared, radio, x-rays, ultra-violet regions, Neutrinos and cosmic rays	2	5
	17	Telescopes and Detectors - Measuring the signal: telescope characteristics	2	5
	18	Chandra X- ray observatory, Hubble space telescope, James web Telescope, Ultra-violet Imaging telescope	2	5
	19	Familiarisation of software for data analysis - DS9, Topcat, Laxpc, Astropy, IRAF	3	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Recall the historical development of astronomy and astrophysics	R	3

CO-2	Identify the key concepts in astronomy and astrophysics and develop basic observational skills to identify celestial objects	R, U	3
CO-3	Differentiate between different types of galaxies and understand the structure of galaxies	U, R	3
CO-4	Describe the structure and composition of the solar system	U	3
CO-5	Explain use of telescopes and observational tools to collect and analyze astronomical data	U, Ap	3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: FUNDAMENTALS OF ASTROPHYSICS

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Understand the historical development of astronomy and astrophysics	PO 1/ PSO 3	R	F, C	L	-
CO-2	Learn the key concepts in astronomy and astrophysics and Develop basic observational skills to identify celestial objects	PO 1/ PSO 3	U	F,C	L	-
CO-3	Differentiate between different types of galaxies and understand the structure of galaxies	PO 1/ PSO 3	U	F,C	L	-
CO-4	Gain knowledge about the structure and composition	PO 1/ PSO 3	U	F,C	L	-

	of the solar system					
CO-5	Understand the use of telescopes and observational tools to collect and analyse astronomical data	PO 2/ PSO 3	U	F,C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	-	-	2	-	-	-	-	1	-	-	-	-	-	-	-
CO-2	-	-	2	-	-	-	-	1	-	-	-	-	-	-	-
CO-3	-	-	2	-	-	-	-	1	-	-	-	-	-	-	-
CO-4	-	-	2	-	-	-	-	1	-	-	-	-	-	-	-
CO-5	-	-	3	-	-	-	-	-	2	-	-	-	-	-	-

Correlation Levels:

Level	**-**	**1**	**2**	**3**
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	-	-	✓
CO-5	✓	✓	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK3DSEPHY204</td></tr>
<tr><td>Course Title</td><td colspan="5">INTRODUCTION TO MEDICAL PHYSICS</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSE</td></tr>
<tr><td>Semester</td><td colspan="5">III</td></tr>
<tr><td>Academic Level</td><td colspan="5">200 - 299</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 Hrs</td><td>-</td><td>-</td><td>4 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">1. Concept of rotation, torque, rigid body
2. Definition of gas pressure, equation of state, velocity of fluid and equation of continuity.
3. Electromagnetic spectrum, properties of light: frequency, wavelength, polarization</td></tr>
<tr><td>Course Summary</td><td colspan="5">The course gives an understanding of biomechanical and fluid mechanical aspects of human body, in terms of motion of bones, joints etc and the blood flow along various body parts. The thermodynamical and mechanical aspects of respiration, metabolism etc are discussed. Different bio-membranes and their functionality including sound is discussed. The optical aspects of eyesight is discussed. The interaction of electro-magnetic radiation with human body and different diagnostic methods using sound and radiation are introduced.</td></tr>
</table>

BOOKS FOR STUDY:

1. Introduction to Medical Physics-Zanichelli Alessandro Bacchettam & Domenico Scannicchio - CEA (2023)

BOOKS FOR REFERENCE:

1. An Introduction to Medical Physics-Springer International Publishing (2017) Muhammed Maqbool (eds.)
2. Encyclopaedia of Medical Physics_ Two Volume Set-CRC Press (2021) Slavik Tabakov, Franco Milano, Magdalena S. Stoeva, Perry Sprawls, Sameer Tipnis, Tracy Underwood

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	**Biomechanics & Fluid mechanics (Chapter 2& 3)**		**12**	
	1	Introduction: muscles and bones, Torque, Rigid body equilibrium, Center of mass and center of gravity	2	1,2,3
	2	Constraints and levers, Mechanical equilibrium applied to body joints- Levers in human body, Hip joint equilibrium	2	2,3
	3	Rotational dynamics, Deformations, Deformations of bones	2	2,3
	4	Introduction: the cardiovascular system, Hydrostatic pressure and buoyancy, Liquid flow and continuity equation (No derivation)	2	1,2,3
	5	Vascular flow- Blood flow rate and velocity, Aneurysm and stenosis	2	2,3
	6	Blood viscosity, Blood pressure and resistance of vessels (No derivation), Effects of hydrostatic pressure	2	2,3
II	**Pulsation, respiration and metabolism (Chapter 4 & 5)**		**12**	
	7	Heart, Cardiac Work & Laplace formula	2	1,2,3,4
	8	Equilibrium radius of vessels, Hydrodynamic effects of vessel dispensability	2	2,3,4
	9	Blood pressure measurements, Pulsatile motion and mechanical impedance (No derivation)	2	2,4
	10	Ideal Gas & Real Gas	1	1,2
	11	Air Composition and Respiration	1	2,4

	12	Basics only -Laws of Thermodynamics, Enthalpy, Entropy	2	4
	13	Metabolism and Spirometry	2	4
III	**Biological membranes and hearing (Chapter 6 & 8)**		**12**	
	14	Biological Membrane, Diffusion Through Membrane (No derivation)	2	2,5
	15	Osmosis and Osmotic Pressure	2	1,5
	16	Pulmonary, digestive and kidney membranes	2	5
	17	Sound Waves, Infra sounds, Ultra Sounds	1	1
	18	Sound Sensation, Ear and the sound Transmission	1	2,5
	19	Stethoscope and the body sound,	2	5
	20	Ultra Sound in Medicine	2	7
IV	**Light and Vision (Chapter 10)**		**12**	
	21	Light wave Propagation, Optical Fiber, Spectrophotometry	2	1
	22	Light polarization, Light polarization and molecules optical rotatory power	2	1
	23	The microscope, Resolving power of microscope, Special Optical Microscopes	3	1
	24	The eye: sight	2	2,6
	25	The eye: vision	3	2,6
V*	**Electromagnetic & Ionic radiation in medicine (Chapter 9 & 11)**		**12**	
	26	Electromagnetic waves: spectrum, emission and absorption	2	1
	27	Electromagnetic waves in medicine	2	1
	28	X-ray imaging, CT Scan	2	1,2,7
	29	Effects of ionizing radiation in biological systems	2	1,2
	30	Diagnostics application in medicine	2	7
	31	Radiotherapy	2	7

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Introduce/revise concepts of physics to prepare for the study of medical physics	R	PSO-1
CO-2	Understand the human body a basic physics point of view	U	PSO-1
CO-3	Explore the mechanical and fluid dynamical aspects of body functioning	R, U	PSO-1,3
CO-4	Learn thermodynamic and mechanical aspects of respiration, metabolism etc	R, U	PSO-1,3
CO-5	Know different types of bio-membranes their functionality	U, Ap	PSO-1,3
CO-6	Introduce physical mechanism of eyesight and the related optics	R,U	PSO-1,3
CO-7	Get a clear understanding of interaction of sound, radiation with body and its diagnostic applications.	U, Ap	PSO-1,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: INTRODUCTION TO MEDICAL PHYSICS

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Introduce/revise concepts of physics to prepare for the study of medical physics	PO1,4,6 / PSO 1	R	F	L	-
CO-2	Understand the human body a basic physics point of view	PO1,4,6 / PSO 1	U	C	L	-

CO-3	Explore the mechanical and fluid dynamical aspects of body functioning	PO1,2,3,4,6/ PSO 1,3	R, U	F,C	L	-
CO-4	Learn thermodynamic and mechanical aspects of respiration, metabolism etc	PO1,2,3,4,6/ PSO 1,3	R, U	F,C	L	-
CO-5	Know different types of bio-membranes their functionality	PO1,2,3,4,6/ PSO 1,3	U, Ap	F,C	L	-
CO-6	Introduce physical mechanism of eyesight and the related optics	PO1,2,3,4,6/ PSO 1,3	R,U	F,C	L	-
CO-7	Get a clear understanding of interaction of sound, radiation with body and its diagnostic applications.	PO1,2,4,5,6,8/ PSO 1,7	U, Ap	C,P	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	3	-	-	-	-	-	-	2	-	-	2	-	2	-	-
CO-2	3	-	-	-	-	-	-	2	-	-	2	-	2	-	-
CO-3	3	-	2	-	-	-	-	2	2	2	2	-	2	-	-

CO-4	3	-	2	-	-	-	-	2	2	2	2	-	2	-	-
CO-5	3	-	2	-	-	-	-	2	2	2	2	-	2	-	-
CO-6	3	-	2	-	-	-	-	2	2	2	2	-	2	-	-
CO-7	3	-	-	-	-	-	3	2	2	-	2	2	-	-	2

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	✓	-	✓
CO-6	✓	✓	-	✓
CO-7	✓	-	✓	✓

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK3DSEPHY205**				
Course Title	**MATHEMATICAL TOOLS FOR PHYSICS**				
Type of Course	**DSE**				
Semester	**III**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 Hrs	-	-	4 Hrs
Pre-requisites					
Course Summary	Mathematical tools serve as the backbone for solving complex physics problems. They encompass concepts such as curvilinear coordinate systems for describing non-linear geometries, differential equations for modeling dynamic systems, complex functions for analyzing oscillatory behavior, infinite and Fourier series for understanding periodic phenomena, matrices and linear vector spaces for handling transformations, and operators for representing physical observables and their interactions within a structured mathematical framework. These tools provide physicists with powerful techniques to describe, analyze, and predict various physical phenomena across diverse fields.				

BOOKS FOR STUDY:

1. Introduction to Electrodynamics by David J Griffith; 4th edition
2. Introduction to mathematical physics by Charlie Harper
3. Mathematical Methods in The Physical Sciences by Mary L Bose; 3rd edition
4. Calculus by Anton, Bivens and Davis; 10th edition
5. Matrices and tensors in physics by A W Joshi; 3rd edition
6. Quantum mechanics by V K Thankappan; 3rd edition

BOOKS FOR REFERENCE:

1. Mathematical Methods for Physicists by Arfken, Weber and Harris; 7th edition.
2. Calculus by Thomas; 13th edition
3. Differential equations with applications with Historical notes by George F Simmons; 3rd edition

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Vector algebra and Orthogonal curvilinear coordinate system (Books 1 & 2)**	**12**	
	1	Orthogonal curvilinear coordinate systems: plane polar, Spherical polar and cylindrical coordinate systems- unit vectors, coordinate transformations.	3	1
	2	Infinitesimal line segment, scale factors, area elements, volume elements, line-surface-volume integrals with examples	3	1
	3	Gradient, divergence, curl and Laplacian in spherical polar and cylindrical coordinate systems (derivation excluded).	3	1
	4	Integral theorems- Stoke's theorem and Gauss divergence theorem (verification with examples only).	3	1
II		**Infinite series (Books 3 & 4)**	**11**	
	5	Infinite series – convergence test (Book 4)	2	2
	6	Maclaurin and Taylor series (Book 4)	3	2
	7	Convergence of Taylor series (Book 4)	1	2
	8	Fourier series – examples (Book 3)	3	2
	9	Fourier transform (qualitative discussion only) (Book 3)	2	2
III		**Complex functions (Books 2 & 3)**	**10**	
	10	Complex numbers, graphical representation (Book 3)	2	3
	11	Complex functions, arithmetic operation-conjugates, modulus (Book 3)	2	3
	12	Polar form, powers and roots (Book 3)	2	3
	13	Euler's formula, Demovre's theorem (Book 3)	1	3

	14	Analytical functions and Cauchy-Riemann Conditions, examples of analytic functions (Book 3)	3	3
IV	**Differential equations and Matrices (Book 2 &3)**		**15**	
	15	First order equations and linear second order differential equations with constant coefficients, homogeneous and inhomogeneous equations. (Book 2)	7	4
	16	Partial differential equation- variable separable solution (elementary ideas). (Book 2)	2	4
	17	Matrices: symmetric matrices, skew symmetric matrices, Hermitian-orthogonal-unitary matrices, rank, trace. (Book 2)	2	5
	18	Eigen value problems, eigen vectors. (Book 2)	2	5
	19	Diagonalization, similarity transformation, rotation matrices, function of a matrix. (Book 2)	2	5
V*	**Linear vector space and operators (Book 5 & 6)**		**12**	
	20	Group, field, linear vector space, linear independence of vectors, vector space of n-tuplets.	3	6
	21	Inner product, orthonormality and linear independence, bases and dimensions, norm.	2	6
	22	Schmidt's orthogonalization method.	1	6
	23	Operators-linear operators, eigen value and eigen functions of an operator.	2	6
	24	Hermitian operator, unitary operator, projection operator.	2	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Explain the curvilinear coordinates which have applications in problems with spherical and cylindrical symmetries.	U, Ap	PSO-1, 2
CO-2	Express functions as infinite series and understand its applications in physics	U, Ap	PSO-1, 2
CO-3	Explain the fundamental ideas of complex numbers and	U, Ap	PSO-1, 2

	complex functions		
CO-4	Describe the methods used for solving differential equations, emphasizing the various approaches based on the type and characteristics of the equations.	U	PSO-1, 2
CO-5	Explain the classification of matrices and their corresponding operations, highlighting the distinctions among different types of matrices and the procedures involved in matrix operations	U, Ap	PSO-1, 2
CO-6	Explain linear vector space and different operations in linear vector space	U	PSO-1, 2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: MATHEMATICAL TOOLS FOR PHYSICS

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Explain the curvilinear coordinates which have applications in problems with spherical and cylindrical symmetries.	PO-1,2,3 PSO-1, 2	U, Ap	F, C	L	-
CO-2	Express functions as infinite series and understand its applications in physics	PO-1,2,3 PSO-1, 2	U, Ap	F, C	L	-
CO-3	Explain the fundamental ideas of complex numbers and complex functions	PO-1,2,3 PSO-1, 2	U, Ap	F, C	L	-
CO-4	Describe the methods used for solving differential equations,	PO-1,2,3 PSO-1, 2	U, Ap	F, C	L	-

	emphasizing the various approaches based on the type and characteristics of the equations.					
CO-5	Explain the classification of matrices and their corresponding operations, highlighting the distinctions among different types of matrices and the procedures involved in matrix operations	PO-1,2,3 PSO-1, 2	U, Ap	F, C	L	-
CO-6	Explain linear vector space and different operations in linear vector space	PO-1,2,3 PSO-1, 2	U	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	3	-	-	-	-	-	3	2	1	-	-	-	-	-
CO-2	2	3	-	-	-	-	-	3	2	1	-	-	-	-	-
CO-3	2	3	-	-	-	-	-	3	2	1	-	-	-	-	-
CO-4	2	3	-	-	-	-	-	3	2	1	-	-	-	-	-
CO-5	2	3	-	-	-	-	-	3	2	1	-	-	-	-	-
CO-6	2	3	-	-	-	-	-	3	2	1	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	-	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	-	-	✓
CO-6	✓	-	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK3DSEPHY206**				
Course Title	**COMPUTER HARDWARE AND OPERATING SYSTEM**				
Type of Course	**DSE**				
Semester	**III**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 Hrs	-	-	4 Hrs
Pre-requisites					
Course Summary	This course gives an overview of different hardware components used in a personal computer. It also discusses how to assemble or disassemble components of a computer for better performance. General idea of operating system is discussed and procedure to configure a computer with a new operating system (Linux and Windows) is discussed in detail. This course will helps one to assemble a new PC and configure it with a new OS.				

BOOKS FOR STUDY:

1. PC Hardware A Beginner’s Guide: Ron Gilster, McGraw-Hill Education (India) Pvt Ltd.
2. The architecture of computer hardware, system software and networking-An information technology approach: Irv Englander, Wiley Publications
3. PC Assembly and Installation: Dr. Tariq Hussain Sheikh, Naresh Kumar, Books clinic Publications
4. Operating Systems: Achyut S Godbole, Atul Kahate, Tata Mc Graw-Hill Education
5. The official Ubuntu Book: Benjamin Mako Hill, Matthew Helmke, Corey Burger, Pearson Education Inc.

BOOKS FOR REFERENCE:

1. Computing Fundamentals, Introduction to Computers: Faithe Wempen, Wiley publications
2. Guide to Operating Systems: Greg Tomsho, Cengage Learning.
3. Operating Systems made easy: C. Madana Kumar Reddy, Lexmi Publications.
4. Operating Systems Internals and Design principles: William Stallings, Prentice Hall publication 7th Edn

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Evolution of computers (Book 1)**	**12**	
	1	Overview of Systems and components, Electronics of the PC – Conductors, Insulators, and Semiconductors – Electronic building blocks of PC (Book1: Chapter1 &2)	3	1
	2	Components of the computer, the concept of virtualization, Architectural history of the computer - hardware, operating system, communication network and internet (Book 2: Chapter1)	5	1
	3	Evolution of PC microprocessor (Book1: Chapter 3)	2	1
	4	The general concepts of systems, IT System architecture (Book2: Chapter 2)	2	1
II		**Overview of Computer Hardware (Book 1, 3)**	12	
	5	Computer hardware-CPU, Motherboard, RAM, HDD, ODD, the power supply (SMPS), Mouse, Monitor.	2	1
	6	Motherboard-Definition, Architecture, Chipset, Bus, CPU Sockets, Interface Ports used to connect different Peripherals I/O Ports (PS/2, Serial, Parallel, USB, VGA, HDMI, Audio, Ethernet).	5	1
	7	Memory-Introduction to RAM, ROM, Cache Memory, Buffer Memory, Virtual Memory, SD, RD, DDR, DDR2, DDR3, Hybrid Memory.	5	1
III		**Computer Assembly (Book 3)**	**12**	
	8	Assembling and Disassembling a PC, Precautions to be taken while assembling the PC.	4	2

	9	Introduction to BIOS/CMOS Setup, POST (Power on Self-Test). BIOS/CMOS Configuration (Date, Time, Enable/Disable Devices).	4	2
	10	Dual BIOS Feature BIOS/CMOS Setup, Booting Sequence/Boot Order	4	2
IV	**Operating Systems (Book 4, 5)**		**12**	
	11	Operating Systems objectives and functions	2	3
	12	Evolution of operating systems, Types of operating systems, Different services of the operating system	4	3
	13	GUI, Kernel, Booting, Virtual Machine, OS design consideration for Multiprocessor and Multicore	4	3
	14	Overview on Operating Systems- WINDOWS, UNIX, LINUX	2	4
V*	**Configuring a computer with Linux OS (Book 4, 5)**		**12**	
	15	Choosing Ubuntu version, Getting Ubuntu, Installing Ubuntu	8	5
	16	Performing Dual Boot / Multi Boot	4	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss the main features of computer hardware, peripherals various memory systems used in it.	U	PSO 5
CO-2	Examine the assembling of PC and introduce the Basic Input/Output System -BIOS	U, Ap	PSO 5,7
CO-3	Describe the evolution, objectives and functions of various operating systems	U	PSO 5
CO-4	Identify various operating Systems and their applications	U	PSO 5
CO-5	Illustrate the methods to configure a computer with Linux and Windows OS	U, Ap	PSO 5,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: COMPUTER HARDWARE AND OPERATING SYSTEM

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Discuss the features of computer hardware and peripherals and compare various memory systems	PO 1/ PSO 5	U	C	L	-
CO-2	Examine the assembling of PC and introduce the Basic Input/Output System	PO1,6/ PSO 5,7	U, Ap	C, P	L	-
CO-3	Describe the evolution, objectives and functions of various operating systems	PO1/ PSO 5	U	C	L	-
CO-4	Identify various operating Systems and their applications	PO1/ PSO 5	U	C	L	-
CO-5	Illustrate the methods to configure a computer with Linux and Windows OS	PO1,6/ PSO 5,7	U, Ap	C, P	T	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-
CO-2	-	-	-	-	1	-	2	1	-	-	-	-	2	-	-
CO-3	-	-	-	-	2	-	-	1	-	-	-	-	-	-	-
CO-4	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-
CO-5	-	-	-	-	2	-	2	1	-	-	-	-	2	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	-	✓	-	✓
CO-5	-	✓	-	-

University of Kerala

Discipline	**PHYSICS**
Course Code	**UK3VACPHY200**
Course Title	**ENERGY CRISIS, SUSTAINABILITY AND MANAGEMENT**
Type of Course	**VAC**
Semester	**III**
Academic Level	**200 - 299**

Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 Hrs	-	-	3 Hrs

Pre-requisites	
Course Summary	This course provides a comprehensive understanding of the historical context, current challenges, and future prospects of global energy consumption and production. Upon completion of the course, graduates will be equipped with the knowledge and skills to analyze energy systems, evaluate sustainability measures, and contribute to informed decision-making in the energy sector

BOOKS FOR REFERENCE:

1. World Issues - Energy Crisis, S Chand Publishing, ISBN : 9788121933391
2. Understanding the Global energy crisis, Edited by Eugene D. Coyle and Richard A. Simmons, ISBIN: 978-1-55753-661-7, Purdue University Press, USA

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Global energy demand**	**7**	**1**
	1	Energy demand before industrial revolution	1	1

	2	Energy sources in 19th century	2	1
	3	Growth of energy demand and sources in 20th century	2	1
	4	Energy demand and gross national product	2	1
II		**Fuel crisis - coal and oil**	**7**	
	5	Oil crisis; Oil extraction, reserves, Oil types- Shale, Heavy and Tar Sands, Environmental Issues	2	2
	6	Coal: Production, reserves, mining, Environmental Issues	3	2
	7	Disinvestment from fossil fuels and rise in oil prices	2	2
III		**Renewable Energy sources**	**11**	
	8	Solar Energy	2	3
	9	Wind Energy	2	3
	10	OCEAN and WAVE ENERGY; Tidal Power, Wave, Ocean Thermal Energy Conversions, Future and Scope	3	3
	11	Scope of Geothermal energy	2	3
	12	Hydroelectric energy, hydroelectric generation, future of hydroelectric energy (Environmental and economical viability)	2	3
IV		**Policies and planning**	**11**	
	13	Energy supply and investment planning	3	4
	14	Future GDP/Energy consumption ratio	3	4
	15	Future energy options for developing nations	3	4
	16	Global energy politics and policies	1	4
	17	India: Energy and Climate Change Policies	1	4
V*		**Energy Options for the Future**	**9**	
	18	Hydrogen and Fuel Cells (Brief description of its Design, working, advantages and disadvantages)	4	5
	19	Future Energy storage options : An introduction on Thermal energy storage systems Mechanical energy storage systems Chemical energy storage systems Electrochemical energy storage systems Solar energy storage storage systems	5	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the historical context of energy consumption prior to the Industrial Revolution. Identify the primary sources of energy utilized before the Industrial Revolution and their limitations. Examine the transition from traditional biomass fuels to fossil fuels during the 19th century.Identify key developments in coal, oil, and natural gas extraction and utilization during the 19th century.Trace the exponential growth of global energy demand throughout the 20th century. Explore the relationship between energy demand and economic growth, as measured by Gross National Product (GNP).	U	PSO-1
CO-2	Understand the historical context, causes, and consequences of oil crises on global economies and energy policies. Analyze techniques, challenges, and geopolitical implications of oil extraction and reserve estimation. Examine characteristics, extraction methods, and environmental impacts of Shale, Heavy, and Tar Sands. Evaluate the ecological consequences and mitigation strategies for environmental issues associated with oil extraction and use. Explore global coal production trends, reserves distribution, and environmental impacts of coal mining and combustion. Explore future implications of divestment movements and their relationship to oil price dynamics.	U, Ap, An	PSO-1,3
CO-3	Understand the principles of solar energy conversion and its significance in renewable energy systems. Discuss the different types of solar technologies, including photovoltaic (PV) and concentrating solar power (CSP), and their applications. Evaluate the environmental and economic benefits and challenges associated with solar energy deployment. Understand the fundamental principles of wind energy generation and its importance as a renewable energy resource. Analyse different wind turbine technologies, including horizontal-axis and vertical-axis turbines, and their operational characteristics. Understand the challenges and opportunities for expanding wind energy .Understand the various	U, Ap, An	PSO-1,3

	forms of ocean energy, including tidal power, wave energy, and ocean thermal energy conversion (OTEC), and their potential for electricity generation. Explore the principles of geothermal energy extraction and its potential as a renewable heat and power source. Understand the basic principles of hydroelectric power generation. Evaluate the environmental and socio-economic impacts of hydroelectric projects, including habitat disruption and resettlement issues. Discuss the challenges and opportunities for expanding hydroelectric capacity		
CO-4	Understand the principles and methodologies involved in strategic energy supply planning and investment decision-making. Analyze the evolving relationship between economic growth (GDP) and energy consumption, and its implications for sustainability and development. Evaluate the potential energy pathways and policy frameworks for sustainable development in developing nations, considering socio-economic contexts and environmental concerns. Examine the interplay of geopolitical factors, international relations, and policy initiatives in shaping global energy landscapes and addressing energy security challenges. Explore India's energy sector dynamics, climate change mitigation efforts, and policy strategies aimed at promoting energy security, sustainability, and economic growth.	U, Ap,E, C	PSO-1,3
CO-5	Understand the design, working principles, advantages, and disadvantages of hydrogen-based fuel cell technologies. Introduce the concepts and applications of various energy storage systems, including thermal, mechanical, chemical, and electrochemical technologies, as well as solar energy storage solutions	Ap, C	PSO-1,3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ENERGY CRISIS, SUSTAINABILITY AND MANAGEMENT

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	**CO**	**PO / PSO**	**Cognitive Level**	**Knowledge Category**	**Lecture (L)/ Tutorial (T)**	**Practical (P)**
CO-1	Understand the historical context of energy consumption prior to the Industrial Revolution. Identify the primary sources of energy utilized before the Industrial Revolution and their limitations. Examine the transition from traditional biomass fuels to fossil fuels during the 19th century.Identify key developments in coal, oil, and natural gas extraction and utilization during the 19th century.Trace the exponential growth of global energy demand throughout the 20th century. Explore the relationship between energy demand and economic growth, as measured by Gross National Product (GNP).	PO1,3 ,4,7/ PSO-1	U	F	L/T	-
CO-2	Understand the historical context, causes, and consequences of oil crises on global economies and energy policies. Analyze techniques, challenges, and geopolitical implications of oil extraction and reserve estimation. Examine characteristics, extraction methods, and environmental impacts of Shale, Heavy, and Tar Sands. Evaluate the	PO1,3 ,4,5,7, 8/ PSO- 1,3	U, Ap, An	F	L	-

	ecological consequences and mitigation strategies for environmental issues associated with oil extraction and use. Explore global coal production trends, reserves distribution, and environmental impacts of coal mining and combustion. Explore future implications of divestment movements and their relationship to oil price dynamics.					
CO-3	Understand the principles of solar energy conversion and its significance in renewable energy systems. Discuss the different types of solar technologies, including photovoltaic (PV) and concentrating solar power (CSP), and their applications. Evaluate the environmental and economic benefits and challenges associated with solar energy deployment. Understand the fundamental principles of wind energy generation and its importance as a renewable energy resource. Analyse different wind turbine technologies, including horizontal-axis and vertical-axis turbines, and their operational characteristics. Understand the challenges and opportunities for expanding wind energy .Understand the various forms	PO1,3,4,5,7,8/ PSO-1,3	U, Ap, An	F, C,P	L	-

	of ocean energy, including tidal power, wave energy, and ocean thermal energy conversion (OTEC), and their potential for electricity generation. Explore the principles of geothermal energy extraction and its potential as a renewable heat and power source. Understand the basic principles of hydroelectric power generation. Evaluate the environmental and socio-economic impacts of hydroelectric projects, including habitat disruption and resettlement issues. Discuss the challenges and opportunities for expanding hydroelectric capacity					
CO-4	Understand the principles and methodologies involved in strategic energy supply planning and investment decision-making. Analyze the evolving relationship between economic growth (GDP) and energy consumption, and its implications for sustainability and development. Evaluate the potential energy pathways and policy frameworks for sustainable development in developing nations, considering socio-economic contexts and environmental concerns.	PO1,3,4,7,8/PSO-1,3	U, Ap, E	F, C,P	L/T	-

	Examine the interplay of geopolitical factors, international relations, and policy initiatives in shaping global energy landscapes and addressing energy security challenges. Explore India's energy sector dynamics, climate change mitigation efforts, and policy strategies aimed at promoting energy security, sustainability, and economic growth.					
CO-5	Understand the design, working principles, advantages, and disadvantages of hydrogen-based fuel cell technologies. Introduce the concepts and applications of various energy storage systems, including thermal, mechanical, chemical, and electrochemical technologies, as well as solar energy storage solutions	PO1,3,4,7/ PSO-1,3	Ap	F, C,P	L/T	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO-1	1	-	-	-	-	-	-	2	-	2	2	-	-	3	-
CO-2	1	-	1	-	-	-	-	2	-	3	2	1	-	1	2
CO-3	1	-	1	-	-	-	-	2	-	1	2	3	-	2	2
CO-4	1	-	1	-	-	-	-	2	-	1	2	-	-	2	3
CO-5	1	-	1	-	-	-	-	2	-	2	2	-	-	2	-

Correlation Levels:

Level	**-**	**1**	**2**	**3**
Correlation	**Nil**	**Slightly / Low**	**Moderate / Medium**	**Substantial / High**

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	✓	✓	✓
CO-5	✓	✓	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK3VACPHY201</td></tr>
<tr><td>Course Title</td><td colspan="5">INTRODUCTION TO LABORATORY SAFETY MEASUREMENTS</td></tr>
<tr><td>Type of Course</td><td colspan="5">VAC</td></tr>
<tr><td>Semester</td><td colspan="5">III</td></tr>
<tr><td>Academic Level</td><td colspan="5">200 - 299</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>3</td><td>3 Hrs</td><td>-</td><td>-</td><td>3 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5"></td></tr>
<tr><td>Course Summary</td><td colspan="5">This course provides a comprehensive overview of laboratory safety, covering general safety principles, operational rules, and safety equipment. It also includes an introduction to electrical and chemical safety measures, focusing on inspection, testing, protective clothing, and safe handling of hazardous substances. Additionally, the course explores radiation effects, monitoring, and safety protocols in nuclear physics labs, as well as gas safety norms, including the characteristics, properties, and standard operating procedures for various gases used in industrial and laboratory environments.</td></tr>
</table>

BOOKS FOR REFERENCE:

1. Safety measurements for Indian Laboratories, Ajay Kumar Gupta & Prithanshu, ISBN: 1312254084, Lulu. (Chapter)
2. Electrical Safety Hand book, John Cadick, Mary-Capelli-Schellpfeffer, Dennis, Neitzal (3rd Edition), McGraw-Hill (Chapter 2)
3. Hand book of Chemicals and Safety, TSS, Dikshith, ISBN No: 13-978-1-4398-2 (E-book), CRC Press, Taylor & Francis. (Chapter 2 & Chapter 3)

4. Nuclear Physics, D. C. Tayal, Himalaya Publishing (Chapter 16)
5. Techniques for Nuclear and Particle Physics experiments, W. R. Leo (Chapter 3)
6. Hazardous Gases: Risk Assessment on the environment and Human health, Jospel singh, R. D. Koushik and Malavika Chawala, ISBN: 978-0323898577, Academic Press

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Introduction**	**9**	
	1	Introduction to general lab safety	4	1
	2	Lab operational rules, safety equipments	5	1
II		**Electrical safety measures (Book 2)**	**9**	
	3	Introduction to electrical safety measures	2	1
	4	General Inspection and Testing, Safety clothing, Insulated tools	2	1
	5	Arc, Electrical flash and thermal protection.	2	1
	6	Safety tags, locks, barriers. Safety grounding, circuit breaker, safety measuring instruments	3	1, 2
III		**Chemical safety measures**	**9**	
	7	Introduction to use of chemical substances.	1	1
	8	Classification/Categorization of chemicals causing - irritation effect, allergens, asphyxiants, acids, alkalies, carcinogens	3	2, 3
	9	Cryogenic gases, EDC, Neurotoxins.	2	2, 3
	10	Safe disposal of Chemical substances, Regulatory agencies and their role.	2	1, 3
	11	Chemical substances, exposure, occupation and hazards	1	1, 3
IV		**Radiation effects** (Book 4: Chapters 3 and 16)	**9**	
	12	Radiation monitoring and dose meter, Physical effects of radiation. Chemical effects of radiation	3	4
	13	Absorbed dose, Relative biological effectiveness, dose equivalent, Biological effects, Maximum	3	4
	14	Permissible Dose (MPD), Schielding, Radiation safety in nuclear physics lab (Book 5, Chapter 3)	3	4

V*	**Gas safety norms**		**9**	
	15	Different gases used in industry and lab,	3	5
	16	characteristics and properties of gases - O2, O3, N2, H2, Co, methylene, ethylene, Petroleum gases, CNG	4	5
	17	Standard operating procedures for gases	2	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Comprehend fundamental laboratory safety guidelines, operational rules, and the appropriate use of safety equipment, fostering a safe lab environment and minimizing the likelihood of accidents or injuries during experiments.	U	PSO-1,3
CO-2	Understand and remember essential electrical safety measures, including inspection, safety clothing, insulated tools, arc protection, and safety devices like tags, locks, grounding, and circuit breakers, ensuring safe practices in electrical work environments.	R, U	PSO-1,3
CO-3	Apply knowledge of chemical substance classification, disposal methods, regulatory agencies, and occupational hazards to effectively manage and mitigate risks in practical scenarios.	Ap	PSO-1,3
CO-4	Demonstrate proficiency in radiation monitoring and the use of dose meters, comprehend the physical and chemical effects of radiation, including absorbed dose and relative biological effectiveness, understand concepts such as dose equivalent and maximum permissible dose (MPD), apply principles of shielding for radiation safety in nuclear physics laboratories.	U	PSO-1,3
CO-5	Identify various gases utilized in industry and laboratory settings, discern their unique characteristics and properties, including O2, O3, N2, H2, Co, methylene, ethylene, petroleum gases, and CNG, and develop standard operating procedures for their safe handling and usage.	U	PSO-1,3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: INTRODUCTION TO LABORATORY SAFETY MEASUREMENTS

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Comprehend fundamental laboratory safety guidelines, operational rules, and the appropriate use of safety equipment, fostering a safe lab environment and minimizing the likelihood of accidents or injuries during experiments.	PO1,3,4, 5,6,8/ PSO-1,3	U	U	L	-
CO-2	Understand and remember essential electrical safety measures, including inspection, safety clothing, insulated tools, arc protection, and safety devices like tags, locks, grounding, and circuit breakers, ensuring safe practices in electrical work environments.	PO1,3,4, 5,6,8/ PSO-1,3	R, U	R, U	L	-
CO-3	Apply knowledge of chemical substance classification, disposal methods, regulatory agencies, and occupational hazards to effectively manage and mitigate risks in practical scenarios.	PO1,3,4, 5,6,8/ PSO-1,3	Ap	Ap	L	-

CO-4	Demonstrate proficiency in radiation monitoring and the use of dose meters, comprehend the physical and chemical effects of radiation, including absorbed dose and relative biological effectiveness, understand concepts such as dose equivalent and maximum permissible dose (MPD), apply principles of shielding for radiation safety in nuclear physics laboratories.	PO1,3,4, 5,6,8/ PSO-1,3	U	U	L	-
CO-5	Identify various gases utilized in industry and laboratory settings, discern their unique characteristics and properties, including O2, O3, N2, H2, Co, methylene, ethylene, petroleum gases, and CNG, and develop standard operating procedures for their safe handling and usage.	PO1,3,4, 5,6,8/ PSO-1,3	U	U	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	-	2	-	-	-	-	2	-	3	2	2	2	-	2
CO-2	2	-	3	-	-	-	-	2	-	2	2	2	2	-	2
CO-3	3	-	2	-	-	-	-	3	-	3	2	2	2	-	2
CO-4	2	-	2	-	-	-	-	3	-	2	2	2	2	-	3
CO-5	2	-	2	-	-	-	-	2	-	3	2	2	2	-	2

Correlation Levels:

Level	**-**	**1**	**2**	**3**
Correlation	**Nil**	**Slightly / Low**	**Moderate / Medium**	**Substantial / High**

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	✓	-	✓

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK3VACPHY202</td></tr>
<tr><td>Course Title</td><td colspan="5">THE HISTORY OF PHYSICS AND ITS INFLUENCE ON SOCIETY</td></tr>
<tr><td>Type of Course</td><td colspan="5">VAC</td></tr>
<tr><td>Semester</td><td colspan="5">III</td></tr>
<tr><td>Academic Level</td><td colspan="5">200 - 299</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>3</td><td>3 Hrs</td><td>-</td><td>-</td><td>3 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5"></td></tr>
<tr><td>Course Summary</td><td colspan="5">This course explores the interconnected narratives of physics and human society. Trace the evolution of scientific thought from ancient civilizations to contemporary breakthroughs. Analyse key discoveries, from Babylonian astronomy to Newton’s laws and quantum mechanics. Uncover Indian physicist’s contributions to modern science and nation-building. Gain insights into technological milestones such as transistors, satellites, and space exploration. Enlighten the mind with a world vision through this course on the history of physics.</td></tr>
</table>

BOOKS FOR STUDY:

1. History of Physics, Florian Cajori, Dover Publications/Maven Books, ISBN-13: 978-9387488472
2. Biographical dictionary of Indian scientists, Anjana Chattopadhyay, Rupa & Company
3. Heat and Thermodynamics, M W Zemansky, McGraw Hill
4. Article: Steps of Power: Note on the history of electrification in India (1883 - 1930), Proceedings of the Indian History Congress, 2017, Vol 78(2107), pp 498-506

5. Nuclear Physics, D C Tayal, Himalaya Publishing House
6. Website of Atomic Energy Regulatory Board, Govt. of India
7. Quantum Mechanics, G Aruldas, PHI Learning Pvt Ltd
8. Article: It's time to go quantum in medicine, J Clin Med, 2023 Jul; 12(13): 4506.
9. A history of the world - Semiconductor Industry, P R Morris, Peter Peregrinus LTD, ISBN: 0863412270
10. Satellite technology: Principles and applications, Anil K. Maini & Varsha Agrawal, John Wiley & Sons

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Birth of physics and early human society (Book 1)**	**5**	
	1	Early civilizations (a) Babelonian & Egyptian (b) Greeks: Aristotle, Archimedes and Heron. Light, Sound, and Atomic theory. Greek physical inquiry and its failure. (c) Romans & Arabs	2	1
	2	Europe during the Middle Ages: Invention of gunpowder, Mariner's Compass, An early concept of Light.	1	2
	3	Contributions of Indians: (a) Aryabhata (b) Brahmagupta (c) Varahamihira (d) Bhaskara	2	1
II		**Renaissance and Newtonian Era (Book 1)**	**6**	
	4	Copernican system: Greek Anticipations of Copernicus, Greek theory of epicycles and eccentrics, Studies of Copernicus, Kepler's Inductive Researches	2	1
	5	Galileo: (a) Experiments at leaning tower (b) The book - Discourses on two new sciences (c) Telescope and studies on the Sun, Moon and Jupiter’s satellite	2	1
	6	Mechanics: Laws of Motion, Law of Gravitation, Motion of projectiles	1	3

	7	Light: Velocity of light, Newton's experiments with prism, Huygen's wave theory of light, Reflection telescope.	1	3
III	**Physics in 18th and 19th and early 20th centuries**		**14**	
	8	(a) Laws of thermodynamics (results only) and their implications (qualitative): zeroth law & concept of temperature, first law and conservation of energy, second law & disorder and entropy, third law and idea of absolute zero temperature. (b) Thermometers, Early development of steam engine	3	4
	9	(a) Concept of atoms & molecules (b) Light: Concepts of wave theory of light, solar spectrum, color photography, human eye	2	5
	10	(a) Electricity: Contributions of Benjamin Franklin's experiment, Cavendish, Volta and Coulomb (b) Beginning of electrolysis, voltage cell and storage batteries, Ohm's law	2	5
	11	Evolution of dynamo and alternating current, Transmission of electricity, Invention of telegraph and telephones (Book 1,4)	2	5
	12	History of Electrification in India (Book 1,4)	1	5
	13	(a) Contributions of Becquerel and Curie. Radio activity: alpha, beta and gamma rays (b) Nuclear fission and fusion, Einstein's Mass energy equivalence (Book 1,5)	2	5
	14	Destructive and Peaceful use of nuclear energy Nuclear power plants in India: Their location, capacity, fuel etc (Book 6)	2	5
IV	**Physics in 20th and 21st centuries (Book 7, 8, 9 & 10)**		**11**	
	15	Emergence of quantum mechanics: (a) Max Plank: Light as photons and a new constant - h (b) de Broglie: The idea of matter wave (c) Schrodinger: Wave equation of matter wave (d) Heisnberg: The uncertainty relation and its implications	2	6
	16	Medical application of quantum theory: Mind, diagnosis & DNA (*based on Article: It's time to go quantum in medicine, book 8*)	2	6

	17	Brief discussion on the Invention of transistor & IC chips: Germanium and silicon transistors, monolithic IC's, Full custom & semi custom circuits, microprocessors (*Chapter 4 of book 9)*	2	7
	18	Definition of Satellite. Orbit of satellite, Basic Principles of orbiting satellite - Newton's Law of Gravitation & Newton second law of motion.	2	7
	19	(a) History of the Evolution of Satellites: Early Communications, Meteorology & Scientific Exploration, Non-geosynchronous Communication Satellites, Emergence of Geosynchronous Communication Satellites, International Communication Satellite Systems, Domestic Communication Satellite Systems (Book 10) (b) Indian Space programmes: Cartosat, Astrosat, Chandrayan I & II, Aditya L1 (refer any relevant source)	3	7
V*	**Indian contributions in the modern era (Book 2 and any other resource)**		**9**	
	20	Three major discoveries (results only) by Indian scientists in modern physics & their implications: (a) Bose-Einstein statistics & Bosons (b) Raman effect & Raman spectroscopy (c) Chandrasekhar limit & death of stars	3	8
	21	Brief discussion on the contribution of Indian scientists & their role in nation building: (a) Homi J Baba & Indian atomic energy research (b) Vikram Sarabahi & his contribution to the development of ISRO (c) J V Narlikar and IUCAA	3	8
	22	Eminent scientists from Kerala and their contribution: (a) R S Krishnan (b) E C G Sudarshan (c) T Padmanabhan	3	8

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Recall key milestones in the history of physics, including significant discoveries made by ancient civilizations, such as the Babylonians, Egyptians Greeks and Indians	R, U	PSO-4
CO-2	Identify important figures and their contributions to physics during pivotal periods, such as the Renaissance and Newtonian Era, highlighting the work of Copernicus, Galileo, and Newton.	R, U	PSO-4
CO-3	Recognize and explain key principles of classical physics, such as Newton's Laws and Kepler's laws, shaping our understanding of the physical world.	U	POS-1,4
CO-4	Understand the importance of the two fundamental branches which fill the gap between Newton’s mechanics and physics of the modern era - namely thermodynamics and electricity.	U,E	POS-1,4
CO-5	Also how for the first time in history, physics started directly influencing the day to day life via steam engine, electrification etc	R,U	POS-1,4
CO-6	Get a glimpse of the most revolutionary discovery in the history of modern physics - quantum mechanics and how profoundly it is influencing human evolution through say medical research.	U,E	POS-1,4
CO-7	Understanding the origin of the semiconductor/electronics industry from physics. Now the basic development of the satellite industry and the physics behind it.	R,U,E	POS-1,4,6
CO-8	Explain the contributions of Indian scientists to physics and their influence on the general public.	U,E	PSO-1,4

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: THE HISTORY OF PHYSICS AND ITS INFLUENCE ON SOCIETY

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Recall key milestones in the history of physics, including significant discoveries made by ancient civilizations, such as the Babylonians, Egyptians Greeks and Indians	PO 2,6,8 / PSO 4	R, U	F, C	L	-
CO-2	Identify important figures and their contributions to physics during pivotal periods, such as the Renaissance and Newtonian Era, highlighting the work of Copernicus, Galileo, and Newton.	PO 6, 8 / PSO 4	R, U	F, C	L	-
CO-3	Recognize and explain key principles of classical physics, such as Newton's Laws and Kepler's laws, shaping our understanding of the physical world.	PO 6, 8 / PSO 1,4	U	F, C	L	-
CO-4	Understand the importance of the two fundamental branches which fill the gap between Newton’s mechanics and physics of the modern era	PO 6, 8 / PSO 1,4	U,E	F, C	L	-

	- namely thermodynamics and electricity.					
CO-5	Also how for the first time in history, physics started directly influencing the day to day life via steam engine, electrification etc	PO 2,6,8 / PSO 1,4	R,U	F, C	L	-
CO-6	Get a glimpse of the most revolutionary discovery in the history of modern physics - quantum mechanics and how profoundly it is influencing human evolution through say medical research.	PO 6, 8 / PSO 1,4	U,E	F, C, M	L	-
CO-7	Understanding the origin of the semiconductor/electronics industry from physics. Now the basic development of the satellite industry and the physics behind it.	PO 6, 8 / PSO 1,4,6	R,U,E	F, C	L	-
CO-8	Explain the contributions of Indian scientists to physics and their influence on the general public.	PO 2,5,6,8 / PSO 1,4	U,E	F, C, M	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	-	-	-	3	-	-	-	-	3	-	-	-	1	-	3
CO-2	-	-	-	3	-	-	-	-	-	-	-	-	1	-	3
CO-3	2	-	-	3	-	-	-	-	-	-	-	-	1	-	3
CO-4	2	-	-	3	-	-	-	-	-	-	-	-	1	-	3
CO-5	2	-	-	3	-	-	-	-	1	-	-	-	1	-	3
CO-6	3	-	-	3	-	-	-	-	-	-	-	-	1	-	3
CO-7	3	-	-	3	-	2	-	-	-	-	-	-	1	-	3
CO-8	2	-	-	3	-	-	-	-	2	-	-	2	1	-	3

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	✓	✓
CO-2	✓	✓	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	✓	✓	✓
CO-6	✓	-	✓	✓
CO-7	✓	-	-	✓
CO-8	✓	✓	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK4DSCPHY200**				
Course Title	**CLASSICAL DYNAMICS**				
Type of Course	**DSC**				
Semester	**IV**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites	1. Knowledge about Newton's laws and their implications. 2. Basic knowledge about a simple pendulum, centre of mass and oscillations				
Course Summary	The course has the following major objectives: 1. Gain deeper understanding of classical mechanics: Consolidate the understanding of concepts in mechanics such as Lagrangian, Hamiltonian, central force field, relativity and small oscillations. 2. Advance skills and capability for formulating and solving problems: applications of LaGrange's and Hamilton's equations of motion, motion in central force field, theory of relativity and the theory of small oscillations. 3. Expand and exercise the students' physical intuition and thinking process through the understanding of the theory and application of this knowledge of classical mechanics to the solution of practical problems.				

BOOKS FOR STUDY:

1. Classical Mechanics: G. Aruldhas, PHI Learning Pvt Ltd., 2008.
2. Classical Mechanics: J. C. Upadhyaya, Himalaya Publishing House.,2005.
3. Mechanics: H. S. Hans and S. P. Puri, Tata-McGraw Hill.,1984

BOOKS FOR REFERENCE:

1. Classical Mechanics, Goldstein, C.P. Poole, J.L. Safko, 3rd Edition. 2002, Pearson Education
2. Introduction to Special Relativity: R. Resnick, John Wiley and Sons, 2005.
3. Solved Problems in classical Mechanics, O.L. Delange and J. Pierrus, 2010, Oxford Press
4. Classical Mechanics, P.S. Joag, N.C. Rana, 1st Edition., McGraw Hill

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Lagrangian Dynamics (Book 2: Chapter 2 and Book1: Chapter 3)**	**09**	
	1	A brief review of Newtonian mechanics of a particle and a system particle	1	1
	2	Constraints and generalized coordinates	1	1
	3	Principle of virtual Work and D' Alembert's principle	1	1
	4	Lagrange's equation from D'Alembert's Principle, Comparison between Newtonian and Lagrangian dynamics	3	1
	5	Applications of Lagrange's equation in simple pendulum, Atwood's machine and compound pendulum	3	1
II		**Hamiltonian Dynamics (Book 2: Chapter 3)**	**09**	
	6	Generalized momentum and cyclic coordinates	1	2
	7	Hamiltonian function and Conservation of energy	2	2
	8	Hamilton's equation	2	2
	9	Examples of Hamiltonian dynamics: Equation of motion of i) one dimensional harmonic oscillator ii) particle in central force field	3	2
	10	Comparison between Hamiltonian and Lagrangian dynamics	1	2
III		**Motion in Central Force Field (Book 2: Chapter 4 and Book1: Chapter 5)**	**09**	
	11	Reduction to one body problem-equations of motion-equivalent one-dimensional problem	2	3

	12	Differential equation for the orbit in the case of integrable power law potentials	2	3
	13	Virial theorem	1	3
	14	Kepler's problem	2	3
	15	Inverse square law of force	2	3
IV		**Special Theory of Relativity (Book 2: chapters 1, 11 & 12 and Book 3: chapters 10, 11 & 12)**	**09**	
	16	Inertial and non- inertial frames of reference, Galilean transformations	1	4
	17	Ether Hypothesis, The Michelson-Morley experiment and explanation of negative result	1	4
	18	Postulates of special theory of relativity and Lorentz transformations.	2	4
	19	Consequences of Lorentz transformations- length contraction, simultaneity, time dilation, twin paradox	3	4
	20	Addition of velocities, Variation of mass with velocity– mass energy relation	2	4
V*		**Theory of Small Oscillations Book1: Chapter 9 and Book2: Chapter 9**	**09**	
	21	Equilibrium and potential energy	3	5
	22	Theory of small oscillations-normal modes	4	5
	23	Two coupled pendula	2	5

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Verification of Newton's second law using an Air Track	6
2	Verification of conservation principles (momentum and energy) using a friction free metal track.	6

3	To determine g and velocity for a freely falling body using Digital Timing Technique	6
4	Estimation of the value of “g” using a Kater’s pendulum.	6
5	Estimation of the moment of inertia about the different axes of a bifilar suspension.	6
6	Estimation of the Rigidity modulus of a metallic wire using a torsion pendulum.	6
7	Estimation of the moment of inertia of a Fly wheel (Calculate percentage error and standard deviation).	6
8	Estimation of acceleration due to gravity and Radius of gyration using Compound pendulum (Symmetric)	6
9	Estimation of acceleration due to gravity and Radius of gyration using Compound pendulum (Asymmetric)	6
10	Estimation of the Rigidity modulus of a metallic wire using a torsion pendulum with two equal masses	6
Part B* – At least One Experiment to be performed		
11	Numerical interpolation using Newton and Lagrangian methods	6
12	Study of motion of projectile in a central force field	6
13	Study of Planetary motion and Kepler’s laws	6
14	Symplectic integration for linear harmonic oscillator	6
15	Solve the simple harmonic oscillator problem with /without damping and visualize the phase-space diagram.	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	To define generalised coordinates, generalised velocities, and generalised force and write Lagrangian for mechanical system in terms of generalised coordinates.	R, U, Ap	PSO-1,2

CO-2	To write Hamiltonian for mechanical systems and derive and solve Hamilton's equation of motion for simple mechanical systems.	R, U, Ap	PSO-1,2
CO-3	To define equations of motion corresponding to reduction to one body problem and to derive equation for orbit and learn about Virial theorem, Kepler's problem and inverse square law of force.	R, U, Ap	PSO-1,2
CO-4	Recapitulate and learn the special theory of relativity and postulates of the special theory of relativity and develop applications of special theory of relativity to dynamical systems of particles.	R, U, Ap	PSO-1,2
CO-5	Formulate the problem of small amplitude oscillation and solve them to obtain normal modes of oscillation and their frequencies in simple mechanical systems.	R, U, Ap	PSO-1,2
CO-6	Able to do simple experiments related to applications of classical dynamics and to perform simple computer programs related to applications of classical dynamics.	U, Ap	PSO-5,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: CLASSICAL DYNAMICS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	**CO**	**PO / PSO**	**Cognitive Level**	**Knowledge Category**	**Lecture (L)/ Tutorial (T)**	**Practical (P)**
CO-1	To define generalised coordinates, generalised velocities, and generalised force and write Lagrangian for mechanical system	PO-1,2,3,4,5,6,8/ PSO-1,2	R, U, Ap	F, C	L	-

	in terms of generalised coordinates.					
CO-2	To write Hamiltonian for mechanical systems and derive and solve Hamilton’s equation of motion for simple mechanical systems.	PO-1,2,3,4,5,6,8/ PSO-1,2	R, U, Ap	F, C	L	-
CO-3	To define equations of motion corresponding to reduction to one body problem and to derive equation for orbit and learn about Virial theorem, Kepler’s problem and inverse square law of force.	PO-1,3,4,5,6,8/ PSO-1,2	R, U, Ap	F, C	L	-
CO-4	Recapitulate and learn the special theory of relativity and postulates of the special theory of relativity and develop applications of special theory of relativity to dynamical systems of particles.	PO-1,3,4,5,6,8/ PSO-1,2	R, U, Ap	F, C	L	-

CO-5	Formulate the problem of small amplitude oscillation and solve them to obtain normal modes of oscillation and their frequencies in simple mechanical systems.	PO-1,3,4,5,6,8/ PSO-1,2	R, U, Ap	F, C	L	-
CO-6	To do simple experiments related to applications of classical dynamics and to perform simple computer programs related to applications of classical dynamics.	PO-1,2, 3,6,7/ PSO-5,7	U, Ap	P	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	2	-	-	-	-	-	2	-	3	2	2	2	-	2
CO-2	2	2	-	-	-	-	-	3	-	2	2	2	2	-	3
CO-3	2	2	-	-	-	-	-	2	-	2	2	2	2	-	3
CO-4	2	2	-	-	-	-	-	2	-	2	2	2	2	-	2
CO-5	2	2	-	-	-	-	-	2	-	2	2	2	2	-	2
CO-6	-	-	-	-	2	-	3	2	2	3	3	2	-	2	2

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	-	-	✓
CO-6	✓	-	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK4DSCPHY201**				
Course Title	**ELECTROMAGNETICS AND TRANSIENT CURRENTS**				
Type of Course	**DSC**				
Semester	**IV**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites	Basics of electrostatics				
Course Summary	This course aims to provide a strong foundation to the principles of electrostatics and magnetostatics and equip the students to be familiar with the theoretical basis of electrodynamics. The course also provides hands on experience in handling different electrical circuits.				

BOOKS FOR STUDY:

1. Electrodynamics: David J Griffith, PHI, 3rd Edn.
2. Electricity and Magnetism:Murugesan, S.Chand & Co.
3. Electricity and Magnetism: K.K.Tiwari, S.Chand & Co. 4. Principles of lectromagnetics: Matthew N.O. Sadiku and S. V. Kulkarni, Oxford University Press, 6th Edn.

BOOKS FOR REFERENCE:

1. Electricity and Magnetism: E.M. Purcell, Berkley Physics course, Vol.2, MGH
2. Classical Electromagnetic Theory, Jack Vanderlinde, Second Edition, Kluwer Academic Publishers, 2004
3. Classical Electrodynamics: Walter Greiner, Springer International Edn.

4. Electricity and Magnetism: Muneer H. Nayfeh & Norton K. Bressel, John Wiley & Sons
5. Electricity and Magnetism: J.H. Fewkes & John Yarwood, University Tutorial Press
6. Electromagnetic waves and radiating systems: Jordan & Balmain, PHI
7. Electromagnetics: B.B.Laud, Wiley Eastern Ltd., 2ndEdn.
8. Introduction to electrodynamics: Reitz & Milford Addison Wesley
9. Electromagnetic theory fundamentals: Bhag Guru and Huseyin Hizirogulu, Cambridge University Press, 2nd Edn.
10. Electricity and Magnetism: D.C.Tayal, Himalaya Publishing Co.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**ELECTROSTATIC FIELD**	**9**	
	1	Coulomb's law, Electric field due continuous charge distribution	2	1
	2	Field lines, flux, Gauss's law, Divergence and Curl of electrostatic fields.	2	1
	3	Electric potential, Poisson's and Laplace's equations, Potential of a localized charge distribution.	2	1
	4	Work and Energy in Electrostatics: The work done to move a charge, Energy of a point charge distribution, The energy of a continuous charge distribution	2	1
	5	Electrostatic boundary conditions	1	1
II		**ELECTROSTATIC FIELD IN MATTER**	**9**	
	6	Polar and Nonpolar molecules, Induced dipole and polarizability. Alignment of polar molecules in uniform and nonuniform electric field.	2	2
	7	Polarization in a Dielectric Material, The field of a polarized object: Bound and Free Charges, Bound Charge Density, Physical interpretation of bound charges	3	2
	8	Electric displacement, Gauss's law in presence of dielectric.	2	1, 2
	9	Boundary conditions, Linear Dielectrics	2	2

III	**MAGNETOSTATICS**		**9**	
	10	Lorentz Force, Electric Current- surface current density, volume current density, Equation of continuity.	2	3
	11	The Biot- Savarts law, Applications-Magnetic field due to long wire and circular loop	2	3
	12	Magnetic flux, Gauss's law in magnetism, Divergence of B (Physical interpretation only)	1	3
	13	Ampere's circuital theorem, Curl of B (Physical interpretation only), Applications- Magnetic field due to Solenoid and Toroid	2	3
	14	Magnetic vector potential.	1	3
	15	Boundary conditions	1	3
IV	**ELECTROMAGNETIC INDUCTION**		**9**	
	16	Electromagnetic Induction, Faraday's law, Lenz's law, Motional e m f, Induced electric field	2	4
	17	Self - inductance and Mutual inductance, back e m f	1	4
	18	Maxwell's equation, correction of Ampere's circuital theorem,	2	4
	19	Waves in one dimension: Wave equation of electromagnetic waves in vacuum, propagation of electromagnetic waves through vacuum and linear dielectric media	3	5
	20	Monochromatic planes waves, Energy and Momentum in EM waves	1	5
V*	**TRANSIENT CURRENTS**		**9**	
	21	Growth and decay of current in LR Circuit	2	6
	22	Growth and decay of current in CR Circuit	2	6
	23	Measurement of high resistance by leakage	1	6
	24	Charging of a capacitor through LCR circuit.	2	6
	25	Discharging of a capacitor through LCR circuit.	2	6

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Potentiometer- Resistivity	6
2	Potentiometer –Calibration of ammeter	6
3	Carey Foster's Bridge-Resistivity	6
4	Carey Foster's Bridge-Temperature coefficient of resistance.	6
5	Mirror galvanometer-figure of merit.	6
6	BG- Absolute capacity of a condenser	6
7	Conversion of galvanometer into ammeter and calibration using digital Multimeter	6
8	Circular coil-Calibration of ammeter.	6
9	Absolute determination of m and B_h using box type and Searle's type vibration magnetometers	6
10	Searle's vibration magnetometer-comparison of magnetic moments.	6
11	Potentiometer – Calibration of high range voltmeter	6
12	Potentiometer - Reduction factor of TG	6
Part B* – At least One Experiment to be performed		
13	. Potentiometer –Calibration of low range voltmeter	6
14	Study of network theorems-Thevenin's & Norton's theorems and maximum power transfer theorem	6
15	Thermo emf- Measurement of thermo emf of thermocouple (Seebeck effect)	6
16	Circular coil-Study of earth's magnetic field using compass box.	6
17	Conversion of galvanometer into voltmeter and calibration using digital Multimeter.	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify the principles of electrostatics and apply it to the solutions of problems relating to electric field and electric potential and boundary conditions	U, Ap	PSO-1,2,3
CO-2	Identify the mechanism of polarization and its various effects in dielectric, by applying the principles of electrostatics.	U, Ap	PSO-1,2,3
CO-3	Identify the principles of magnetostatics and apply it to the solutions of problems relating to magnetic field and boundary conditions.	U, Ap	PSO-1,2,3
CO-4	Recognize the concepts related to Faraday ‘s law, induced emf, Maxwell ‘s equations	U, Ap	PSO-1,2,3,5
CO-5	Compare the properties of electromagnetic waves in vacuum, and matter	U, Ap	PSO-1,2,3,6
CO-6	Analyse the growth and decay of current in various electrical circuits	U, An	PSO-1,2,3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ELECTROMAGNETICS AND TRANSIENT CURRENTS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Identify the principles of electrostatics and apply it to the solutions of	PSO-1,2,3	U, Ap, An	F, C	L	-

	problems relating to electric field and electric potential and boundary conditions					
CO-2	Identify the mechanism of polarization and its various effects in dielectric, by applying the principles of electrostatics.	PSO-1,2,3	U, Ap, An	C	L	-
CO-3	Identify the principles of magnetostatics and apply it to the solutions of problems relating to magnetic field and boundary conditions.	PSO-1,2,3	U, Ap, An	C	L	-
CO-4	Recognize the concepts related to Faraday ‘s law, induced emf, Maxwell ‘s equations	PSO-1,2,3,5	U, Ap, An	F, C	L	-
CO-5	Compare the properties of electromagnetic waves in vacuum, and matter	PSO-1,2,3,6	U, Ap, An	C, P	L	-

CO-6	Analyse the growth and decay of current in various electrical circuits	PSO-1,2,3	U, Ap, An	P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	3	3	2	-	-	-	-	2	-	-	-	-	-	-	-
CO-2	3	3	2	-	-	-	-	2	-	-	-	-	-	-	-
CO-3	3	3	2	-	-	-	-	1	-	-	-	-	-	-	-
CO-4	3	3	2	-	1	-	-	2	-	-	-	-	-	-	-
CO-5	2	3	2	-	-	3	-	2	-	-	-	-	-	-	-
CO-6	2	3	2	-	-	-	-	2	-	-	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	-	-	✓
CO-6	✓	-	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK4DSEPHY200</td></tr>
<tr><td>Course Title</td><td colspan="5">ATMOSPHERIC THERMODYNAMICS</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSE</td></tr>
<tr><td>Semester</td><td colspan="5">IV</td></tr>
<tr><td>Academic Level</td><td colspan="5">200 - 299</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>3 Hrs</td><td>-</td><td>2 Hrs</td><td>5 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">1. The students should have a basic understanding of atomic and molecular structure
2. The students must have a fundamental idea of phase change and latent heat
3. The students must be familiar with the phenomena of scattering, absorption etc.</td></tr>
<tr><td>Course Summary</td><td colspan="5">• The course gives a comprehensive understanding of atmospheric thermodynamics. The first module gives an introduction to electromagnetic spectrum and blackbody radiation. This module also describes the nature of solar radiation and the blackbody spectrum of sun and earth. Laws of thermodynamics are discussed in the second module and establishes hydrostatic and hypsometric equations which are used in arriving at stability criteria in the atmosphere. In the third module the concept of air parcel and various conditions in lifting an air parcel are introduced. The role of aerosols and clouds in the global energy budget and climate are discussed in the fourth module. The fifth module describes how</td></tr>
</table>

	radiative equilibrium is achieved through the interaction of solar and outgoing long wavelength radiation with the atmosphere. • The practical course is designed to equip students with the skills needed to understand and apply the basic thermodynamics processes. The course also aims to understand and analyse the structure of earth atmosphere its absorption and emission based on the data collected from various sources

BOOKS FOR STUDY:

1. Atmospheric Science : An Introductory Survey : Second Edition, John M Wallace and Peter V. Hobbs, ELSEVIER, 2006
2. Basis of Atmospheric Science, A Chandrasekhar, PHI., 2010
3. Physics of the Atmosphere and Climate : Murry L. Salby, Cambridge University Press

BOOKS FOR REFERENCE:

1. Essentials of Meteorology : An Invitation to the Atmosphere, C. Donald Ahrens
2. An Introduction To Atmospheric Physics, Cambridge University Press, Second Edition, David G. Andrews, 2010
3. Atmospheric Aerosols Properties and Climate Impact, Olivier Boucher, © Springer, 2015.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Solar and Terrestrial Radiation (Book : 1 – Chapter: 4; Book : 2 – Chapter: 4)**	**9**	
	12	Electromagnetic Spectrum – Atomic and Molecular Spectra- Black body Radiation	1	1
	3	Ideal gas equation	1	1
	4	Laws of Radiation –Kirchoff's Law- emissivity, absorptivity, reflectivity, transmittivity	2	1
	5	Wien's Displacement Law, Stefan's Law, Planck's Law	2	1
	6	Nature of Solar Radiation, Blackbody Spectrum of Sun and Earth	2	1
	7	Radiometric quantities – Spectral Radiance, Radiance, Spectral Irradiance, Irradiance	1	1

II	**Thermodynamics of the Atmosphere (Book : 1 – Chapter: 3, Book : 2 – Chapter: 3)**		**9**	
	8	Thermodynamic System, State variables	1	3
	9	First law of thermodynamics, Internal Energy, Heat capacity, Latent Heat, Adiabatic processes	1	3
	10	Reversible and irreversible processes, Second Law of Thermodynamics, Entropy	1	3
	11	Hydrostatic Equation, Geopotential, Scale height and Hypsometric equations	3	3
	12	Stability Criteria – stable, neutral and unstable	3	3
III	**Moisture and Atmospheric Stability (Book : 1 – Chapter: 3; Book : 2 – Chapter: 3)**		**9**	
	13	Hydrologic Cycle	1	3
	14	Moisture Variables	1	3
	15	Concept of an air parcel	1	3
	16	Processes that lift air – Orographic lifting, Frontal Lifting, Convergence, Localized convective lifting	1	3
	17	Adiabatic Lapse Rate, Saturated Adiabatic Lapse Rate	1	3
	18	Atmospheric Stability- Types of stability- Absolute Stability, Absolute Instability	2	3
	19	Concept of Static Stability- Unsaturated Air – Static Stability, Saturated Air- Conditional and Convective Instability	2	3
IV	**Aerosols and Clouds (Book : 3 – Chapter: 9; Book : 1 – Chapter: 5,6)**		**9**	
	20	Morphology of atmospheric aerosol - Continental aerosol, marine aerosol and stratospheric aerosol	2	2
	21	Microphysics of Clouds - Droplet growth by condensation and collision, Growth of ice particles	2	2
	22	Macroscopic Characteristics of cloud- Formation and classification, microphysical properties, Cloud dissipation	1	2

	23	Radiative transfer in aerosol and cloud - Scattering by molecules and particles, Radiative transfer in a cloudy atmosphere	2	2
	24	Roles of cloud and aerosol in climate - Involvement in the global energy budget, Involvement in chemical processes	2	2
V*		**Interaction of Radiation with Atmosphere (Book : 1 – Chapter: 4)**	**9**	
	25	Solar short wavelength radiation and Outgoing Long wavelength Radiation	1	4
	26	Absorption of Solar Radiation by Atmosphere- Radiative Transfer –Beer Lambert's Law	2	4
	27	Atmospheric Window	2	4
	28	Scattering and emission of Solar Radiation	2	4
	29	Radiative Equilibrium of Earth, Global Mean energy Balance, Horizontal Distribution of Radiative transfer	2	4

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	To determine the melting point of ice and boiling point of water.	5
2	The effect of salt on the Boiling point of Water	5
3	To determine the specific heat capacity of a given solid by the method of mixtures.	5
4	Phase transition-determination of melting point of wax	5
5	Plotting of Solar irradiance data	6
6	Plotting of Outgoing Longwave Radiation	6
7	Plotting of vertical profile of atmospheric temperature and pressure over various locations	6
8	Study of Solar Spectrum	6

Part B* – At least One Experiment to be performed		
9	Study of photoelectric effect and determination of Planck's constant	6
10	Determination of Stefan's constant	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Review the basics of black body radiation and radiation laws	R	PSO-1,3
CO-2	Distinguish the cloud microphysics and interpret the morphology of aerosols and impact of aerosols in climate	U	PSO-1,3
CO-3	Remember the concept of thermodynamics and apply in to the atmosphere system to establish the stability criteria of the atmosphere and the factors affecting stability	R, U, Ap	PSO-1,3
CO-4	Discuss the process of absorption, emission and scattering of radiation in the planetary atmosphere	U	PSO-1,3
CO-5	Employ the basic thermodynamics concepts of boiling point, melting point, phase change, etc and elucidate the thermodynamics laws	U, Ap	PSO-1,3,7
CO-6	Analyse the variation in the structure of atmosphere and solar spectrum and Estimate the changes in the incoming and outgoing radiation	U, An	PSO-1,3,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ATMOSPHERIC THERMODYNAMICS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Review the basics of black body radiation and radiation laws	PO1,2/ PSO-1,3	R	F	L	-
CO-2	Distinguish the cloud microphysics and interpret the morphology of aerosols and impact of aerosols in climate	PO1/ PSO-1,3	U	C	L	-
CO-3	Remember the concept of thermodynamics and apply in to the atmosphere system to establish the stability criteria of the atmosphere and the factors affecting stability	PO1,2/ PSO-1,3	R,U, Ap	F,C	L	-
CO-4	Discuss the process of absorption, emission and scattering of radiation in the planetary atmosphere	PO1/ PSO-1,3	U	C	L	-

CO-5	Employ the basic thermodynamics concepts of boiling point, melting point, phase change, etc and elucidate the thermodynamics laws	PO1,2,3/ PSO-1,3,7	U, Ap	C,P	-	P
CO-6	Analyse the variation in the structure of atmosphere and solar spectrum and Estimate the changes in the incoming and outgoing radiation	PO1,2,3/ PSO-1,3,7	U, An	C,P	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	1	-	2	-	-	-		1	2	-	-	-	-	-	-
CO-2	2	-	2	-	-	-		1	-	-	-	-	-	-	-
CO-3	2	-	2	-	-	-	-	2	2	-	-	-	-	-	-
CO-4	2	-	2	-	-	-	-	2	-	-	-	-	-	-	-
CO-5	1	-	2	-	-	-	2	2	2	2	-	-	-	-	-
CO-6	1	-	2	-	-	-	2	2	2	2	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	✓	-	
CO-5	✓	-	-	-
CO-6	✓	-	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK4DSEPHY201**				
Course Title	**BASIC DIGITAL PRINCIPLES AND APPLICATIONS**				
Type of Course	**DSE**				
Semester	**IV**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites					
Course Summary	To equip the students with the concepts of Boolean algebra, digital logic gates, combinational and sequential digital circuits				

BOOKS FOR STUDY:

1. Digital Principles and Applications: Malvino and Leach, Tata McGraw Hill Education Private Limited
2. Basic Electronics Solid State: B. L. Theraja, S Chand& Company LTD
3. Basic Electronics: Devices, circuits and IT fundamentals: Santiram Kal, PHI, 2010

BOOKS FOR REFERENCE:

1. Digital Fundamentals: Thomas L Floyd, 11th Edition by Pearson Education
2. Fundamentals of Digital Circuits – Anand Kumar – PHI
3. Digital Electronics Principles and Integrated circuits – Maini – Wiley India.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Number Systems, Boolean Algebra (Book 2, Chapter 32 & 34 Book 1 Chapter 3)**	**9**	
	1	Review of number system, binary, octal, hexa-decimal	2	1
	2	Binary addition and subtraction (1's and 2's complement methods)	2	1
	3	Boolean algebra- Laws and identities, De-Morgan's Theorems	2	1,6
	4	Simplification of Boolean expressions using Boolean identities	1	6
	5	Reduction of Boolean expressions using Karnaugh Maps - Sum of Products (SOP) representation (up to four variables)	2	6,
II		**Logic Families (Book 2, Chapter 35)**	**9**	
	6	Saturated and Non-Saturated Logic Circuits - Characteristics of Logic Families	2	2
	7	RTL Circuit - DTL Circuit - TTL Circuit	3	3
	8	ECL Circuit - I^2L Circuit	2	3
	9	MOS Family - PMOS, NMOS and CMOS Circuits.	2	3,5
III		**Adders, Subtractors and Flip Flops (Book 2 Chapter 33 & Book 1 Chapter 8)**	**9**	
	10	Half and Full adder	2	5,
	11	Half and Full Subtractors	2	5,
	12	Flip flops –SR flip flop, JK flip flop, JK Master slave Flip flop	3	4,5
	13	D flip flop, T flip flop	2	4,5
IV		**Counters (Book 1, Chapter 10)**	**9**	
	14	Asynchronous Counter, Synchronous Counter (timing diagram)	3	2
	15	Ring Counter, Ripple Counters	3	5

	16	Mod 10,16, n Counter- popular IC versions (7490A)	3	5
V*	**Registers (Book 1, Chapter 9)**		**9**	
	17	Shift registers Serial in – Serial out shift register	2	5
	18	Serial in – Parallel out shift register	2	5
	19	Parallel in – Serial out shift register	2	5
	20	Parallel in – Parallel out shift register	2	5
	21	Bidirectional Shift Register	1	

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Characteristics of PN junction diode.	4,5
2	Network theorems (Superposition, Thevenin's & Norton's theorems) - To verify the (i) Superposition, (ii) Thevenin's & (iii) Norton's theorems	4,5
3	Characteristics of LED	4,5
4	Familiarising and verifying different logic gates using 74XX series	4,5
5	Verification of truth tables of AND, OR, NOT Gates using IC 74XX series	4,5
6	Verification of truth tables of NAND, NOR, EXOR Gates using IC 74XX series	4,5
7	Construction of basic gates using NAND and NOR gates using IC.	4,5
8	Construct and verify a Half Adder using IC 74XX series.	4,5
9	Construct and verify a Full Adder using IC 74XX series.	4,5
10	Verification of truth tables of flip flops: RS, D, and JK using IC 74XX series.	4,5
Part B* – At least One Experiment to be performed		
11	To verify the Maximum Power Transfer Theorem	4,5
12	Characteristics of photo diode	4,5
13	Construction of binary counters using IC 74XX series	4,5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the basics of number systems	U	1
CO-2	Understand basics of Digital electronics	U	1
CO-3	Describe commonly used logic families	E	1
CO-4	Test commonly used IC chips	Ap, E	3
CO-5	Design logic circuits using ICs	Ap	5
CO-6	Solve digital equations using De-Morgans theorem	Ap	2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: BASIC DIGITAL PRINCIPLES AND APPLICATIONS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Understand the basics of number systems	PO1/ PSO 1	U	C	L	-
CO-2	Understand basics of Digital electronics	PO1/ PSO 1	U	C	L	-
CO-3	Describe commonly used logic families	PO2,3 /PSO 1	E	C	L	-
CO-4	Test commonly used IC chips	PO 2,3/ PSO 3	An, E	P	L	P
CO-5	Design logic circuits using ICs	PO 2,3 /PSO 5	Ap	P	L	P
CO-6	Solve digital equations using De-Morgans theorem	PO 1/ PSO 2	Ap	C,P	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO-2	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO-3	2	-	-	-	-	-	-	-	1	1	-	-	-	-	-
CO-4	-	-	2	-	-	-	-	-	1	1	-	-	-	-	-
CO-5	-	-	-	-	3	-	-	-	1	1	-	-	-	-	-
CO-6	-	3	-	-	-	-	-	1	-	-	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	✓	-	✓
CO-3	✓		-	✓
CO-4	✓	-	-	-
CO-5	✓	-	-	✓
CO-6	✓	-	-	✓

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK4DSEPHY202**				
Course Title	**SYNTHESIS OF NANOMATERIALS**				
Type of Course	**DSE**				
Semester	**IV**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites	-				
Course Summary	The course has the following major objectives: Introductory Quantum Mechanics, Fabrication of Nanostructured Materials Physical Methods, Fabrication of Nanostructured Materials Chemical Methods, Self-assembly and Lithography, Elementary ideas of structural and optical characterization of nanostructures.				

BOOKS FOR STUDY:

1. Advances in the Liquid-phase synthesis of inorganic nanoparticles, Brain L. Cushing, Vladimir L. Kolesnichenko, Charles J. O'Connor, Chem Rev. 104 (2004) 3893-3946.
2. Nanocrystals: Synthesis, Properties and Applications, C. N. R. Rao, P. J. Thomas and G. U. Kulkarni, Springer, (2007).
3. Nanostructures & Nanomaterials: Synthesis, Properties & Applications, Guozhong Gao, Imperial College Press, (2004).
4. Introduction To Nanoscience And Nanotechnology By Chattopadhyay, PHI ,India
5. Nanochemistry: A Chemical Approach to Nanomaterials-Royal Society of Chemistry, Cambridge, UK, (2005).
6. DIY NANO, Published by the NISE Network

BOOKS FOR REFERENCE:

1. Fundamentals of Nanotechnology, CRC press, by G.L. Hornyak, J.J. Moone, H.F. Tihhale, J. Dutta
2. Nanotechnology by Mark Ratner and Daniel Ratner, Pearson Education.
3. Nano Essentials- T.Pradeep/TMH
4. Nanostructures and Nanomaterials- Synthesis, Properties & applications by Guozhong Cao, Imperial College Press, (2006).

WEB REFERENCE

1. https://mmrc.caltech.edu/Cary%20UV-Vis%20Int.Sphere/Literature/Spectroscopy%20Jaramillo.pdf
2. https://sci-hub.se/https://doi.org/10.1021/acs.jpclett.8b02892
3. https://mmrc.caltech.edu/FTIR/Literature/Diff%20Refectance/Kubelka-Munk.pdf
4. https://nptel.ac.in/courses/118/102/118102003/
5. https://nptel.ac.in/courses/118/107/118107015/
6. https://nptel.ac.in/content/syllabus_pdf/118102003.pdf

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Introductory Quantum Mechanics**	**9**	
	1	Band Structure and Density of State at nanoscale: Energy Bands, Density of States at low dimensional structures	2	1,2
	2	Size effects in small systems, Quantum behaviours of nanometric world	1	1,2
	3	Trapped particle in 3D (nanodot), electron trapped in 2D plane (nanosheet),	3	1,2
	4	Electrons moving in 1D (nanowire, nanorod, nanobelt), Excitons, Quantum confinement effect in nanomaterials	2	1,2
	5	Classification of Nanomaterials, OD, 1D, 2D and 3D types of nanomaterials, (Quantum dots, Quantum wires etc.)	1	1,2
II		**Fabrication of Nanostructured Materials Physical Methods**	**9**	
	6	Top-down and bottom-up approaches of nanomaterial synthesis, Mechanical Methods, High Energy Ball Milling	2	3
	7	Physical Vapour Deposition - thermal Evaporation method	3	3
	8	Laser Vaporization (Ablation),		

	9	Sputter Deposition; DC Sputtering, RF Sputtering, Magnetron Sputtering	3	3
III	**Fabrication of Nanostructured Materials Chemical Methods**		**9**	
	10	Colloids and Colloids in Solutions, Colloids in a Medium, Effect of Charges on Colloids,	3	3
	11	Synthesis of Metal Nanoparticles by Colloidal Route, Co-precipitation Method,	2	3
	12	Sol-Gel Method, Combustion Method	2	3
	13	Hydrothermal Synthesis, Green Synthesis Using Plant Extracts,	2	3
IV	**Self-assembly and Lithography**		**9**	
	14	Self-assembly, Process of self-assembly,	4	4
	15	Introduction to Lithography, E-beam Lithography.	5	4
V*	**Elementary ideas of structural and optical characterization of nanostructures**		**9**	
	16	Basic ideas of X-ray diffraction (XRD) technique, Braggs Law, Quantitative determination of phase and grain/crystallite size calculation	4	5
	17	UV visible spectroscopy, Determination of optical band gap, Tauc's plot, KM function (Web resources-1,2,3)	5	5

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Synthesis of noble nanoparticles by using biological method	6
2	To study the Absorption spectrum of Noble metal nanoparticles	6
3	Find the average grain/crystallite size and phase of the materials using X-ray diffraction pattern of the given sample	6
4	Interpretation of UV- visible spectra of materials – direct band gap OR indirect band gap materials	6
5	To find the optical band gap of the given semiconducting materials by measuring UV Visible transmission spectrum.	6

6	X-ray diffraction-structure evaluation and identification of material.	6
7	Deposition of any sulphide thin film by chemical bath deposition	6
8	Synthesis of noble metal nanoparticles by using biological method	6
9	Deposition of various sulphide thin film by chemical bath deposition.	6
10	Synthesis of noble metal nanoparticles by Chemical Route.	6
11	Synthesis of Au/Ag nanoparticles using co-precipitation method	6
12	Synthesis of Metal sulphide nanoparticle using hydrothermal process.	6
13	Synthesis of Transition Metal Oxides nanoparticles by any one of these methods Green synthesis/Hydrothermal method/Co-precipitation	6
14	Using the given XRD data find the phase and crystalline size of the materials	6
Part B* – At least One Experiment to be performed		
15	Analysis of powder XRD data and phase analysis	6
16	Determination of band gap of a semiconductor nanomaterial using UV-visible absorption spectra	6
17	Synthesis of Metal Oxide/Sulphide/ nanoparticles using sol-gel process.	6
18	Synthesis of Metal Oxide nanofibers using electrospinning	6
19	Preparation of Transition metal oxide nanostructures using microwave synthesis	6
20	Synthesis of Transition Metal Oxides OR Sulphide nanoparticles by any one of these methods Green synthesis/Hydrothermal method/Co-precipitation	6
21	Determination of Fermi energy of copper	6
22	Find the optical band gap of the given semiconducting materials from the data of given transmission spectra	6
23	Find the optical band gap of the given semiconducting materials from given transmission spectra	6
24	To optimize the concentration of nanoparticles dispersed solution using UV-vis spectroscopy.	6
25	Synthesis of Metal Oxide thin films using sputtering process.	6

26	Find the thickness of a thin film from the given UV-Visible spectra	6
27	Find the band gap of a bulk material and corresponding nanomaterials using UV-Visible spectra and	6

<u>COURSE OUTCOMES</u>

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe the role of density of states on its physical, chemical, and electrical properties	U	PSO-1,2
CO-2	Classify and interpret quantum structures and their confinement phenomena with low dimensional structures.	U, Ap	PSO-2,3
CO-3	Describe the synthesis of Nanomaterials and their merits	R, U	PSO-1,2,3
CO-4	List and discuss various characterization techniques available for studying the structural and optical properties of nanostructured materials.	R, U	PSO-4,5
CO-5	Analyse the obtained characterization data and categorise applications of nanomaterials and to develop devices for sustainable future.	Ap, An	PSO-5,6
CO-6	Practice experiments related to nanomaterial synthesis	Ap	PSO-6,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: SYNTHESIS OF NANOMATERIALS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Describe the role of density of states on its physical,	PO1,3,4,5 ,6,8/ PSO-1,2	U	F, C	L	-

	chemical, and electrical properties					
CO-2	Classify and interpret quantum structures and their confinement phenomena with low dimensional structures.	PO1,2,3,4 ,5,8/ PSO-2,3	U, Ap	F, C	L	-
CO-3	Describe the synthesis of Nanomaterials and their merits	1.2.3.4.5. 6.8/ PSO-1,2,3	R, U	F, C	L	-
CO-4	List and discuss various characterization techniques available for studying the structural and optical properties of nanostructured materials.	PO1,2,3,4 ,6,7/ PSO-4,5	R, U	F, C	L	-
CO-5	Analyse the obtained characterization data and categorise applications of nanomaterials and to develop devices for sustainable future.	1,2,3,4,7/ PSO-5,6	Ap, An	F, C	L	-
CO-6	Practice experiments related to nanomaterial synthesis	1,2,3,4,5, 7,8/ PSO-6,7	Ap	F, C	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	2	-	-	-	-	-	2	2	1	1	1	1	-	1
CO-2	-	2	1	-	-	-	-	2	2	1	1	1	-	-	1
CO-3	2	2	3	-	-	-	-	2	2	1	1	1	1	-	1
CO-4	-	-	-	2	2	-	-	2	2	2	1	-	1	2	-
CO-5	-	-	-	-	2	1	-	2	2	2	1	-	1	2	-
CO-6	-	-	-	-	-	2	3	2	2	2	2	-	2	2	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	-	✓	-	✓
CO-3	-	✓	-	✓
CO-4	-	✓	-	✓
CO-5	✓	-	-	-
CO-6	✓	-	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK4DSEPHY203**				
Course Title	**SOLAR TERRESTRIAL PHYSICS**				
Type of Course	**DSE**				
Semester	**IV**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites	Knowledge about solar system, laws of motion, different heat transfer methods and electromagnetism.				
Course Summary	This course aims to impart basic knowledge on the characteristics and composition of the Sun, Earth, solar activity and Earth's upper atmosphere via geomagnetism. After completing the course, the student gets a thorough understanding of the fundamental characteristics of the sun, earth, and solar-terrestrial interaction phenomena.				

BOOKS FOR STUDY:

1. Hand book of the Solar-Terrestrial Environment, Yohsuke Kamide AbrahamC.-L.Chian (Eds.)
2. Physics of the Space Environment, Gombosi, T. I., Cambridge University Press, 1998
3. Solar activity and earth’s climate, Rasmus E Benestad, Springer
4. Earth’s Proximal Space- ChanchalUberoi (2000), Universities Press (India)
5. The Sun, the Earth, and Near-Earth Space,John A Eddy,NASA
6. The Solar Terrestrial Environment, J. K. Hargreaves, Cambridge Atmospheric and space science
7. Physics of the Earth's Space Environment,Gerd W. Prolss,Springer

BOOKS FOR REFERENCE:

1. Introduction to Space Physics, M. G. Kivelson and C. T. Russle,Cambridge University Press
2. Fundamentals of solar astronomy by Arvind Bhatnagar, William Livingston (World Scientific Series in Astronomy Astrophysics, Vol-6)
3. A Beginner's Guide to Working with Astronomical Data, Markus Possel (1905.13189v2.pdf (arxiv.org))

WEB RESOURCES-THEORY

1. https://www.swpc.noaa.gov/phenomena/earths-magnetosphere
2. https://solarscience.msfc.nasa.gov/the_key.shtml
3. http://jsoc.stanford.edu/~jsoc/keywords/Chris_Russel/Geophysical%20Coordinate%20Transformations.htm

WEB RESOURCES-PRACTICAL

1. https://va-iitk.vlabs.ac.in/?page=exp13
2. https://va-iitk.vlabs.ac.in/?page=exp5
3. https://www.researchgate.net/publication/324106257_Apparent_and_Absolute_Magnitudes of_Stars_A_Simple_Formula

DETAILED SYLLABUS: THEORY

<table>
<tr><th>Module</th><th>Unit</th><th>Content</th><th>Hrs</th><th>CO No</th></tr>
<tr><td rowspan="4">I</td><td colspan="2">The Sun
(Book 2: chapter 11, Book 3: Chapter 3)</td><td>08</td><td></td></tr>
<tr><td>1</td><td>The Sun: Physical properties, Internal structure, Solar atmosphere,</td><td>4</td><td>1</td></tr>
<tr><td>2</td><td>Source of solar energy- thermonuclear reactions</td><td>2</td><td>1</td></tr>
<tr><td>3</td><td>solar disk and sunspots, magnetic field, solar rotation and the solar cycle</td><td>2</td><td>1</td></tr>
<tr><td rowspan="4">II</td><td colspan="2">Solar Activity
(Book 1: Chapter 5, Book 3: Chapter 4, Book 5: Chapter 3)</td><td>10</td><td></td></tr>
<tr><td></td><td>Solar magnetic field, Generation of solar magnetic field</td><td>3</td><td>2</td></tr>
<tr><td></td><td>Solar wind, Origin of solar wind, Characteristics of solar wind</td><td>3</td><td>2</td></tr>
<tr><td></td><td>Solar storm, Coronal mass ejections, Solar flare, solar prominence, solar energetic particle events</td><td>4</td><td>2</td></tr>
</table>

III	**Terrestrial Atmosphere** (Book 5: Chapter 4)		**07**	
	1	Physical properties of earth	2	3
	2	Layers of earth's atmosphere and its composition and temperature distribution	3	3
	3	The pressure profile,	1	3
	4	Scale height, Density variation	1	3
IV	**Terrestrial Magnetism** (Book 2: Chapter 14, Book 4: Chapter 4, Book 6: Chapter 5, Book : 7 Chapter 5)		**11**	
	1	Introduction to Earth's magnetic Field, Origin and elements of earth's magnetic field	1	4
	2	Geographic and geomagnetic coordinates,	2	4
	3	Earth's variable magnetic field	2	4
	4	Solar activity and Earth's magnetic weather,	2	4
	5	Solar wind interaction, structure of the magnetosphere: Magneto tail and Plasma sheet, Plasma sphere.	4	4
V*	**Terrestrial upper atmosphere** (Book 1: Chapter 8, Book 7: Chapter 3 & 4)		**09**	
	1	The Ionosphere: production of Different layers- derivation, , Ionisation profile,	4	3
	2	Effect on scale height, Ionospheric electric fields. Ionospheric hydrogen and Helium	5	3

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	To determine solar constant using principle of calorimetry	5
2	Using dry bulb – wet bulb psychrometer method calculate the relative humidity under different conditions	5

3	To study the Fraunhofer lines of the solar spectrum	5
4	To download the catalog of AGN host galaxies (Galaxy Zoo survey, catalog name: J/ApJ/711/284/table3) directly from VizieR using TOPCAT and to save the loaded catalog in CSV format.	5
5	(i) To download the GALEX images (FUV and NUV) of the Sombrero galaxy from the archive (GALEX MAST) and display the galaxy image in DS9 software. (ii) To overlay RA, Dec coordinate grid on the images and give appropriate contrast levels for the image. (iii) To export the image of the galaxy in JPEG format.	5
6	Analysis of the spectra of stars	5
7	To estimate the relative magnitude of a group of stars	5
8	Determination of Bh using deflection and vibration magneto meters.	5
9	To analyze cosmic ray intensity data from cosmic ray stations and compare the variations with the 11-year solar activity cycle.	5
10	Measurement and analysis of Sunshine duration and solar radiation using pyrheliometer	5
Part B* – At least One Experiment to be performed		
11	To determine the distance and age of cluster using Colour Magnitude Diagram	5
12	To study the effective temperature of stars by B-V photometry.	5
13	Measurement of distance to moon by parallax method	5
14	To load the AGN host galaxy catalog in TOPCAT and plot (i) Histogram of stellar mass of the galaxies (Mstar) (ii) Histogram of color (u-r color) and save the plots.	5
15	To overlay the GAIA catalog on the NUV images of the Sombrero galaxy using the catalog feature in DS9 and thus identify the stars in the GALEX image.	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe the structure and nuclear reactions of the sun	U	1,3
CO-2	Explain different solar activities like solar storm, solar flare etc.	U	3
CO-3	Describe about Earth's atmosphere	U	3
CO-4	Describe Earth's magnetosphere and sun earth interactions	U	3
CO-5	Apply and analyse the concepts of astronomy and space science	U, Ap, An	2,3,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: SOLAR TERRESTRIAL PHYSICS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Describe the structure and nuclear reactions of the sun	PO 1/ PSO 1,3	U	F,C	L	-
CO-2	Explain different solar activities like solar storm, solar flare etc.	PS 1/ PSO 3	U	F,C	L	-
CO-3	Describe about Earth's atmosphere	PS 1/ PSO 3	U	F,C	L	-
CO-4	Describe Earth's magnetosphere and sun earth interactions	PS 1/ PSO 3	U	F,C	L	-

CO-5	Apply and analyse the concepts of astronomy and space science	PO 1,2,7/ PSO 2,3,7	U, Ap, An	C, P	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	-	2	-	-	-	-	2	-	-	-	-	-	-	-
CO-2	-	-	2	-	-	-		2	-	-	-	-	-	-	-
CO-3	-	-	2	-	-	-		2	-	-	-	-	-	-	-
CO-4	-	-	2	-	-	-		2	-	-	-	-	-	-	-
CO-5	-	1	1		-	-	1	1	1	-	-	-	-	1	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	-	-	✓
CO-4	✓	-	-	✓
CO-5	✓	-	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK4DSEPHY204**				
Course Title	**PHYSICAL ASPECTS OF DIAGNOSTICS**				
Type of Course	**DSE**				
Semester	**IV**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites	1. Sound and light waves-their properties, reflection and refraction 2. Torque acting on a magnetic moment, nuclear magnetic moment, X-ray and types of nuclear radiation				
Course Summary	In this course the application of various physical phenomena (such as sound, light, magnetic field, X ray and nuclear radiation) in medical diagnostics is discussed. For this purpose the basic physics of each phenomenon is introduced which is then developed to the application in medical diagnostics. Thus a thorough introduction to piezoelectricity, fiber optics, nuclear spin magnetic resonance, bremsstrahlung, nuclear radiation etc is given. Based on this, science of various medical imaging techniques and dosimetry are discussed.				

BOOKS FOR STUDY:

1. Medical Physics_ Physical Aspects of Diagnostics and Therapeutics-De Gruyter (2023) Hartmut Zabel –

BOOKS FOR REFERENCE:

1. Far's Physics for Medical Imaging-Elsevier (2024) Alim Yucel-Finn, Fergus McKiddie, Sarah Prescott, Rachel Griffiths –
2. Encyclopaedia of Medical Physics_ Two Volume Set-CRC Press (2021) Slavik Tabakov, Franco Milano, Magdalena S. Stoeva, Perry Sprawls, Sameer Tipnis, Tracy Underwood -

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Sonography**	**9**	
	1	Introduction and overview - Ultrasound transducer , Piezoelectric effect, Ultrasonic head	1	1,2
	2	Medical imaging- A-mode scan, B-mode scan , C-scan ,M-mode, Shear wave sonography	3	1,2
	3	Scan characteristics -Dynamic focusing, Line density , Scan frequency Depth of view , Penetration depth ,Spatial resolution ,Axial resolution , Lateral resolution Artifacts	3	1,2
	4	Doppler method - Doppler shift, cw Doppler method , Pulsed Doppler method (duplex mode) , Duplex scan of umbilical cord	2	1,2
II		**Endoscopy**	**9**	
	5	Standard uses of medical endoscopes , Fiber optics (Basic Idea Only)	1	1,3
	6	Endoscope optics , Resolution and magnification	1	1,3
	7	Specialized endoscopes ,Narrowband imaging ,Chromoendoscopy ,Endomicroscopy	2	1,3
	8	Confocal laser endoscopy -General working principle	1	1,3
	9	Optical coherence tomography endoscopes , Basic principle of OCT , Resolution and scan range , Additional methods and applications ,	3	1,3
	10	Capsule endoscopy, Future trends	1	1,3
III		**Magnetic resonance imaging**	**10**	
	11	Nuclear spin basics, Nuclear magnetic resonance basics	1	4
	12	NMR and MRI procedures, Saturation, Chemical shift, Standard nomenclature	1	4

	13	Contrast generation, T1 contrast, T2 contrast , PD contrast ,Inversion recovery (IR) ,Short time inversion recovery (STIR)	2	5
	14	MR signal localization , Slice encoding gradient ,Frequency encoding gradient (FEG) , Phase encoding gradient (PEG) K-map , Data acquisition	2	5
	15	Magnets and coils , Main coil , Gradient coils , rf-coils , MRI machine specifications	2	5
IV	**X-ray**		**8**	
	16	Introduction , General components of x-ray tubes	1	6,7
	17	Bremsstrahlung radiation	1	6,7
	18	Characteristic radiation , Atomic transitions , Energy dispersive x-ray chemical analysis ,Target material	3	6,7
	19	X-ray generators , X-ray tubes for radiography , Linear accelerators for radiotherapy , Synchrotron radiation	3	6,7
V*	**Dosimetry**		**9**	
	20	Introduction , Definitions of dose and dose rate	1	8
	21	Kerma , Flux and fluence , Energy fluence , Mass energy transfer coefficient ,Mass energy absorption coefficient , Definition of kerma , Examples	4	8
	22	Dosimeters and radiation monitors , Ionization chamber, Proportional counters, Geiger-Müller detectors, Dead time	3	8
	23	Radiation exposure ,Radiation protection	1	8

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		CO No
Sl No	**Name of Experiment**	
1	To study of Digital multimeter. a) Measurement of AC and DC voltages	9

	b) Measurement of Current c) Measurement of resistance d) Measurement of parameters of diodes and transistors.	
2	To study Cathode Ray Oscilloscope (CRO). a) To study of controls ofCRO b) To measure amplitude, time period and frequency of time varying signals. c) To study Lissajous figures to know about the phase difference between the two signals and the ratio of their frequencies	9
3	To study function generator. a) Study of controls of Function generator b) To configure the function generator to output a 10Vpp, 1 KHz different types of wave	9
4	To study the performance of Biosensor (Pulse measurement technique) https://sl-coep.vlabs.ac.in/exp/performance-bio-sensor/index.html	9
5	Determine the blood oxygen level and pulse rate using Pulse oximeter, compare the results by placing the oximeter at various parts of the human body	9
6	Determine the blood pressure of human body by Auscultatory Method using BP apparatus at (a) Rest (b) after walking 10 min (c) Jogging 5 min	9
7	Determine the pulse rate using stethoscope	10
8	Determine the temperature of human body using contact and non-contact thermometer. Compare it by placing on different parts of the body.	10
9	Study of the characteristics of a GM tube and determination of its operating voltage, plateau length/slope	10
10	Estimation of Efficiency of the GM detector for (a) Gamma source (b) Beta source	10
Part B* – At least One Experiment to be performed		
11	To measure the resistivity and energy band gap of the given sample with the given four-probe arrangement	9
12	Determine the refractive index of air - Michelson interferometer	9

13	To determine the inter-planar spacing of graphite from the relationship between the radius of diffraction rings and the wavelength hence to understand the wave-particle duality of matter.	9
14	Demonstration of Nucleonic level gauge principle using GM Counting System & Detector	9

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand/revise the basic physics behind various medical diagnostic methods	R,U	PSO-1
CO-2	Know ultrasonics, Piezo electricity and various sound based medical imaging techniques	U,R	PSO-1,7
CO-3	Understand the role of Fiber optics in medical endoscopes. Classification of endoscope and their functioning	U, Ap	PSO-1,3,7
CO-4	Learn the basics of NMR and its different aspects.	R,U	PSO-1
CO-5	Implementation of NMR in MRI and its features. Application of MRI in medical diagnostics.	U	PSO-1,7
CO-6	Understand the basic physics behind the generation of X-ray and its interaction with matter.	R,U	PSO-1
CO-7	Introduce X-ray production technologies and radiotherapy	U	PSO-1,7
CO-8	Introduce the fundamentals of dosimetry and its quantitative analysis. Radiation counters, detectors and radiation safety.	U	PSO-1,7
CO-9	Practice of basic electric measurement instruments	U, An	PSO-1,5
CO-10	Practice basic medical instruments such as stethoscope,	U, Ap, An	PSO-5

	oximeter, medical thermometer, nuclear detection etc		
CO-11	Practice and learn basic physics ideas such as refractive index, band gap and nuclear radiation etc	U, An	PSO-5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: PHYSICAL ASPECTS OF DIAGNOSTICS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Understand/revise the basic physics behind various medical diagnostic methods	PO1,4,6/ PSO 1	R,U	F	L	-
CO-2	Know ultrasonics, Piezo electricity and various sound based medical imaging techniques	PO1,2,4, 5,6,8/ PSO 1,7	U,R	F,C	L	-
CO-3	Understand the role of Fiber optics in medical endoscopes. Classification of endoscope and their functioning	1,2,3,4,5, 6,8/ PSO 1,3,7	U, Ap	F,C	L	-
CO-4	Learn the basics of NMR and its different aspects.	PO1,4,6/ PSO 1	R,U	F	L	-
CO-5	Implementation of NMR in MRI and its features. Application of	PO1.2.4. 5.6.8/ PSO 1,7	U	F,C	L	-

	MRI in medical diagnostics.					
CO-6	Understand the basic physics behind the generation of X-ray and its interaction with matter.	PO1,4,6/ PSO 1	R,U	F	L	-
CO-7	Introduce X-ray production technologies and radiotherapy	PO1,2,4, 5,6,8/ PSO 1,7	U	F,C	L	-
CO-8	Introduce the fundamentals of dosimetry and its quantitative analysis. Radiation counters, detectors and radiation safety.	PO1,2,4, 5,6,8/ PSO 1,7	U	F,C	L	-
CO-9	Practice of basic electric measurement instruments	PO1,2,3, 4,6,7/ PSO 1,5	U, An	F,P	-	P
CO-10	Practice basic medical instruments such as stethoscope, oximeter, medical thermometer, nuclear detection etc	PO1,2,3, 7/ PSO 5	U, Ap, An	F,P,M	-	P
CO-11	Practice and learn basic physics ideas such as refractive index, band gap and nuclear radiation etc	1,2,3,7/ PSO 5	U, An	F,P	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	3	-	-	-	-	-	-	2	-	-	2	-	2	-	-
CO-2	3	-	-	-	-	-	2	2	2	-	2	2	2	-	2
CO-3	2	-	3	-	-	-	2	2	2	-	2	2	2	-	2
CO-4	3	-	-	-	-	-	-	2	-	-	2	-	2	-	-
CO-5	3	-	-	-	-	-	2	2	2	-	2	3	2	-	2
CO-6	3	-	-	-	-	-	-	2	-	-	2	-	-	2	-
CO-7	3	-	-	-	-	-	2	2	2	-	2	3	3	-	2
CO-8	3	-	-	-	-	-	2	2	2	-	2	2	2	-	2
CO-9	3	-	-	-	3	-	-	2	2	2	2	-	2	2	-
CO-10	-	-	-	-	3	-	-	2	2	2	-	-	-	2	-
CO-11	-	-	-	-	2	-	-	2	2	3	-	-	-	3	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	-	✓	✓
CO-4	-	✓	-	✓
CO-5	✓	-	✓	✓
CO-6	✓	✓	-	✓
CO-7	✓	✓	-	✓
CO-8	✓	-	✓	✓
CO-9	-	-	-	✓
CO-10	-	-	-	✓
CO-11	-	-	-	✓

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK4DSEPHY205**				
Course Title	**C++ PROGRAMMING FOR PHYSICS**				
Type of Course	**DSE**				
Semester	**IV**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites	-				
Course Summary	This course discusses basic programming concepts in C++. Students will get an understanding of programming logic in C++. Discussion on conditional statements, loops, arrays and functions will allow students to write any simple programs in C++.				

BOOKS FOR STUDY:

1. Programming with C++, D. Ravichandran, Third edition, Tata McGraw Hill, 2011

BOOKS FOR REFERENCE:

1. Object oriented programming with C++, E Balaguruswami 5th Edition, Tata McGraw Hill
2. The C++ programming language, Biome Stroustrup, Addison Wiley
3. Programming in C++, M T Somasekharan, PHI PVT Publishing, 2005

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	**Basics of C++**		**9**	
	1	Object-oriented programming, Characteristics of OOPs, Advantages of OOPs, Disadvantages of OOPs	3	1, 4

	2	Compiling and debugging C++ programs	1	2
	3	Identifiers and keywords, C++ simple data types, variables, constants	2	2
	4	C++ operators- arithmetic operator - assignment operator, logical operators, bitwise operator, special operators	3	2
II	**Conditional Statement and Loops in C++**		**10**	
	5	Conditional expressions, if statement, if else statement, nested if else - switch-case	4	2, 3, 5
	6	Loop statements: for loop, while loop, do-while loop	4	2, 3, 5
	7	Breaking control statements: goto statement, break statement, continue statement	2	3, 5
III	**Arrays and pointers**		**8**	
	8	Array declaration, Array initialisation, Multidimensional array, Character array	3	3, 5
	9	Pointer declaration, pointer operation, address operator, pointer expression	3	3
	10	Pointers and arrays, pointers and strings	2	3
IV	**Functions in C++**		**9**	
	11	Defining a function, function prototypes	3	2, 3, 5
	12	Local vs global variables, nested functions, scope rules	4	3
	13	Recursive functions, standard functions	2	3, 5
V*	**Classes in C++**		**9**	
	14	Structure and class, Declaration of a class, member functions	4	1, 4
	15	defining object of a class, accessing member of a class, array of class objects, pointers and classes	5	4

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		CO No
Sl No	**Name of Experiment**	
1	Program to find Cross product and fit product of two vectors	5
2	Program to check whether the entered number is prime or not	5
3	Program to list values of sin(x), tan(x) and exp(x) for a range of x values.	5
4	Program to display factors of a number	5
5	Program to convert given number to binary number	5
6	Program to find roots of a quadratic equation	5
7	Program to calculate range and maximum height of a projectile	5
8	Program to display sum and difference of two matrices	5
9	Program to find factorial of a number using functions	5
10	Program to find reduced mass and centre of mass of two spherical objects	5
Part B* – At least One Experiment to be performed		
11	Program to enter name and marks of n students and to generate rank list	5
12	Program to multiply two matrices	5
13	Program to enter names of n students and to sort them alphabetically.	5
14	Program to manage inventory of a supermarket with name, quantity and price of items.	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Gain knowledge about object oriented programming concept in C++	R, U	2, 5, 7
CO-2	Identify the structure and basic elements of a C++	R,U	2, 5, 7

	program		
CO-3	Use the concepts of conditional statements, loops and functions to write simple programs in C++ and acquire basic programming logic	U, Ap	2, 5, 7
CO-4	Describe the concepts of classes and objects	U, Ap	2, 5, 7
CO-5	Write programs in C++ to solve basic problems.	U, Ap	2, 5, 7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: C++ PROGRAMMING FOR PHYSICS

Credits: 3:0:1 (Lecture:Tutorial:Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Gain knowledge about object oriented programming concept in C++	PSO 2, 5, 7 / PO 1, 2, 3, 7	R, U	F, C	L	-
CO-2	Identify the structure and basic elements of a C++ program	PSO 2, 5, 7 / PO 1, 2, 3, 7	R,U	F, C	L	-
CO-3	Use the concepts of conditional statements, loops and functions to write simple programs in C++ and acquire basic programming logic	PSO 2, 5, 7 / PO 1, 2, 3, 7	U, Ap	F, C	L	-

CO-4	Describe the concepts of classes and objects	PSO 2, 5, 7 / PO 1, 2, 3, 7	U, Ap	F, C	L	-
CO-5	Write programs in C++ to solve basic problems.	PSO 2, 5, 7 / PO 1, 2, 3, 7	U, Ap	F, C, P	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	-	2	-	-	1	-	1	1	1	1	-	-	-	1	-
CO-2	-	2	-	-	2	-	2	1	2	1	-	-	-	2	-
CO-3	-	3	-	-	1	-	1	1	2	1	-	-	-	2	-
CO-4	-	2	-	-	1	-	1	1	1	1	-	-	-	1	-
CO-5	-	2	-	-	3	-	7	2	3	2	-	-	-	3	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	✓	-	-
CO-5	✓	✓	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK4DSEPHY206**				
Course Title	**FIBRE OPTIC COMMUNICATION**				
Type of Course	**DSE**				
Semester	**IV**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hr	5 Hrs
Pre-requisites					
Course Summary	This course gives the learner a good understanding of the role of fiber optic technology in the current telecommunications industry. It will equip the learner with the ideas of optical fibers and its constitution. Starting from the basics of light and ending with the testing of cables, the proposed modules will ensure that a good knowledge in OFC is transacted.				

BOOKS FOR STUDY:

1. Fiber Optics Installer and Technician Guide: Bill Woodward and Emile B. Hauson, Neil Eddie, San Francisco (2005)
2. Fiber-optic communication systems: Govind P. Agrawal, Wiley Interscience, 3rd edition (2002)
3. Introduction to Fiber Optics: John Crisp and Barry Elliot, Elsevier, Amsterdam, 3rd Edition (2005)

BOOKS FOR REFERENCE:

1. Introduction to Fiber Optics: Ajoy Ghatak and K. Thyagarajan, Cambridge University Press (1997)

2. Troubleshooting Optical-Fiber Networks - Understanding and using your optical time-Domain reflectometer: Duwayne R, Anderson, Larry Johnson and Florian G. Bell, Elsevier Academic Press, Amsterdam, 2nd Edition (2004)

WEB RESOURCES:

1. https://www.vedantu.com/physics/optical-fiber
2. http://krct.ac.in/ktgadmin/assets/php/pdf/1576331029.pdf

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**BASIC CONCEPTS OF LIGHT**	**9**	
	1	Electromagnetic waves, electromagnetic spectrum, modes of light- single mode, multi mode	2	1
	2	Critical angle, acceptance angle, cone of acceptance, numerical aperture	2	2
	3	Losses- absorption, scattering, reflection, dispersion: intermodal, intramodal	3	1
	4	Effect on bandwidth, optical power: gain, loss	2	1
II		**INTRODUCTION TO OPTICAL FIBRE**	**9**	
	5	Structure of Optical fiber	1	1
	6	Types of fibers: based on refractive index, material, modes	2	1
	7	Fiber optic cable construction, geometry of cable	2	2
	8	Cable sizes, colour coding, types of cables: simplex, duplex, multifiber, GI, SI, tight buffer, loose tube, ribbon, breakout cable, distribution cable, hybrid cable, composite, aerial and submarine cables	4	1
III		**FIBRE CABLING TOOLS**	**9**	
	9	General tools, slit and ring tool, stripping tool, buffer stripper, polishing film, polishing pad, polishing puck	2	1
	10	Cleaning devices, crimping tool, inspection microscope, cleavers, fusion splicer	2	1

	11	Light source, power meter, optical loss test set	2	2
	12	Visual fault locator, mechanical splices, splice tray	2	3
	13	Optical time domain reflectometer	1	2
IV	**CABLE SPLICING**		**9**	
	14	Fusion in splicing, mechanical splicing, single fiber fusion splicing, mass fusion splicing	2	1
	15	Stages of splicing, splicing precautions	3	4
	16	Misalignment, end gap, end angle	2	1
	17	Numerical Aperture mismatch, core mismatch	1	3
	18	Axial run-out, bubble, incomplete fusion	1	3
V*	**TESTING OF CABLES**		**9**	
	19	Continuity test, light source power meter, OLTS, visual fault locator	3	2
	20	OTDR testing, measuring cable span, attenuation coefficient, connector/splice loss measurement	3	3
	21	Distance-to-fault, OTDR trace analysis, optical loss budget	3	3

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Introduction to optical fiber cable (i) Study the composition of fiber optic cable (ii) single and ribbon type (iii) underground and overhead and colour coding (iv) pig tail (v) patch chord (vi) splice protection sleeve (vii) fusion splicer (viii) fiber closure	1
2	Measuring instruments identification: (ix) Light source, (x) power meter, ((xi) optical loss test set (xii) OTDR	1
3	Connectors (i) FC/SC/ST/LC/FDDI/ESCON/SMA (ii) various types of ratio couplers (iii) splitters	2

4	Measurement of Numerical Aperture of a fiber	1
5	Study of losses in Optical fiber	1
6	Power vs Current (P-I) characteristics and measure slope efficiency of Laser Diode	1
7	Voltage vs Current (V-I) characteristics of Laser Diode	1
8	Power vs Current (P-I) characteristics and measure slope efficiency of LED	1
9	Voltage vs Current (V-I) characteristics of LED	1
10	Characteristics of Photodiode and measure the responsivity.	1
Part B* – At least One Experiment to be performed		
11	Splicing (i) fusion splicing setup (ii) splicing stages (iii) arranging in splice tray (iv) securing in fiber closure	4
12	Fiber optic testing (i) fiber continuity test using light source and power meter (ii) cable loss test	3
13	OTDR test (i) setting up of OTDR (ii) measuring cable span (iii) measuring attenuation coefficient (iv) connector/splice loss measurement (v) distance to fault	3
14	OTDR trace analysis and optical loss budget in long distance optical links and FTTH networks.	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the essential basic elements of Fiber optics and telecommunication systems	U	PSO-1,5
CO-2	Apply the acquired knowledge in the selection of desired optical fibres, cabling tools, splicing and its testing	Ap	PSO-5,7
CO-3	Analyse different aspects of optical Fiber communication including OTDR trace analysis and optical loss budget	An	PSO-1,5

CO-4	Evaluate the different types of cable splicing in selecting the optimum configuration for low-loss communication	E	PSO-1,5,7
CO-5	Create various types of miniature models of optical communication systems, fueling the development of real-time scenarios	C	PSO-1,5,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: FIBRE OPTIC COMMUNICATION

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Understand the essential basic elements of Fiber optics and telecommunication systems	PO-1,3,6 PSO-1,5	U	F, C	L	-
CO-2	Apply the acquired knowledge in the selection of desired optical fibres, cabling tools, splicing and its testing	PO-1,2,3 PSO-5,7	Ap	P	L	-
CO-3	Analyse different aspects of optical Fiber communication including OTDR trace analysis and optical loss budget	PO-1,2,6 PSO-1,5	An	C, P	L	-
CO-4	Evaluate the different types of cable splicing in selecting the	PO-1,2,3 PSO-1,5,7	E	C, P	L	-

	optimum configuration for low-loss communication					
CO-5	Create various types of miniature models of optical communication systems, fueling the development of real-time scenarios	PO-1,2,3,6 PSO-1,5,7	C	P, M	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	1	-	-	-	2	-	-	1	-	1	-	1	-	-	-
CO-2	-	-	-	-	3	-	2	3	3	3	-	-	-	-	-
CO-3	1	-	-	-	3	-	-	1	2	-	-	-	2	-	-
CO-4	2	-	-	-	3	-	2	3	2	1	-	-	-	-	-
CO-5	1	-	-	-	3	-	2	3	3	3	-	-	2	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	✓	✓
CO-2	✓	✓	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	-	✓	✓
CO-5	✓	✓	✓	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK4SECPHY200**				
Course Title	**BASIC INSTRUMENTATION SKILLS**				
Type of Course	**SEC**				
Semester	**IV**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	2 Hrs	-	2 Hr	4 Hrs
Pre-requisites					
Course Summary	This course provides students with a comprehensive understanding of key concepts and practical skills in instrumentation. It will help the students to emerge with a solid foundation in instrumentation, equipped with the knowledge and skills needed to design experiments, collect and analyze data, and effectively communicate their findings in various settings.				

BOOKS FOR STUDY:

1. Kalsi H.S. *Electronic Instrumentation, (2nd ed.)*, New Delhi: Tata McGraw Hill publishing.
2. Cooper W.D. and Helfrick A.D. (2008). *Electronic Instrumentation and Measuring Techniques, (3rd ed.)*, New Delhi: PHI.
3. Salivahanan S., Suresh Kumar N. (2012). *Electronic Devices and Circuits, (3rd ed.)*, New Delhi: Tata McGraw Hill Education Private Limited.
4. Kishore K.L. (2010). *Electronic measurements and Instrumentation*, Delhi: Pearson.
5. Sedha R.S. (2013).*Electronic Measurements and Instrumentation*, S. Chand Publishing.

BOOKS FOR REFERENCE:

1. Principles of Electronics, Malvino A.P, 7th Edition, Tata McGraw Hill (2011).
2. Principles of Electronics, Mehta V. K. (11th ed.), S. Chand & Co. (2014).
3. Anand M.M.S. (2009. *Electronic Instruments and Instrumentation Technology*, PHI Learning).

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Measurements and basic components**	**8**	**CO**
	1	Qualities of measurements- Static characteristics- instrument, measurement, accuracy, resolution, precision, expected value, sensitivity. Book : 1, Chapter 1	1	1
	2	Significant figures. Types of error. Book : 2, Chapter 1	2	1
	3	Passive components- resistors, types (names only), colour coding of resistors, Connecting resistors-resistors in series, resistors in parallel, capacitors, types of capacitors (names only), Connecting capacitors - capacitors in series, capacitors in parallel, inductors, types of inductors (names only), diodes, zener diode Book : 3, Chapter 2,5	3	1
	4	Bipolar Junction Transistors, Transistor biasing(basic ideas only), transistor as an amplifier, IC - Introduction Book : 3:Chapter 6,19	2	1
II		**Digital and analog meters**	**4**	
	5	DC ammeter, multirange ammeter, DC voltmeter, multirange voltmeter, Loading Book : 1, Chapter 3,4	2	1
	6	Digital voltmeter, Types of Digital voltmeter, Advantages of Digital voltmeter, Digital Multimeter, Features of Basic Digital Multimeter, Block diagram of Digital Multimeter, Advantages Book :5, Chapter 6	2	1
III		**Function Generators and CRO**	**6**	
	7	Types of Signal Generators -Sine, square and Triangular wave (basic ideas only) Book : 4, Chapter 2	2	2

	8	Block diagram of basic CRO, Types of CRO probes, Applications of CRO Book : 4, Chapter 4	2	2
	9	Digital CRO, Block diagram of a digital CRO, CRO probes Book : 4, Chapter 5	2	2
IV	**LEDs and LCDs**		**6**	
	10	Light Emitting Diode (LED), Advantages and Disadvantages of LED, Applications of LED, Multicolour LEDs Book : 5, Chapter 12	3	3
	11	Liquid Crystal Displays, Advantages and Disadvantages of LCD, Applications of LCD, comparison between LED and LCD Book : 5, Chapter 12	3	3
V*	**Transducers**		**6**	
	12	Transducers, Classification of transducers, Active and Passive Transducers, Requirements of a good Transducer, Characteristics of a Transducer, Selection of Transducer, Book : 5, Chapter 14	2	3
	13	Resistive transducer, Inductive transducer, Capacitive transducer (basics only), Advantages and Disadvantages of Capacitive transducer. Book : 5, Chapter 14	2	3
	14	Photoelectric transducers, Piezoelectric transducer. Book : 3, Chapter 21	2	3

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Identify the measuring equipments and their functioning (Multimeter, voltmeter, ammeter)	4
2	Identifying and measuring the values of the passive components	4
3	Test the circuits with active and passive components	4
4	Make a two-socket electric extension board.	4

5	Observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.	4
6	Design and construction of variable dc power supply (0-12V) using diodes, capacitors and IC 7812	4
7	Study the operation of Multimeters (Analog and Digital)	4
8	Measurement of voltage, frequency, time period and phase angle using CRO.	4
9	Measurement of rise, fall and delay times using a CRO	4
10	Study the operation of Signal Generator, Regulated Power Supplies, CRO.	4
Part B* – At least One Experiment to be performed		
11	LED bulb assembling	4
12	LED tube assembling	4
13	Familiarization with basic transducers	4
14	Measurement of speed using photoelectric transducers	4

<u>COURSE OUTCOMES</u>

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Recognize the fundamental concepts of measurement and identify basic components and systems used in analog circuits	R, U	PSO-1,5
CO-2	Explain the functioning of measurement devices, function generators and CROs	R, U	PSO-1,5
CO-3	Describe the fundamental concepts of transducers, LEDs, LCDs and their applications	R, U	PSO-1,5, 7
CO-4	Apply basic analog devices to form simple circuits and evaluate its performance	Ap	PSO-1, 2, 6, 7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: BASIC INSTRUMENTATION SKILLS

Credits: 2:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Recognize the fundamental concepts of measurement and identify basic components and systems used in analog circuits	PO-1/ PSO-1,5	R, U	F,C	L	-
CO-2	Explain the functioning of measurement devices, function generators and CROs	PO-1,3/ PSO-1,5	R, U	C, P	L	-
CO-3	Describe the fundamental concepts of transducers, LEDs, LCDs and their applications	PO-1,3/ PSO-1, 5,7	R, U	C, P	L	-
CO-4	Apply basic analog devices to form simple circuits and evaluate its performance	PO-1,2,3,4/ PSO-1, 2, 5,6, 7	Ap	C, P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	1	-	-	-	3	-	-	1	-	-	-	-	-	-	-
CO-2	1	-	-	-	3	-	-	1	-	1	-	-	-	-	-
CO-3	1	-	-	-	3	-	2	1	-	1	-	-	-	-	-
CO-4	1	2	-	-	3	1	2	1	2	1	1	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	✓	-	✓
CO-4	-	✓	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK4SECPHY201**				
Course Title	**WIRING AND ELECTRICAL DEVICES**				
Type of Course	**SEC**				
Semester	**IV**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	2 Hrs	-	2 Hrs	4 Hrs
Pre-requisites	1. Fundamental Physics concepts 2. Basic understanding of mathematics, including algebra and trigonometry				
Course Summary	This course is designed to provide a comprehensive understanding of electrical principles, circuits, and essential skills. It also covers topics on fuses, circuit breakers, electrical protection, meters, electrical wiring, soldering, and electrical and electronic drawings. Students will learn about various components, their symbols, operational principles, and practical applications in electrical systems. The course aims to equip students with the necessary knowledge and skills for effective work in electrical networks, with a strong emphasis on safety practices and efficient maintenance techniques.				

BOOKS FOR STUDY:

1. Practical Electronics for Inventors: Paul Scherz and Simon Monk, Third edition, McGraw-Hill, 2013.
2. A Text Book of Electrical Technology AC and DC Machines: B L Teraja & A K Teraja, S.Chand, Volume II
3. Electricity Metering in Easy Steps: An Outline Book on Smart Energy Meters for Everyone: Dr. Shashikanth Bakre, Kindle Edition, 2015.

4. Electrical Workshop A Text Book: R. P. Singh, Second Edition, I.K. International, 2008.
5. The Complete Guide to Wiring, Updated 7th Edition: Editors of Cool Springs Press, 2017.
6. Engineering Drawings and Design: Jensen-Helsel, McGraw-Hill Book Company, 7th Edition,2007.

BOOKS FOR REFERENCE:

1. Electrical Circuits: K A Smith and R. E. Alley, Cambridge University Press, 2014
2. Basic Electronics: B L Teraja, S.Chand & Company Ltd, 2005
3. Concept in Electric Circuits: Dr.Wasif Naseem, Ventus Publishing Aps,2009.
4. Electrical Circuit Theory and Technology: John Bird, Routledge, Fifth edition, 2014
5. Electrical Wiring Residential: Ray C. Mullin & Phil Simmons, 18th edition, Cenage Learning, 2015.
6. Handbook of Electrical Design Details: Niel Sclater & John E. Traister, The McGraw.Hill Companies, Second Edition, 2003.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Basic Circuit Elements (Book 1)**	**6**	
	1	Ohm's law, series-parallel combinations of resistors and capacitors	3	1
	2	Measuring Voltage, Current and Resistance, Kirchhoff’s laws, Passive circuit elements (Resistor, Inductor and Capacitor) and active components	3	1,2
II		**Transformers and Electric Motors (Book 2)**	**6**	
	3	Transformers- Basic operations, Types of transformers, Single Phase and Three Phase Transformer	3	1,3
	4	Electric Motors: DC motors, AC Motors- Classification, Induction Motor-Construction	3	2,3
III		**Electric Connectors and Meters (Book 1 & 3)**	**6**	
	5	Wires, Cables and connectors, Fuses and Circuit Breakers	3	1,4
	6	Electric Meters- classification (Electromechanical, static, and numeric), Metering arrangements, Specification of	3	4

		numeric meters, calculation of electric consumption in home (Book 9)		
IV	**Electrical Wiring (Book 4 & 5)**		**6**	
	7	Soldering- Introduction, Types of solders, Flux, Soldering Equipment, Precaution	2	4
	8	Home wiring tools and wiring safety, Conduit, NM cables	2	4
	9	Earthing and Electrical Safety	2	4
V*	**Electrical and Electronic Drawings (Book 6)**		**6**	
	10	Symbols, Schematic Diagrams, Wiring Diagrams	3	5
	11	Ladder diagrams, Block Diagrams, and Logic Diagrams	3	5

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Verification of Ohm's law	5
2	Measurement of voltage and current in series circuit: using multimeter	5
3	Voltage Conversion: Step-up and Step-down Transformers	5
4	Construct Extension Board	5
5	Repair of Electric Iron box	5
6	Energy auditing	5
7	Construction of a mini-fan with DC Motor	5
8	Prepare LED Flashlight Circuit: Soldering Practices	5
Part B* – At least One Experiment to be performed		
11	Evaluate the total resistance in Series and Parallel combinations of resistors on the breadboard setup.	5
12	Verification of Kirchoff's law	5
13	Repair of electric Mixer-grinder	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss the fundamental concepts of Electricity, electrical circuits, their principles and passive devices	U	PSO-1,2
CO-2	Differentiate and Construct necessary skills on Multimeter, voltmeter, ammeter and electric circuit elements.	U, Ap	PSO-2,3
CO-3	Identify different types of DC and AC Circuits, the principle and operations of generators, transformers, and motors and utilize this information to promote safe maintenance practices	U, Ap	PSO-2,3,5
CO-4	Construct general awareness and skills to do soldering, electrical wiring with assured electrical protection devices, troubleshooting the electrical circuits, networks and appliances and being able to examine electric metering system leading to reduce cost of living	U, Ap	PSO-2,3,5
CO-5	Use skills in interpreting and distinguishing electrical and electronic diagrams, preparing them for fostering careers in electrical and electronics, automation, and related fields	U, An, Ap	PSO-3,5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: WIRING AND ELECTRICAL DEVICES

Credits: 2:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Discuss the fundamental concepts of Electricity, electrical	PO-1,3/ PSO-1,2	U	F, C	L	-

	circuits, their principles and passive devices					
CO-2	Differentiate and Construct necessary skills on Multimeter, voltmeter, ammeter and electric circuit elements.	PO-1,3/ PSO-2,3	U, Ap	F,C ,P	L	P
CO-3	Identify different types of DC and AC Circuits, the principle and operations of generators, transformers, and motors and utilize this information to promote safe maintenance practices	PO-1,3/ PSO-2,3,5	U, Ap	F,C,P	L	P
CO-4	Construct general awareness and skills to do soldering, electrical wiring with assured electrical protection devices, troubleshooting the electrical circuits, networks and appliances and being able to examine electric metering system leading to reduce cost of living	PO-1,3/ PSO-2,3,5	U, Ap	F,C,P	L	P

CO-5	Use skills in interpreting and distinguishing electrical and electronic diagrams, preparing them for fostering careers in electrical and electronics, automation, and related fields	PO-1,3/ PSO-3,5	U, An, Ap	F, C, P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	1	-	-	-	-	-	2	-	1	-		-		
CO-2	-	2	2	-	-	-	-	1	1	-	-	-	-		
CO-3	-	2	2	-	2	-	-	1	-	1	-	-	-		
CO-4	-	1	2	-	3	-	-	1	-	3	-	-	-		
CO-5	-	-	1	-	1	-	-	1		2	-	-	-		

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	✓	-	✓
CO-4	-	✓	✓	✓
CO-5	✓	-	-	

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK4VACPHY200</td></tr>
<tr><td>Course Title</td><td colspan="5">INTRODUCTORY COURSE ON PHYSICS IN FINANCIAL MARKET</td></tr>
<tr><td>Type of Course</td><td colspan="5">VAC</td></tr>
<tr><td>Semester</td><td colspan="5">IV</td></tr>
<tr><td>Academic Level</td><td colspan="5">200 - 299</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>3</td><td>3 Hrs</td><td>-</td><td>-</td><td>3 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5"></td></tr>
<tr><td>Course Summary</td><td colspan="5">This course is a fascinating interdisciplinary field that combines principles from economics and physics to study the behaviour of financial markets. By applying scientific methods and theories, econophysicists analyse the complex dynamics of economic systems, offering insights into market fluctuations and trends. This innovative approach sheds light on the intricate interactions between various economic variables, shaping our understanding of global financial phenomena.</td></tr>
</table>

BOOKS FOR STUDY:

1. R. Mantegna and H.E. Stanley, An Introduction to Econophysics, Cambridge
2. Introduction to Econophysics, Contemporary Approaches with Python Simulations, Carlo Requião da Cunha, CRC Press, Taylor & Francis Group, LLC
3. P.R. Bevington and D.K. Robinson, Data Reduction and Error Analysis for the Physical Sciences, McGraw-Hill
4. Sitabhra Sinha, Arnab Chatterjee, Anirban Chakraborti, Bikas Chrakrabarti, Econophysics - An Introduction, Wiley
5. Self-Organised Criticality in Astrophysics - Statistics of nonlinear processes in universe, M Aschwanden, Springer - Praxis publishing

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Introduction to Econophysics (Chapters 1 and 2 of Book 1, Chapter 1 of Book 2)**	5	
	1	Motivation and Approach	1	1
	2	Arbitrage, Supply & demand	1	1
	3	Stochastic processes	1	1
	4	Efficient market hypothesis	1	1
	5	Stock, bond and derivative	1	1
II		**Basic Statistical methods (Chapter 1 of Book 3, Sec 4. 1 of Book 1)**	12	
	6	Uncertainties in measurements: Mean, Mode, Median	2	2
	7	Measures of Dispersion: Standard Deviation, Variance	2	2
	8	Statistical Distributions: Binomial , Poisson, Gaussian and Lorentzian Distributions	2	2
	9	Central limit theorem (only statement, no proof)	2	2
	10	Power spectral density	2	2
	11	Two stable distributions: Gaussian and Lorentzian	2	2
III		**Random walk in physics and economics (Sec 2.1, 2.2 of Book 4; Sec 3.2 of Book 1)**	11	
	12	Bernoulli process, random walk	2	3
	13	Binomial distribution, Gaussian distribution	3	3
	14	Wiener process and Langevin equation	2	3
	15	Brownian motion	2	3
	16	Market and random walk: Time series and normal distribution	2	3
IV		**Temporal correlations of stochastic processes (Sec 6.1 to 6.4 and 7.1 to 7.4 of Book 1)**	8	
	17	Stationary stochastic process and autocorrelation function	1	4
	18	Integral of autocorrelation function and time scale	2	4

	19	Short-range and Long-range correlated random processes: Exponentially decaying autocorrelation - white noise and Wiener process. The $1/f^{\eta}$ noise.	2	4
	20	Stochastic dynamics of the logarithm of stock price and random walk.	1	4
	21	Volatility: Definition, significance and power law behaviour.	1	4
	22	Analysis of a dataset containing daily stock prices of a company for the past year.	1	4
V*	**Power law distributions in physics and economics (Sec 1.1, 1.4, 1.5, 1.7 of Book 5, Sec 5.1 of Book 4)**		9	
	23	Self-Organised criticality - SOC (qualitative idea)	1	5
	24	Power law distribution of SOC: Biophysics, Geophysics, Planetary Physics	3	5
	25	Power law in finance: inverse cubic law	2	5
	26	TP statistics TE statistics and their comparison	3	5

COURSE OUTCOMES

No.	**Upon completion of the course the graduate will be able to**	**Cognitive Level**	**PSO addressed**
CO-1	Understand how financial markets operate, including the different types of markets such as stocks, bonds, and derivatives, as well as who participates in them.	U	1,4
CO-2	Apply probability theory and statistics to analyze financial data, make investment decisions, and assess market risk.	Ap	2,4
CO-3	Understand stochastic processes and their use in financial modeling, enabling them to interpret market behavior and make informed decisions based on time series data and probability distributions.	U	2,4

CO-4	Analyze stochastic processes, autocorrelation, and volatility in financial data, gaining insight into market dynamics and random walk models.	An	2,4
CO-5	Comprehend self-organized criticality, power-law distributions across diverse domains, including finance, and gain insight into TP and TE statistics for temporal dynamics analysis.	U	2,4

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: INTRODUCTORY COURSE ON PHYSICS IN FINANCIAL MARKET

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Understand how financial markets operate, including the different types of markets such as stocks, bonds, and derivatives, as well as who participates in them.	PO 1,2/ PSO 2	U	F	L	-
CO-2	Apply probability theory and statistics to analyze financial data, make investment decisions, and assess market risk	PO 1,2// PSO 1	Ap	P	L, T	-
CO-3	Understand stochastic processes and their use	PO 1,2// PSO 1	U	C	L	-

	in financial modeling, enabling them to interpret market behavior and make informed decisions based on time series data and probability distributions.					
CO-4	Analyze stochastic processes, autocorrelation, and volatility in financial data, gaining insight into market dynamics and random walk models.	PO 1,2// PSO 1	An	P	L	-
CO-5	Comprehend self-organized criticality, power-law distributions across diverse domains, including finance, and gain insight into TP and TE statistics for temporal dynamics analysis.	PO 1,2// PSO 1	U	C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	1	-	-	2	-	-	-	2	3	-	-	-	-	-	-
CO-2	-	3	-	2	-	-	-	-	-	-	-	-	-	-	-
CO-3	-	3	-	2	-	-	-	3	3	-	-	-	2	-	-
CO-4	-	3	-	2	-	-	-	2	2	-	-	-	-	-	-
CO-5	-	1	-	2	-	-	-	1	1	-	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	✓	✓	✓
CO-5	✓	✓	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK4VACPHY201**				
Course Title	**RESEARCH AND PUBLICATION ETHICS**				
Type of Course	**VAC**				
Semester	**IV**				
Academic Level	**200 - 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 Hrs	-	-	3 Hrs
Pre-requisites					
Course Summary	The objective of this course is to instruct the students interested and expecting to do research, about the philosophy of research; research and publication ethics; accessibility of .publications and the publication misconduct				

BOOKS FOR STUDY:

1. Indian National Science Academy. 2019. Ethics in Science Education, Research and Governance.Edited by K Muralidhar Amit Ghosh AK Singhvi ISBN: 978-81-939482-1-7
2. Research and Publication Ethics,Dr. Upendra Pratap,Ms. Sakshi Ahlawat,Dr. Sushma Sharma SULTAN CHAND & SONS

BOOKS FOR REFERENCE:

1. Alexander Bird,. (2006). Philosophy of Science. Routledge.ISBN 9781857285048
2. Chaddah, P. (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized. ISBN 9387480860
3. Israel, M. (2015). Research Ethics and Integrity for Social Scientists: Beyond Regulatory Compliance. (Second ed.) SAGE Publications Ltd.
4. RESEARCH & PUBLICATION ETHICS, Dr.S.B.Kishor , Dr.Ajay S.Kushwaha , Dr.Gitanjali J ,DAS GANU Prakashan.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
		Introduction	**9**	
I	1	Introduction to philosophy: definition, nature and scope, concept, branches	4	1
	2	Ethics: definition, moral philosophy, nature of moral judgements and reactions	5	1
		Scientific Conduct	**9**	
II	3	Ethics with respect to science and research,Ethics in Measurement Practices,Ethical Practices in Science Outreach,Ethical Issues Associated with Gender-Bias : Chapter Chapter 6,7,8 of Book2	3	1
	4	Intellectual honesty and research integrity, Chapter 3 of Book 6	2	1
	5	Scientific Misconducts: Falsification, Fabrication, and Plagiarism (FFP) Chapter 10 of Book 6	2	2
	6	Redundant publications: duplicate and overlapping publication, salami slicing, Selective reporting and misrepresentation of data Chapter 4 of Book 6	2	2
		Publication Ethics: **(chapter 4 and 5 of Book 3, Chapter 5,6 and 8 of Book 6)**	**9**	
III	7	Publication Ethics: definition, introduction and importance. Best practices – standards setting initiatives and guidelines: COPE & WAME	3	3`
	8	Conflict of interest d. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice-versa, types	2	2
	9	Violation of publication ethics, authorship and contributorship ,	2	3
	10	Identification of publication misconduct, complaints and appeals ,Predatory publishers and journal	2	2

IV	**Databases and Research Metrics (Book 6 : Chapter 11 & 12)**		**9**	
	11	Databases a. Indexing databases b. Citation databases: Web of Science, Scopus, etc.	4	4
	12	Research Metrics a. Impact factor of journal as per journal citation report, SNIP, SJR, IPP, Cite Score b. Metrics: h-index, g index, i10 index, altmetrics	5	4
V*	**Online Publishing (Book 6 : Chapter 7 ,9 and 10)**		**9**	
	13	Open Access publications and Initiatives	2	5
	14	online resource to check publisher copyright and self-achieving policies	2	5
	15	Software tool to identify predatory publications developed by SPPU	2	5
	16	Journal Finder/ Journal Suggestion tools viz. JANE, ELSEVIER, SPINGER, Journal suggester etc.	2	5
	17	Use of plagiarism software Urkund and other open source software tools	1	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Students will understand the basics of philosophy of science and ethics, research integrity, publication ethics.	U	PSO-4,7
CO-2	Students will be able to identify research misconduct and predatory publications	R, U	PSO-4,7
CO-3	Students will get a good insight of best practises in publications ,violations , author contributions	R,U	PSO-7
CO-4	Students will get an in- depth knowledge on Indexing and citation databases. Students will be able to calculate publications research metrics(citations, h-index, Impact Factor, etc.) and plagiarism tools	Ap	PSO-7

CO-5	Students will be able to use Software tool to identify predatory publications, Journal Finder/ Journal Suggestion tools, plagiarism softwares and other open source software tools	U,AP	PSO-7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: RESEARCH AND PUBLICATION ETHICS

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Students will understand the basics of philosophy of science and ethics, research integrity, publication ethics.	PO1,2,4,5,6,8/ PSO-4,7	U	F, C	L	-
CO-2	Students will be able to identify research misconduct and predatory publications	PO1,2,4,5,6,8/ PSO-4,7	R, U	F, C	L	-
CO-3	Students will get a good insight of best practises in publications ,violations , author contributions	PO1,2,4,5,8/ PSO-4	R,U	F, C	L	-
CO-4	Students will get an in-depth knowledge on Indexing and citation databases. Students will be able to calculate publications research	PO1,2,4,5,8/ PSO-4	Ap	F, C, P	L	-

	metrics(citations, h-index, Impact Factor, etc.) and plagiarism tools					
CO-5	Students will be able to use Software tool to identify predatory publications, Journal Finder/ Journal Suggestion tools, plagiarism softwares and other open source software tools	PO1,2,4,5,8/ PSO-4	U,AP	P	L/T	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	-	-	-	1	-	-	2	2	2	-	2	2	2	-	2
CO-2	-	-	-	1	-	-	2	1	2	-	1	1	2	-	3
CO-3	-	-	-	2	-	-	-	2	2	-	3	3	-	-	2
CO-4	-	-	-	2	-	-	-	2	2	-	2	2	-	-	2
CO-5	-	-	-	2	-	-	-	2	2	-	3	2	-	-	2

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	✓	✓	✓
CO-5	✓	✓	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK4VACPHY202</td></tr>
<tr><td>Course Title</td><td colspan="5">DISASTER MANAGEMENT</td></tr>
<tr><td>Type of Course</td><td colspan="5">VAC</td></tr>
<tr><td>Semester</td><td colspan="5">IV</td></tr>
<tr><td>Academic Level</td><td colspan="5">200 - 299</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>3</td><td>3 Hrs</td><td>-</td><td>-</td><td>3 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5"></td></tr>
<tr><td>Course Summary</td><td colspan="5">This course provides a comprehensive overview of various phases of disaster management. The course is intended to provide a general concept in the dimensions of disasters caused by nature beyond the human control as well as the environmental hazards induced by human activities with emphasis on disaster preparedness, response and recovery. Additionally, the course explores role of national and state level agencies in disaster mitigation and disaster reduction.
Case studies of a few disasters happened in India and across the globe.</td></tr>
</table>

BOOKS FOR STUDY:

1. Introduction to disaster management, Satish Modh, Mcmillan Publishers, India Ltd ISBN 13: 978-0230-63979-9
2. DISASTER MANAGEMENT, Uday Singh,VIKAS╟ PUBLISHING HOUSE PVT LTD ISBN : 978-93-5338-045-8 (https://ddceutkal.ac.in/Syllabus/MCOM/Disaster_Management.pdf)
3. Natural disaster mitigation – a scientific and practical approach: Science Press, Beijing, 2009
4. Environmental health in emergencies and disasters: A practical guide, B.Wisner & J.Adams (Eds.), WHO, Geneva, 2002 ISBN 92-4 154541-0.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Type of Natural disasters (Book 2:Chapter 1 & Book 1:Chapter 1)**	**9**	
	1	Natural Disasters - Flood Drought, Cyclone,	2	1
	2	Geographical Disaster, Earthquake, Landslide	2	1
	3	Climatic Disaster- Heat and Cold Wave, Climate Change	3	1
	4	Lecture/Tutorial Session (Debate/group discussion on) i) Impacts of Global Warming - Sea level Rise, ii) Ozone Depletion and its impacts on other natural disasters (Group discussion)	2	1
II		**Man Made Disaster (Book 2, Chapter 2 & Book 1:Chapter 1)**	**9**	
	5	Nuclear Disaster, Chemical Disaster, Biological Disaster,	3	1,2
	6	Building Fire, Coal Fire, Oil Fire,	2	1,2
	7	Air Pollution, Water Pollution, Industrial Pollution, Deforestation	2	1,2
	8	Tutorial/Lecture - GroupWise presentation on Main Air & Sea Accidents in the last decade	2	1,2
III		**Disaster Prevention and Control (Book 2, Chapter 3 & Book 1:Chapter 2)**	**9**	
	9	Disaster preparedness, prevention and mitigation, Community based disaster management (CBDM) and its operation, Disaster Information, National Institute of Disaster Management	5	3
	10	Role of Various Agencies in Disaster Mitigation- National level and State levels - National Disaster Response Force (NDRF)	3	3
	11	Tutorial/Lecture - GroupWise presentation on "the role and awareness of of National and State level agencies"	1	3

IV	**Risk assessment and management (Book 2, Chapter 3,4 & Book 1:Chapter 3,4)**		**9**	
	12	Role of the UN, and international agencies in disaster management; United Nations Disaster Relief coordinator (UNDRO), UNDRO Mandate in Disaster Relief and Management, General Assembly, Guiding Principles, Prevention, Preparedness, Stand-By Capacity, Consolidated Appeals; Coordination, Cooperation And Leadership; Continuum From Relief To Rehabilitation And Development, Yokohama Conference, Kobe Conference, Plan of Action	3	4
	13	National disaster management in India - an overview National Policy, National Crisis Management Committee (NCMC), Crisis Management Group, Funding Mechanisms, The Disaster Management Act, 2005, The National Disaster Management Authority (NDMA), State Disaster Management Authorities, District Disaster Management Authority, Indian Agencies for Disaster Management, Indian Red Cross Society,	4	4
	14	Tutorial/Lecture Discussion on the role of various agencies in disaster management,	2	4
V*	**Case Studies (Book 1, Chapter 3)** Note: Tutor can use any available resources to impart knowledge on this topic		**9**	
	15	Disasters in India: Bhopal gas tragedy of 1984, Orissa cyclone 1999, Kerala Flood 2018	3	4,5
	16	Disasters across globe: Chernobyl nuclear accident 1986, Tsunami 2004, Brumadinho Dam, Brazil 2019	3	4,5
	17	Tutorial/Lecture Power point presentation and discussion on the various disasters and mitigation across globe and in our country	3	4,5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the need and significance of studying disaster management	U	PSO-1,2,3
CO-2	Gain knowledge on the impacts Disasters on environment and society	R, U	PSO -1,2,4
CO-3	Understand the types of disaster their origin causes and their management and the disaster profile of India	R, U	PSO - 1,3,6,
CO-4	Learning to apply the knowledge of technology for monitoring and management of the Disaster	Ap	PSO- 1,3,5,6
CO-5	Explain Emergencies and controls, with examples of natural and manmade disasters and their consequences.	R, Ap	PSO-2,4,5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: DISASTER MANAGEMENT

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Understand the need and significance of studying disaster management	PSO 1,2,3	U	F, C	L / T	-
CO-2	Gain knowledge on the impacts Disasters on environment and society	PSO 1,2,4	R, U	F, C	L / T	-
CO-3	Understand the types of disaster their origin	PSO 1,3,6	R, U	C	L / T	-

	causes and their management and the disaster profile of India					
CO-4	Learning to apply the knowledge of technology for monitoring and management of the Disaster	PSO 1,3,5,6	Ap	C	L / T	-
CO-5	Explain Emergencies and controls, with examples of natural and manmade disasters and their consequences.	PSO 2,4,5	R, Ap	C,P	L / T	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	1	1	2	-	-	-	-	1	1	-	-	-	-	-	-
CO-2	1	1	-	2	-	-	-	1	2	-	-	-	-	-	-
CO-3	1	-	1	-	-	2	-	-	1	2	-	-	-	-	-
CO-4	1	-	1	-	2	2	-	-	-	1	1	1	-	-	-
CO-5	-	1	-	2	2	-	-	-	-	1	1	2	1	-	-
CO-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	✓	✓	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK5DSCPHY300</td></tr>
<tr><td>Course Title</td><td colspan="5">OPTICS</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSC</td></tr>
<tr><td>Semester</td><td colspan="5">V</td></tr>
<tr><td>Academic Level</td><td colspan="5">300 - 399</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>3 Hrs</td><td>-</td><td>2 Hrs</td><td>5 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">-</td></tr>
<tr><td>Course Summary</td><td colspan="5">Optics, a branch of physics dedicated to the study of light, delves into a myriad of phenomena such as interference, where light waves interact to form distinct patterns of constructive and destructive interference. Diffraction, another fundamental aspect, elucidates the bending of light waves around obstacles or through small apertures, altering their propagation paths. Furthermore, dispersion unveils the separation of light into its constituent wavelengths. Finally, polarization explores the alignment of light waves along specific planes, influencing various optical properties.</td></tr>
</table>

BOOKS FOR STUDY:

1. Optics by Ajoy Ghatak 7th edition
2. Text Book of Optics: Subramaniam & Brijlal
3. Optics and spectroscopy: R.Murugesan and K Sivaprasad, S. Chand & Co., 2010

BOOKS FOR REFERENCE:

1. Optics: Eugene Hecht, Addison-Wesley 2002
2. Basic optics: principles and concepts: Avijit Lahiri, Elsvier
3. Lasers-Principles, types and applications, K R Nambiar

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Interference of light**	**9**	
	1	The principle of superposition - coherent sources – superposition of waves from coherent and incoherent sources, Young's double slit experiment	2	1
	2	Interference by division of wave front-Fresnel's biprism	2	1
	3	Interference by division of amplitude -interference in thin films (reflection only), colours in thin films, air wedge testing of optical flatness	3	1
	4	Newton's rings (reflected system)-refractive index of a liquid	2	1
II		**Fresnel Diffraction**	**9**	
	5	Introduction, Huygens theory, Fresnel and Fraunhofer diffractions.	1	1,2
	6	Fresnel diffraction: Fresnel's assumptions, Half-period zones, - explanation of rectilinear propagation of light	2	1,2
	7	Diffraction at a straight edge	2	2
	8	Zone plate-Comparison between zone plate and convex lens.	2	2
III		**Fraunhofer diffraction**	**9**	
	9	Introduction, Diffraction at a single slit	1	2
	10	Diffraction through a circular aperture	2	2
	11	Diffraction through double slits and N-slits	2	2
	12	Diffraction grating	2	2
	13	Limit of resolution, Rayleigh's criterion for resolution, resolving power of microscope and grating.	2	2
IV		**Polarisation and Dispersion**	**9**	
	14	Polarization, Plane polarized light, Malus law	1	4

	15	Polarization by reflection, Brewster's law	1	4
	16	Double refraction, positive and negative crystals, Nicol prism-construction, Nicol prism as a polarizer and analyzer	3	4
	17	Quarter and half wave plates. Theory- production and analysis of plane, circularly and elliptically polarized light.	3	4
	18	Dispersion: Normal and anomalous dispersion-Cauchy's relation (Qualitative ideas only).	1	3
V*		**Lasers**	**9**	
	19	Laser beam characteristics, spatial and temporal coherence (qualitative ideas)	1	5
	20	Basic principle of laser operation, spontaneous and stimulated emission, Einstein coefficient	2	5
	21	Light propagation through medium and condition for light amplification, metastable state and population inversion, pumping and optical resonant cavity	2	5
	22	Ruby laser , He-NE laser and semiconductor laser	3	5
	23	Application of lasers.	1	5

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Spectrometer-A, D and n of a solid prism	6
2	Spectrometer –Dispersive power and Cauchy's constants	6
3	Spectrometer Grating—Normal incidence- N & wavelength	6
4	Spectrometer-i-d curve	6
5	Spectrometer- Hollow prism	6
6	Liquid lens-refractive index of liquid and lens	6

7	Newton's Rings—Reflected system	6
8	Air wedge-diameter of a wire	6
9	Method of parallax: optical constants of convex lens i. using mirror and mercury ii. using mirror and water	6
10	Method of parallax: refractive index of a liquid	6
Part B* – At least One Experiment to be performed		
11	a. Laser beam characteristics b. Diffraction grating b. Diffraction at different types of slits and apertures	6
12	Refractive index of liquids and liquid mixtures using Abbe's refractometer	6
13	Optical activity studies using Polarimeters	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe the different basic phenomena of light such as Interference, Diffraction, Dispersion and Polarization	U	PSO-1,2,3
CO-2	Relates diffraction theory in Rayleigh's criterion for resolution and in finding resolving power of diffraction grating	U, Ap	PSO-1,2,3
CO-3	Explain the phenomenon- dispersion	U	PSO-1,2,3
CO-4	Differentiate the different types of polarizations, its theory and the production/analysis methods and apply the concept in studying Nicol prism, quarter wave and half wave plates	U, Ap, An	PSO-1,2
CO-5	Explain the basic constituents of a laser, different types and working	U	PSO-1,2

CO-6	Apply various optical instruments and techniques to analyse and manipulate light, including lenses, mirrors, prisms, and optical fibers.	U, Ap	PSO-2, 7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: OPTICS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Describe the different basic phenomena of light such as Interference, Diffraction, Dispersion and Polarization	PO-1, 2 PSO-1,2,3	U	F, C	L	-
CO-2	Relates diffraction theory in Rayleigh's criterion for resolution and in finding resolving power of diffraction grating	PO-1, 2 PSO-1,2,3	U, Ap	C,P	L	-
CO-3	Explain the phenomenon-dispersion	PO-1, 2 PSO-1,2,3	U	F, C	L	-
CO-4	Differentiate the different types of polarizations, its theory and the production/analysis	PO-1, 2 PSO-1,2	U,Ap, An	F, C	L	-

	methods and apply the concept in studying Nicol prism, quarter wave and half wave plates					
CO-5	Explain the basic constituents of a laser, different types and working	PO-1, 2 PSO-1,2	U	F, C	L	-
CO-6	Apply various optical instruments and techniques to analyse and manipulate light, including lenses, mirrors, prisms, and optical fibers.	PO-1, 2 PSO-2,7	U, Ap	F, C,P	T	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	2	1	-	-	-	-	3	2	-	-	-	-	-	-
CO-2	2	2	3	-	-	-	-	3	2	-	-	-	-	-	-
CO-3	1	2	1	-	-	-	-	3	2	-	-	-	-	-	-
CO-4	3	1	-	-	-	-	-	3	2	-	-	-	-	-	-
CO-5	3	2	-	-	-	-	-	3	2	-	-	-	-	-	-
CO-6	-	2	-	-	-	-	2	3	2	-	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	-	✓	✓
CO-5	✓	✓	-	-
CO-6	✓	-	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK5DSCPHY301</td></tr>
<tr><td>Course Title</td><td colspan="5">QUANTUM MECHANICS I</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSC</td></tr>
<tr><td>Semester</td><td colspan="5">V</td></tr>
<tr><td>Academic Level</td><td colspan="5">300 - 399</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 Hrs</td><td>-</td><td>-</td><td>4 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">● The students should have a basics understanding of elementary classical mechanics
● The students should have basic ideas in electricity and magnetism
● The students be familiar with the fundamentals of algebra and trigonometry, vectors, matrices, complex numbers, ordinary differential and integral calculus</td></tr>
<tr><td>Course Summary</td><td colspan="5">This course aims to present the basics of quantum mechanics in an easily understandable way. The course begins with an introduction to limitations of classical mechanics and the emergence of quantum mechanics. The second module comprises of the basic ideas of wave packets and wave functions. The Schrodinger equation, operators, eigenfunctions etc are discussed in the third module. One dimensional eigen value problems and a glossary of the approximate methods is described with a few examples in the fourth module. Finally, general formalism of quantum mechanics and various operators are also presented.</td></tr>
</table>

BOOKS FOR STUDY:

1. Concepts of Modern Physics: Arthur Beiser, Mc Graw Hills
2. Introduction to Quantum Mechanics : David, J Griffith, Prentice Hall
3. Quantum Mechanics : G Aruldhas, PHI, 2^{nd} Edition, 2020
4. Quantum Mechanics, Bransden and Joachain, 2^{nd} Edition, Pearson education Ltd.,2000

BOOKS FOR REFERENCE:

1. Quantum Mechanics Theory and Applications-Ajoy Ghatak, S Lokanathan , 5^{th} Edn
2. Quantum Mechanics-Leonard I Schiff ,3rd Edn
3. Quantum Mechanics-V K Thankappan , 5^{th} Edn
4. Principles of Quantum Mechanics-R Shankar, 2^{nd} Edn

WEB RESOURCES:

1. **https://nptel.ac.in/courses/115101010**

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	**Limitations of Classical Physics and Emergence of Quantum theory (Book :1, Chapter-2 & 4; Book: 4, Chapter-1)**		**12**	
	1	Black Body Radiation	4	1
	2	Photoelectric Effect	2	1
	3	Compton effect	2	1
	4	Bohr atom model	2	1
	5	Stability of atoms, Atomic spectra, Correspondence Principle	2	1
II	**Wave packets and wave functions (Book:1, Chapter-3; Book:2- Chapter 1; Book:3, Chapter-2; Book:4, Chapter-2)**		**12**	
	1	Wave particle duality, de Broglie Wave, Electron diffraction - Experimental confirmation	3	3
	2	Wave packet, group velocity, phase velocity	2	2

	3	Wave functions, properties of wave function, statistical interpretation and normalisation of wave functions	3	2
	4	de Broglie's explanation for Bohr's quantisation condition for angular momentum, Application of wave nature of electrons - electron microscope	2	2
	5	Uncertainty Principle and its applications- non existence of electron inside the nucleus, width of spectral lines	2	2
III	**Schrodinger Equation (Book:2- Chapter 1; Book:3, Chapter-2 & 3; Book:4, Chapter-3)**		**12**	
	1	Postulates of Quantum Mechanics: wave functions, superposition principle, physical quantities and their operators (position, momentum, angular momentum, time and energy), expectation value, eigen functions and eigenvalues, time evolution of wave function	2	4
	2	Time dependent Schrodinger Equation	3	4
	3	Time independent Schrodinger equation and stationary states	3	5
	4	Commutation operation: properties, operator form of uncertainty principle	2	5
	5	General uncertainty relation	2	5
IV	**One Dimensional energy eigen value problems (Book:2, Chapter2; Book:3, Chapter-4; Book:4, Chapter-4)**		**12**	
	1	Free particle	2	5
	2	Particle in infinite square well potential (particle in a box), energy levels for particle in a box problem	3	5
	3	Particle in finite square well potential	4	5
	4	Finite square barrier potential (No Derivation), Ideas of Quantum Tunnelling	2	5
	5	Harmonic oscillator (No Derivation), Energy expression	1	5
V*	**Mathematical Formulation of quantum mechanics (Book:3, Chapter 3; Book:4, Chapter-5)**		**12**	
	1	Linear vector space, linear operators, Dirac Notation	4	6

	2	Hilbert space – properties	2	6
	3	Hermitian operators: properties and examples	2	6
	4	Unitary operators: properties and general form	2	6
	5	Schrodinger's cat paradox	2	3

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Recognize the limitations of Classical Physics and to understand the quantum concept-based explanation.	U	PSO-1
CO-2	Identify the properties and quantum mechanical concepts applicable to Physical systems	U	PSO-1,2
CO-3	Learn the physical and mathematical concepts of quantum physics	U	PSO-1,2
CO-4	Apply the concept of quantum mechanics to derive equations and solve problems	Ap	PSO-1,2
CO-5	Employ the quantum mechanical concept to explain certain physical phenomena and Analysis of specific problems.	Ap,An	PSO-1,2
CO-6	Application and evaluation of the operators to explain various physical states	U, Ap	PSO-1,2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: QUANTUM MECHANICS I

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Recognize the limitations of Classical Physics and to understand the quantum concept-based explanation.	PO1/ PSO1	U	F, C	L	-
CO-2	Identify the properties and quantum mechanical concepts applicable to Physical systems	PO1/ PSO1,2	U	C	L	-
CO-3	Learn the physical and mathematical concepts of quantum physics	PO1/ PSO1,2	U	C	L	-
CO-4	Apply the concept of quantum mechanics to derive equations and solve problems	PO2/ PSO1,2	Ap	C	L	-
CO-5	Employ the quantum mechanical concept to explain certain physical phenomena and Analysis of specific problems.	PO2/ PSO1,2	Ap, An	C	L	-
CO-6	Application and evaluation of the operators to explain various physical states	PO1/PSO 1,2	U, Ap	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PS	PS	PS	PS	PS	PS	PS	PO	PO	PO	PO	PO	PO	PO	PO
CO-1	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO-2	2	2	-	-	-	-	-	2	-	-	-	-	-	-	-
CO-3	2	2	-	-	-	-	-	2	-	-	-	-	-	-	-
CO-4	2	1	-	-	-	-	-	-	1	-	-	-	-	-	-
CO-5	2	3	-	-	-	-	-	-	3	-	-	-	-	-	-
CO-6	1	2	-	-	-	-	-	2		-	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	✓	-	✓
CO-6	✓	✓	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK5DSCPHY302**				
Course Title	**THERMODYNAMICS AND STATISTICAL MECHANICS**				
Type of Course	**DSC**				
Semester	**V**				
Academic Level	**300 - 399**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites	1. Students should know the basic concept of heat, temperature, calorimetry, specific heat capacities and latent heat 2. Students should be aware of transfer of heat through conduction, convection, and radiation. 3. Students should be familiar with Thermal equilibrium, Zeroth law and first law of thermodynamics 4. Students should know the basics mathematics of permutations, combinations, logarithm, and Sterling's approximation				
Course Summary	• Get an essence of the basic concepts of thermodynamics, the first and the second law of thermodynamics, the concept of entropy and the associated theorems, the thermodynamic potentials, and their physical interpretations along with Maxwell's thermodynamic relations and Phase transition • Gain the basic knowledge about the fundamentals of Statistical Mechanics, Maxwell-Boltzmann distribution law. • Learn about thermal conductivity, black body radiations, Stefan's law, and Planck's law and their significances.				

	• In the laboratory course, the students are expected to: Measure of Planck's constant using black body radiation, coefficient of thermal conductivity of a bad conductor, determine the temperature coefficient of resistance, study variation of thermo-emf across two junctions of a thermocouple with temperature etc.

BOOKS FOR STUDY:

1. Heat and Thermodynamics and Statistical Mechanics: Brijlal , Subramaniam, P S Hemne, S. Chand &Co (2021).
2. Heat and Thermodynamics: M. Zemansky, McGraw Hill, New Delhi (2007).
3. " How things works – The Physics of everyday life" Louis A Bloomfield , 5^{th} Edition, Wiley Publications (2013)

BOOKS FOR REFERENCE:

1. Heat and Thermodynamics: D. S. Mathur, S. Chand & Sons, New Delhi (1995)
2. Statistical Mechanics, Sathyaprakash, Kedar Nath Ram Nath, Delhi, Edn (2021).
3. Statistical Mechanics, B K Agarwal, Melvin Eisner, New Age International (P) Limited, Publishers London – Dew Delhi (2024).
4. Introduction to Statistcal Mechanics, S K Sinha, Narosa publishing House Pvt. Limited.
5. Heat and Thermodynamics: Rose C. McCarthy, The Rosen Publishing Group, Inc. NY, (2005).
6. Thermodynamics Kinetic Theory and Statistical Thermodynamics: F. W. Sears and G.L. Salinger, Addison-Wesley Publishing Company, 3rd Edn. (1975).
7. Thermal and Statistical Mechanics: S. K. Roy, New Age International- 2001

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	**TRANSFER OF HEAT (Book 1)**		**11**	
	1	Thermoelectric effects – Seebeck, Peltier and Thomson effects, Thermoelectric power	2	3
	2	Thermal conductivity – Radial flow of heat, cylindrical flow	2	3
	3	Black body radiation – Discussion of black body radiation curve, Wein's Displacement Law, Rayleigh - Jeans Law,	3	1, 3

		Planck's Quantum Postulates- Radiation law, Stefan Boltzmann law (Proof not required).		
	4	Air conditioning System– Equipments used in Air conditioning system, Classification of Air Conditioning systems- Summer Air conditioning system, Winter Air Conditioning System.	3	1, 3
	5	Global Warming – Effects, Efforts to control Global warming	1	3
II	**THERMODYNAMICS (Book 1, 2, 3)**		**14**	
	6	Thermodynamic Equilibrium, Equation of state, Hydrostatic systems, Work in changing the volume of hydrostatic system, stretched wire, P V diagram. (Book 2)	4	3
	7	First law of thermodynamics, Thermodynamic processes – Isothermal, Adiabatic, reversible, and irreversible, Isobaric and Isochoric, adiabatic expansion of gas, cyclic processes (Basic ideas)	2	1, 3
	8	Expression for work done in isothermal and adiabatic process	1	3
	9	Carnot's Ideal Heat engine	2	3
	10	Petrol engine & Diesel engine – working and efficiency, Multi Cylinder Engines(Book 1), Diesel Engines and Turbochargers (Book3)	4	1, 3
	11	Second law of thermodynamics – Clausius and Kelvin - Planck statements, Refrigerator (Qualitative idea)	1	3
III	**ENTROPY (Book 1, 2)**		**5**	
	12	Change in entropy – physical Concept, Change of entropy in reversible and irreversible thermodynamic processes.	1	4
	13	Principle of increase of entropy, Heat Death of universe	1	1, 4
	14	T -S diagram (Book 2)	1	4
	15	Change in Entropy for the conversion of ice to steam	1	4
	16	Nernst theorem and third law of thermodynamics, Zero-point energy	1	1, 4

IV	**THERMODYNAMIC POTENTIALS AND MAXWELL'S RELATIONS (Book 1)**		**7**	
	17	Basic concept of thermodynamic variables & potentials	1	5
	18	Internal energy, enthalpy, Helmholtz free energy, Gibb's free energy – Physical Significance	1	5
	19	Relation of thermodynamic Potentials with variables - Maxwell's thermodynamic relations - Clausius - Clapeyron's Latent Heat equation	3	5
	20	Change of phase - Phase diagram – first and second order phase transitions	2	5
V*	**STATISTICAL MECHANICS (Book 1)**		**9**	
	21	Statistical Basis – Probability, Principle of equal A priory, probability	1	6
	22	Macrostates and Microstates, Phase space	1	6
	23	Density of quantum states of energy of a particle	1	6
	24	Statistical Ensembles – Microcanonical, Canonical, Grand Canonical	1	6
	25	Partition function	1	6
	26	Maxwell – Boltzmann statistics- Energy and velocity distribution – Derivation	2	6
	27	Need of Quantum statistics, Maxwell - Boltzmann statistics, Bose - Einstein statistics, Fermi - Dirac statistics – Comparative study only	2	6

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	To determine the coefficient of thermal conductivity of Cu by Searle's apparatus.	2
2	To determine the coefficient of thermal conductivity of a bad conductor by Lee's disc method.	2

3	To determine the temperature coefficient of resistance by Carey Foster's Bridge.	2
4	To study the variation of thermo-emf across two junctions of a thermocouple with temperature.	2
5	To determine mechanical equivalent of heat, J, by Callender and Barne's constant flow method.	2
6	Determination of thermal conductivity of rubber.	2
7	Measurement of Planck's constant using black body radiation.	2
8	Characteristics of Thermistor.	2
9	Determine the specific heat capacity of water	2
10	Determine the Latent heat of fusion of ice	2
Part B* – At least One Experiment to be performed		
11	Verification of Newton's Law of Cooling.	2
12	Phase transition-determination of Melting Point of wax	2
13	To determine the temperature coefficient of resistance using Platinum Resistance Thermometer using Callender and Griffith Bridge	2

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe the fundamental laws of thermal Physics, Thermodynamics and Statistical Mechanics and interpret its significance.	U, Ap	PSO - 1
CO-2	Identify the thermal properties, applications of heat transfer, various thermodynamic processes and judge the efficiency of engines by comparing the performance of various vehicles	R, U, Ap	PSO-1,2
CO-3	Distinguish entropy and available energy in various thermodynamic processes and illustrate various phase transitions	U, Ap	PSO – 1, 2

CO-4	Describe thermodynamic variables, thermodynamic potentials, and its physical significance and hence derive maxwell's equations	U	PSO – 1, 2
CO-5	Able to explain phase space, microstate, microstate, ensemble and learn to distinguish different statistical distributions and judge which distribution applies to a given system	U, Ap	PSO – 1, 2
CO-6	Identify thermal properties of materials, inculcate experimental skills, and appraise the temperature dependent properties through experimentation.	U, Ap, An	PSO – 1, 2, 7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: THERMODYNAMICS AND STATISTICAL MECHANICS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Describe the fundamental laws of thermal Physics, Thermodynamics and Statistical Mechanics and interpret its significance.	PSO - 1	U, Ap	C	L	-
CO-2	Identify the thermal properties, applications of heat transfer, various thermodynamic processes and judge the efficiency of engines by comparing the performance of various vehicles	PSO-1,2	R, U, Ap	C	L	-

CO-3	Distinguish entropy and available energy in various thermodynamic processes and illustrate various phase transitions	PSO – 1, 2	U, Ap	C	L	-
CO-4	Describe thermodynamic variables, thermodynamic potentials, and its physical significance and hence derive maxwell's equations	PSO – 1, 2	U	C	L	-
CO-5	Able to explain phase space, microstate, microstate, ensemble and learn to distinguish different statistical distributions and judge which distribution applies to a given system	PSO – 1, 2	U, Ap	C	L	-
CO-6	Identify thermal properties of materials, inculcate experimental skills, and appraise the temperature dependent properties through experimentation.	PSO – 1, 2, 7	U, Ap, An	P		P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	3	-	-	-	-	-	-	1	1	-	2	-	2	-	-
CO-2	3	3	-	-	-	-	-	3	3	3	2	-	2	1	-
CO-3	3	3	-	-	-	-	-	3	3	2	1	-	1	1	-
CO-4	3	3	-	-	-	-	-	3	3	2	2	-	2	-	-
CO-5	3	3	-	-	-	-	-	3	3	1	2	-	2	-	-
CO-6	3	3	-	-	-	-	3	3	3	3	3	3	3	2	3

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	✓	-
CO-3	✓	✓	-	✓
CO-4	✓	-	-	✓
CO-5	✓	-	-	✓
CO-6	✓	-	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK5DSEPHY300</td></tr>
<tr><td>Course Title</td><td colspan="5">DYNAMICS OF THE ATMOSPHERE</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSE</td></tr>
<tr><td>Semester</td><td colspan="5">V</td></tr>
<tr><td>Academic Level</td><td colspan="5">300 - 399</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 Hrs</td><td>-</td><td>-</td><td>4 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">1. The students should be familiar with the co-ordinate systems and equation of motion
2. The students should have basic idea about viscosity, turbulence and diffusion
3. The students should have basic understanding about monsoon and cyclones</td></tr>
<tr><td>Course Summary</td><td colspan="5">This course introduces with a study of the role of dynamics in the general physics of the atmosphere and the observed large-scale phenomenology of the atmosphere. The governing laws of atmospheric motion are given in the first module. The real and apparent forces that appear in the equation of motion on a rotating coordinate system are described. Global circulation patterns and the models to explain them are given in the second module. An introduction to various atmospheric waves are discussed in the third module. The atmospheric boundary layer that exists very close to the earth's surface is important and plays a crucial role in the transport of momentum, mass and energy through processes which are responsible for various weather phenomena. The fourth module includes earth's atmospheric boundary layer and its characteristics. In</td></tr>
</table>

	the fifth module various meteorological systems in the low latitudes such as monsoon and tropical cyclones are discussed.

BOOKS FOR STUDY:

1. Atmospheric Science : An Introductory Survey : Second Edition, John M Wallace and Peter V. Hobbs, ELSEVIER, 2006
2. Basis of Atmospheric Science, A Chandrasekhar, PHI., 2010
3. Physics of the Atmosphere and Climate : Murry L. Salby, Cambridge University Press
4. Essentials of Meteorology – An Invitation to the Atmosphere, Third Edition, C Donald Adherens

BOOKS FOR REFERENCE:

1. Dynamics in Atmospheric Physics, R.S. Lindzen, Cambridge University Press, 1990,(online publication, 2009)
2. An Introduction To Atmospheric Physics, Second Edition, David G. Andrews, Cambridge University Press, 2010

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Governing Laws of Atmospheric Motion (Book : 1 – Chapter: 7; Book : 2 – Chapter: 6,7)**	**12**	
	1	Equation of Motion in a Rotating Co-ordinate system	2	1
	2	Apparent and Real forces – Centrifugal forces, Coriolis force, Frictional forces, Pressure Gradient Force	2	1
	3	Conservation of mass – continuity equation	2	1
	4	Circulation and Vorticity	2	1
	5	Geostrophic Wind, Gradient Wind, Inertial Flow, Cyclostrophic flow, Thermal Wind	2	1
	6	Barotropic and Baroclinic Atmosphere	1	1
II		**General Circulation (Book : 4 – Chapter: 7)**	**12**	
	7	General Circulation Models – Single Cell Model, Tri Cell Model	2	2
	8	Hadley Cell, Ferrel Cell, Polar Cell	2	2

	9	Pressure Zones – Equatorial low, Inter tropical Convergence Zone (ITCZ), Subtropical high, Subpolar low, Polar high	2	2
	10	Westerlies, Jet Streams, Polar Jet Stream, Subtropical Jet Stream	2	2
	11	Global Distribution of Precipitation, ocean currents	2	2
	12	Walker Circulation, El- Nino- La Nina- Southern Oscillation (ENSO)	2	2
III	**Atmospheric Waves (Book : 2 – Chapter: 9)**		**12**	
	13	Characteristics of Waves	2	4
	14	Rossby Waves, Rossby Waves in Barotropic Atmosphere	2	3,4
	15	Gravity Waves, Gravity Waves in Shallow Water, Atmospheric tides	3	3,4
	16	Orographic and Sound Waves	2	3,4
	17	Internal Gravity Waves	1	3,4
	18	Equatorial Waves - Mixed Rossby Gravity Waves, Equatorial Kelvin Wave	2	3,4
IV	**Atmospheric Boundary Layer (Book : 1 – Chapter: 9 ; Book : 2 – Chapter: 8)**		**12**	
	19	Viscosity- Expression for Viscosity from Kinetic theory	2	5
	20	Viscous Forces in the Equation of Motion	2	5
	21	Turbulence and Diffusion	1	5
	22	Equation of Mean Motion in Turbulent Flow	2	5
	23	Mixing Length	1	5
	24	Surface Layer and Ekman Layer	2	5
	25	Secondary Circulations and Spin-Down in the Atmosphere	2	2
V*	**Meteorological Systems in Low Latitudes (Book : 2 – Chapter: 11)**		**12**	
	26	Differential Heating of Land and Sea - Compressibility, Rotation and Moisture Effects	1	6

	27	Tropical and Oceanic Convergence Zones	1	6
	28	Indian Monsoon- Intraseasonal and Interannual Variability of Indian Monsoon	1	6
	29	Monsoon Disturbances over India – Monsoon Depressions, Onset Vortex, Mid-tropospheric Cyclone, Offshore Trough	2	6
	30	Semi-permanent Monsoon Systems Over India – Heat Low, Monsoon Trough, Tropical Easterly Jet, Tibetan Anticyclone	2	6
	31	ENSO and Indian Monsoon	1	6
	32	Tropical Cyclones- Factors responsible for Formation of Tropical Cyclone, Life cycle of a Tropical Cyclone	2	6
	33	Thunderstorms and Tornadoes, Life Cycle of Thunderstorms	2	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Review of various coordinate systems and understand the forces existing in the atmosphere	R,U	PSO-1,2,3
CO-2	Comprehend various circulation patterns and global distribution of precipitation	U	PSO-1,2,3
CO-3	Delineate different type of waves existing in the atmosphere	U	PSO-1,3
CO-4	Describe the generation and propagation of atmospheric waves	U	PSO-1,3
CO-5	Discuss the concept of viscosity in the atmosphere and understand turbulence and diffusion	R,U	PSO-1,2,3
CO-6	Realise the monsoon variability over low latitude region and the factors affecting the generation of monsoons, tropical cyclones over low latitudes	U, Ap	PSO-1,3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: DYNAMICS OF THE ATMOSPHERE

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Review of various coordinate systems and understand the forces existing in the atmosphere	PO 1/ PSO-1,2,3	R,U	F, C	L	-
CO-2	Comprehend various circulation patterns and global distribution of precipitation	PO 1/ PSO-1,2,3	U	C	L	-
CO-3	Delineate different type of waves existing in the atmosphere	PO 1/ PSO-1,3	U	F,C	L	-
CO-4	Describe the generation and propagation of atmospheric waves	PO 1/ PSO-1,3	U	F,C	L	
CO-5	Discuss the concept of viscosity in the atmosphere and understand turbulence and diffusion	PO 1/ PSO-1,2,3	R,U	C	L	-
CO-6	Realise the monsoon variability over low latitude region and the factors affecting the generation of monsoons, tropical	PO 1/ PSO-1,3	U,Ap	C	L	-

	cyclones over low latitudes					

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	1	2	-	-	-	-	2	-	-	-	-	-	-	-
CO-2	2	2	2	-	-	-	-	2	-	-	-	-	-	-	-
CO-3	2		1	-	-	-	-	1	-	-	-	-	-	-	-
CO-4	2		2	-	-	-	-	2	-	-	-	-	-	-	-
CO-5	2	2	2	-	-	-	-	2	-	-	-	-	-	-	-
CO-6	2		1	-	-	-	-	2	-	-	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	✓	✓
CO-2	✓	-	✓	✓
CO-3	✓	-	✓	✓
CO-4	✓	✓	✓	✓
CO-5	✓	✓	✓	✓
CO-6	✓	✓	✓	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK5DSEPHY301**				
Course Title	**TRANSISTOR AMPLIFIERS AND OSCILLATORS**				
Type of Course	**DSE**				
Semester	**V**				
Academic Level	**300 - 399**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 Hrs	-	-	4 Hrs
Pre-requisites					
Course Summary	To equip the student to understand the theory of different amplifier and oscillator circuits using transistors. It also gives an idea regarding different breakdown devices and FET.				

BOOKS FOR STUDY:

1. Basic Electronics Solid State: B. L. Theraja, S Chand & Company LTD.
2. Principles of Electronics, V K Mehta and Rohith Mehta, S Chand & Company LTD.
3. Electronic Devices and Circuit theory, Robert *Boylestad*

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	**Large Signal Amplifiers (Book 1, Chapter 22)**		**12**	
	1	Power Amplification: Class A, Class B, Class C Operations	2	1
	2	Power rectangle and power efficiency	2	1

	3	Class B Push-Pull Amplifier Circuit	2	1,3
	4	Complementary Symmetry Push-Pull amplifier and crossover distortion	2	1,3
	5	Distortion in Amplifiers: linear and nonlinear distortions	3	1
	6	Noise and Noise Figure	1	1
II		**Sinusoidal Oscillators (Book 1, Chapter 28)**	**12**	
	7	Oscillator circuit and Barkhausen criterion for sustained oscillations,	1	1
	8	Tuned Base Oscillator	2	1,6
	9	Tuned Collector Oscillator	2	1,6
	10	Hartley Oscillator - Colpitt's Oscillator - Clapp Oscillator - Phase Shift Oscillator (derivations not required for all oscillators)	3	1,6
	11	Wien Bridge Oscillator.	2	1,6
	12	Crystal: piezoelectric effect, equivalent electric circuit, Q-factor, temperature coefficient - Crystal Controlled Oscillators	2	1,2
III		**Nonsinusoidal Oscillators (Book 1, Chapter 29)**	**12**	
	13	Nonsinusoidal Waveforms – mark-to-space ratio, pulse repetition time, pulse repetition frequency	2	1,6
	14	Classification of Nonsinusoidal Oscillators	2	1,6
	15	Multivibrators - Astable Multivibrator	2	6
	16	Monostable Multivibrator	2	6
	17	Bistable Multivibrator	2	6
	18	Schmitt Trigger	2	6
IV		**Field Effect Transistors (Book 1, Chapter 26)**	**12**	
	19	FET - JFET: Structure, Theory of Operation	3	2

	20	JFET Characteristics and JFET Parameters	3	5
	21	Common source JFET Amplifier	2	2
	22	MOSFET - DE MOSFET and E only MOSFET Working and Characteristics	4	2,5
V*	**Breakdown Devices (Book 1, Chapter 27)**		**12**	
	23	Unijunction Transistor (UJT)	2	4
	24	UJT Relaxation Oscillator	2	6
	25	Silicon Controlled Rectifier (SCR), 90^0 phase control of SCR	3	4
	26	Triac and Diac	3	4
	27	Silicon Controlled Switch	2	4

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the basics of Analog electronic functions.	U, R	**1**
CO-2	Analyse different solid-state devices	An	3
CO-3	Analyse transistor amplifier circuits	Ap, An	3
CO-4	Understand the working of breakdown devices	U	1
CO-5	Analyze the V-I characteristics of the circuits	E	2
CO-6	Describe oscillator circuits	U	1,2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: TRANSISTOR AMPLIFIERS AND OSCILLATORS

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO	CO	PO /	Cognitive	Knowledge	Lecture (L)/	Practical

No.		PSO	Level	Category	Tutorial (T)	(P)
CO-1	Understand the basics of Analog electronic functions.	PO 1/ PSO 1	U, R	F	L	
CO-2	Analyse different solid-state devices	PO 1/PSO 3	An	C	L	
CO-3	Analyse transistor amplifier circuits	PO2/ PSO 3	Ap, An	P	L	P
CO-4	Understand the working of breakdown devices	PO 1/ PSO 1	U	C	L	
CO-5	Analyze the V-I characteristics of the circuits	PO1 /PSO 2	E	P	L	P
CO-6	Describe oscillator circuits	PO1, 3/ PSO 1,2	U	C, P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO-2	-	-	2	-	-	-	-	1	-	-	-	-	-	-	-
CO-3	-	-	2	-	-	-	-	-	1	-	-	-	-	-	-
CO-4	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO-5	-	3	-	-	-	-	-	1	-	-	-	-	-	-	-
CO-6	3	3	-	-	-	-	-	1	-	1	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	-	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	-	-	-
CO-5	✓	-	-	✓
CO-6	✓	✓	-	✓

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK5DSEPHY302</td></tr>
<tr><td>Course Title</td><td colspan="5">CHARACTERIZATION OF NANO MATERIALS</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSE</td></tr>
<tr><td>Semester</td><td colspan="5">V</td></tr>
<tr><td>Academic Level</td><td colspan="5">300 - 399</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 Hrs</td><td>-</td><td>-</td><td>4 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5"></td></tr>
<tr><td>Course Summary</td><td colspan="5">Structural Characterization, Microscopic and Morphological Analysis, Spectroscopy. Electrical, Mechanical, Magnetic, Thermal and Optical Properties of nanomaterials.</td></tr>
</table>

BOOKS FOR STUDY:

1. Nanotechnology - Enabled Sensors, Kourosh Kalantar-zadeh and Benjamin Fry, Springer (2008).
2. Introduction to Nanoscience and Nanotechnology by Chattopadhyay, PHI, India
3. Handbook of Microscopy for Nanotechnology, Ed. By Nan Yao and Zhong Lin Wang, Kluwer Academic Press, (2005).
4. Nanostructures & Nanomaterials: Synthesis, Properties & Applications, Guozhong Gao, Imperial College Press, (2004).
5. Encyclopaedia of Materials Characterization, C. Richard Bundle, Charles A. Evans Jr., Shaun Wilson, Butterworth-Heinemann Publishers, (1992).
6. Nano chemistry, G. B. Sergeev, Elsevier, (2006).
7. Nanotechnology: Principles and Practices, Third Edition, by Sulabha K. Kulkarn (2014)

8. Cyclic Voltammetry Basic Principles, Theory & Setup(https://www.ossila.com/pages/cyclic-voltammetry) Written by Dr. Chris Bracher, Harry Robson and Dr. Max Reinhardt
9. Vibrating Sample Magnetometry, Brad Dodrill, Jeffrey R. Lindemuth,Pages 15-37.
10. The SQUID Handbook: Fundamentals and Technology of squids and SQUID Systems, I by Book Editor(s):Prof. Dr. John Clarke, Prof. Dr. Alex I. Braginski, (Chapter 2-SQUID Theory)
11. Thermal Analysis From Introductory Fundamentals to Advanced Applications, El-Zeiny Ebeid, Mohamed Barakat Zakaria, Paperback ISBN: 9780323901918, e-Book ISBN: 9780323901925 (1st Edition - June 23, 2021)
12. Dr. anchal srivastava, https://ebooks.inflibnet. ac.in/msp09/chapter/photoluminescence-pl-spectra/)
13. Superconducting quantum interference device (squid) aaron kraft, christoph rupprecht, yau-chuen yam, ubc physics 502 project (2017 fall)

BOOKS FOR REFERENCE:

1. Nanotechnology: Basic Science and Emerging Technologies – Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons, Burkhard Raguse, Overseas Press, (2005)
2. Nanocomposite Science and Technology, Pulickel M.Ajayan, Linda S.Schadler, Paul V. Braun,Wiley-VCH Verlag, Weinheim, (2003).
3. Introduction to Nanoscience, S. M. Lindsay, 1st Edition, Oxford University Press, (2010).

WEB REFERENCE

1. https://nptel.ac.in/courses/118/104/118104008/
2. https://nptel.ac.in/courses/113/107/113107081/
3. https://www.classcentral.com/course/swayam-structural-analysis-of-nanomaterials-14310

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	**Structural Characterization (Book 1)**		**12**	
	1	X-ray diffraction (XRD) technique, Powder X-ray diffractometer	3	1,2
	2	Strain (W-H plot) and Particle size determination using Scherer formula, Applications of XRD.	5	1,2
	3	Infrared Spectroscopy and Raman Spectroscopy	4	1,2

II	**Microscopic and Morphological Analysis**		**12**	
	4	Introduction to Optical microscopy (Book 3)	1	4
	5	Field Emission Scanning Electron Microscopy (FESEM) and Energy Dispersive x-ray spectroscopy (EDS) (Book 2)	3	4
	6	Transmission Electron Microscopy (TEM) – Basic Instrumentation, SAED pattern, Bright Field and Dark field image analysis (Book 2)	3	4
	7	Scanning tunnelling microscope (STM) (Book 7)	3	4
	8	Brunauer – Emmer – Teller Surface area analysis (BET). (Book 5)	2	4
III	**Spectroscopy**		**12**	
	9	Photoelectron Spectroscopy (X-Ray Photoelectron Spectroscopy) (Book 7)	4	3
	10	Mass Spectroscopy – Secondary Ion Mass Spectroscopy (SIMS) –ICPMS (Book 5)	4	3
	11	Nuclear magnetic resonance (NMR) – Electron spin resonance (ESR). (Book 1)	4	3
IV	**Electrical, Mechanical and Magnetic Properties**		**12**	
	12	Electro analytical Techniques: Potentiometry – Cyclic Voltammetry (Book: 8)	4	4
	13	Vibrating sample magnetometer (Book:9)	4	4
	14	SQUID elementary ideas only (Book: 10, Chapter 2 & Book:13)	4	4
V*	**Thermal and Optical Properties (Book 11: Chapter 1)**		**12**	
	15	Differential scanning calorimeter (DSC) (Book 11)	3	4
	16	Thermogravimetric/Differential thermal analyzer (TG/DTA) (Book 11)	3	4
	17	Photoluminescence (PL) Emission and Excitation spectra (Book 12) Photoluminescence (PL) Spectra,	6	4

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	List and classify characterization techniques for structure of nanomaterials	R, U	PSO-1,2
CO-2	Classify and interpret different structural parameters of nanomaterials	U, Ap	PSO-3
CO-3	Analyse about different spectroscopic techniques to characterize nanomaterials	An	PSO-5,7
CO-4	Analyse and evaluate different instruments to quantify the properties of materials	An, E	PSO-3,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: CHARACTERIZATION OF NANO MATERIALS

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	List and classify characterization techniques for structure of nanomaterials	PO1,2, 3/ PSO-1,2	R, U	F, C	L	-
CO-2	Classify and interpret different structural parameters of nanomaterials	PO1,2,3/ PSO-3	U, Ap	F, C	L	-
CO-3	Analyse about different spectroscopic techniques to characterize nanomaterials	PO1,2,3,7,8/ PSO-5,7	An	F, C	L	-
CO-4	Analyse and evaluate different instruments to quantify the properties of materials	PO1,2,3,7,8/ PSO-3,7	An, E	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	2	-	-	-	-	-	1	1	1	-	-	-	-	-
CO-2	-	-	3	-	-	-	-	2	2	2	-	-	-	-	-
CO-3	-	-	-	-	2	-	2	2	2	2	-	-	-	1	1
CO-4	-	-	2	-	-	-	3	2	2	2	-	-	-	1	1

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	-	-	-	✓
CO-3	-	-	-	✓
CO-4	✓	-		-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK5DSEPHY303</td></tr>
<tr><td>Course Title</td><td colspan="5">SOLAR AND PLASMA PHYSICS</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSE</td></tr>
<tr><td>Semester</td><td colspan="5">V</td></tr>
<tr><td>Academic Level</td><td colspan="5">300 - 399</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 Hrs</td><td>-</td><td>-</td><td>4 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Basic idea about the physical properties and structure of sun and earth.</td></tr>
<tr><td>Course Summary</td><td colspan="5">This course intends to provide detailed study of solar activities, solar plasma and space weather. On completion of the course students will get a comprehensive understanding of the various solar activity aspects and its effect on space weather.</td></tr>
</table>

BOOKS FOR STUDY:

1. Physics of Space Weather Phenomena: A Review Ashok Kumar Singh,*et al*, Geosciences,2021
2. Gombosi, T. I., Physics of the Space Environment, Cambridge University Press, 1998
3. The Solar Terrestrial Environment, J. K. Hargreaves, Cambridge Atmospheric and space science
4. Handbook of the Solar-Terrestrial Environment, YohsukeKamide Abraham C.-L. Chian, Springer
5. Solar activity and earth's climate, Rasmus E Benestad, Springer
6. The Sun, the Earth, and Near-Earth Space,John A Eddy,NASA

BOOKS FOR REFERENCE:

1. Introduction to Plasma Physics,Chen F F Plenum Press New York 1990
2. Introduction to Space Science, Ji Wu, Springer
3. Introduction to Space Physics - M. Kivelson, C. Russell, Cambridge University Press
4. Sun Earth and Sky, Kenneth R Lang, Springer

WEB RESOURCES:

1. https://scied.ucar.edu/learning-zone/sun-space-weather/predicting-space-weather
2. https://science.nasa.gov/sun/exploration/
3. https://www.ngdc.noaa.gov/stp/solar/solar-indices.html

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	**Solar Wind** (Book 1: section 2, Book 2: chapter 12, Book 3: chapter 4 & 5)		**08**	
	1	Solar Corona and origin of solar wind, Types and sources of solar wind	3	1
	2	Co-rotating interaction regions (CIR), termination shock, heliosheath, heliopause	2	1
	3	Interplanetary Magnetic Field: Field lines and streamlines, Parker spiral.	3	1
II	**Sunspots** (Book 4: chapter 1 & 2, Book 5: chapter 4)		**08**	
	4	Sunspots-Differential rotation and evolution, basic features	3	2
	5	Magnetic fields of sunspots	2	2
	6	Evolution of sunspot number, Variation of sunspot number, solar cycle, Latitude variation of sunspot	3	2
III	**Solar activities and solar indices** (Book 1: section 2, Book 4: chapter 5)		**14**	
	7	Coronal mass ejections- The Physical processes of CME evolution, properties and morphology of CME, ICME: Basics and properties, Interplanetary shock waves	4	3

	8	Solar Flare: origin, Types (Hα, radio, X-ray), characteristics, different stages of solar flare.	5	3
	9	Basic ideas of Solar energetic particle events, Solar radio emission.	3	3
	10	Fundamentals of solar indices- Sunspot number, Coronal index, Solar flare index, solar flux index F10.7, Application	2	3
IV	**Plasma Physics** (Book 2: chapter 3, Book 4: Chapter 10)			**18**	
	11	Occurrence of Plasmas in Nature - Definition of Plasma - Concept of Temperature - DebyeShielding	3	4
	12	The Plasma Parameter - Criteria for Plasmas, Application in space physics and Astrophysics	3	4
	13	Plasma waves: Electromagnetic Waves and magnetic field	3	4
	14	Alfven waves- Hydromagnetic Waves, Magnetosonic Waves – Hydro-magnetic Equilibrium	6	4
	15	Idea of plasma β, diffusion of magnetic field into plasma	3	4
V*	**Space weather** (Book 4: chapter 17, Book 6: chapter 8 & 9)		**12**	
	16	Importance of space weather and Factors affecting space weather-Effect of space weather in terrestrial life	3	3
	17	Prediction of space weather-methods and techniques, Space weather events	4	5
	18	Satellite based observations of Sun- SOHO, ACE, Aditya L1, Parker Solar Probe (Basic ideas), Challenges and Technology	5	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Define solar wind and its properties	U	3
CO-2	Describe sunspots and its basic features	U	3

CO-3	Describe different solar activities and solar indices and its applications	U, Ap	3
CO-4	Discuss the basics of plasma physics and its importance in solar physics	U	3
CO-5	Explain different solar observational methods and techniques and differentiate these methods.	U, An	3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: SOLAR AND PLASMA PHYSICS

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Define solar wind and its properties	PO 1/ PSO 3	U	F,C	L	-
CO-2	Describe sunspots and its basic features	PO 1/ PSO 3	U	F,C	L	-
CO-3	Describe different solar activities and solar indices and its applications	PO 1,2,7/ PSO 3	U, Ap	F,C	L	-
CO-4	Discuss the basics of plasma physics and its importance in solar physics	PO 1/ PSO 3	U	F,C	L	-
CO-5	Explain different solar observational methods and techniques and differentiate these methods.	PO 1/ PSO 3	U, An	F,C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	-	-	2	-	-	-	-	1	-	-	-	-	-	-	-
CO-2	-	-	2	-	-	-	-	1	-	-	-	-	-	-	-
CO-3	-	-	2	-	-	-	-	2	1	-	-	-	-	1	-
CO-4	-	-	2	-	-	-	-	1	-	-	-	-	-	-	-
CO-5	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	-	-	✓
CO-5	✓	-	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK5DSEPHY304**				
Course Title	**PHYSICAL ASPECTS OF THERAPEUTICS**				
Type of Course	**DSE**				
Semester	**V**				
Academic Level	**300 - 399**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 Hrs	-	-	4 Hrs
Pre-requisites					
Course Summary	Basic knowledge about basics of radiobiology, neutron radiotherapy. X-ray radiotherapy, charged particle radiotherapy and applications of laser and nanomaterials in medicine.				

BOOKS FOR STUDY:

1. Medical Physics_ Physical Aspects of Therapeutics-De Gruyter (2023) Hartmut Zabel

BOOKS FOR REFERENCE:

1. An Introduction to Medical Physics-Springer International Publishing (2017) Muhammed Maqbool (eds.)
2. Encyclopedia of Medical Physics_ Two Volume Set-CRC Press (2021) Slavik Tabakov, Franco Milano, Magdalena S. Stoeva, Perry Sprawls, Sameer Tipnis, Tracy Underwood

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Radiobiology basics & Neutron radiotherapy (Chapter 1 & 4)**	**14**	
	1	Introduction (Qualitative only) - Life cycle of cells, Tumour cells, Cancer cell development, Tumour growth	2	1

	2	Radiation response of cells - LQ model, Dose fractionation, biological effect of radiation, Reaction distance, Relative biological effectiveness (RBE), Oxygen enhancement ratio.	3	1
	3	Radiation therapies - Dose control, Hypoxia and chemotherapy, Types of radiotherapies, Radiation treatment planning overview, Staging	3	1
	4	Introduction- Neutron energies and lifetime, Fast neutron production by fission	1	1
	5	Accelerator-based neutron sources - ^{9}Be(p,n),^{9}B reaction, ^{9}Be(d,n)^{10}B reaction, ^{3}H(d,n)^{4}He reaction	2	1
	6	Accelerator facility, LET, RBE, and OER of fast neutrons, Boron neutron capture therapy	3	1
II	**X-ray radiotherapy (Chapter 2)**		**10**	
	8	Introduction - Absorbed dose by high-energy photon beam, Percent depth dose for electrons, Percent depth dose for photons, Reference dosimetry and beam quality correction factor, Monte Carlo simulations, Dose to isocenter	4	2
	9	Target volume and collimators- Target volume definition, Multi leaf collimator, Intensity-modulated radiotherapy	2	2
	10	Linear accelerators for x-ray generation	1	2
	11	New developments -Cyber- knife technology, MR-linac hybrid systems, FLASH-RT	2	2
	12	Gamma knife	1	2
III	**Charged particle radiotherapy**		**12**	
	13	Proton beam therapy: overview	1	3
	14	Characteristics of proton beams -Interaction channels, Proton beam range, Beam profile, Formation of SOBP, Beam delivery and scanning, Dose requirements, Charge particle fluence	4	3

	15	Positioning and range monitoring- Treatment plan and positioning, PET monitoring, Prompt gamma monitoring, Patient monitoring	3	3
	16	Examples for proton beam therapy (Basic Idea only)- Posterior fossa tumour, Prostate tumour, Uveal melanoma	1	3
	17	Accelerators and gantries for proton beam therapy	1	3
IV		**Laser applications in medicine**	**12**	
	18	Laser basics- Two-level system, Three-level system, Basic laser components, YAG laser, Laser types, wavelengths, and units, Laser specifications	2	4
	19	Laser pulsation- Mechanical switching, Q-switch, Mode locking	2	4
	20	Laser interaction with tissue- Laser beam penetration depth, Laser-tissue interaction, Photothermal interaction, Photoablation, Plasma-induced ablation, Photomechanical interaction, Photochemical interaction	6	4
	21	Laser applications in ophthalmology- Photorefractive keratectomy, Diabetic retinopathy, Cataract and glaucoma	2	4
V*		**Nanoparticles for nanomedical applications**	**12**	
	22	Pathway of nanoparticles through the body	2	5
	23	Magnetic nanoparticles for diagnostics and therapeutics	3	5
	24	MR imaging contrast	2	5
	25	Metal nanoparticles for diagnostics and therapeutics	1	5
	26	Plasmon resonance	2	5
	27	Imaging and spectroscopy	1	5
	28	Multimodality of theragnostic nanoparticles	1	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify the causes of cancer and tumor, describe the cancer response of cells and relate different radiation therapy techniques.	U, R, Ap	PSO-1,2, 3
CO-2	Describe the instrumentation and techniques of X-ray radiotherapy	R, U	PSO-1,2, 3
CO-3	Explain the instrumentation and outline the characteristics of charged particle radiotherapy.	R, U	PSO-1,2, 3
CO-4	Memorize laser basics, describe the laser interaction with tissues and illustrate the applications of laser in medicine.	R, U, Ap	PSO-1,2, 3
CO-5	Outline the pathway of nanoparticles throughout the body and summarize nanomedical applications	R, U	PSO-1,2, 3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: PHYSICAL ASPECTS OF THERAPEUTICS

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Identify the causes of cancer and tumor, describe the cancer response of cells and relate different radiation therapy techniques.	PO1,2,3 ,4,5,6,8/ PSO-1,2, 3	U, R, Ap	F, C	L	-
CO-2	Describe the instrumentation and	PO1,2,3 ,4,5,6,8/	R, U	F, C	L	-

	techniques of X-ray radiotherapy	PSO-1,2, 3				
CO-3	Explain the instrumentation and outline the characteristics of charged particle radiotherapy.	PO1,2,3,4,5,6,8/ PSO-1,2, 3	R, U	F, C	L	-
CO-4	Memorize laser basics, describe the laser interaction with tissues and illustrate the applications of laser in medicine.	PO1,2,3,4,5,6,8/ PSO-1,2, 3	R, U, Ap	F, C	L	-
CO-5	Outline the pathway of nanoparticles throughout the body and summarize nanomedical applications	PO1,2,3,4,5,6,8/ PSO-1,2, 3	R, U	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	1	2	2	-	-	-	-	2	2	2	2	2	2	-	2
CO-2	2	3	2	-	-	-	-	2	3	2	2	2	3	-	3
CO-3	2	2	1	-	-	-	-	2	2	2	2	2	2	-	2
CO-4	2	3	2	-	-	-	-	2	3	2	3	2	2	-	2
CO-5	1	1	2	-	-	-	-	3	2	2	2	2	3	-	2

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	-	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK5DSEPHY305**				
Course Title	**FORENSIC PHYSICS**				
Type of Course	**DSE**				
Semester	**V**				
Academic Level	**300 - 399**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 Hrs	-	-	4 Hrs
Pre-requisites					
Course Summary	The elective course "Forensic Physics" offers a comprehensive exploration of physics principles as they apply to forensic investigations. Starting with an introduction to forensic science, students gain a foundational understanding of its core concepts and methodologies. The microscopy module delves into advanced techniques for analyzing microscopic evidence. Moving on to blood pattern analysis, students learn the principles of physics behind stain formation and to interpret bloodstains at crime scenes, contributing crucial insights to case reconstructions. The ballistics module introduces the physics of firearms and trajectory analysis, focusing on ballistic evidences. The Physical Evidence module widens the scope to include various types of physical evidence encountered in forensic settings, teaching students how to collect, preserve, and analyze diverse materials using physics principles.				

BOOKS FOR STUDY:

1. Criminalistics: An Introduction to Forensic Science, Richard Saferstein, (12/e), Pearson Education Inc.
2. Forensic Science in Criminal Investigation and trials, Dr. BR.Sharma, (4/e), Universal Law Publishing Co. Pvt. Ltd.
3. Bloodstain Pattern Analysis: With an Introduction to Crime Scene Reconstruction, (3/e), Tom Bevel & Ross M. Gardner, CRC Press.
4. Handbook of Firearms and Ballistics, Brian J. Heard, (2/e), Wiley - Blackwell.

BOOKS FOR REFERENCE:

1. Beginners Forensic Science, Dr. C. Hegde & Dr. R. Shekhar, Himalaya Publishing House.
2. Crime Scene Forensics: A Scientific Method Approach, Robert C Shaler, CRC Press
3. Bloodstain Pattern Analysis in Crime Scenarios, Kacper Choromanski, Springer
4. Solving Crimes with Physics, Carla Miller Nozigia, Mason Crest Publishers

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Introduction to Forensic Science** **[Book 1, Chapter 1,2,3 (sec 1,3,4); Book 2, Chapter 1, sec 2]**	**12**	
	1	Definition and scope of forensic science, History and Development of Forensic Science	2	1
	2	Basic Principles of Forensic Science	1	1
	3	Processing the Crime Scene, Collecting and Packaging Physical Evidences, Maintaining the chain of custody, Ensuring crime scene safety	5	1
	4	Common types of physical evidences, The significance of physical evidences	4	1
II		**Microscopy** **[Book 1, Chapter 8]**	**8**	
	5	Basics of microscope	1	2
	6	The compound microscope	2	2
	7	The comparison microscope	1	2

	8	The Stereoscopic microscope	1	2
	9	The polarizing microscope	1	2
	10	The Spectrophotometer	1	2
	11	The Scanning Electron microscope	1	2
III	**Blood Pattern Analysis [Book 3, Chapter 5]**		**14**	
	12	Spatter droplet dynamics	2	3
	13	Spatter droplet dynamics on impact: {contact/collapse, displacement, dispersion, refraction, liquid-to-liquid impacts}	4	3
	14	Blood behaviour when exposed to different mediums: {Blood dispersed through the air as a function of gravity, Blood dispersed from a point source, Blood ejected from an object in motion, Blood ejected in volume under pressure, Blood that accumulates and/or flows on a surface, Blood deposited through transfer}	8	3
IV	**Ballistics [Book 2, Chapter 9 (sec 15, 16); Book 4, Chapter 3 (sec 17, 18, 19)]**		**14**	
	15	Importance	1	4
	16	Nature -Firearms, Firearm parts, Classifications, Single shot firearms, Repeaters, Ammunition, The firing process.	4	4
	17	Internal Ballistics - Introduction, Velocity, Recoil and muzzle lift, Theory of recoil, Recoil energy.	3	4
	18	External Ballistics - Introduction, Ballistic coefficient, Maximum range of missiles, Angle of elevation of the barrel, Muzzle energy, Momentum.	3	4
	19	Terminal Ballistics - Introduction, General wound ballistic concepts, Other factors influencing the wounding capabilities of a missile, Penetration of bullet-resistant jackets and vests.	3	4

V*	**Physical Evidences [Book 1, Chapter 10 (sec 20,21,22), Chapter 14 (sec 23,24,25)]**		**12**	
	20	Forensic analysis of glass - Composition of glass, Comparing glass fragments, Measuring and comparing density, Determining and comparing refractive index, Classification of glass samples.	3	5
	21	Glass fractures	1	5
	22	Collection and preservation of glass evidences	1	5
	23	Forensic analysis of trace elements - Evidence in the Assassination of President Kennedy	1	5
	24	Forensic examination of paint - Composition of paint, Microscopic examination of paint, Analytical Techniques used in paint comparison, Significance of paint evidence, Collection and Preservation of paint evidence.	3	5
	25	Forensic analysis of soil - Significance of soil evidence, Forensic examination of soil, Variations in soil, Collection and preservation of soil evidence.	3	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe the various aspects in a crime scene including values of physical evidences as well as the physical principles behind their analysis.	R, U	1, 3, 7
CO-2	Connect different features and utility of various microscopes to forensic analysis.	R, U, An	1, 3, 7
CO-3	Examine the general features and physical principles of bloodstain formation	R, U, Ap	1, 3, 7
CO-4	Discuss the physical principles of Forensic Ballistics	R, U	1, 3, 7
CO-5	Illustrate the physical principles behind the forensic analysis of glass, trace elements, paint and soil.	R, U, Ap	1, 3, 7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: FORENSIC PHYSICS

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Describe the various aspects in a crime scene including values of physical evidences as well as the physical principles behind their analysis.	PO-1 PSO-1, 3, 7	R, U, Ap	F, C	L	-
CO-2	Connect different features and utility of various microscopes to forensic analysis.	PO-1, 6 PSO-1, 3, 7	R, U, An	F,C	L	-
CO-3	Examine the general features and physical principles of bloodstain formation	PO-1, 2, 3, 6 PSO-1, 3, 7	R, U, Ap	F,C	L	-
CO-4	Discuss the physical principles of Forensic Ballistics	PO-1, 2, 3, 6 PSO-1, 3, 7	R, U	F,C	L	-
CO-5	Illustrate the physical principles behind the forensic analysis of glass, trace elements, paint and soil.	PO-1, 2, 3, 6 PSO-1, 3, 7	R, U, Ap	F,C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	-	2	-	-	-	1	2	-	-	-	-	-	-	-
CO-2	1	-	1	-	-	-	1	1	-	-	-	-	2	-	-
CO-3	3	-	3	-	-	-	3	3	2	3	-	-	1	-	-
CO-4	2	-	2	-	-	-	1	3	2	3	-	-	1	-	-
CO-5	3	-	2	-	-	-	2	3	2	3	-	-	1	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	✓	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK5DSEPHY306**				
Course Title	**RESEARCH METHODOLOGY**				
Type of Course	**DSE**				
Semester	**V**				
Academic Level	**300 - 399**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 Hrs	-	-	4 Hrs
Pre-requisites					
Course Summary	The aim of this course is to impart research skills to the beginners and help to improve the quality of research by the existing researchers. It also encompasses the understanding of appropriate research design, statistics and report writing.				

BOOKS FOR STUDY:

1. Research Methodology Methods & Techniques, C.R. Kothari – New Age international Publishers, Reprint 2008.
2. Research in Education Best, John W(2003)
3. Fundamentals of Mathematical statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand & Sons, New Delhi,1999.

BOOKS FOR REFERENCE:

1. Santhosh Gupta, Research Methodology and Statistical Techniques, New Delhi: Deep and Deep Publication, 2000.
2. Segha, R.L. Statistical Techniques for Librarians, New Delhi: Ess Ess Publication, 1998.
3. Young, Pauline. Scientific Social Surveys and Research, New York: Prentice Hall, 1982.

4. Creswell, J.W. and Creswell, J.D., 2017. Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications
5. Kaul, Lokesh (1984). Methodology of Educational Research. New Delhi: Vikas Publications
6. Research Methodology, Mukul Gupta, Deepa Gupta – PHI Learning Private Ltd., New Delhi, 2011(units-1,2,3,).

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Introduction (Book.1 chapter1)**	**13**	
	1	Meaning and Objectives of Research	2	1
	2	Different types of Research	2	1
	3	Research approaches	1	1
	4	Significance of Research	2	1
	5	Research methods and methodology	2	1
	6	Criteria of a Good Research	2	1
	7	Ethics of Research and Plagiarism	2	1
II		**Research Design (Book.1 chapter3)**	**12**	
	8	Concept and Importance	1	4
	9	Features of a good research design	2	3
	10	Exploratory Research Design – concept, types and uses	2	3
	11	Descriptive Research Designs – concept, types and uses.	3	2
	12	Experimental Design: Concept of Independent & Dependent variables	3	2
	13	Review of related literature,Hypothesis-Characteristics and Types	1	2
III		**Sampling and interpretation of data (Book.1 chapter4, Book.2 chapter1)**	**11**	

	14	Types and sources of data – primary and secondary	2	4
	15	Concepts and Characteristics of a good sample	4	4
	16	Sampling frame, sample, characteristics of good sample, simple random sampling, purposive sampling, convenience sampling, snowball sampling,	5	4
IV		**Applications of Statistical tools & Methods (Book.2, Book.3)**	**12**	
	17	Diagrammatic & graphical presentation of data	2	5
	18	Data analysis with statistical tools like mean, median, mode; dispersion: variance and deviation	3	5
	19	Analysis of variance : ANOVA and ANOCOVA, correlation, regression	3	5
	20	Hypothesis testing: parametric and nonparametric tests(chi square, t-test, two tailed test, one tailed test etc.)	4	5
V*		**Layout of a Research Report/Thesis writing (Book 1 chapter 14)**	**12**	
	21	Preliminary section (Title page, declaration of author, certificate of supervisor, table of contents, list of tables and figures, preface acknowledgement)	4	5
	22	Main Text (abstract, introduction, experimental section, results and discussion)	4	5
	23	Conclusions, references, scope for future study.	4	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe about the nature, purpose, scope, areas, and types of research methodology	U	PSO-1,2
CO-2	Interpret Research Designs – concept, types and uses.	R, U	PSO-1,2

CO-3	Relate knowledge about Sampling and interpretation of data	U, An	PSO-1,2,4
CO-4	Connect the students with Applications of Statistical tools & Methods	U,An	PSO-1,2
CO-5	Extend the knowledge about Research Report/Thesis writing	U, An	PSO-1,2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: RESEARCH METHODOLOGY

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Describe about the nature, purpose, scope, areas, and types of research methodology	PO 1/ PSO 1,2	U	F, C	L	-
CO-2	Interpret Research Designs – concept, types and uses.	PO 1/ PSO 1,2	R, U	F,C	L	-
CO-3	Relate knowledge about Sampling and interpretation of data	PO 1/ PSO 1,2,4	U, An	F,C	L	-
CO-4	Connect the students with Applications of Statistical tools & Methods	PO 1,2/ PSO 1,2	U,An	F, P	L	-
CO-5	Extend the knowledge about Research Report/Thesis writing	PO 1/ PSO 1,2	U, An	F, M	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	1	1	-	-	-	-	-	1	-	1	1	2	-	-	1
CO-2	2	2	-	-	-	-	-	2	-	1	1	1	-	-	1
CO-3	1	1	-	-	-	-	-	2	-	1	1	1	-	-	1
CO-4	3	3	-	2	-	-	-	2	2	1	2	3	2	-	1
CO-5	3	2	-	-	-	-	-	2	-	1	2	3	-	-	1

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	✓	-	✓

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK5SECPHY300</td></tr>
<tr><td>Course Title</td><td colspan="5">OPTICS IN DIGITAL PHOTOGRAPHY</td></tr>
<tr><td>Type of Course</td><td colspan="5">SEC</td></tr>
<tr><td>Semester</td><td colspan="5">V</td></tr>
<tr><td>Academic Level</td><td colspan="5">300 - 399</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Hands on training per week</td><td>Total Hours/Week</td></tr>
<tr><td>3</td><td>2 Hrs</td><td>-</td><td>1 Hr</td><td>3 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5"></td></tr>
<tr><td>Course Summary</td><td colspan="5">The course is intended to equipped with the knowledge and skills needed to understand the basics of light, how cameras work, different types of photographic lenses, composition techniques, and the art of taking photos, including handling various light situations and conditions. With hands-on training, students will be able to experiment and enhance their photography skills.</td></tr>
</table>

BOOKS FOR STUDY:

1. Applied Photographic Optics: Sidney F. Ray, Third Edition, Focal Press, 2002.
2. DSLR Photography for Beginners, Brian Black, 2013.
3. 4-H Digital Photography Project, Jode Jorgensen, Second Edition, Canadian 4-H Council 2009
4. Complete Digital Photography, Ben Long, Charles River Media,2007.
5. Astrophotogaphy Book 1 Basicsonly Practical Amateur Astronomy Digital SLR Astrophotography Michael A. Covington, Cambridge University Press, 2007.
6. https://esawebb.org/about/general/image-processing/

BOOKS FOR REFERENCE:

1. Text Book of Optics: Subramaniam & Brijlal,. Avadhanulu, 23rd edition,2006.
2. Optics and spectroscopy: R.Murugesan and K Sivaprasad, S. Chand & Co., 2010
3. Optics: Eugene Hecht, Addison-Wesley 2002.
4. Optics in Photography: Rudolf Kingslake, SPIE Press,1992.
5. Optical Imaging and Photography:Introduction to science and Technology of optics, Sensors and Systems: Ulrich Teubner, Hans Jose Bruckner, de Grruyter,2019
6. Fundamentals of Optics: Jenkins and White, MCH
7. Fundamentals of Optics-Geometrical Physical and Quantum:D. R. Khanna and H. R. Gulati, R. Chand,1984
8. Modern Classical Optics: Geoffrey Brooker, Oxford University Press, 2003

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Light, Lenses and Image Formation (Book 1 and Book2)**	**9**	
	1	Introduction to light – Theories related to light, Properties of light-Transmission, Absorption, Reflection, Refraction, Dispersion, Interference, Diffraction, Scattering, Polarisation and Attenuation (Basics Only),	2	1
	2	Lens- cardinal points, . Image formation when objects are at different position of both convergent and divergent lenses.	1	1
	3	Different types of photographic lenses- Spherical lenses, Aspherical lenses, Telephoto lens, Wide Angle Lens, (Lens Multiplication factor), Zoom Lens-Wide angle zoom Lens, Telephoto zoom lens, Superzoom Lens, Prime lens, Macro or Close Up Lens, Fish Eye Lens, Tilt and Shift Lens.	3	1
	4	Hands on training on different phenomena of light-reflection, refraction, interference and diffraction.	3	1
II		**Know your Camera (Book -2 & Book- 3)**	**9**	
	5	Types of camera- Parts of a digital camera- Viewfinder, Lens,Aperture,Shutter,Memory card slot andUSB port.	2	2

	6	Working of a DigitalCamera (A brief description), colour theory.	1	2
	7	Composing the Picture: Light, Framing and Focus, Rule of Thirds, including context, Focal points, . Integrity and wholeness Line, colour. Texture and shapes, Simplicity and empty space, Eye contact	3	2
	8	Hands-on training on ● Handling a digital camera ● Composing the picture	3	2
III		**DSLR Camera - Hints and Tricks (Book- 3 &Book- 4**	**11**	
	9	Choosing a digital Camera – Budget, Point-and-Shoot or SLR , Resolution , Point-and-Shoot Lens Specifications , Basic Controls, Camera Design , Feature.	1	2
	10	Options Menu,Exposure Modes-Automaticmodes, Landscapemode, Macromode,Sports/Action mode,Night mode,Potraitmode, Aperture priority, Shutter priority,Manualmode, Auto-Multiprogram, Reason for blurred picture.	3	2
	11	Hints and tricksin taking photos of type- Children's portrait, Group photos, animal Photography, Land scape photography, Night photography, sports photography, Black and white photography	4	2
	12	Hands-on training on ● Photography Experiment of different types of photos	3	2
IV		**Enhancing the photograph (Book-1)**	**7**	
	13	Optics in lighting system- Lighting-Attributes,Illumination, Lighting ratio, Shadow, Artificial source, Day light, Luminaire, Electronicflash (Basics only).	2	4
	14	Optical filters-Spectral properties, Filter factor, Optical quality, Filter sizes, Focusing, Colour filters for Photography, Haze penetration	2	4
	15	Hands on training on	3	4

		• Composing the frame • Optical Filters Experiment		
V*	**UV,IR & Night photography (Book 1,4 &Website Ref.)**		**9**	
	16	Night Photography-Basic Camera Operation- Taking apicture manually-Shutter speedand aperture, manual focussing, ISOspeed,white balance ,Automatic dark frame, Tripping the shutter without saking the telescope, Mirror vibration, Vibration reducing lens,Camera as your log book, Limitting light emission from the camera,Menu setting, Determining exposures, cool down between long exposures.	3	5
	17	UV and IR Photography	1	5
	18	UV and IR Filter- ansorption and transmission	1	5
	19	James Web Telescope photographs	1	5
	20	Hands on training on experiencing night photography	3	5

<u>COURSE OUTCOMES</u>

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe and correlate the fundamental theories of light, basics of lens and image formation, could identify and differentiate various photographic lenses.	U, An	PSO-1,4
CO-2	Summarize the working principles of a digital camera, experiment the colour theory principles to enhance the visual appeal of photographs and able to compose visually appealing pictures using various techniques.	U, An, Ap	PSO-1,4,5
CO-3	Describe the basics of specifications, features, various settings, option menus, exposure modes of a digital camera, deduce the knowledge to capture well-exposed photograph and able to choose right camera based on various requirements.	U, An	PSO-1,4,5

CO-4	Summarize, distinguish and experiment various lighting sources, the role of lighting attributes and essentiality of filters in photography,	U, An, Ap	PSO-1,4,5
CO-5	Discuss the basics of UV, IR and night photography, including the use of UV and IR filters in image enhancement.	U	PSO-1,4,5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: OPTICS IN DIGITAL PHOTOGRAPHY-PHOTO EDITING

Credits: 2:0:1 (Lecture: Tutorial: Hands on training)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Understand the fundamental theories of light, basics of lens and image formation, could identify and differentiate various photographic lenses.	PO-3,6,7/ PSO-1,4,5	U, An	F, C	L	P
CO-2	Understand the working principles of a digital camera,apply color theory principles to enhance the visual appeal of photographs and able to compose visually appealing pictures using various techniques	PO-3,6,7/ PSO-1,4,5	U,An, Ap	F,C,P	L	P
CO-3	Understand the basics		U,An	F,C,P	L	P

	of specifications, features, various settings, option menus, exposure modes of a digital camera, utilize the knowledge to capture well-exposed photograph and able to choose right camera based on various requirements.	PO-3,6,7/ PSO-1,4,5				
CO-4	Understand and identify various lighting sources, the role of lighting attributes and essentiality of filters in photography,	PO-3,6,7/ PSO-1,4,5	U, An, Ap	F,C,P	L	P
CO-5	Understand the basics of UV, IR and night photography, including the use of UV and IR filters in image enhancement.	PO-3,6,7/ PSO-1,4,5	U	F,C	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	1	-	-	2	-	-	-	-	-	2	-	-	3	2	-
CO-2	1	-	-	2	3	-	-	-	-	2	-	-	3	2	-
CO-3	1	-	-	2	3	-	-	-	-	2	-	-	3	2	-
CO-4	1	-	-	2	3	-	-	-	-	2	-	-	3	2	-
CO-5	1	-	-	2	3	-	-	-	-	2	-	-	3	2	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	-	✓	-	✓
CO-5	-	✓	-	✓

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK5SECPHY301**				
Course Title	**PROGRAMMING IN JAVA**				
Type of Course	**SEC**				
Semester	**V**				
Academic Level	**300 - 399**				
Course Details	Credit	Lecture per week	Tutorial per week	Hands on Practices per week	Total Hours/Week
	3	2 Hrs	-	1 Hr	3 Hrs
Pre-requisites					
Course Summary	The course aims to provide a solid foundation in object-oriented programming concepts using Java, equipping students with the skills necessary to design and implement Java programs effectively.				

BOOKS FOR STUDY:

1. E Balagurusamy, "Programming with Java – A Primer", McGraw Hill, 2017.

BOOKS FOR REFERENCE:

1. Dr. K. Somasundaram, Programming in Java 2, Jaico publishing House, McGraw Hill,2018.
2. "Java the Complete Reference" Java Seventh Edition, Herbert Schildt,
3. Deitel, Java: How to Program, Pearson Education
4. Java Programming, Schaum Outline Series.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Java Introduction**	**9**	
	1	Object Oriented Programming concepts, Overview of Java programming, Java program structure, Literals.	1	1
	2	Primitive Data types - Integers, Floating Point Types, and Characters, Boolean. Literals, Type Conversion and Casting, Variables, Arrays, Strings, Vector class.	1	1
	3	Control Statements - Selection Statements, Iteration Statements and Jump Statements.	2	1
	4	Operators - Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, Conditional (Ternary) Operator, Operator Precedence.	2	1
	5	Discuss minimum two • Implement inheritance, polymorphism, and encapsulation within the class hierarchy. • Write a basic "Hello, World!" program in Java. • Create a simple Java program to demonstrate the use of packages and imports. • Program to perform arithmetic operations using integer and floating-point literals. • Create a Java program to manipulate characters and demonstrate the use of boolean literals.	3	5
II		**Object Oriented Programming**	**9**	
	6	Object Oriented Programming in Java - Class Fundamentals, Declaring Class and Objects, Introduction to Methods, and this Keyword.	2	2
	7	Method Overloading, Using Objects as Parameters, Returning Objects, Recursion, Access Control, Static Members, Final Variables, Inner Classes, Command Line Arguments, Variable Length Arguments.	2	2
	8	Inheritance - Super Class, Sub Class, The Keyword super, protected Members,	2	2

		Method Overriding, the Object class, Abstract Classes and Methods, using final with Inheritance.		
	9	Method Overloading and Overriding, Constructors and encapsulation.	2	2
	10	Discuss minimum one program • Create a Java program with a class representing a student, including attributes like name, age, and grade. Demonstrate the instantiation of multiple student objects and access their properties. • Develop a Java program with a class representing a bank account. Implement methods for deposit, withdrawal, and balance inquiry, utilizing the 'this' keyword to distinguish between instance variables and parameters. • Program demonstrating method overloading for calculating the area of different shapes (e.g., circle, rectangle, triangle) by passing objects as parameters to the methods. • Program showcasing the usage of final variables in Java, both as instance variables and local variables. Implement an inner class within another class and access its members. • Create an abstract class representing a shape with abstract methods for calculating area and perimeter. Implement concrete subclasses (e.g., Circle, Rectangle) extending the abstract class. Also, demonstrate the usage of 'final' with methods and classes in the context of inheritance.	1	5
III		**Packages, Thread and Exception Handling**	**9**	
	11	Packages and Interfaces - Defining Package, CLASSPATH, Access Protection, Importing Packages, Interfaces.	2	3
	12	Input/Output - I/O Basics, Reading Console Input, Writing Console Output, Print Writer Class, Object Streams and Serialization, Working with Files.	1	3

	13	Introduction, types of errors- Compile time errors and run time errors. Exception Handling - Checked Exceptions, Unchecked Exceptions, try Block and catch Clause, Multiple catch Clauses, Nested try Statements, throw, throws and finally.	2	3
	14	Multithreaded Programming - The Java Thread Model, The Main Thread, Creating Thread, Creating Multiple Threads, Synchronization, Suspending, Resuming and Stopping Threads.	1	3
	15	Discuss minimum two • Create a package structure for a simple Java project, including multiple classes organized within different packages. Demonstrate how to define packages, set the CLASSPATH, and import packages into other classes. • Implement an interface representing a shape with methods for calculating area and perimeter. Create classes representing specific shapes (e.g., Circle, Rectangle) that implement the interface. • Create a Java program that demonstrates multithreading by creating multiple threads to perform different tasks concurrently. • Implement synchronization mechanisms to ensure thread safety when accessing shared resources, such as using synchronized methods or blocks. • Write a program that illustrates suspending, resuming, and stopping threads using thread control methods like suspend(), resume(), and stop(). • Write a Java program to implement a simple client-server application using sockets. Demonstrate how clients can connect to the server and exchange messages.	3	5
IV		**Java Library and Collections**	**9**	
	16	Java Library - String Handling – String Constructors, String Length, Special String Operations -Character Extraction, String Comparison, Searching Strings.	2	4

	17	Collections framework - Collections overview, Collections Interfaces- Collection Interface.	2	4
	18	Event handling - Event Handling Mechanisms, Delegation Event Model	1	4
	19	Collections Class – Array List class. Accessing a Collection via an Iterator.	1	4
	20	Discuss minimum two • Create a program that demonstrates various String constructors by initializing String objects using different methods (e.g., literals, character arrays, String Buffer). • Write a program that calculates the length of a given String and displays it to the user. • Implement a program that performs special string operations such as extracting characters, creating substrings, comparing strings, and searching for specific substrings within a given string. • Create a program that utilizes the Array List class to store and manipulate a collection of objects. Implement operations such as adding, removing, and accessing elements from the Array List • Develop a program that demonstrates how to access elements in an Array List using an Iterator	3	5
V*		**Graphical User Interface Programming**	**9**	
	21	Introduction, Applet class, Applet Structure, Examples of Applet Program- , Applet Life Cycle,	2	4
	22	Creating an executable applet, Graphics, Graphic class-Lines and Rectangles, Circles and ellipse, Line graphs, Drawing Polygons, drawing arcs, Line graphs, Drawing bar charts	2	4
	23	Swings fundamentals - Swing Key Features, Model View Controller (MVC), Swing Controls, and Components.	2	4
	24	• Develop an applet program that draws basic shapes such as lines, rectangles, circles, and ellipses using the Graphics class.	3	5

		• Implement a program that draws various polygons and arcs using the Graphics class.		

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Summarize JAVA basics, primitive data type, master control system and explore operators.	R, U	PSO-4,5
CO-2	Relate the basic concepts and fundamentals of platform independent object-oriented language and apply it to do programs in JAVA.	R, U, Ap	PSO-4,5,7
CO-3	Demonstrate the skills in writing programs using exception handling techniques and multithreading.	R, U, Ap	PSO-4,5,7
CO-4	Administer the utilization of JAVA library and collections and able to solve real time applications using event handling concepts.	R, U, Ap	PSO- 4,5,7
CO-5	Experiment Graphical User Interface Programming to develop an APPLET program.	R, U, Ap	PSO-4,5,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: PROGRAMMING IN JAVA

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Understand JAVA basics, primitive data type, master control system and explore operators.	PO-6,7 /PSO-4,5	U	F	L	-

CO-2	Understand the basic concepts and fundamentals of platform independent object-oriented language and able to do programs in JAVA.	PO-6,7 /PSO-4,5,7	U, Ap	C,P	L	-
CO-3	Develop skills in writing programs using exception handling techniques and multithreading.	PO-6,7 /PSO-4,5,7	U, Ap	C,P	L	-
CO-4	Understand the utilization of JAVA library and collections and able to design real time applications using event handling concepts.	PO-6,7 /PSO-4,5,7	U, Ap	C,P	L	-
CO-5	Understand Graphical User Interface Programming and able to develop an APPLET program.	PO-6,7 /PSO-4,5,7	U, Ap	C,P	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	-	-	-	2	2	-	3	-	-	-	-	-	2		-
CO-2	-	-	-	2	2	-	3	-	-	-	-	-	2	3	-
CO-3	-	-	-	2	2	-	3	-	-	-	-	-	2	3	-
CO-4	-	-	-	2	2	-	3	-	-	-	-	-	2	3	-
CO-5	-	-	-	2	2	-	3	-	-	-	-	-	2	3	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	-	✓	-	✓
CO-5	✓	✓	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK5SECPHY302</td></tr>
<tr><td>Course Title</td><td colspan="5">PROGRAMMING IN PYTHON</td></tr>
<tr><td>Type of Course</td><td colspan="5">SEC</td></tr>
<tr><td>Semester</td><td colspan="5">V</td></tr>
<tr><td>Academic Level</td><td colspan="5">300 - 399</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>3</td><td>3 Hrs</td><td>-</td><td>-</td><td>3 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Basic computer skill</td></tr>
<tr><td>Course Summary</td><td colspan="5">Learners will possess a solid foundation in Python programming, enabling them to tackle a wide range of computational tasks and pursue further learning and specialization in Python-based development and data science domains.</td></tr>
</table>

BOOKS FOR STUDY:

1. Kenneth A Lambet , Fundamentals of Python : first Programs, 2/e, Cengage Publishing, 2016.
2. Christian Hill, Learning Scientific Programming with Python, Cambridge University Press (2015)
3. Jeeva Jose, “Taming PYTHON By Programming”, Khanna Publications, 2017.
4. Peter Norton etal., Beginning Python, Wiley Publishing (2005)

BOOKS FOR REFERENCE:

1. Allen B. Downey, Think Python- How to think like a computer scientist, 2nd Edition, O’Reilly, 2016.
2. Paul Gries, Jennifer Campbell and Jason Montojo, “Practical Programming: An Introduction to Computer Science using Python 3”, Second edition, Pragmatic Programmers, LLC, 2013.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Introduction to Python**	**9**	
	1	What is Python, Features of Python, Python input/ output.	2	1
	2	Syntax and Comments in Python	2	1
	3	Identifiers, Keywords, Variables and its types.	2	1
	4	Import Functions, Operators.	2	1
	5	Discuss minimum one • Write a program that takes input in Celsius and converts it to Fahrenheit using the formula (°C × 9/5) + 32. • Display the result using print () function.	1	1
II		**Data Type and Control Statements**	**9**	
	6	Python Data types- int, float, complex, Strings, List, Tuple, Set, Dictionary and Boolean.	2	2
	7	Mutable and Immutable Objects, Type Conversions in Python.	2	2
	8	Flow control - Decision Making, Loops-for, range() while, break, continue, pass;	3	2
	9	Discuss minimum two • Implement a program that prints the multiplication table of a number entered by the user using a for loop. • Write a program that asks the user for a number and prints whether it is prime or not using a while loop. • Develop a program that takes a string input from the user and checks if it is a palindrome (reads the same forwards and backwards), then prints the result.	2	2
III		**Functions and Modules**	**9**	
	10	Creating and calling a function, arguments and types, passing and returning values, Lambda Function.	1	3

	11	Modules & Packages - Built-in Modules, Creating Modules and importing Modules	1	3
	12	Packages in Python; How to Create Package in Python.	2	3
	13	File Handling- open, close, write, read, methods, rename, delete, directories. Defined exceptions. Assertions in Python.	2	3
	14	Discuss minimum two • Write a program that defines a function to calculate the area of a rectangle based on its length and width. Allow the user to input the length and width, call the function, and print the result. • Write a program that defines a function to check if a number is even or odd. Allow the user to input a number, call the function, and print whether the number is even or odd. • Develop a program that uses a lambda function to calculate the square of a given number entered by the user. • Develop a program that renames a file named old_name.txt to new_name.txt and then deletes the new_name.txt file.	3	3
IV	**Object oriented programming in Python**		**9**	
	15	Class, object, Creating a class and object with class and instance attributes; inheritance and polymorphism.	3	4
	16	Collections in Python: named tuple (), Dequeue, Chain Map and Counter.	2	4
	17	Memory allocation for classes and objects. Arrays of objects.	2	4
	18	Discuss minimum one • Write a program that reads the contents of a text file named sample.txt, capitalizes all the letters, and writes the modified content into another file named output.txt.	2	4

		• Create a program that lists all the files in a specified directory and prints their names to the console. • Develop a program that defines a function to calculate the factorial of a number. Use assertions to ensure that the input number is non-negative.		
V*	**Data Visualization and Python SQL Database Access**		**9**	
	19	NumPy - Basics, creating arrays, Arithmetic, Slicing, Matrix Operations, Random numbers Plotting and visualization. Matplotlib - Basic plot, Ticks, Labels, and Legends. Working with CSV files. – Pandas - Reading, Manipulating, and Processing Data.	3	5
	20	Python SQL DBMS Access-Connection, Create, insert, update, delete, commit, rollback, disconnection.	2	5
	21	Iterators- Data type supports iterators, CGI Programming-HTTP Header, Env variables, Forms, Radio button, Dropdown box, check box, text area, cookies, uploading file. Regular Expressions-Introduction, Split and quatifiers**.**	2	5
	22	Discuss minimum one • Write a program that imports NumPy and creates a one-dimensional array containing numbers from 1 to 10. • Create a two-dimensional array representing a 3x3 matrix and print its shape and dimensions. • Implement a program that performs arithmetic operations like addition, subtraction, multiplication, and division on two NumPy arrays. • Perform matrix multiplication and dot product of two matrices using NumPy. • Write a program that demonstrates slicing of NumPy arrays to extract specific elements or sub-arrays. • Create a simple line plot using Matplotlib to visualize the trend of a dataset.	2	5

		• Customize the plot by adding title, labels to x and y-axis, and a legend. • Develop a program that reads a CSV file containing student data using Pandas. • Manipulate the data by sorting, filtering, and performing basic		

<u>COURSE OUTCOMES</u>

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the programming basics of interactive mode, script mode, the order of operations in python .and apply to simple programs	U, Ap	PSO-4,5,7
CO-2	Understand the data type and control system and relate the knowledge to do the python programmes of higher order.	U, Ap	PSO-4,5,7
CO-3	Understand to perform call function, modules and able to exeute packages in python leading to analyse and apply in python programmes.	U, Ap,An	PSO- 4,5,7
CO-4	Understand the object-oriented programming (OOP) concepts in Python and proficiently apply them to develop robust and efficient Python programs	U, Ap	PSO-4,5,7
CO-5	Explain data analysis, visualization and management in Python articulate the knowledge to do higher order pro Data Visualization and Python SQL Database Access	U, Ap	PSO-4,5,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: PROGRAMMING IN PYTHON

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Understand the programming basics of interactive mode, script mode, the order of operations in python .and apply to simple programs	PO-6,7 /PSO-4,5,7	U, Ap	F, C	L	-
CO-2	Understand the data type and control system and relate the knowledge to do the python programmes of higher order.	PO-6,7 /PSO-4,5,7	U, Ap	C,P	L	-
CO-3	Understand to perform call function, modules and able to execute packages in python leading to analyse and apply in python programmes.	PO-6,7 /PSO-4,5,7	U, Ap	C,P	L	-
CO-4	Understand the object-oriented programming (OOP) concepts in Python and proficiently apply them to develop robust and efficient Python programs	PO-6,7 /PSO-4,5,7	U, Ap	C,P	L	-

CO-5	Explain data analysis, visualization and management in Python articulate the knowledge to do higher order pro Data Visualization and Python SQL Database Access	PO-6,7 /PSO-4,5,7	U, Ap	C,P	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	-	-	-	2	2	-	3	-	-	-	-	-	2	-	-
CO-2	-	-	-	2	2	-	3	-	-	-	-	-	2	3	-
CO-3	-	-	-	2	2	-	3	-	-	-	-	-	2	3	-
CO-4	-	-	-	2	2	-	3	-	-	-	-	-	2	3	-
CO-5	-	-	-	2	2	-	3	-	-	-	-	-	2	3	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	-	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	✓	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK6DSCPHY300**				
Course Title	**ATOMIC AND MOLECULAR PHYSICS**				
Type of Course	**DSC**				
Semester	**VI**				
Academic Level	**300 - 399**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 Hrs	-	-	4 Hrs
Pre-requisites	1. Basic knowledge about atoms and molecules. 2. Basic knowledge about electromagnetic spectrum and quantum theory. 3. Basic ideas about Bohr model of atom and structure of hydrogen atom. 4. Basic ideas about influence of electric and magnetic fields on charges.				
Course Summary	The course has the following major objectives: The course introduces students to the basic physics of atoms, molecules, their spectra and the interaction of light with matter including the study of influence of electric and magnetic fields on atoms with the help of Zeeman and Stark effect. The students are expected to learn spin of electrons, space quantisation, and effect of nuclear motion on atomic spectra, Raman effect, NMR, ESR, rotational, vibrational and electronic spectra of diatomic molecules.				

BOOKS FOR STUDY:

1. G Aruldas: “Molecular structure and Spectroscopy” Prentice Hall of India ,2002.
2. 2. Modern Physics: R. Murugesan, S Chand & Co., Reprint, 2002
3. 3. Atomic Physics: J B Rajam, S Chand & Co.,1980.

4. 4. C N Banwell and E.M. McCash: “Fundamentals of Molecular Spectroscopy”, Tata McGrow Hill.,1983.

BOOKS FOR REFERENCE:

1. Straughan and Walker (Eds): “Spectroscopy”- Vol. I and II (Chapman and Hall)
2. G.M. Barrow: “Introduction to molecular Spectroscopy”, (McGraw Hill)
3. Modern Physics: G Aruldas and P Rajagopal, PHI, New Delhi, 2005.
4. Atomic Physics: Christopher J Foot, Oxford Master series in Physics,2005
5. J.M. Hollas, Modern Spectroscopy, Fourth Edition, John Wiley &Sons (2004)
6. Suresh Chandra, Molecular Spectroscopy, Narosa Publishing Co (2009)
7. H E White, Introduction to Atomic Spectroscopy McGraw-Hill Inc. 1st Edition. (1934).
8. D.N. Satyanarayana, Vibrational Spectroscopy-Theory and applications, New Age International Pvt Ltd (2004)
9. J.L. McHale, Molecular Spectroscopy, Pearson education Inc (2008).

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	**Atomic Spectra & Atoms in External Fields (Book2 chapter 4 and Book3)**		**12**	
	1	Hydrogen atom spectrum	1	1
	2	Stern Gerlach experiment, Vector atom model	2	1
	3	Quantum states of electron in atoms	2	1
	4	Spin-orbit coupling (LS and JJ coupling schemes)	1	1
	5	Fine structure – Spectroscopic terms and selection rules	2	1
	6	Hyperfine structure	1	1
	7	Normal Zeeman effect	2	1
	8	Elementary Ideas of Anomalous Zeeman effect, Paschen Back effect and Stark effect	1	1
II	**Microwave & Infrared Spectroscopy (Book1 chapters 6 and 7 and Book4 chapters 2 and 3)**		**13**	
	9	Classification of molecules, Rotational spectra of diatomic molecules, Intensity of spectral lines, Effect of isotopic substitution	3	1,2

	10	The non-rigid rotor	1	1,2
	11	Rotational spectra of polyatomic molecules – Linear, symmetric top and asymmetric top molecules	2	1,2
	12	Microwave Oven	1	1,2
	13	Vibrational energy levels of diatomic molecules-harmonic oscillator and anharmonic oscillator (Morse Curve)	2	1,3
	14	IR spectra of vibrating diatomic molecule, selection rule	1	1,3
	15	Diatomic Vibrating rotator – selection rules, P, Q, R branches. Linear and symmetric top molecules	3	1,3
III	**Electronic Spectroscopy of Molecules (Book1 chapter 9 and Book4 chapter 6)**		**10**	
	16	Vibrational coarse structure: Progression and sequences	2	1
	17	The Franck-Condon principle	1	1
	18	Dissociation energy and dissociation products.	2	1
	19	Rotational fine structure of electronic vibration transitions	3	1
	20	Fortrat diagram, Pre-dissociation (elementary ideas)	2	1
IV	**Raman Spectroscopy (Book1 chapter 8 and Book4 chapter 4)**		**13**	
	21	Quantum and Classical theory of Raman effect	3	4
	22	Pure rotational Raman Spectrum –linear, Symmetric and Spherical top molecule	3	4
	23	Vibrational Raman Spectra, mutual exclusion principle	2	4
	24	Instrumentation and methods: Raman spectrometer	2	4
	25	Structure determination from Raman and IR spectroscopy	3	4
V*	**Resonance Spectroscopy (Book1 chapters 10 and 11 and Book4 chapter 7)**		**12**	
	26	NMR principle-Resonance condition	2	5
	27	NMR spectrometer	1	5
	28	Chemical shift-indirect spin-spin Interaction	1	5

	29	Applications of NMR spectroscopy- NMR Imaging and Interpretation of NMR Spectra	2	5
	30	ESR principle- Resonance condition	2	5
	31	ESR spectrometer	1	5
	32	Hyperfine interaction	1	5
	33	Applications of ESR spectroscopy-Study of Free Radicals and Structural Determination, Advantages of ESR Spectroscopy	2	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify and describe the rotational, vibrational and electronic energy states of various types of molecules and the interaction of electromagnetic radiation with molecules.	R, U	PSO-1,2
CO-2	Define and describe the microwave spectra of the molecule and compute various parameters	R, U, Ap	PSO-1,2
CO-3	Outline and explain the IR spectra of molecule and manipulate information about the molecule.	R, U, Ap	PSO-1, 2
CO-4	Describe, explain and construct molecular structure from combined analysis of Raman and IR spectra	R, U, Ap	PSO-1,2
CO-5	Recognise and infer the mechanism of spin resonances and interaction of electromagnetic radiations under resonance conditions of spin reorientation.	R, U	PSO-1,2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ATOMIC AND MOLECULAR PHYSICS

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	**CO**	**PO / PSO**	**Cognitive Level**	**Knowledge Category**	**Lecture (L)/ Tutorial (T)**	**Practical (P)**
CO-1	Identify and describe the rotational, vibrational and electronic energy states of various types of molecules and the interaction of electromagnetic radiation with molecules.	PO1,3,4, 5,6,8/ PSO-1,2	R, U	F, C	L	-
CO-2	Define and describe the microwave spectra of the molecule and compute various parameters	PO1,3,4, 5,6,8/ PSO-1,2	R, U, Ap	F, C	L	-
CO-3	Outline and explain the IR spectra of molecule and manipulate information about the molecule.	PO1,3,4, 5,6,8/ PSO-1,2	R, U, Ap	F, C	L	-
CO-4	Describe, explain and construct molecular structure from combined analysis of Raman and IR spectra	PO1,3,4, 5,6,8/ PSO-1,2	R, U, Ap	F, C	L	-

CO-5	Recognise and infer the mechanism of spin resonances and interaction of electromagnetic radiations under resonance conditions of spin reorientation.	PO1,3,4, 5,6,8/ PSO-1,2	R, U	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	1	-	-	-	-	-	2	-	2	2	2	2	-	2
CO-2	2	2	-	-	-	-	-	2	-	3	2	2	3	-	2
CO-3	2	1	-	-	-	-	-	2	-	2	2	2	3	-	2
CO-4	2	1	-	-	-	-	-	3	-	2	2	2	2	-	3
CO-5	2	2	-	-	-	-	-	2	-	2	2	2	2	-	2

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	-	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK6DSCPHY301</td></tr>
<tr><td>Course Title</td><td colspan="5">NUCLEAR AND PARTICLE PHYSICS</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSC</td></tr>
<tr><td>Semester</td><td colspan="5">VI</td></tr>
<tr><td>Academic Level</td><td colspan="5">300 - 399</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 Hrs</td><td>-</td><td>-</td><td>4 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">1. The student should have a fundamental understanding of atomic structure
2. The students must be familiar with the phenomenon of radioactivity
3. The students should have a basic understanding of fission and fusion reactions</td></tr>
<tr><td>Course Summary</td><td colspan="5">This course introduces the fundamental concepts of nuclear and particle physics. The first module comprises of the properties of nucleus and nuclear models. The nuclear decays and basics of radioactivity are discussed in the second module. The third module incorporates different types of nuclear reactions including fission and fusion, associated with nuclear science and technology as well as expanding the scope of application of radioactivity. The basics of particle physics, fundamental interactions and the dynamics of elementary particles under these forces are included in the fourth module. Fifth module explains the physical principles of various particle accelerators and detectors</td></tr>
</table>

BOOKS FOR STUDY:

1. Concepts of Modern Physics: Arthur Beiser, Mc Graw Hills, Fifth Edition, 1995
2. Modern Physics – R Murugesan, S. Chand & Co., 2008
3. Nuclear Physics- D C Tayal, Himalaya Publication House, Fifth Edition, 2009
4. Modern Physics – G Aruldhas, PHI, 2018
5. Techniques for Nuclear and Particle Physics Experiments: A How-to Approach, Second Revised Edition, W. R. Leo, Springer-Verlag

BOOKS FOR REFERENCE:

1. Atomic and Nuclear Physics, N Subramaniam and Brijlal, S. Chand & Co.
2. Nuclear Physics, S N Ghoshal, S. Chand & Co.
3. Introduction to Elementary Particles, D Griffith, John Wiley & sons
4. Introductory Nuclear Physics, Kenneth S Krane, Wiley India Pvt. Ltd. 2008
5. Gaseous radiation detectors: Fundamentals and Applications, Fabio Sauli, Cambridge University Press.
6. The Quantum Frontier :The Large Hadron Collider :Don Lincoln, Johns Hopkins University Press,2009

WEB RESOURCES

1. https://nptel.ac.in/courses/115102017
2. https://www.space.com/large-hadron-collider-particle-accelerator (LHC)

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	**Properties of Nuclei and Nuclear Models (Book:1 - Chapter: 11)**		**12**	
	1	Constituents of nucleus and their Intrinsic properties	2	1
	2	Binding energy, binding energy versus mass number curve, nuclear stability	2	1
	3	Nuclear forces- properties	1	1
	4	Meson theory	2	1
	5	Liquid drop model -semiempirical mass formula and significance of various terms	2	1

	6	Assumptions of Shell model-evidence for nuclear shell structure, nuclear magic numbers	2	1
	7	Collective model	1	1
II	**Radioactivity (Book: 1 - Chapter: 12; Book: 2 – Chapter: 34)**		**12**	
	8	Basics of radioactivity, properties of α, β and γ	1	2
	9	Law of radioactive disintegration, Half life, mean life	2	3
	10	Law of successive disintegration, Radioactive equilibrium (Transient, Secular)	2	3
	11	Basics of α-decay processes, theory of α-emission, α-ray spectrum, Geiger Nuttal law	3	2
	12	Beta decay- beta ray spectrum, Pauli's neutrino hypothesis, positron emission, electron capture	3	2
	13	Gamma decay, Gamma ray spectrum, internal conversion	1	2
III	**Nuclear Reactions (Book: 1 – Chapter: 12; Book: 2 - Chapter 34; Book: 4 – Chapter: 19)**		**12**	
	14	Types of Reactions, Conservation Laws	1	4
	15	Kinematics of reactions, Q-value- reaction rate- reaction cross section	2	4
	16	Reaction mechanism-Concept of direct reaction mechanism and compound nucleus.	2	4
	17	Nuclear fission-Bohr and Wheeler's theory	1	4
	18	Chain reaction -multiplication factor-critical size-atom bomb	2	4
	19	Nuclear fusion-sources of stellar energy, thermonuclear reactions-hydrogen bomb	2	4
	20	Controlled thermo-nuclear reactions, plasma confinement basics (magnetic bottle-Tokamak- inertial confinement).	2	4
IV	**Particle Physics (Book: 1 – Chapter: 13; Book: 3 - Chapter 18)**		**12**	
	21	Classification of elementary particles, basic features, Fundamental interactions	4	5

	22	Quantum numbers - Baryon number, Lepton number, Isospin, Hypercharge, Strangeness	2	5
	23	Symmetries and Conservation Laws	3	5
	24	Concept of quark model and standard model	3	5
V*	**Particle detectors and Accelerators (Book: 2 – Chapter: 29 & 30; Book: 4 – Chapter: 20; Book: 5 – Chapter: 2&9)**		**12**	
	25	Charged particle interaction with matter- Range, stopping power, The Bethe Bloch Formula (qualitative only)- Interaction of Radiation with matter	4	6
	26	Particle detectors - GM counter, scintillation counter, Resistive Plate Chambers	4	6
	27	Particle Accelerators - Linear accelerator, Cyclotron, Synchrotron, betatron	3	6
	28	Large Hadron Collider (Qualitative concepts only)*	1	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify nuclear constituents and general properties of nuclei and distinguish different nuclear models	U	PSO-1
CO-2	Describe the phenomenon of radioactivity	R, U	PSO-1
CO-3	Discuss and apply the basic idea of radioactivity for the mathematical formulation.	U, Ap	PSO-1,2
CO-4	Interpret different types of nuclear reactions, fission & fusion energies and applications	U, Ap	PSO-1,2
CO-5	Classify the elementary particles and relate their properties	U	PSO-1,2
CO-6	Delineate the application of different particle detectors and accelerators	Ap	PSO-1,2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: NUCLEAR AND PARTICLE PHYSICS

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Identify nuclear constituents and general properties of nuclei and distinguish different nuclear models	PO 1/ PSO 1	U	F, C	L	-
CO-2	Describe the phenomenon of radioactivity	PO 1/ PSO 1	R, U	F,C	L	-
CO-3	Discuss and apply the basic idea of radioactivity for the mathematical formulation.	PO 1,2/ PSO 1,2	U, Ap	C	L	-
CO-4	Interpret different types of nuclear reactions, fission & fusion energies and applications	PO 1/ PSO 1,2	U, Ap	F,C	L	-
CO-5	Classify the elementary particles and relate their properties	PO 1/ PSO 1,2	U	F, C	L	-
CO-6	Delineate the application of different particle detectors and accelerators	PO 1/ PSO 1,2	Ap	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO-2	2	-	-	-	-	-	-	2	-	-	-	-	-	-	-
CO-3	2	2	-	-	-	-	-	2	2	-	-	-	-	-	-
CO-4	2	2		-	-	-	-	2	-	-	-	-	-	-	-
CO-5	2	2	-	-	-	-	-	2	-	-	-	-	-	-	-
CO-6	2	2	-	-	-	-	-	2	-	-	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	✓	-	✓
CO-6	✓	✓	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK6DSCPHY302**				
Course Title	**SOLID STATE PHYSICS**				
Type of Course	**DSC**				
Semester	**VI**				
Academic Level	**300 - 399**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 Hrs	-	-	4 Hrs
Pre-requisites	Basic ideas of quantum mechanics				
Course Summary	This course is designed to introduce the structure, electronic, and other fundamental properties of solids to the students. This course covers the detailed representation of crystal structure, symmetries in solid, x-ray diffraction, bonding, transport properties, electronic structure, vibration of the lattice, outline of magnetism, and superconductivity.				

BOOKS FOR STUDY:

1. Elements of Solid-State Physics, J. P Srivastava, Prentice Hall of India 2015 Fourth Edition
2. Elementary Solid-State Physics- Principles and Applications, M. Ali Omar, Pearson Education inc. 2011
3. Solid state Physics- Structure and properties of Materials, M. A Wahab, Narosa Publishing House Third Edition

BOOKS FOR REFERENCE:

1. Introduction to Solid State Physics: Charles Kittel, Wiley India Pvt. Ltd., 8 th Edn., 2004
2. Solid State Physics- S. O. Pillai, New Age international Publishers 10^{th} Edition
3. Introduction to Solids: Leonid V. Azaroff, Tata Mc-Graw Hill, 2004

4. Solid State Physics: Neil W. Ashcroft and N. David Mermin, Cengage Learning, 1976
5. Solid State Physics: Rita John, McGraw Hill, 2014

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Crystal Structure (Book 1)**	**12**	
	1	Basic Crystal Structure- Unit cell: primitive cell structures- Symmetry operations	2	1
	2	Crystal types- Indices of a lattice direction and a lattice plain- Crystal point groups and space groups	2	1
	3	Common crystal structures	1	1
	4	Reciprocal lattice- Bragg's law, Miller indices	2	1
	5	Laue's interpretation- Construction of a reciprocal lattice and applications	2	1
	6	X-ray diffraction Technique- Powder diffraction method.	1	1
	7	Electron and neutron diffraction techniques	2	1
II		**Free electron theory and Band theory of solids (Book 1)**	**12**	
	8	The Drude - Lorentz theory: Electrical, thermal conductivity and specific heat	2	2
	9	The Sommerfield model: Fermi surface and Fermi energy	3	2
	10	The electronic heat capacity- Wiedmann-Franz Law - Hall effect	2	2
	11	Bloch Theorem	1	2
	12	Kronig-Penney Model	3	2
	13	Brillouin Zones (Basic concepts only)	1	2
III		**Magnetic Properties of Materials (Book 2)**	**12**	
	14	Classification of magnetic materials-Origin of permanent magnetic moments	1	3
	15	Langevin's classical theory of diamagnetism	2	3

	16	Langevin's classical and quantum theory of paramagnetism	3	3
	17	Ferromagnetism- Temperature dependence of spontaneous magnetisation	2	3
	18	Ferromagnetic domains and Domain theory	2	3
	19	Antiferromagnetism-ferrimagnetism and ferrites (Basic concepts)	1	3
	20	Multiferroics and Giant Magnetic Resistance (Basic concepts only)	1	3
IV	**Superconductivity (Book 3)**		**12**	
	21	Superconductor- Properties, Critical Temperature	1	4
	22	Critical magnetic field- Meissner effect- Type I and Type II superconductors	2	4
	23	Origin of energy gap- Isotope effect	2	4
	24	London's Equations - London Penetration Depth-Coherence length	2	4. 5
	25	BCS theory	2	4,5
	26	dc and ac Josephson Effect	1	4,5
	27	High Temperature superconductivity, Metallic superconductors- Superconductivity in fullerenes- Applications of superconductivity (Basic concepts only)	2	4
V*	**Dielectric Properties of Materials (Book 3)**		**12**	
	28	Polarisation-Local electric field at an atom, Sources of polarizability	2	6
	29	Dielectric constant and its measurements, Electric susceptibility	2	6
	30	Polarizability- (Dipolar, Ionic and Electronic)- Clausius - Mossotti Equation	3	6
	31	Dipolar polarizability - Classical Theory	3	6
	32	Piezo, Pyro and ferro electric properties of crystals (Derivations not required)	1	6
	33	Ferroelectricity and ferroelectric domains-Qualitative ideas only	1	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify different crystal systems, reciprocal lattice and diffraction techniques.	U, Ap	1
CO-2	Understand the theories of electrical and thermal conduction	U, Ap	1,2
CO-3	Understand the magnetic properties of different materials	U, Ap	1, 3
CO-4	Understand the phenomena of superconductivity	R. Ap	1
CO-5	Discuss the theoretical formulations of superconductors and applications	U	1, 2
CO-6	Understand and evaluate dielectric properties of materials	U, Ap	1

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: SOLID STATE PHYSICS

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Identify different crystal systems, reciprocal lattice and diffraction techniques.	PO 1/ PSO 1	U, Ap	F, C	L	-
CO-2	Understand the theories of electrical and thermal conduction	PO 1/ PSO 1,2	U, Ap	F, C	L	-
CO-3	Understand the	PO 1/	U, Ap	C	L	-

	magnetic properties of different materials	PSO 1, 3				
CO-4	Understand the phenomena of superconductivity	PO 1/ PSO 1	R. Ap	F	L	-
CO-5	Discuss the theoretical formulations of superconductors and applications	PO 1/ PSO 1, 2	U	C	L	-
CO-6	Understand and evaluate dielectric properties of materials	PO 1/ PSO 1	U, Ap	C	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO-2	2	1		-	-	-	-	1	-	-	-	-	-	-	-
CO-3	2	-	1	-	-	-	-	1	-	-	-	-	-	-	-
CO-4	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO-5	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-
CO-6	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	-	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	-	-	✓
CO-5	✓	✓	-	✓
CO-6	✓	-	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK6DSEPHY300</td></tr>
<tr><td>Course Title</td><td colspan="5">OBSERVING WEATHER AND CLIMATE</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSE</td></tr>
<tr><td>Semester</td><td colspan="5">VI</td></tr>
<tr><td>Academic Level</td><td colspan="5">300 - 399</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>3 Hrs</td><td>-</td><td>2 Hrs</td><td>5 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">1. The students must have knowledge about the structure of the atmosphere and its measurable parameters
2. The students should know the electromagnetic spectrum and interaction of radiation with matter
3. The students must be familiar with the structure of the atmosphere based on pressure, composition and temperature changes</td></tr>
<tr><td>Course Summary</td><td colspan="5">● The course has been designed to improve knowledge in weather and climate. First module introduces various atmospheric parameters such as temperature, pressure, humidity, wind velocity/direction, aerosol and cloud parameters. Second module describes the working of various instruments to measure the surface parameters. These instruments include thermometers, hygrometers, barometer, rain gauge, ceilometer etc. The the techniques involved in upper air weather measurements such as radars, lidars, rockets, satellites etc are discussed in third module. Various methods for measuring aerosol and cloud parameters are given in the fourth module. In the fifth module various observation systems such as automatic weather</td></tr>
</table>

	stations, aircrafts observations, marine observations and operational satellite systems are described. ● The practical course is designed to equip students with the skills needed to analyze and interpret surface and upper-air observations, data from insitu, satellites and radar/lidar observations, atmospheric soundings, and severe weather indices

BOOKS FOR STUDY:

1. Basis of Atmospheric Science, A Chandrasekhar, PHI., 2010
2. Atmospheric Aerosols - Properties and Climate Impacts, Olivier Boucher, Springer, 2015
3. Guide to Meteorological Instruments and Methods of Observation, World Meteorological Organization-No. 8 Seventh edition 2008

BOOKS FOR REFERENCE:

1. Atmospheric Science : An Introductory Survey : John M Wallace and Peter V. Hobbs, Academic Press, 2nd Edition, 2006
2. Guide to Meteorological Instruments and Methods of Observation : Volume III - Observing Systems, WMO, 8th Editions, 2021.
3. An Introduction To Atmospheric Physics, Second Edition, David G. Andrews, Cambridge University Press, 2010

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Atmospheric Parameters (Book:1 – Chapter: 2)**	**09**	
	1	Surface Weather Parameters and Upper-air Parameters	2	1
	2	Temperature, Dew Point Temperature, Humidity, Pressure	2	1
	3	Wind Velocity and Direction	1	1
	4	Cloud Ceiling, Visibility, Cloud Cover Fraction, Cloud top temperature and pressure, Cloud Base Temperature and Pressure, Cloud Optical depth	2	1
	5	Aerosol - Size distribution, Chemical Composition, Optical Properties	2	1

II	**Instruments to Measure Surface Weather Parameters (Book:1 – Chapter: 2)**		**09**	
	6	Thermometers – Resistance Thermometers	1	1
	7	Humidity Measurements – Dew- point hygrometers, Psychrometer	2	1
	8	Barometers- Aneroid barometers	1	1
	9	Wind Measurements – Wind vane, Wind Sock, Cup Anemometer, Sodar	2	1
	10	Precipitation Measurements – Raingauge	1	1
	11	Cloud Ceiling – Laser beam Ceilometer	2	1
III	**Upper Air Weather Observations (Book:1 – Chapter: 2, Book: 3 – (Part I) - Chapter: 12,13; Book: 3 –Part II)**		**9**	
	12	Measurement Approaches - In Situ Observations and Remote Sensing, Passive and Active Remote Sensing	1	1
	13	Soundings, Rawinsonde, RadioSonde	2	1
	14	Radar – Atmospheric Radars, Doppler Radars, Wind Profilers	2	1
	15	Sounding Rockets	1	1
	16	Atmospheric Lidars	1	1
	17	Satellites	2	1
IV	**Measurements of Aerosol and Cloud Parameters (Book: 2 – Chapter: 6; Book:3 – (Part I) -Chapter: 15)**		**09**	
	18	Passive Remote Sensing Measurement methods of aerosols- Measurements of Extinction - Ground based photometry, Spaceborn occultation measurements Measurement of Scattering - Ground based and spaceborne measurements of scattered radiation	2	2
	19	Active remote sensing measurements of aerosols – Lidar, Satellite observation of aerosol optical depth	2	2

	20	In situ aerosol measurements - Aerosol concentration and Aerosol chemical composition, Aerosol Scattering and Absorption measurements	2	2
	21	Observation of clouds - Estimation and observation of cloud amount, height and type, Instrumental measurements of cloud amount	2	3
	22	Ground based and Satellite based observation of cloud parameters (Cloud optical thickness and Cloud Particle Size)	1	3
V*	**Observing Systems (Book: 3 –Part II)**		**9**	
	23	Automatic Weather Stations	2	4
	24	Aeronautical Meteorological Stations	2	4
	25	Aircraft Observations	2	4
	26	Marine Observations - observations from ships, buoys	1	4
	27	Operational Satellite Systems	2	4

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Analysis and plotting of aerosols data from aerosol spectrometer	5,6
2	Analysis and plotting Aerosol data from solar radiometer	5,6
3	Analysis and plotting of aerosols data from satellite based sensors	5,6
4	Analysis and plotting surface meteorological data like temperature, pressure, wind speed, rainfall etc from Automatic Weather Station	5,6
5	Analysis and plotting of upper air data from radiosondes/ozonezonde	5,6
6	Analysis and plotting of aerosol characteristics from LIDAR data	5,6
7	Analysis and plotting of cloud characteristics from LIDAR data	5,6
8	Analysis and plotting of precipitation characteristics from disdrometer and Micro Rain Radar	5,6

Part B* – At least One Experiment to be performed		
9	Analysis and plotting of upper air data from RADAR data	5,6
10	Analysis and plotting of upper air data from Satellite data	5,6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Review of various observable atmospheric parameters and comprehend various methods to observe surface weather and upper air parameters	R,U	PSO-1,3
CO-2	Discuss the various measurement techniques for aerosol observations	U	PSO-1,3
CO-3	Describe the various measurement techniques for cloud observations	U	PSO-1,3
CO-4	Realise the different general observing systems of the atmosphere	U, Ap	PSO-1,3
CO-5	Analyse the atmospheric data from in situ/ground based and space-based observations and interpret the variations in different atmospheric parameters	An, E	PSO-1,3,7
CO-6	Predict the weather through application of the principles of physics, supplemented by a variety of statistical and empirical techniques	An, E	PSO-1,3,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: OBSERVING WEATHER AND CLIMATE

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Review of various observable atmospheric parameters and comprehend various methods to observe surface weather and upper air parameters	PO 1/PSO-1,3	R,U	F	L	-
CO-2	Discuss the various measurement techniques for aerosol observations	PO 1/PSO-1,3	U	F,C	L	-
CO-3	Describe the various measurement techniques for cloud observations	PO 1/PSO-1,3	U	F,C	L	-
CO-4	Realise the different general observing systems of the atmosphere	PO 1/PSO-1,3	U, Ap	F,C	L	-
CO-5	Analyse the atmospheric data from in situ/ground based and space-based observations and interpret the variations in different atmospheric parameters	PO 1,6,7/PSO-1,3,7	An, E	C,P	-	P

CO-6	Predict the weather through application of the principles of physics, supplemented by a variety of statistical and empirical techniques	PO 1,6,7/PSO-1,3,7	An, E	C,P	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	-	2	-	-	-	-	2	-	-	-	-	-	-	-
CO-2	3	-	3	-	-	-	-	2	-	-	-	-	-	-	-
CO-3	2	-	2	-	-	-	-	2	-	-	-	-	-	-	-
CO-4	2	-	2	-	-	-	-	2	-	-	-	-	-	-	-
CO-5	2	-	2	-	-	-	2	2	-	-	-	-	2	2	-
CO-6	2	-	2	-	-	-	2	2	-	-	-	-	2	2	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	✓	-	-
CO-5	✓	-	-	-
CO-6	✓	-	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK6DSEPHY301**				
Course Title	**OPERATIONAL AMPLIFIERS AND APPLICATIONS**				
Type of Course	**DSE**				
Semester	**VI**				
Academic Level	**300 - 399**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites					
Course Summary	This course aims to get a thorough knowledge of analog ICs. It also helps to understand instrumentation techniques and get an idea regarding transducers.				

BOOKS FOR STUDY:

1. Op Amps and Linear Integrated Circuits by Ramakant A Gayakwad
2. Principles of Electronics: V. K. Mehta and Rohit Mehta, S. Chand Ltd.,2020 Edition
3. Basic Electronics-Solid State: B. L. Theraja, S. Chand Ltd. 2005

BOOKS FOR REFERENCE:

1. Basic Electronics: Devices, circuits and IT fundamentals: Santiram Kal, PHI, 2010
2. Linear Integrated Circuits- D Roy Choudhury and Shail B Jain
3. Integrated Electronics by Jacob Millman& C Halkias (Tata McGraw Hill)

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Operational Amplifiers (Book 2, Chapter 25)**	**9**	
	1	Emitter Coupled Differential amplifier, Block diagram of Op-Amp	1	1
	2	Concept of Virtual ground Characteristics of Op-Amp, Op-Amp parameters - Input resistance, Output resistance, Common Mode Rejection Ratio (CMMR), Slew rate, offset voltages	2	1
	3	Basic Op-Amp circuits - Inverting Op-Amp, Non-inverting Op-Amp	2	1,3
	4	Op-Amp as: Summing amplifier, Subtractor, Comparator, Voltage follower	2	1,3
	5	Integrator, and Differentiator	2	1,3
II		**Active Filters (Book 1, Chapter 8)**	**9**	
	6	Introduction, Active Filters (different types- qualitative idea only)	1	2
	7	First Order Low Pass Butterworth filter: filter design and frequency scaling	3	2
	8	First Order High Pass Butterworth filter	3	2
	9	Band-Pass Filter: Wide Band-Pass Filter	1	2
	10	Band Reject Filters: Wide Band-Reject Filter	1	2
III		**Op-amp oscillators (Book 1, Chapter 8)**	**9**	
	11	Oscillator types, frequency stability	1	3
	12	Phase Shift Oscillator	1	4
	13	Wien Bridge oscillator	1	4
	14	Quadrature Oscillator	1	4
	15	Square Wave Generator, Triangular Wave Generator (derivations not required)	3	4
	16	Sawtooth Wave Generator (derivations not required)	2	4

IV	**Specialised IC Applications (555 Timer) (Book 1, Chapter 10)**		**9**	
	17	The 555 Timer – block diagram	2	2
	18	The 555 Timer as a Monostable Multivibrator	1	2,4
	19	Monostable Multivibrator applications: frequency divider, pulse stretcher	2	4
	20	The 555 Timer as an Astable Multivibrator	2	4
	21	Astable multivibrator applications: square wave oscillator, free running ramp generator	2	4
V*	**Transducers and Instrumentation (Book 3, Chapter 36,37)**		**9**	
	22	Transducers and its Classification	1	5
	23	LVDT - Piezoelectric Transducer - Strain Gauge	2	5
	24	Temperature Transducers – Resistance Temperature Detectors - Thermistors - Thermocouples	2	5
	25	Various Types of Microphones- Loudspeaker	1	5
	26	Analog and Digital Instruments - Essentials of an Electronic Instrument - Multimeter	1	5
	27	Cathode Ray Oscilloscope - Cathode Ray Tube - Deflection Sensitivity of CRT, Digital Storage Oscilloscope (working principles only)	2	6

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	FET characteristics: (i) To plot the static drain characteristics of FET (ii) To calculate the FET parameters (drain dynamic resistance, mutual conductance and amplification factor at a given operating point)	3
2	Hartley oscillator: To observe the output wave form and to measure the frequency of oscillations	3
3	Phase shift oscillator: (i) Trace the circuit (ii) To measure the frequency from the output waveform	4

4	OP Amp as Summing amplifier and Comparator (Zero crossing detector)	3
5	OP amp. - Inverting amplifier using IC 741 (i) Trace the circuit (ii) To construct an inverting amplifier using IC 741 and determine its voltage gain for different input voltages	3
6	OP amp. – Non-inverting amplifier using IC 741 (i) Trace the circuit (ii) To construct a Non-inverting amplifier using IC 741 and determine its voltage gain for different input voltage	3
7	Astable Multivibrator using IC 555- To design and set up an astable multivibrator using 555 timer for a frequency of 1 kHz	4
8	Monostable Multivibrator using IC 555 - To design a monostable multivibrator using 555 timer for 1 ms pulse width	4
9	First Order Low pass filter using IC 741	4
Part B* – At least One Experiment to be performed		
11	Operational Amplifier - Integrator	3
12	Operational Amplifier - Differentiator	3
13	First Order High pass filter using IC 741	3

C6OURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the concept of differential amplifier	U, R	1
CO-2	Describe the Op-Amp IC 741 and IC 555 Timer	U	1
CO-3	Apply the concepts of op-amp in electronic functions	Ap	2
CO-4	Construct waveform generators using IC 741 and IC 555 Timer	Ap	5
CO-5	Understand the basics of different transducers	U	1
CO-6	Apply the concepts of transducers in instrumentation	Ap	2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: OPERATIONAL AMPLIFIERS AND APPLICATIONS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Understand the concept of differential amplifier	PO1/ PSO 1	U, R	F	L	
CO-2	Describe the Op-Amp IC 741 and IC 555 Timer	PO 1 /PSO 1	U	C	L	
CO-3	Apply the concepts of op-amp in electronic functions	PO 1/ PSO 2	Ap	C	L	P
CO-4	Construct waveform generators using IC 741 and IC 555 Timer	PO 1/ PSO 5	Ap	C,P	L	P
CO-5	Understand the basics of different transducers	PO 1/ PSO1	U	C, P	L	
CO-6	Apply the concepts of transducers in instrumentation	PO 1/ PSO 2	Ap	C	L	

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	-	-	-	-	-	-	2	-	-	-	-	-	-	-
CO-2	2	-	-	-	-	-	-	2	-	-	-	-	-	-	-
CO-3	-	2	-	-	-	-	-	2	-	-	-	-	-	-	-

CO-4	-	-	-		2	-	-	2	-	-	-	-	-	-	-
CO-5	2	-	-	-	-	-	-	2	-	-	-	-	-	-	-
CO-6	-	2	-	-	-	-	-	2	-	-	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	-	-	✓
CO-4	✓	-	-	✓
CO-5	✓	-	-	-
CO-6	✓	-	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK6DSEPHY302</td></tr>
<tr><td>Course Title</td><td colspan="5">NANOTECHNOLOGY FOR ENERGY CONVERSION AND STORAGE DEVICES</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSE</td></tr>
<tr><td>Semester</td><td colspan="5">VI</td></tr>
<tr><td>Academic Level</td><td colspan="5">300 - 399</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>3 Hrs</td><td>-</td><td>2 Hrs</td><td>5 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">-</td></tr>
<tr><td>Course Summary</td><td colspan="5">This course is designed to understand the basic concepts of electrochemical energy storage systems and conversion technology. The curriculum covers basic concepts of energy storage systems and conversion technology. This course covers different types of fuel cell, battery, supercapacitor and solar cells and also includes uses and challenges of nanomaterials in energy storage and conversion technology.</td></tr>
</table>

BOOKS FOR STUDY:

1. Allen J.Bard and Larry R Electrochemical methods: Fundamentals and Applications, Faulkner, 2ndEdition John Wiley & Sons. Inc, (2004).
2. 2 D. Linden. Thomas B. Reddy, Handbook of Batteries, 3rd Edition, McGraw-Hill, New York, (2002). ‘
3. B.E. Conway, Electrochemical supercapacitors: Scientific Fundamentals and Technological Applications, Kluwer Academic Plenum publisher, New York, (1999).
4. C. Brabec, V. Dyakonov, U. Scherf, Organic Photovoltaics: Materials, Device Physics, and Manufacturing Technology, 2nd Edition, Wiley VCH, (2014).
5. J. Larmine and A. Dicks, Fuel Cell System Explained, John Wiley, New York, (2000).

BOOKS FOR REFERENCE:

1. Science and Technology of Lithium Batteries-Materials Aspects: An Overview, A. Manthiram, Kulwer Academic Publisher, (2000).
2. M. S. Whittingham, A. J. Jacobson, Intercalation Chemistry, Academic Press, New York, (1982).
3. M. Wakihara, O. Yamamoto, (Eds.) Lithium Ion Batteries: Fundamentals and Performance, Wiley –VCH, Weinheim, (1998).

WEB REFERENCES

1. https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ch26/
2. https://nptel.ac.in/courses/112/107/112107283/
3. https://nptel.ac.in/courses/102/107/102107058/

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Fundamental Concepts in Electrochemistry (Book 1)**	**9**	
	1	Electrochemical Cell - Faraday's laws - Electrode Potentials (Book 1: Chapter 1)	3	1
	2	Thermodynamics of electrochemical cells - Polarization losses in electrochemical cells	3	1
	3	Electrode process and kinetics, Electrical double layer	2	1
	4	Photoelectrochemical cell	1	1
II		**Energy Conversion Systems**	**9**	
	5	Issues and Challenges of functional Nanostructured Materials for electrochemical Energy - Conversion Systems	3	2
	6	Fuel Cells - Principles and nanomaterials design for; Proton exchange membrane fuel cells (PEMFC) (Book 5: Chapter 1&4)	3	2.3
	7	Direct methanol fuel cells (DMFC) - Solid-oxide fuel cells (SOFC) - Current status and future trends. (Book 5: Chapter 6&7)	3	2,3
III		**Energy Storage System - Batteries**	**9**	
	8	Energy Storage Devices - Primary and Secondary Batteries (Lithium-ion Batteries) - Cathode and anode materials (Book 2: Chapter 14&22)	4	4

	9	Nanostructured Carbon-based materials – Novel hybrid electrode materials	3	4
	10	Current status and future trends.	2	4
IV	**Electrochemical Capacitor**		**9**	
	11	Capacitor - Electrochemical supercapacitors - electrical double layer model - Principles and materials design	5	5
	12	Redox capacitor - Conducting polymers	3	5
	13	Current status and future trends	1	5
V*	**Photovoltaic Systems**		**9**	
	14	Principles of photovoltaic energy conversion (PV) - Types of photovoltaic Cells - Physics of photovoltaic cells. (Book 2: Chapter 10)	4	5
	15	Organic photovoltaic cells – Qualitative ideas of thin-film Dye-Sensitized Solar Cells (Book 2: Chapter 2&20)	3	5
	16	Current status and future trends	2	5

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	From the given XRD data find the strain and particle size	6
2	Using the given absorbance spectra of the dye find the degradation rate	6
3	Using the given SAED pattern find the crystalline nature of the material	6
4	To determine the drug concentration using UV-Vis spectroscopy	6
5	To study the optical, structural, and surface morphological properties of semiconductor nanostructures prepared via sol-gel method and wet chemical methods	6
6	From the given BET data find the surface area and pore size	6
7	To optimize the concentration of nanoparticles dispersed solution using	6
8	UV-vis spectroscopy.	6

9	Interpretation of simple molecule using Raman and IR spectra	6
10	Using the CV Or GCD data find the specific capacitance of the given nanomaterial	6
11	Find the capacitance of a given nanomaterials from CV measurements	6
12	From the given data of doped nanomaterials XRD pattern find the strain using W-H plot	6
Part B* – At least One Experiment to be performed		
13	To find the nature of optical band gap of the given semiconducting materials by measuring UV-Visible transmission spectrum.	6
12	To find the average grain/crystallite size, unit cell parameters, micro-strain by recording the X-ray diffraction pattern of the given sample.	6
15	Find the macrostrain and unit cell parameters from the XRD pattern of given thin films/nanostructures	6
16	Using PV system using a readymade PV cells, DC ammeter to find how wavelength of the light affect the electricity production	6
17	Using the given CV data find the specific capacitance and comment on the nature of capacitance	6
18	Using W-H plot find the strain in transition metal oxide nanomaterials XRD pattern	6
19	Using the dye degradation absorption spectra evaluate the percentage of degradation,	6
20	Analysis of CNT nanoparticles by UV-Visible spectroscopy	6
21	Analysis of CNT nanoparticles by FTIR spectroscopy	6
22	From the given data of doped semiconductors find the absorption coefficient and variation in optical band gap	6
23	Find the band gap variation in nanocomposites suing UV-visible spectroscopy	6
24	Grain size measurements using optical microscopy	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Cite the fundamentals of basic concepts of Electrochemistry	U	PSO-1,2
CO-2	Describe about the fundamental energy conversion systems	R, U	PSO-2,3
CO-3	Outline the working of fuel cells	U	PSO-1,3
CO-4	Illustrate the role of nanomaterials in rechargeable batteries	Ap	PSO-3,4
CO-5	Summarise carbon-based supercapacitors and pseudo capacitors and relate and analyse the basic concepts of photovoltaic cells and future trends	R, Ap, An	PSO-5
CO-6	Describe and demonstrate simple experiments	Ap	PSO-7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: NANOTECHNOLOGY FOR ENERGY CONVERSION AND STORAGE DEVICES

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Cite the fundamentals of basic concepts of Electrochemistry	PO1,3,4, 5,6,8 / PSO-1,2	U	F, C	L	-
CO-2	Describe about the fundamental energy conversion systems	PO1,2,3, 4,5,8 / PSO-2,3	R, U	F, C	L	-
CO-3	Outline the working	PO1,2,3,	U	F, C	L	-

	of fuel cells	4,6 / PSO-1,3				
CO-4	Illustrate the role of nanomaterials in rechargeable batteries	PO1.2.3. 4.6 / PSO-3,4	Ap	F, C	L	-
CO-5	Summarise carbon-based supercapacitors and pseudo capacitors and relate and analyse the basic concepts of photovoltaic cells and future trends	PO1,2,3, 7 / PSO-5	R, Ap, An	F, C	L	-
CO-6	Describe and demonstrate simple experiments	PO1,2,4. 5.8 / PSO-7	Ap	F, C	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	2	-	-	-	-	-	2	-	2	2	1	1	-	1
CO-2	-	2	2	-	-	-	-	2	2	2	1	1	-	-	1
CO-3	2	-	1	-	-	-	-	2	2	1	1	-	1	-	-
CO-4	-	-	3	2	-	-	-	2	2	2	1	-	1	-	-
CO-5	-	-	-	-	2	-	-	2	2	2		1	-	1	-
CO-6	-	-	-	-	-	-	3	2	1	2	1	1	-	-	1

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	-	✓	-	✓
CO-3	-	✓	-	✓
CO-4	-	✓	-	✓
CO-5	✓	-	-	-
CO-6	✓	-	-	--

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK6DSEPHY303**				
Course Title	**IONOSPHERE- MAGNETOSPHERE**				
Type of Course	**DSE**				
Semester	**VI**				
Academic Level	**300 - 399**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites	1. Basic equations of motion, behaviour of a charged particle in electric and magnetic fields. 2. Basic knowledge of earth's atmosphere and magnetosphere				
Course Summary	The course aims to give a fundamental concept of Earth's atmosphere, ionosphere and magnetosphere. The production and maintenance of different ionospheric layers are included in this course. On completion of the course, the student will get a comprehensive understanding of the significance of different layers of ionosphere, different ionospheric phenomena which affect communication and geo magnetospheric properties.				

BOOKS FOR STUDY:

1. Introduction to Ionospheric Physics –Henry Rishbeth and Owen K Garrriot
2. Handbook of the Solar-Terrestrial Environment, Yohsuke Kamide AbrahamC.-L. Chian (Eds)
3. Gombosi, T. I., Physics of the Space Environment, Cambridge University Press, 1998

BOOKS FOR REFERENCE:

1. The Earth's Ionosphere-Michael C. Kelley
2. Tropospheric and Ionospheric Effects on Global Navigation Satellite Systems,Timothy H. Kindervatter,IEEE Press WILEY
3. Ionospheric Prediction and Forecasting,Bruno Zolesi · Ljiljana R. Cander,Springer

WEB RESOURCES:

1. MOOC, SWAYAM, NPTEL
2. https://www.ncei.noaa.gov/products/geomagnetic-indices
3. Geomagnetic Indices in Solar-Terrestrial Physics and Space Weather. Menvielle, M., Marchaudon, A. (2007). In: Lilensten, J. (eds) Space Weather. Astrophysics and Space Science Library, vol 344. Springer, Dordrecht. https://doi.org/10.1007/1-4020-5446-7_24

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	**Fundamentals of Earth's atmosphere and Ionosphere (Book 1: Chapter 1& 3)**		**14**	
	1	Atmospheric Nomenclature, The hydrostatic equation of atmospheric structure, Scale height,	3	1
	2	Ionosphere – The balance of Ionization . The basic theory of Photoionization , Chapman's production function and the Chapman Layer,	8	1
	3	Production of Ionospheric layers, Loss reactions	3	1
II	**Morphology of the Ionosphere and Some Ionospheric Phenomena (Book1: Chapter 5 & 6)**		**07**	
	4	Electron density profile and different layers of Ionosphere-The D,E, F1 and F2 layers	3	2
	5	Maintenance of the night F2 Layer, The polar F layer, The equatorial F2 Layer,	2	2
	6	Some ionospheric Phenomena-Sporadic E, Ionospheric irregularities, Spread F	2	2

III	**Geomagnetosphere (Book 2: Chapter 7, Book 3: Chapter 14)**		**11**	
	7	Interaction of the Solar Wind with the Terrestrial Magnetic Field: The Bow Shock and the Magnetopause, The Magnetospheric Cavity.	4	3
	8	Magnetospheric Current Systems, The Ring Current , Field-Aligned Currents	3	3
	9	Magnetic reconnection-Magnetospheric models-The Chapman Ferraro closed magnetosphere, Dungey's open magnetosphere.	3	3
	10	Polar Cap Convection for Southward IMF	1	3
IV	**Geomagnetic pulsations (Book 2: chapter 16)**		**04**	
	11	Geomagnetically induced current, Continuous and Irregular pulsation : Low frequency, Mid frequency and High frequency pulsations	4	4
V*	**Geomagnetic storms and geomagnetic activity indices (Book 3: Chapter 14)**		**09**	
	12	Geomagnetic Storms and its SolarWind Causes, Ring Current as a Dominant Signature of Geomagnetic Storms , Aurorae, Substorms,The SolarWind as a Driver of SubstormActivity Standoff distance	5	5
	13	Geomagnetic Activity Indices-Disturbance storm time index(Dst), SYM-H, ASYM-H	2	5
	14	Auroral indices, PC, Kp, Ap and Wp indices.	2	5

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	To compare the solar spectrum and associated black body spectrum at Sun's surface temperature by available data and To identify some of the prominent spectral lines in the spectrum of the Sun.	6

2	Identification of different phases of a storm using Dst index	6
3	Study of North South asymmetry of sunspot number	6
4	Study the variation of sunspots during different solar cycles.	6
5	Using Auroral indices identify different phases of a substorm.	6
6	To calculate periodicity using power spectral density method from geophysical/astrophysical time series data	6
7	To study the variations in geomagnetic components X, Y and Z OR H, D, F observed at different latitudes during a solar flare event	6
8	Study the effective temperature of stars by B-V photometry.	6
9	To analyze the variations of the ionospheric parameters, and obtained from ionospheric stations using digisonde during a space weather event	6
10	To generate Vertical TEC data from RINEX files and analyse diurnal variation of VTEC at a given location	6
11	Any other equivalent experiment in the relevant area of specialization	6
Part B* – At least One Experiment to be performed		
12	Study of Limb Darkening Effect and Rotation Period of Sun by using Solar Telescope	6
13	Study the variation of sunspot area during different solar cycles.	6
14	The 21 cm Hydrogen Line experiment: Exploring the solar system through hydrogen line spectrum radio data analysis	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Explain the different regions of the neutral atmosphere based on temperature profile, formation of ionosphere and fundamentals of production and loss mechanisms	U	3
CO-2	Discuss the electron density profile of the ionosphere and the different regions of the ionosphere. It also includes	U	3

	different ionospheric phenomena which can affect radio wave propagation.		
CO-3	Describe different geomagnetic activities and models	U	3
CO-4	Explain geomagnetic pulsations on the atmosphere due to sun-earth interactions	U	3
CO-5	Identify various geomagnetic and auroral indices and apply the same for data analysis	U, Ap, An	3
CO-6	Apply and analyse various solar and geomagnetic indices	Ap, An	2,3,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: IONOSPHERE- MAGNETOSPHERE

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Understand the different regions of the neutral atmosphere based on temperature profile and to learn about the formation of ionosphere and fundamentals of production and loss mechanisms	PO 1/ PSO 3	U	F,C	L	-
CO-2	Understand the electron density profile of the ionosphere and the	PO 1/ PSO 3	U	F,C	L	-

	different regions of the ionosphere. It also includes different ionospheric phenomena which can affect radio wave propagation.					
CO-3	Gain knowledge about different geomagnetic activities and models	PO 1/ PSO 3	U	F,C	L	-
CO-4	Understand geomagnetic pulsations on the atmosphere due to sun-earth interactions	PO 1/ PSO 3	U	F,C	L	-
CO-5	Understand various geomagnetic and auroral indices and apply the same for data analysis	PO 1,7/ PSO 3	U, Ap, An	F,C	L	-
CO-6	Apply and analyse various solar and geomagnetic indices	PO 1,2,7/ PSO 2,3,7	Ap, An	C,P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	-	-	2	-	-	-	-	2	-	-	-	-	-	-	-
CO-2	-	-	2	-	-	-	-	2	-	-	-	-	-	-	-
CO-3	-	-	2	-	-	-	-	2	-	-	-	-	-	-	-
CO-4	-	-	2	-	-	-	-	2	-	-	-	-	-	-	-
CO-5	-	-	2	-	-	-	-	2		-	-	-	-	1	-
CO-6	-	1	1	-	-	-	1	2	1	-	-	-	-	2	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	-	-	✓
CO-5	✓	✓	-	-
CO-6	✓	-	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK6DSEPHY304**				
Course Title	**PRACTICAL MEDICAL PHYSICS**				
Type of Course	**DSE**				
Semester	**VI**				
Academic Level	**300 - 399**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites					
Course Summary	Basic knowledge about working and safety of MRI and ultrasound scan, imaging using X-ray, nuclear medicine, radiotherapy physics, radiation safety.				

BOOKS FOR STUDY:

1. Practical Medical Physics_ A Guide to the Work of Hospital Clinical Scientists-CRC Press (2021) Debbie Peet, Emma Chung -

BOOKS FOR REFERENCE:

1. Encyclopedia of Medical Physics_ Two Volume Set-CRC Press (2021) Slavik Tabakov, Franco Milano, Magdalena S. Stoeva, Perry Sprawls, Sameer Tipnis, Tracy Underwood

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	**MRI & Ultra Sound (Chapter 2 & 3)**		**10**	
	1	Working of MRI, The MRI Scanner, Setting Up an MRI Scan and Choice of Sequences, Performing a Scan	1	1

	2	MR Safety	2	1
	3	MRI QC, The Future of MRI	1	1
	4	Working of Ultrasound, Ultrasound Equipment- Ultrasound Transducers, The Scan Engine – Knobology	2	1
	5	Safety of Diagnostic Ultrasound- Thermal Index, Mechanical Index, Safety Tests of Non-CE Marked Ultrasound Equipment	2	1
	6	Ultrasound Quality Control- Acceptance, Annual QC Tests, The Future of Ultrasound Physics	2	1
II	**Imaging Using Xray (Chapter 4)**		**8**	
	7	Generation of Diagnostic X-rays, X-ray Imaging Modalities	3	2
	8	Performance Measurements	1	2
	9	Patient Dose Measurement and Calculations	3	2
	10	The Future of X-ray Imaging Physics	1	2
III	**Nuclear Medicine (Chapter 5)**		**9**	
	11	The Professional Role of a Clinical Scientist in Nuclear Medicine	1	3
	12	Radionuclide Imaging Equipment	2	3
	13	Equipment Management of Gamma Cameras and PET/CT Scanners	1	3
	14	Optimization of Imaging Parameters in Nuclear Medicine	2	3
	15	Therapeutic Techniques in Nuclear Medicine	2	3
	16	Patient Dosimetry in Nuclear Medicine, Future Developments	1	3
IV	**Radio Therapy Physics (Chapter 6)**		**9**	
	17	Radiobiology	1	4
	18	Linear Accelerators	1	4

	19	Treatment Planning	1	4
	20	Preparation for Treatment	2	4
	21	Manual Treatment Calculations	2	4
	22	Checks on Complex Plans	1	4
	23	The Future of Radiotherapy	1	4
V*	**Radiation safety (Chapter 7)**		**9**	
	24	The Role of the Clinical Scientist in Radiation Safety-Non-Ionizing Radiation Safety	1	5
	25	Ionizing Radiation Safety – Key Concepts	2	5
	26	Hospital Ionizing Radiation Hazards	2	5
	27	Radiation Safety Risk Assessments	1	5
	28	Local Rules	1	5
	29	Patient Safety, Radiation Safety Culture, Monitoring Radiation Safety	1	5
	30	Contingency Planning, The Future of Radiation Safety	1	5

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Measuring the Diameter of a Human Hair by Laser Diffraction	6
2	Verify Malus law using Laser	6
3	Convert a linearly polarized light into elliptically/circularly polarized light using quarter wave plate	6
4	Analysis of ECG/EMG/EEG Report (any One)	6
5	To observe the normal Zeeman Effect and anomalous Zeeman effect in Cadmium spectral lines and to perform quantitative measurements to determine the value of Bohr magneton	6

6	Determine the magneto-strictive properties of various ferromagnetic materials as well as non-ferromagnetic materials	6
7	Analysis of X-ray Imaging / CT Scan Imaging for Diagnostic Purposes	6
Part B* – At least One Experiment to be performed		
8	Conducting experiments with an MRI simulator	6
9	Conducting Experiments with ECO Cardiogram simulator	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe the working of MRI and ultrasound scan and illustrates their safety.	R, U, Ap	PSO-1,2.3
CO-2	Describe the imaging using X-ray and interpret dose measurements and future	R, U, Ap	PSO-1,2.3
CO-3	Outline nuclear medicine equipment and explain techniques and manipulate dosimetry used in nuclear medicine.	R, U, Ap	PSO-1,2.3
CO-4	Define radiotherapy physics, discuss radiobiology treatment and demonstrate its future	R, U, Ap	PSO-1,2.3
CO-5	List radiation safety methods, distinguish ionizing and non-ionizing radiation effects and construct local rules for radiation safety	R, U, Ap	PSO-1,2.3
CO-6	Describe and demonstrate simple experiments	U, Ap	PSO-1,2.3, 7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: PRACTICAL MEDICAL PHYSICS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Describe the working of MRI and ultrasound scan and illustrates their safety.	PO1,2,3,4,5,6,8/ PSO-1,2.3	R, U, Ap	F, C	L	-
CO-2	Describe the imaging using X-ray and interpret dose measurements and future	PO1,2,3,4,5,6,8/ PSO-1,2.3	R, U, Ap	F, C	L	-
CO-3	Outline nuclear medicine equipment and explain techniques and manipulate dosimetry used in nuclear medicine.	PO1,2,3,4,5,6,8/ PSO-1,2.3	R, U, Ap	F, C	L	-
CO-4	Define radiotherapy physics, discuss radiobiology treatment and demonstrate its future	PO1,2,3,4,5,6,8/ PSO-1,2.3	R, U, Ap	F, C	L	-
CO-5	List radiation safety methods, distinguish ionizing and non-ionizing radiation effects and construct local rules for radiation safety	PO1,2,3,4,5,6,8/ PSO-1,2.3	R, U, Ap	F, C	L	-

CO-6	Describe and demonstrate simple experiments	PO1,2,3 ,4,5,6,8/ PSO-1,2.3	U, Ap	P	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	1	2	2	-	-	-	-	2	2	2	2	2	2	-	2
CO-2	2	2	2	-	-	-	-	3	2	3	2	2	2	-	3
CO-3	3	3	2	-	-	-	-	2	2	2	2	2	2	-	3
CO-4	2	2	2	-	-	-	-	2	2	2	2	2	3	-	2
CO-5	2	2	2	-	-	-	-	2	3	2	3	2	2	-	2
CO-6	1	1	1	-	-	-	3	2	2	2	2	2	3	-	2

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	-	✓	-	✓
CO-4	-	✓	-	✓
CO-5	✓	-	-	-
CO-6	✓		-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK6DSEPHY305</td></tr>
<tr><td>Course Title</td><td colspan="5">APPLIED OPTICS</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSE</td></tr>
<tr><td>Semester</td><td colspan="5">VI</td></tr>
<tr><td>Academic Level</td><td colspan="5">300 - 399</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>3 Hrs</td><td>-</td><td>2 Hrs</td><td>5 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">-</td></tr>
<tr><td>Course Summary</td><td colspan="5">The course on Applied Optics delves into advanced topics including holography for three-dimensional imaging, optical fibers for communication and sensing applications, nonlinear optics for manipulating light properties, optical sensors for detection and measurement purposes, and biophotonics for applications in biological and medical sciences. Students explore practical applications and theoretical principles underlying these optical technologies, gaining insights into their significance across various fields such as telecommunications, healthcare, and scientific research.</td></tr>
</table>

BOOKS FOR STUDY:

1. Optics by Ajoy Ghatak 7th edition
2. Laser and Non-linear Optics by B B Laud
3. Introduction to Biophotonics by P N Prasad
4. Principles of nanophotonics by Motoichi Ohtsu , Kiyoshi Kobayashi, Tadashi Kawazoe, Takashi Yatsui
5. Nanophotonics by Paras N Prasad

BOOKS FOR REFERENCE:

1. Optics: Eugene Hecht, Addison-Wesley 2002
2. Nonlinear Optics by Robert W Boyd
3. Biophotonics: Concepts to Applications by Gerd Keiser
4. Introduction to Nanophotonics by Sergey V. Gaponenko

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Holography**	**8**	
	1	Principle of holography, recording of holograms, reconstruction of images, theory, requirements, distinguishing characteristics of holograms.	4	1
	2	Different types of holograms, transmission and reflection types.	2	1
	3	Applications of holography	2	1
II		**Optical fibers**	**9**	
	4	Introduction, total internal reflection, optical fibre, step index fibre, Graded index fibre, Coherent bundle, the numerical aperture	3	2
	5	Attenuation in optical fibre, single mode fibre, multimode fibre, power law profile	2	2
	6	Pulse dispersion in multimode fibre: Ray Dispersion in Multimode Step Index Fibers, Material Dispersion.	2	2
	7	Fibre sensors (qualitative), fibre optic communication (qualitative), Advantages of fibre optic communication system.	2	2
III		**Non-linear Optics**	**9**	
	8	Harmonic generation- second harmonic generation- phase matching, third harmonic generation	4	3
	9	Optical mixing, parametric generation of light, self-focusing of light	2	3

	10	Multiquantum photoelectric effect, two photon processes and theory of two photon processes	2	3
	11	Multiphoton processes- three photon processes, second harmonic generation	1	3
IV	**Bio photonics**		**10**	
	12	Photobiology—At the Core of Biophotonics, Interaction of Light with Cells, Light Absorption in Cells, Light-Induced Cellular Processes, Photochemistry Induced by Exogenous Photosensitizers.	3	4
	13	Interaction of Light with Tissues, Photoprocesses in Biopolymers- The Human Eye and Vision, Photosynthesis	3	4
	14	In Vivo Photoexcitation, Free-Space Propagation, Optical Fiber Delivery System, Articulated Arm Delivery, Hollow Tube Waveguides	2	4
	15	In Vivo Spectroscopy, Optical Biopsy, Single-Molecule Detection	2	4
V*	**Nano photonics**		**9**	
	16	Introduction to nanophotonics-breaking through diffraction limit, evanescent waves, nanophotonics and its true nature	2	5
	17	Foundations of nanophotonics: photons and electrons; similarities and differences, free space propagation, confinement of photons and electrons, propagation through classically forbidden zone: tunnelling.	2	5
	18	Localization under a periodic potential: band gap, Cooperative effects for photons and electrons.	2	5
	19	Nanoscale optical interactions, nanoscale confinement of electronic interactions; nanoscale electronic energy transfer, Near field interaction and microscopy, nanoscale enhancement of optical interactions.	3	5

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		CO No
Sl No	**Name of Experiment**	
1	Optical fibre characteristics – numerical aperture of an optical fiber	6
2	Attenuation in Optical fiber	6
3	Bandwidth of given optical fiber	6
4	Fiber optic testing (i) fiber continuity test using light source and power meter (ii) cable loss test	6
5	Characteristics light detectors (i) Photodiode (ii) LDR	6
6	Study of photoelectric effect and determination of of Planck's constant	6
Part B* – At least One Experiment to be performed		
7	Bio photonics box experiments: Light penetration, Fluorescence, Sunscreen, Light scattering and propagation	6
8	Recording and reconstruction of a transmission hologram	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Explain the process of holographic imaging and the principles behind the formation of three-dimensional images from holographic recordings.	U	PSO-1,2,3,5,6
CO-2	Explain the basic principles of optical fiber, propagation of light through optical fiber, attenuation in optical fiber and applications of optical fibers	U, Ap	PSO-1,2,3,5,6
CO-3	Explain the mechanism behind non-linear optical phenomena such as harmonic generations, optical mixing, multiphoton process etc.	R, U	PSO-1,2,3,5

CO-4	Explain the fundamental concepts of bio photonics, such as light tissue interactions and the principles of biophotonic imaging technique.	U	PSO-1,2,3,5
CO-5	Explain the basic principles of light matter interactions in the nanoscale.	R, U	PSO-1,2,3,5
CO-6	Apply theoretical knowledge in designing, conducting, and interpreting experiments in applied optics to solve real-world problems effectively.	U, Ap, An	PSO-1,2,3,5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: APPLIED OPTICS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Explain the process of holographic imaging and the principles behind the formation of three-dimensional images from holographic recordings.	PSO-1,2,3,5,6 PO-1,2	U	F, C	L	-
CO-2	Explain the basic principles of optical fiber, propagation of light through optical fiber, attenuation in optical fiber and applications of optical fibers	PSO-1,2,3,5,6 PO-1,2	U, Ap	F, C	L	-

CO-3	Explain the mechanism behind non-linear optical phenomena such as harmonic generations, optical mixing, multiphoton process etc.	PSO-1,2,3,5 PO-1,2	R, U	F, C	L	-
CO-4	Explain the fundamental concepts of bio photonics, such as light tissue interactions and the principles of biophotonic imaging technique.	PSO-1,2,3,5 PO-1,2	U	F, C	L	-
CO-5	Explain the basic principles of light matter interactions in the nanoscale.	PSO-1,2,3,5 PO-1,2	R, U	F, C	L	-
CO-6	Apply theoretical knowledge in designing, conducting, and interpreting experiments in applied optics to solve real-world problems effectively.	PSO-1,2,3,5 PO-1,2	U, Ap, An	F, C	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	2	2	-	2	1		3	2	-	-	-	-		
CO-2	2	2	2	-	2	-		3	2	-	-	-	-		
CO-3	3	2	2	-	1	-		3	2	-	-	-	-		
CO-4	3	2	2	-	1	-		3	2	-	-	-	-		
CO-5	3	2	2	-	1	-		3	2	-	-	-	-		
CO-6	1	2	1	-	2	-		3	2	-	-	-	-		

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	✓	-	-
CO-6	✓	-	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK6DSEPHY306</td></tr>
<tr><td>Course Title</td><td colspan="5">COMPUTATIONAL PHYSICS</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSE</td></tr>
<tr><td>Semester</td><td colspan="5">VI</td></tr>
<tr><td>Academic Level</td><td colspan="5">300 - 399</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>3 Hrs</td><td>-</td><td>2 Hrs</td><td>5 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">1. Basic computer skills.
2. Some knowledge of differential equations and linear algebra.</td></tr>
<tr><td>Course Summary</td><td colspan="5">This course is aimed to introduce the features of Python programming and computational numerical methods. At the end of this course, students should be able to get a broad understanding of the numerical methods used to solve problems in physics and astronomy.</td></tr>
</table>

BOOKS FOR STUDY:

1. Learning Python, B. Nagesh Rao, Cyber Plus Infotech Pvt Ltd., Bengaluru, India, 2nd Edn.
2. Numerical methods: Dr. V. N. Vedamurthy and Dr. N. Ch. S. N. Iyengar, Vikas Publishing House, Pvt Ltd. New Delhi, India.
3. Introductory methods of Numerical Analysis: S.S Sastry, PHI Learning Pvt Ltd., Delhi, India.
4. Python for Education: Learning maths & science using Python and writing them in Latex by Ajith Kumar B.P, IUAC, New Delhi (e-book freely downloadable from https://www.iuac.res.in/phoenix/python4schools/Python-for-Education.pdf)

BOOKS FOR REFERENCE:

1. Fundamentals of Python -First Programs: Kenneth Lambert, Cengage Learning India Pvt Ltd, Delhi, India.
2. Python for Programmers: Paul Deitel and Harvey Deitel, Pearson India Education Services Pvt Ltd, Uttar Pradesh, India.
3. Computer oriented numerical methods: V. Rajaraman, PHI Learning Pvt Ltd., Delhi, India.
4. Python for Programmers: Paul Deitel and Harvey Deitel, Pearson India Education Services Pvt Ltd, Uttar Pradesh, India.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Introduction to Python Programming (Book 1: Chapters 2 & 3)**	**09**	
	1	Introduction to Python Language; Advantages and unique features of Python; Python editors and IDEs; Python scripts; Writing and execution of programs; Statements and lines in Python; Comments.	02	01
	2	Basic Data types (Literals and Operations)- int type, float type, complex type, str type, bool type; Identifiers; Keywords; Variables; Print ( ), input ( ) and format ( ) functions.	03	01
	3	Control flow statements: Decision statements (if , if-else and nested if); Loops [while, for,range ( )]; Break and Continue statements;	04	01
II		**Lists and Tuples (Book 1: Chapters 4 & 5)**	**09**	
	4	Lists: Definition; Creating lists; Accessing and counting list elements; Searching elements within Lists (checking for existence, counting occurrences and locating elements); Adding and deleting elements - appending elements, inserting elements, deleting elements using del, remove( ), pop( ) and clear( ); Adding, multiplying and copying lists; Operations on Lists [min( ), max( ), list reverse ( ), list .sort ( )];	04	02

	5	Tuples: Definition; Creating Tuples; Accessing and counting Tuple elements; Searching elements within Tuples (checking for existence, counting occurrences and locating elements); Adding, multiplying and copying Tuples; Operations on Tuples [min( ), max( ), sorted( )] Sample programs using Python: 1. Write a program to convert temperatures to and from Celsius and Fahrenheit. 2. Write a program that prints all the numbers from 0 to 6 except 3 and 6. 3. Write a program to get the Fibonacci series between 0 and 50. 4. Write a program that prints the multiplication table of a number entered by the user using a for loop. 5. Write a program that takes a string input from the user and checks if it is a palindrome and then print the result. 6. Write a program to classify a given number as prime or not. 7. Write a program for sum of squares of first n natural numbers. 8. Write python program to print even numbers in a list. 9. Write python program to print odd numbers in a list. 10. Write a python program to add two Matrices.	05	02
III	**Computer Oriented Numerical Methods (Book 2: Chapters 3 & 5)**		**9**	
	6	Introduction to numerical methods; Comparison between analytical and numerical methods; Method of successive bisection to find the roots of an equation (include algorithm also), Numerical problems; Newton – Raphson iterative method (include algorithm also), Numerical problems.	04	03
	7	Forward and backward differences; Construction of difference table; Error propogation in difference table; Interpolation technique- Introduction, Lagrange interpolation (include algorithm also), Newton - Gregory	05	03

		forward interpolation, Newton - Gregory backward interpolation.		
IV	**Curve fitting, Numerical Differentiation and Integration (Book 2: Chapter 9)**		**09**	
	8	Least square curve fitting *(Book 3: Chapter 4)* – fitting a straight line, nonlinear curve fitting (power function, polynomial of n^{th} degree) (Include algorithm for linear curve fitting); Numerical differentiation using Newton's forward difference formulae-First order and second order.	04	04
	9	Numerical integration using general quadrature formulae; Trapezoidal rule, Simpson's 1/3 and 3/8 rules (Include algorithms for integration of tabulated function using Trapezoidal rule and Simpson's 1/3 rule); Numerical solutions to ordinary differential equations-Euler and Runge Kutta methods (second order only) (qualitative study only).	05	04
V*	**Modules in Python (Book 4: Chapters 3 & 4)**		**09**	
	10	Modules: Need for modules; Creating modules; Numpy module- introduction, creation of arrays and matrices, various array operations, matrix multiplication, inversion.	04	05
	11	Matplotlib modules – introduction, plot ( ), show ( ) functions, syntax for plotting graphs, multiple plots, labelling, scaling of axes and colouring of plots; Plotting of functions – sin(x), cos(x), exp(x).	04	05
	12	Fourier series representation of square wave using Python.	01	05

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		CO No
Sl No	**Name of Experiment**	
1	Program to find square, cube, square root and factorial of a number	5
2	Program to find logarithm and anti-logarithm of a number	5
3	Program to find the roots of a quadratic equation	5

4	Program to find sin (x), cos (x) and tan (x)	5
5	Program to print the sum of digits of a given number	5
6	Program to classify a given number as prime or not	5
7	Program to generate all prime numbers till a given number	5
8	Program to determine whether a number is a palindrome or not	5
9	Program to determine the solution of a non linear equation using Bisection method	5
10	Program to determine the integral of a tabulated function using trapezoidal rule	5
Part B* – At least One Experiment to be performed		
11	Program to determine the derivative of a tabulated function from difference table	5
12	Modelling the projectile motion using Python – Tabulation of position, velocity and acceleration as a function of time and plot the trajectory (Horizontally projected case only)	5
13	Modelling of freely falling body - Tabulation of position, velocity and acceleration as a function of time	5
14	Program to determine the solution of a non linear equation using Newton Raphson method	5
15	Program for finding the equation of a straight line that best fit the given data using least square curve fitting technique	5
16	Program to determine the integral of a tabulated function using Simpson's $1/3^{rd}$ rule	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss the unique features of Python language, its data types and control flow statements	U	PSO-5
CO-2	Explain Lists and Tuples in Python and apply the features to compile programs	U,Ap	PSO-5

CO-3	Discuss the different numerical methods to solve non linear equations and able to compile programs based on it.	U, Ap	PSO-2,5
CO-4	Summarize the regression analysis for computing curve fitting coefficients and apply numerical differentiation and integration methods to solve numerical problems and compile programs.	U, Ap	PSO-2,5
CO-5	Use the different modules in Python to solve numerical problems	U, Ap	PSO-5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: COMPUTATIONAL PHYSICS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Discuss the unique features of Python language, its data types and control flow statements	PO-7/ PSO-5	U	F	L	-
CO-2	Explain Lists and Tuples in Python and apply the features to compile programs	PO-7/ PSO-5	U, Ap	C,P	L	-
CO-3	Discuss the different numerical methods to solve non linear equations and able to compile programs based on it.	PO-3/ PSO-2,5	U, Ap	C,P	L	-
CO-4	Summarize the	PO-3/	U, Ap	C, P	L	-

	regression analysis for computing curve fitting coefficients and apply numerical differentiation and integration methods to solve numerical problems and compile programs.	PSO-2,5				
CO-5	Use the different modules in Python to solve numerical problems	PO-7/ PSO-5	U, Ap	C, P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	-	-	-	-	3	-	-	-	-	-	-	-	-	3	-
CO-2	-	-	-	-	3	-	-	-	-	-	-	-	-	3	-
CO-3	-	3	-	-	2	-	-	-	-	2	-	-	-	-	-
CO-4	-	3	-	-	2	-	-	-	-	2	-	-	-	-	-
CO-5	-	-	-	-	3	-	-	-	-	-	-	-	-	3	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	-	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	✓	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK6DSEPHY307</td></tr>
<tr><td>Course Title</td><td colspan="5">NUMERICAL METHODS IN PHYSICS</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSE</td></tr>
<tr><td>Semester</td><td colspan="5">VI</td></tr>
<tr><td>Academic Level</td><td colspan="5">300 - 399</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>3 Hrs</td><td>-</td><td>2 Hrs</td><td>5 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">1Knowledge of programming languages such as Python/C++</td></tr>
<tr><td>Course Summary</td><td colspan="5">By the end of the course, students will acquire a solid foundation in different numerical methods for solving complex problems in theoretical and applied physics. They will construct programs in python/C++ to solve the problems using these techniques. Students will be equipped to apply the techniques in their higher studies and research in areas such as Computational Physics and statistical data Analysis.</td></tr>
</table>

BOOKS FOR STUDY:

1. Numerical Methods , E Balaguruswamy **McGraw Hill Education**

BOOKS FOR REFERENCE:

1. S. S. Sastry, Introductory method of Numerical analysis, Fifth Edition, PHI (2012).
2. Numerical methods: Dr. V. N. Vedamurthy and Dr. N. Ch. S. N. Iyengar, Vikas Publishing House, Pvt Ltd. New Delhi, India
3. P. Ghosh, Numerical Methods with computer programs in C++,PHI learning Pvt Ltd
4. Introduction to Numerical Analysis, F.B.-Hildebrand, Second Edition
5. Numerical Methods for Scientists and Engineers Richard Hamming.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Roots of Equations (Chapter 6,7,8)**	**9**	
	1	Bi-Section Method, False Position Method,	3	1
	2	Newton-Raphson Method, Secant Method,	3	1
	3	Two Equation Newton-Raphson Method, Mullers Method	3	1
II		**Roots of Equations II (Chapter 6,7,8)**	**9**	
	4	Gauss elimination method, Gauss elimination with pivoting,	3	1
	5	Gauss-Jordan method, Computing Matrix Inverse	3	1
	6	Jacobi Iteration Method, Gauss-Seidel Method	3	1
III		**CURVE-FITTING (Chapter 9,10)**	**9**	
	7	Linear Interpolation, Lagrange Interpolation, Newton Interpolation	3	2
	8	Interpolation with Equidistant Points, Forward, Backward difference Table	3	2
	9	Fitting Linear Equation: Least Square Method , Fitting Polynomial Function	3	2
IV		**NUMERICAL DIFFERENTIATION AND INTEGRATION (Chapter 11,12)**	**9**	
	10	Differentiating continuous functions: Forward difference only	2	3
	11	Differentiating tabulated functions	3	3
	12	Trapezoidal Rule, Simpson’s 1/3 rule, Simpson’s 3/8 rule, Boole’s Rule	4	3
V*		**Ordinary & Partial Differential Equations (Chapter 13,15)**	**9**	
	13	Taylor Series Method, Eulers Method	2	4

	14	Rung Kutta Methods	2	4
	15	Elliptic Equation: Laplace Equation	3	4
	16	Parabolic Equation : Heat Equation	2	4

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment/Program**	
1	Root of a nonlinear equation using the bisection method	5
2	Root of an equation by false position method	5
3	Root of an equation by Newton-Raphson method	5
4	Root of a nonlinear equation by secant method	5
5	Root of a polynomial using Muller's method	5
6	Solution of first order differential equation using Runge-Kutta method	5
7	Integrate a given function using trapezoidal rule	5
8	Integrate a given function using the Simpsons 1/3 rule	5
9	Integrate a given function using the Simpsons 3/8 rule	5
10	Least square fitting	5
Part B* – At least One Experiment to be performed		
11	Numerical interpolation using Newton and Lagrangian methods	5
12	Program to solve a system of linear equations using simple Gaussian elimination method	5
13	Solution of the first order differential equation at a given point using Euler's method	5
14	First derivative of tabulated function by difference table	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand and apply different methods to find the roots of nonlinear equations to solve problems.	U, Ap	PSO-2
CO-2	Understand and apply different interpolation methods and curve fitting methods.	U, Ap	PSO-2
CO-3	Understand different methods of numerical differentiation and integration and apply those methods to solve problems.	U, Ap	PSO-2
CO-4	Understand the methods to solve ordinary and partial differential equations.	U, Ap	PSO-2
CO-5	Create programs in C^{++} or python for solving problems using different Numerical Techniques.	U, Ap	PSO-2,5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: NUMERICAL METHODS IN PHYSICS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Understand and apply different methods to find the roots of nonlinear equations to solve problems.	PO 1/ PSO 2	U, Ap	F, C, P	L	-
CO-2	Understand and apply different interpolation methods and curve fitting methods.	PO 1/ PSO 2	U, Ap	C,P	L	-

CO-3	Understand different methods of numerical differentiation and integration and apply those methods to solve problems.	PO 1/ PSO 2	U, Ap	C,P	L	-
CO-4	Understand the methods to solve ordinary and partial differential equations.	PO 1/ PSO 2	U, Ap	C,P	L	-
CO-5	Create programs in C^{++} or python for solving problems using different Numerical Techniques.	PO 1,7/ PSO 2,5	U, Ap	C, P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-
CO-2	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-
CO-3	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-
CO-4	-	2	-	-	-	-	-	1	-	-	-	-	-	-	-
CO-5	-	2	-	-	2	-	-	1	-	-	-	-	-	2	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	-	-	✓
CO-5	✓	✓	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK6SECPHY300**				
Course Title	**FIBRE OPTIC TECHNOLOGY**				
Type of Course	**SEC**				
Semester	**VI**				
Academic Level	**300 - 399**				
Course Details	Credit	Lecture per week	Tutorial per week	Hands on Training per week	Total Hours/Week
	3	2 Hrs	-	1 Hr	3 Hrs
Pre-requisites					
Course Summary	This course provides a well-rounded understanding of optical fiber communication, from theoretical concepts to practical skills necessary for installation, maintenance, troubleshooting and safety measures for the same.				

BOOKS FOR STUDY:

1. "An introduction to fiber optics." Ghatak AK, Thyagarajan K. Cambridge university press; 1998 Jun 28.
2. "Technician Guide to Fiber Optics, by Donald J Sterling1999
3. "Fiber optics installer and technician guide." by Woodward B, Husson EB. John Wiley & Sons; 2006

BOOKS FOR REFERENCE:

1. "Technician Guide to Fiber Optics, by Donald J Sterling1999
2. "Fiber optics installer and technician guide." by Woodward B, Husson EB. John Wiley & Sons; 2006 Feb 20.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Overview Of Optical Fiber Communication**	**9**	
	1	Introduction to fiber optics, peripheral structure of optical fibers, numerical aperture, acceptance angle. Optical fibers communication-block diagram and principle, Optical fiber classification on the variation of refractive index, mode of transmission	3	1
	2	Light sources for fiber optics, optical fiber cables design, optical fiber connection. Fiber optics cable- fibre optic tools-fiber, Buffer, Strength, member jacket. Indoor and Outdoor cables.	2	21
	3	Fiber to cable assembling characteristics- Length, Colour coding, Load, Understanding cable specification.	1	
	4	Hands-on training: Fiber Optic Cable Handling. • Understanding cable specification.	3	5
II		**Connectors and Splicers**	**9**	
	5	Connectors and Splicers -difference and their need, Connector components, recent connector technology, connector installation overview, inter connection losses, intrinsic and extrinsic factors, fiber termination, ferrules, epoxy and polish.	3	2
	6	Boot or Dust Cap, Strain Relief, Latching Mechanism	2	2
	7	Splicers- fusion splice and mechanical splice. Splicing equipment – steps involved in splicing.	1	2
	8	Hands-on training: Splicing and Termination	3	5
III		**Basics of Cable Lying**	**9**	
	9	System specification, Basics of power budget and risetime budget.	3	3
	10	Cable installation and hardware- Installation specification, Installation hardware, hardware management	3	3
	11	Hands- on training: Installation and Maintenance	3	5

IV	**Fiber optic System Application**		**9**	
	12	LANS – Topology, Network layer, Quality of Service, ETHERNET	3	4
	13	Fiber Optic Testing- Standard test- Power Meter, OTDR and its uses.	3	4
	14	Hands- on training: Testing and Measurement	3	5
V*	**Link/Cable Troubleshooting and Optical Power safety**		**9**	
	15	**Connector Inspection, Connector End face Evaluation, Visible Fault Locator, , Fiber Identifier, Restoration Practices**	3	4
	16	**Laser Safety, Handling Fiber, Site Safety, Emergencies**	3	4
	17	Hands on training: Safety Procedures	3	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	To understand the basic principles, classifications and operation of optical fibre communications	U	PSO-1,5,6,7
CO-2	To Understand related mechanisms behind connectors and splicers, their uses and will be able to perform splicing and connector installation	R, U, Ap	PSO-1,5,6,7
CO-3	To understand system specifications, different cable installation techniques and hardware management.	R, U	PSO-1,5,6,7
CO-4	To understand various features and types of Local Area Network (LAN) concepts, including various topologies and the network layer and familiarise principles behind various tests and their applications in assessing optical fiber network performance.	R, U, C	PSO-1,5,6,7

CO-5	To understand various connector inspection, maintenance procedures and will be equipped with the knowledge and skills to mitigate potential hazards associated with optical fiber systems	U, An, Ap	PSO-1,5,6,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: FIBER OPTICS TECHNOLOGY

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	To understand the basic principles, classifications and operation of optical fibre communications	PSO-1,5,6,7 PO-1,6,7	U	F, C	L/T	-
CO-2	To Understand related mechanisms behind connectors and splicers, their uses and will be able to perform splicing and connector installation	PSO-1,5,6,7 PO-1,6,7	R, U, Ap	F,C,P	L/T	P
CO-3	To understand system specifications, different cable installation techniques and hardware management.	PSO-1,5,6,7 PO-1,6,7	R, U	F, C	-	P
CO-4	To understand various features and types of Local Area Network (LAN) concepts,	PSO-1,5,6,7 PO-1,6,7	R, U, C	F, C, P	L/T	P

	including various topologies and the network layer and familiarise principles behind various tests and their applications in assessing optical fiber network performance.					
CO-5	To understand various connector inspection, maintenance procedures and will be equipped with the knowledge and skills to mitigate potential hazards associated with optical fiber systems	PSO-1,5,6,7 PO-1,6,7	U, An, Ap	F, C, P	L/T	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	1	-	-	-	2	2	2	1	-	-	-	-	2	2	-
CO-2	1	-	-	-	2	2	2	1	-	-	-	-	2	2	-
CO-3	1	-	-	-	2	2	2	1	-	-	-	-	2	2	-
CO-4	1	-	-	-	2	2	2	1	-	-	-	-	2	2	-
CO-5	1	-	-	-	2	2	2	1	-	-	-	-	2	2	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	✓	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK6SECPHY301**				
Course Title	**PCB MAKING AND DESIGNING**				
Type of Course	**SEC**				
Semester	**VI**				
Academic Level	**300 - 399**				
Course Details	Credit	Lecture per week	Tutorial per week	Hands on Training per week	Total Hours/Week
	3	2 Hrs	-	1 Hr	3 Hrs
Pre-requisites					
Course Summary	This course aims to provide students with a comprehensive understanding of the PCB manufacturing process, from initial design to final assembly, enabling them to create functional and reliable circuit boards for a variety of electronic applications.				

BOOKS FOR STUDY:

1. Printed Circuit Boards, Design, Fabrication, Assembly and Testing, R.S. Khandpur Tata McGraw Hill Publishing Company Limited (2005).

BOOKS FOR REFERENCE:

1. Introduction to Embedded Systems, Shibu K.V.2nd Edition**,** McGraw Hill Education (India) Private Limited (2017).
2. Printed Circuit Boards, Design and Technology, Walter C Bosshart, Tata McGraw Hill Publishing Company Limited (2002).

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Printed Circuit Boards (Book 1: Chapter 1)**	**9**	
	1	Components of a printed circuit board , Classification of printed circuit boards (basic information only)	3	1
	2	Manufacturing of basic printed circuit boards	2	1
	3	Challenges in Modern PCB design and manufacture	1	1
	4	Hands on training Familiarising of the components used in PCB (resistors, transistors, capacitors)	3	2
II		**Lay out Planning (Book 1: Chapter 3)**	**9**	
	5	General PCB Design considerations, Mechanical Design considerations	3	2
	6	Electrical Design considerations	2	2
	7	Conductor Patterns (Rules for lay out design), component placement rules	2	2
	8	Hands on training Preparation of layout and artwork layout planning.	3	5
III		**Lay out Design (Book 1: Chapter 3)**	**9**	
	9	Grid systems, Layout scale, Layout sketch/design, Lay out considerations	2	3
	10	Materials and aids, Land requirements, Manual Lay out Procedure, Layout methodology	2	3
	11	Layout Design checklist, Documentation	2	3
	12	Hands on training Creating a sample layout design of a simple PCB.	3	5
IV		**Mechanical Operations (Book 1: Chapter 9, 10)**	**9**	
	13	Need for Mechanical Operations, Methods (Brief study of cutting, hole punching, drilling)	2	4

	14	Brief discussion on Etching solutions and chemistry (Ferric chloride, Ammonium persulphate, chromic aid, cupric chloride, alkaline ammonia), Etching equipments	4	4
	15	Hands on training Etching and Drilling of PCB. Preparation and mounting components.	3	4,5
V*	**Fabrication (Book 1: Chapters 8, 13, 14)**		**9**	
	16	Solder Mask	3	4
	17	PCB Assembly Process, Testing for quality control	3	4
	18	Hands on training Prepare a PCB for any one of the following: Seven Segment Display driver interface Light switching using LDR LED Flasher circuit Water level controller circuit. (Use of Transistor)	3	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Recognize and explain the basic concepts of PCBs and their importance in electronic devices.	R, U	PSO-1
CO-2	Distinguish PCBs that meet electrical, mechanical, and manufacturing requirements, and enable to contribute effectively in roles related to PCB design, engineering, and manufacturing.	R, U	PSO-1,5
CO-3	Interpret appropriate components for a design and how to place them optimally on the PCB layout.	U, Ap	PSO-1, 5
CO-4	Administer and apply the various manufacturing techniques such as etching, drilling, and soldering involved in producing PCBs.	U, Ap	PSO-1, 5

CO-5	Infer and Interpret the process of assembling components onto the fabricated PCB and assemble a PCB	U, Ap, An	PSO- 1, 5, 7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: PCB MAKING AND DESIGNING

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PSO / PO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Recognize and explain the basic concepts of PCBs and their importance in electronic devices.	PSO-1/ PO-1	R,U	F, C	L	-
CO-2	Distinguish PCBs that meet electrical, mechanical, and manufacturing requirements, and enable to contribute effectively in roles related to PCB design, engineering, and manufacturing.	PSO-1/ PO-1	R, U	P	L	H
CO-3	Interpret appropriate components for a design and how to place them optimally on the PCB layout.	PSO-1, 5/ PO-1,3,4	U, Ap	C	L	-
CO-4	Administer and apply the various	PSO-1, 5/ PO-	U, Ap	C,P	L	H

	manufacturing techniques such as etching, drilling, and soldering involved in producing PCBs.	1,2,3.4.6				
CO-5	Infer and Interpret the process of assembling components onto the fabricated PCB and assemble a PCB	PSO- 1, 5, 7/ PO-1,2,3,6	U, Ap, An	C,P	L	H

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO-2	3	-	-	-	1	-	-	2	1	1	-	-	-	-	-
CO-3	3	-	-	-	2	-	-	2	-	1	1	-	-	-	-
CO-4	3	-	-	-	2	-	-	1	1	1	1	-	1	-	-
CO-5	3	-	-	-	2	-	2	2	3	3	-	-	2	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	-	-	✓
CO-4	✓	✓	-	✓
CO-5	-	✓	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK6SECPHY302</td></tr>
<tr><td>Course Title</td><td colspan="5">SCIENTIFIC WRITING</td></tr>
<tr><td>Type of Course</td><td colspan="5">SEC</td></tr>
<tr><td>Semester</td><td colspan="5">VI</td></tr>
<tr><td>Academic Level</td><td colspan="5">300 - 399</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Hands on Practices per week</td><td>Total Hours/Week</td></tr>
<tr><td>3</td><td>2 Hrs</td><td>-</td><td>1 Hr</td><td>3 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5"></td></tr>
<tr><td>Course Summary</td><td colspan="5">The course on Scientific Writing typically aims to equip students with the necessary skills and knowledge to undertake research effectively. It enables the students with the essential knowledge, skills, and competencies to engage in demanding, ethical, and impactful research practice across various disciplines and professional settings.</td></tr>
</table>

BOOKS FOR STUDY:

1. C.R. Kothari, *Research Methodology Methods and Techniques*, New Age International Publishers (2013).
2. K.Prathapan, *Research Methodology for Scientific Research*, I.K International Publishing House Pvt. Ltd. (2014).
3. Latex for beginners Work book 5th edition, Document Reference:3722-2014, March 2014

BOOKS FOR REFERENCE:

1. Research Methods Design, and Analysis, Larry B. Christensen, R. Burke Johnson, Lisa A Turner, Eleventh edition, Pearson (2015).

2. Research Methodology, Ranjit Kumar, Sage Publications (2012).
3. Fundamentals of Research Methodology and statistics: Yogesh Kumar Singh, New Age international Publications
4. Ethics in science education, research and governance: Edited by Kambadur Muralidhar, Amit Ghosh, Ashok Kumar Singhvi, Indian National Science Academy
5. L. Lamport, *LATEX: A Document Preparation System, User's Guide and Reference Manual*, Addison- Wesley.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Introduction to Research**	**9**	
	1	Meaning and Objectives of Research, Significance of Research, Criteria for good research, Meaning of Research design, Need for Research design, Features of a Good Design Book :1, Chapter1,3	4	CO - 1
	2	Validity and reliability in research (basic information only), hypothesis- sources of hypothesis, types of hypothesis, characteristics of good hypothesis. Book :2, Chapter 3, 4	2	CO - 1
	3	Training Familiarising any one document editing software	3	CO - 6
II		**Data collection and Presentation**	**9**	
	4	Data collection and analysis – Introduction, Need for data collection Book : 2, Chapter 5	1	CO - 1
	5	Methods of data collection, principles for accessing research data Book : 2, Chapter 5	3	CO - 1
	6	Presentation of data, error analysis- types of errors. Book : 2, Chapter 5	2	CO - 1
	7	Training Preparing a slide presentation using any one software	3	CO - 6
III		**Research in Practice**	**9**	
	8	Literature review, Need for Literature review, Writing a Literature review Book : 2, Chapter 6	2	CO -2
	9	Research ethics – importance, values and principles, plagiarism (basic information only) Book : 2, Chapter 8	1	CO -2,3

	10	Publication Types in Journals- Short communication, Rapid communication, Research paper, Review paper, Conference Proceedings Book : 2, Chapter 6	2	CO -2
	11	Indexing - Journal impact factor, citation index, h- index, g-index, hg-index (basic information only) Book : 2, Chapter 6	1	CO -2,3
	12	Practices Writing literature review and plagiarism checking	3	CO -5
IV		**Scientific Paper Writing**	**9**	
	13	Scientific paper – Title, Abstract, Keywords, Introduction, Materials and Methods, Results and Discussion, Conclusion, acknowledgements, References. Book : 2, Chapter 7	2	CO -4
	14	Writing a scientific paper, Importance of scientific writing, Characteristics of scientific writing, Rules for scientific writing. Book : 2, Chapter 7	2	CO -4
	15	Communicating to a Journal- Submission methods, Peer review (basic informations only). Book : 2, Chapter 7	2	CO -4,5
	16	Practices Writing a model scientific paper	3	CO -4,5
V*		**Software**	**9**	
	17	Basics of Latex – Document Structure, Typesetting Text, Tables, Figures, Equations, References Book : 3	6	CO - 6
	18	Training Creating a scientific document using Latex	3	CO - 6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Explain the principles and steps involved in designing a research work	R, U	PSO-4 ,5,7
CO-2	Understand the need for Literature review, familiarise different types of journal publications.	R, U	PSO-4 ,5,7

CO-3	Recognize and understand the importance, values, and principles of research ethics	R, U	PSO-4 ,5,7
CO-4	Inculcate a culture of integrity, transparency, and accountability in research and scientific writing	R, U Ap	PSO-4 ,5,7
CO-5	Interpret and apply research findings	Ap	PSO-4 ,5,7
CO-6	Enhance skills in communicating research through Information technology.	Ap	PSO-4 ,5,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: SCIENTIFIC WRITING

Credits: 2:0:1 (Lecture: Tutorial: Hands on Training)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Explain the principles and steps involved in designing a research work	PO-1,4/ PSO-4 ,5,7	U	F, C	L	-
CO-2	Understand the need for Literature review, familiarise different types of journal publications.	PO - 4,6,8/ PSO-4 ,5,7	U	F, C	L	-
CO-3	Recognize and understand the importance, values, and principles of research ethics	PO- 8/PSO-4 ,5,7	R,U	C	L	-
CO-4	Inculcate a culture of	PO-	U, Ap	C, P	L	H

	integrity, transparency, and accountability in research and scientific writing	1,6,8/PSO-4 ,5,7				
CO-5	Interpret and apply research findings	PO-1,6,8/PSO-5,7	Ap	C, P	L	H
CO-6	Enhance skills in communicating research through Information technology.	PO-1,4,6,8/PSO-4 ,5,7	Ap	C, P	-	H

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	-	2	-	-	2	-	3	2	-		1	-	-	-	-
CO-2	-	-	-	2	3	-	3	-	-	-	1	-	2	-	3
CO-3	-	-	-	2	3	-	3	-	-	-	-	-	-	-	3
CO-4	-	-	-	2	3	-	3	2	-	-	-	-	-	-	3
CO-5	-	-	-	2	3	-	2	2	-	-	-	-	-2	-	3
CO-6	-	-	-	2	3	-	3	2	-	-	1	-	2	-	3

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	✓	-	✓
CO-5	-	✓	-	-
CO-6	-	✓	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK6SECPHY303</td></tr>
<tr><td>Course Title</td><td colspan="5">COMPUTER HARDWARE AND ASSEMBLING</td></tr>
<tr><td>Type of Course</td><td colspan="5">SEC</td></tr>
<tr><td>Semester</td><td colspan="5">VI</td></tr>
<tr><td>Academic Level</td><td colspan="5">300 - 399</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Hands on Training per week</td><td>Total Hours/Week</td></tr>
<tr><td>3</td><td>2 Hrs</td><td>-</td><td>1 Hr</td><td>3 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">-</td></tr>
<tr><td>Course Summary</td><td colspan="5">The course will empower students to build a robust understanding of PC technology, arming them with the expertise required to assemble, configure, and troubleshoot personal computer systems with confidence and efficiency.</td></tr>
</table>

BOOKS FOR STUDY:

1. Reddy N. S., PC Hardware Maintenance & Troubleshooting, NEO Institute of Hardware Technology.
2. Wempen F., Computing Fundamentals, Digital Literacy Edition, Wiley Publications (2014).
3. Zacker C., Rourke J., The Complete Reference: P C Hardware, TMH Publishers (2008).
4. Gulati M., Introduction to Computers, Silicon Media Press (2009).
5. How to Build a Computer: Learn, Select Parts, Assemble and Install, Jacob Beckerman.

BOOKS FOR REFERENCE:

1. Computer Organization, Carl Hamacher, Zvonko Vranesic, Safwat Zaky. Fifth Edition, McGraw-Hill Education (India) Pvt Ltd. (2002).

2. Computer Organization and Design, P Pal Chaudhuri, Third edition, PHI Learning Private Limited (2009).
3. Fundamentals of Computers, E. Balaguruswamy, McGraw-Hill Education (India) Pvt Ltd (2014).
4. Computer Systems, Design and Architecture, Vincent P. Heuring, Harry F. Jordan, Second Edition, Prentice-Hall of India Private Limited (2005).
5. The essentials of Computer Organization and Architecture, Linda Null, Julia Lobur, Third edition, Jones & Bartlett Learning.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	**Fundamentals of PC Technology (Book 1)**		**9**	
	1	Introduction to Computer parts and Peripherals, power supplies, UPS,	3	1
	2	Interface Ports used to connect different Peripherals I/O Ports, drive connectors, USB (and its different generations), Compare USB types, versions and speed, VGA (D-Sub), HDMI, Audio, Ethernet).	3	1,2
	3	Hands on training 1. Identification of different types of hardware components in a computer 2. Study of input devices (keyboard and mouse)	3	4
II	**Memory (Book 1, 2, 3)**		**9**	
	4	Primary Storage Devices- Basic ideas of SDRAMs, DDRAMs, PPRAM, RDRAM, ROM, PROM, Cache Memory, EPROM, EEPROM, Buffer Memory, VRAMs and graphic cards. (Book 2 &3)	3	2
	5	Secondary Storage Devices- HDDs, SSDs and NVMes (Book 1 & 2)	3	2
	6	Hands on training (minimum two) 1. Study semiconductor storage devices. (RAM/SSD/Pen Drive/Memory Card)	3	2, 4

		2. Study optical storage devices. 3. Study magnetic storage devices. 4. Installing the motherboard, CPU and RAM		
III	**Peripherals**			
	7	Different types of Keyboards, Pointing devices, Scanning devices, Digital camera, Printers, Scanners (Book 2)	3	2
	8	Power conditioning device: SMPS, UPS, trouble shooting in all these devices	3	2
	9	Hands on training (minimum two) 1. Study of SMPS. 2. Study of UPS. 3. Study of types of printers and scanners. 4. Study of display devices.	3	1, 4
IV	**Assembling (Book 3)**			
	10	Assembling and Disassembling a PC- Selection of processor and identification of compatible motherboards and SDRAMs; Plugging-in processors and SDRAMs precisely into their sockets; setting up processor cooling systems (thermal paste, CPU fans etc.)	2	4
	11	Motherboard form factor and selection of PC cabinet; selection of storage devices; Connecting HDDs, SSDs, NVMes and ODDs to their ports with precision; Requirement, selection and connection of graphic cards; selection of SMPS of suitable power and connecting it to the components; Selecting I/O devices and connecting them to the computer unit.	3	4
	12	Precautions to be taken while assembling the PC.	1	4
	13	Hands on training (minimum two) 1. Installing storage devices 2. Connecting power supply 3. Cleaning and maintaining computer hardware	3	4

		4. Upgrading RAM, storage, and other components 5. Study of different cables and connectors for interfacing various peripheral devices		
V*	**Booting essentials (Book 1)**			
	14	Introduction to BIOS/CMOS Setup, UEFI systems, POST (Power on Self-Test). BIOS/CMOS Configuration (Date, Time, Enable/Disable Devices), overview of Trusted Platform Module 2.0.	3	3
	15	Dual BIOS Feature BIOS/CMOS Setup, Booting Sequence/Boot Order	3	3
	16	Hands on training 1. Understanding BIOS/UEFI settings 2. Configuring Booting sequence	3	4

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify computer hardware parts and connect peripherals	R, U	PSO- 4, 5,6, 7
CO-2	Compare the function of input, output and storage devices.	R, U	PSO- 4, 5,6, 7
CO-3	Describe the functions of booting process of a computer	R, U	PSO- 4, 5,6, 7
CO-4	Select different components of personal computer to assemble and configure.	Ap	PSO- 4, 5,6, 7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: COMPUTER HARDWARE AND ASSEMBLING
Credits: 2:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Identify computer hardware parts and connect peripherals	PO-1,2,3,6,7 / PSO-5,6, 7	R, U	F, C	L	-
CO-2	Compare the function of input, output and storage devices.	PO-1,2,3,6,7 / PSO-5,6, 7	R, U	F, C	L	-
CO-3	Describe the functions of booting process of a computer	PO-1,2,3,6,7 / PSO-5,6, 7	R, U	F, C	L	-
CO-4	Select different components of personal computer to assemble and configure.	PO-1,2,3,6,7 / PSO-5,6, 7	Ap	F, C, P	T	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	-	-	-	-	2	1	1	2	1	1	-	-	2	2	-
CO-2	-	-	-	-	3	1	1	1	1	1	-	-	2	2	-
CO-3	-	-	-	-	2	1	1	1	1	2	-	-	2	3	-
CO-4	-	-	-	-	3	1	1	2	1	2	-	-	3	3	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	-	-	✓
CO-4	✓	-	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK7DSCPHY400</td></tr>
<tr><td>Course Title</td><td colspan="5">ADVANCED MATHEMATICAL PHYSICS</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSC</td></tr>
<tr><td>Semester</td><td colspan="5">VII</td></tr>
<tr><td>Academic Level</td><td colspan="5">400 - 499</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 Hrs</td><td>-</td><td>-</td><td>4 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Need an understanding of vectors, Fourier series, Complex numbers, Partial and Ordinary differential equations.</td></tr>
<tr><td>Course Summary</td><td colspan="5">By the end of the course, students will have developed advanced mathematical skills and a solid foundation in the mathematical techniques essential for tackling complex problems in theoretical and applied Physics. They will be well-equipped to pursue further studies or research in areas such as quantum field theory, general relativity, condensed matter physics, and mathematical physics.</td></tr>
</table>

BOOKS FOR STUDY:

1. G.B. Arfken and H.J. Weber, Mathematical methods for Physcisits,6th Edition, Elsevier, 2005.
2. C. Harper, Introduction to Mathematical Physics, Prentice Hall ,1986.
3. B.S. Rajput, Mathematical Physics, 16th edition, Pragati Prakashan, 2003.
4. Daniel Fleisch, A Student’s guide to Vectors and Tensors, Ist Edition, Cambridge University Press, 2012.
5. A.W. Joshi, Matrices and Tensors in Physics,3rd Edition, New Age International Pub, 2003.

BOOKS FOR REFERENCE:

1. Complex Variables and Applications, J.W. Brown& R.V. Churchill, 7^{th} Ed. 2003, Tata McGraw-Hill
2. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
3. W.W. Bell, Special Functions for Scientists and Engineers, Dover Publications (2004)
4. H.K. Dass and R. Verma, Mathematical Physics, S. Chand & Co Pvt Ltd (1997)
5. B.D. Gupta, Mathematical Physics, 4^{th} Edition, Vikas Publishing House (2004)
6. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
7. Mathematics for Physicists, P. Dennery and A. Krzywicki, 1967, Dover Publications.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Complex Analysis**	**10**	
	1	Cauchy's integral theorem and Formula	3	1
	2	Taylor expansion and Laurent series, zeroes and singularities	2	1
	3	Cauchy's residue theorem, Poles	3	1
	4	Evaluation of definite Integrals.	2	1
II		**Differential equations and Special Functions**	**16**	
	5	Second Order linear ODEs- singular points	1	2
	6	Series solution- Frobenius method and its applications to differential equations	2	2
	7	Legendre, Bessel (first and second kind), Hermite and Laguerre Differential Equations	6	2
	8	Properties -Rodrigues Formula (Derivations not needed), Generating Function	4	2
	9	Orthogonality and recurrence relations of Legendre, Bessel, Hermite and Laguerre.	3	2
III		**Integrals Transforms**	**16**	
	10	Fourier Transforms- Fourier Integral theorem	1	3
	11	Fourier sine and cosine transform	1	3

	12	Examples: Fourier transform of single pulse, trigonometric, exponential and Gaussian Functions.	2	3
	13	Inverse Fourier transform and Convolution theorem	2	3
	14	Properties of Fourier transforms (translation, change of scale, complex conjugation, One dimensional Wave Equations	2	3
	15	Laplace Transform (LT) of Elementary functions.	1	3
	16	Properties of LTs: Change of Scale Theorem, Shifting Theorem	1	3
	17	LTs of Derivatives and Integrals of Functions	2	3
	18	Derivatives and Integrals of LTs	1	3
	19	LT of Unit Step function, Periodic Functions	1	3
	20	Convolution Theorem and Inverse LT	2	3
IV		**Some Special Integrals**	**06**	
	21	Gamma Functions, Expression of Integrals in terms of Gamma Functions	2	4
	22	Dirac delta function and properties, Laplace and Fourier transform of Dirac delta function.	2	4
	23	Green Function and general properties.	2	4
V*		**Tensor Analysis**	**12**	
	24	Coordinate transformation, Contravariant and mixed tensors	2	5
	25	Addition, Subtraction, Outer product, Inner product and Contraction	2	5
	26	Symmetric and antisymmetric tensors. Quotient law	1	5
	27	Metric tensor, Raising and lowering of indices	1	5
	28	Tensor derivatives, The Christoffel symbols and their transformation laws	2	5
	29	Covariant derivative of tensors	1	5
	30	Equation of Geodesic	1	5
	31	Riemannian curvature tensor	2	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Develop a strong foundation in complex analysis and apply its applications in Physics.	Ap, An	1,2,7
CO-2	Able to solve second-order linear ODEs with singular points, applying series solutions using the Frobenius method, and understanding the properties and applications of special functions such as Legendre, Bessel, Hermite, and Laguerre functions.	Ap.An	1,2,7
CO-3	Acquired skills to solve complex problems involving differential equations and system analysis using transform techniques.	U,Ap	1,2,7
CO-4	Understand and apply Gamma function, Green function and Dirac Delta function to express integrals, analyse distributions and solve differential equations.	U,Ap	1,2,7
CO-5	Understanding basic tensor operations, using tensor notation, and Apply of tensor calculus in studying physical systems.	U, Ap	1,2,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ADVANCED MATHEMATICAL PHYSICS

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Develop a strong foundation in complex analysis and its applications in Physics.	PO 1,2/ PSO 1,2,7	Ap, An	C,P	L	-

CO-2	Able to solve second-order linear ODEs with singular points, applying series solutions using the Frobenius method, and understanding the properties and applications of special functions such as Legendre, Bessel, Hermite, and Laguerre functions.	PO 1,2/ PSO 1,2,7	Ap.An	C,P	L	-
CO-3	Acquired skills to solve complex problems involving differential equations and system analysis using transform techniques.	PO 1,2/ PSO 1,2,7	U,Ap	C,P	L	-
CO-4	Understand and apply Gamma function, Green function and Dirac Delta function to express integrals, analyse distributions and solve differential equations.	PO 1,2,6/ PSO 1,2,7	U,Ap	F,C,P	L	-
CO-5	Understanding basic tensor operations, using tensor notation, and Apply of tensor calculus in studying physical systems.	PO 1,2,6/ PSO 1,2,7	U, Ap	F,C,P	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	3	3	-	-	-	-	3	3	3	-	-	-	-	-	-
CO-2	3	3	-	-	-	-	3	3	3	-	-	-	-	-	-
CO-3	3	3	-	-	-	-	3	3	3	-	-	-	-	-	-
CO-4	3	3	-	-	-	-	3	3	3	-	-	-	3	-	-
CO-5	3	3	-	-	-	-	3	3	3	-	-	-	3	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	✓	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK7DSCPHY401</td></tr>
<tr><td>Course Title</td><td colspan="5">QUANTTUM MECHANICS – II</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSC</td></tr>
<tr><td>Semester</td><td colspan="5">VII</td></tr>
<tr><td>Academic Level</td><td colspan="5">400 - 499</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 Hrs</td><td>-</td><td>-</td><td>4 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Inadequacy of classical theory, Basic quantum mechanics, Schrodinger equation, One dimensional problem-solutions</td></tr>
<tr><td>Course Summary</td><td colspan="5">This course aims to provide a strong foundation to the principles of quantum mechanics and equip the students to apply these principles to solve advanced quantum mechanical problems</td></tr>
</table>

BOOKS FOR STUDY:

1. Introduction to quantum mechanics : David, J Griffith, Prentice Hall, Second Edition
2. Quantum Mechanics : B H Bransden and C J Joachain, Pearson Education Ltd
3. Quantum Mechanics : G Aruldhas, PHI, 2^{nd} Edition, 2020

BOOKS FOR REFERENCE:

1. A text book of Quantum Mechanics- P M Mathews & Venkitesan, Tata Mc Graw Hill, 2010
2. Quantum Mechanics Theory and Applications-Ajoy Ghatak, S Lokanathan , 5^{th} Edn
3. Quantum Mechanics-Leonard I Schiff ,3rd Edn
4. Quantum Mechanics-V K Thankappan , 5^{th} Edn
5. Quantum Mechanics: Concepts and Applications- Nouredine Zettili, Second Edition,Wiley.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**SYMMETRIES AND CONSERVATION LAWS**	**11**	
	1	Unitary transformation: Definition and properties, Infinitesimal and finite unitary transformation	3	1,2
	2	Generator of infinitesimal and finite translation, Conservation of linear momentum	3	1
	3	Generator of infinitesimal and finite rotation, Conservation of angular momentum	3	1
	4	Time evolution operator	2	1
II		**MATRIX REPRENSENTATION AND PICTURES**	**11**	
	5	Matrix representation of operators and wave functions	2	2
	6	Simple Harmonic Oscillator: Operator form	3	2,4
	7	Matrix representation of Hamiltonian, Number operator, raising and lowering operators	3	2
	8	Pictures: Schrodinger picture, Heisenberg picture and interaction picture	3	2
III		**ANGULAR MOMENTUM**	**20**	
	9	Orbital angular momentum operators and commutation relations	2	3
	10	Eigen values and eigen functions of L^2 and Lz	4	2,3
	11	General angular momentum-eigen values of J^2 and Jz-	4	2,3
	12	Matrix representation of angular momentum operators	3	2,3
	13	Spin angular momentum –spin vectors for a spin ½ system	3	3
	14	Addition of angular momentum- Clebsch-Gordan coefficients.	4	3
IV		**THREE-DIMENSIONAL ENERGY EIGENVALUE PROBLEMS**	**6**	
	15	Particle in spherical symmetric potential-general solution	2	4
	16	Rigid rotator	1	2,4

	17	Hydrogen atom problem	3	4
V*	**RELATIVISTIC WAVE EQUATIONS**		**12**	
	18	Klein Gordon Equation, interpretation and equation of continuity	2	5
	19	Dirac Equation: Dirac matrices	2	5
	20	Probability current density and equation of continuity	2	5,2
	21	Covariant form of Dirac equation	1	5
	22	Plane wave solution of Dirac equation	3	5
	23	Negative energy states, Spin of Dirac particle	2	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify the quantum mechanical concepts of symmetry operations and associated conservation laws	U, Ap	PSO-1,2
CO-2	Identify the concepts of matrix representation of operators and wave functions and apply these concepts to solve quantum mechanical problem	U, Ap	PSO-1,2
CO-3	Recognize the concepts related to angular momentum operators, their eigen values, eigen functions, commutation relations and matrix representation	U, Ap	PSO-1, 2
CO-4	Apply problem solving techniques in quantum mechanics to three dimensional problems	U, Ap	PSO-1, 2, 3
CO-5	Compare the physical concepts of Klein Gordon equation and Dirac relativistic equation	U, Ap	PSO-1,2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: QUANTTUM MECHANICS – II

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Identify the quantum mechanical concepts of symmetry operations and associated conservation laws	PO1,3,4, 5,6,8/ PSO-1,2	U, Ap	F, C	L	-
CO-2	Identify the concepts of matrix representation of operators and wave functions and apply these concepts to solve quantum mechanical problem	PO1,3,4, 5,6,8/ PSO-1,2	U, Ap	F, C	L	-
CO-3	Recognize the concepts related to angular momentum operators, their eigen values, eigen functions, commutation relations and matrix representation	PO1,3,4, 5,6,8/ PSO-1, 2	U, Ap	F, C	L	-
CO-4	Apply problem solving techniques in quantum mechanics to three dimensional problems	PO1,3,4, 5,6,8/ PSO-1, 2	U, Ap	F, C	L	-
CO-5	Compare the physical concepts of Klein Gordon equation and Dirac relativistic equation	PO1,3,4, 5,6,8/ PSO-1,2	U, Ap	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	3	2	-	-	-	-	-	2	-	2	2	2	2	-	3
CO-2	3	2	-	-	-	-	-	2	-	2	2	2	2	-	2
CO-3	3	2	-	-	-	-	-	3	-	2	2	2	3	-	3
CO-4	3	2	2	-	-	-	-	2	-	3	3	2	2	-	2
CO-5	3	2	-	-	-	-	-	2	-	2	2	2	2	-	2

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	-	-	✓
CO-5	✓	-	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK7DSEPHY400</td></tr>
<tr><td>Course Title</td><td colspan="5">WEATHER ANALYSIS AND FORECASTING</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSE</td></tr>
<tr><td>Semester</td><td colspan="5">VII</td></tr>
<tr><td>Academic Level</td><td colspan="5">400 - 499</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>3 Hrs</td><td>-</td><td>2 Hrs</td><td>5 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">1. The students must be aware of the difference between weather and climate
2. The students must be familiar with the general circulation pattern
3. The students should have knowledge in any of the programming application/ software for data coding/decoding</td></tr>
<tr><td>Course Summary</td><td colspan="5">● This course is designed to introduce students to the basic tools of weather analysis and techniques of weather forecasting. Basics of weather forecasting are given in the first module which include types of weather forecasting and forecasting methods. Different types of climate variability are described in the second module. The third module comprises various climate models and their applications. Different forecasting strategies and ranges of weather prediction are discussed in the fourth module. Numerical weather prediction modelling is also introduced in the fourth module. The fifth module incorporates the application of climate models for prediction and policy development.
● The practical course introduces the collection, display, analysis and application of various weather forecasts. The control mechanisms and</td></tr>
</table>

	atmospheric processes associated with various forms of severe weather events will also be examined. Upon successful completion of the course, students will be able to make forecasts of temperature, precipitation, and other meteorological conditions.

BOOKS FOR STUDY:

1. Weather Analysis and Forecasting, Christo Georgiev Patrick Santurette, 2016
2. Physics of Climate, Jose P. Peixoto and Abraham H. Oort, Springer, 1992.
3. Adaptation and mitigation strategies for climate change, Sumi A., Fukushi and Ahiramatsu, Springer, 2010.
4. Fundamentals of Atmospheric Modelling, Marc Z. Jacobson, Cambridge University Press, 2005.
5. Numerical Weather Prediction Basics: Models, Numerical Methods, and Data Assimilation Zhaoxia Pu and Eugenia Kalnay.2018
6. Atmospheric Science : An Introductory Survey : John M Wallace and Peter V. Hobbs, Academic Press, 2^{nd} Edition, 2006

BOOKS FOR REFERENCE:

1. Synoptic and Dynamic Climatology, Roger G. Barry and Andrew M Carleton, Routledge London and New York, 2001.
2. Atmosphere, Ocean and Climate Dynamics, John Marshall and R. Alan Plumb, Elsevier Academic Press, 2008.
3. Guide to preparation of synoptic weather charts and diagrams, WMO (Publications), No.151, WMO Technical Publication, 1964.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Basics of Weather Forecasting (Book: 1- Part I)**	**9**	
	1	Weather forecasting - analysis and its historical background, need of measuring weather	2	1
	2	Scales of weather systems, Map Projections, Climatological and seasonal distribution of Global pressure and wind systems	1	1

	3	Types of weather forecasting, weather forecasting methods	2	1
	4	Satellites observations in weather forecasting, weather maps, synoptic charts	2	1
	5	Uncertainty and predictability, probability forecasts	2	1
II	**Climate Dynamics (Book: 2- Chapter : 2; Book: 6 – Chapter: 10)**		**9**	
	6	The Present-Day Climate, Annual Mean Conditions Climate Variability	2	2
	7	Dependence on Time of Day, Seasonal Dependence	2	2
	8	Internally Generated Climate Variability, Externally Forced Climate Variability	3	2
	9	Climate Monitoring and Prediction	2	2
III	**Climate Modelling and Application (Book: 2- Chapter : 17, Book:4 – Chapter 21)**		**9**	
	10	Introduction to regional and global climate models	2	3
	11	Filtering problem, barotropic model, equivalent barotropic model	2	3
	12	Two level Baroclinic model, Regional and Global climate models	2	3
	13	Basic concepts of parameterization	2	3
	14	Chemical transport model	1	3
IV	**Weather Prediction (Book: 1- Part II, Book: 5 – Chapter 2)**		**9**	
	15	Different forecasting strategies - synoptic, statistical, analogue, empirical and dynamical methods	2	3
	16	Ranges of weather prediction and seamless - mesoscale, general circulation and coupled models	1	3
	17	Limitations of weather predictions - Sources of uncertainties	1	3
	18	Numerical Weather Prediction modelling system – NWP ; interpretation and limitations	2	3
	19	Global Forecast System, Regional and mesoscale forecast system (WRF, ARPS)	2	3
	20	NWP products for: aviation services, cyclone forecasting & warning, monsoon rainfall system, localized severe weather	1	3

V*	**Global Climate and Climate Change (Book: 2- Chapter : 16, Book:3 – Part II & IV)**		**9**	
	21	Application of climate model for prediction and policy development	2	4
	22	Forecast bulletin & products, presentation and dissemination	1	4
	23	Heavy rainfall monitoring, forecasting and warning services.	2	4
	24	Future climate scenarios - global warming and sea level rise - impacts of sea level rise – impact on fresh water sources	2	4
	25	Impact on natural ecosystems - International efforts to minimize climatic change and their impacts	2	4

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Analysis and plotting of surface meteorological data like temperature, pressure, wind speed, rainfall etc	5,6
2	Decoding and plotting of upper air data	5,6
3	Techniques of analysis - Climatological charts, Surface charts, Upper wind charts	5,6
4	Analysis of surface and upper air charts of monsoon depression	5,6
5	Analysis of surface and upper air charts of Cyclonic Storm	5,6
6	Plotting of Charts- Chart reading, Surface chart analysis, Analysis of NCEP/NCAR data	5,6
7	Objective identification of Monsoon Onset over Kerala using reanalysis data	5,6
8	Analysis of Jet streams and Tropical Cyclones	5,6
Part B* – At least One Experiment to be performed		
9	Composite SST analysis during ElNino-LaNina years	5,6
10	Analysis and monitoring of weather systems using short to medium range NWP model outputs	5,6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Interpret and classify different scale of the weather features and climate changes and apply for forecasting strategies	U	PSO-1,3
CO-2	Evaluate the components of climate systems and climate feedback mechanisms and predict future climate change scenarios	U	PSO-1,3
CO-3	Understand simple atmospheric models and complicated atmospheric coupled models	Ap	PSO-1,3
CO-4	Predict weather systems at different space-time domains and forecasting of climate change	Ap	PSO-1,3,6
CO-5	Analyse atmospheric data and examine weather charts/synoptic charts	An, E, C	PSO-1,3,6,7
CO-6	Predict Monsoon Onset over Kerala using reanalysis data and Create and develop Model outputs	An, E, C	PSO-1,3,6,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: WEATHER ANALYSIS AND FORECASTING

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Interpret and classify different scale of the weather features and climate changes and apply for forecasting strategies	PO1,2/PSO-1,3	U	FC	L	-

CO-2	Evaluate the components of climate systems and climate feedback mechanisms and predict future climate change scenarios	PO1,2/PSO-1,3	U	C, P	L	-
CO-3	Understand simple atmospheric models and complicated atmospheric coupled models	PO1,2/PSO-1,3	Ap	C	L	-
CO-4	Predict weather systems at different space-time domains and forecasting of climate change	PO1,2/PSO-1,3,6	Ap	C	L	-
CO-5	Analyse atmospheric data and examine weather charts/synoptic charts	PO1,6,7/PSO-1,3,6,7	An, E, C	C,P		P
CO-6	Predict Monsoon Onset over Kerala using reanalysis data and Create and develop Model outputs	PO1,6,7/PSO-1,3,6,7	An, E, C	C,P,M		P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	-	3	-	-	-	-	3	3	-	-	-	-	-	-
CO-2	3	-	2	-	-	-	-	3	3	-	-	-	-	-	-
CO-3	2	-	3	-	-	-	-	3	3	-	-	-	-	-	-
CO-4	3	-	3	-	-	-	-	3	3	-	-	-	-	-	-
CO-5	2	-	3	-	-	2	2	3	-	-	-	-	3	-	-
CO-6	3	-	3	-	-	2	2	3	-	-	-	-	3	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	-	✓	-
CO-5	✓	-	-	-
CO-6	✓	-	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK7DSEPHY401</td></tr>
<tr><td>Course Title</td><td colspan="5">ENVIRONMENTAL SUSTAINABILITY OF NANOMATERIALS</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSE</td></tr>
<tr><td>Semester</td><td colspan="5">VII</td></tr>
<tr><td>Academic Level</td><td colspan="5">400 - 499</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 Hrs</td><td>-</td><td>-</td><td>4 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">-</td></tr>
<tr><td>Course Summary</td><td colspan="5">Knowledge about Photocatalysis for Environmental Remediation, Understanding Photocatalysis and Photocatalyst, Water Splitting for Hydrogen Production, Nanotechnology for Carbon Dioxide Capture and Conversion, Circular Economy for Waste Reduction and Carbon Footprint.</td></tr>
</table>

BOOKS FOR STUDY:

1. Photocatalysis and Water Purification - From Fundamentals to Recent Applications, Pierre Pichat (Editor), Wiley-VCH Verlag GmbH &Co. K Ga A, Boschstr. 12, 69469 Weinheim, Germany 2013.
2. Testing Novel Water Oxidation Catalysts for Solar Fuels Production, Ed. By Carminna Ottone, Simelys Hernández, Marco Armandi, Barbara Bonelii, Springer, 2019.
3. Nanomaterials and Direct Air Capture of CO2, Dirk Fransaer, Nanotechnology for Energy Sustainability, Ed. Marcel Van de Voorde, Wiley VCH, 2017.
4. Green Carbon Dioxide: Advances in CO2 Utilization - Gabriele Centi, Siglinda Perathoner ISBN: 978-1- 118-59088-1 March 2014.
5. Waste Valorisation: Waste Streams in a circular economy - Carol Sze Ki Lin, Guneet Kaur, Chong Li, Xiaofeng Yang, Christian V. Stevens, Wiley, ISBN: 978-1-119-50270-8; 2020.

BOOKS FOR REFERENCE:

1. Sustainable Bioconversion of Waste to Value Added Products - Inamuddin, Anish Khan, Springer Cha, ISBN978-3-030-61839-1; 2021.
2. Nanomaterials for Environmental Protection, Ed. By Boris I. Kharisov, Oxana V. Kharissova, H. V. Rasikha Dias, John Wiley, 2015.
3. Nanotechnologies for Environmental Remediation : Applications and Implications, edited by Giusy Lofrano, Giovanni Libralato, Jeanette Brown, Springer, 2016.
4. Hydrogen Production by Electrolysis, Edited by AgataGodula –Jopek, Wiley – VCH, 2015.
5. Environmental Applications of Nanomaterials: Synthesis, Sorbents and Sensors By Glen E. Fryxell, Guozhong Cao, Imperial Collge Press, 2007.

WEB REFERENCES

1. https://nptel.ac.in/content/storage2/courses/105108075/module9/Lecture40.pdf
2. https://nptel.ac.in/courses/118/107/118107015/
3. https://nptel.ac.in/courses/105/107/105107181/

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Photocatalysis for Environmental Remediation (Book1: Chapter 1&2)**	**12**	
	1	Introduction – Definition – type of photocatalysis	2	1
	2	TiO2 based photocatalytic reactions - Key Species in		
	3	Photocatalytic Reactions -	3	1
	4	Trapped Electron and Hole - Superoxide Radical and Hydrogen Peroxide - Hydroxyl Radical (OH•) - Singlet Molecular Oxygen	3	1
II		**Understanding Photocatalysis and Photocatalyts (Book 1: Chapter 3)**	**12**	
	5	Photocatalytic rate -Kinetic models	2	2
	6	Thermodynamic Aspect of Photocatalysis - Design of Active Photocatalysts –	2	2
	7	A Conventional Kinetics in Photocatalysis: First-Order Kinetics Langmuir–Hinshelwood Mechanism	3	2
	8	Problems Related to Particle Size of Photocatalysts -	2	2

	9	Recombination of a Photoexcited Electron and a Positive Hole - Electron Traps as a Recombination Centre.	3	2
III		**Water Splitting for Hydrogen Production (Book 2: Chapter 1 and 5)**		
	10	General – The water splitting reaction – Natural water splitting	2	3
	11	Water oxidation catalysts – Semiconductors for water splitting	4	3
	12	Electrochemical measurement as screening method for water oxidation	3	3
	13	Preparation of active electrodes – wet method – dry method – Assessment of electrocatalytic activity.	3	3
IV		**Nanotechnology for Carbon Dioxide Capture and Conversion (Book 3: Chapter 46)**	**12**	
	14	Introduction – CO2 as a resource – Circular CO2 economy	2	4
	15	CO2 capture/Separation technologies – Direct air capture and nanomaterials.	3	4
	15	Nanomaterials – Metal Organic Frame (MOF)		
	16	Gas separation	3	4
	17	Carbon Nanotubes (CNTs) Nanoporous membranes –	2	4
V*		**Circular Economy for Waste Reduction and Carbon Footprint**	**12**	
	18	Carbon's critical role as life essential element and in non-renewable fuels and chemicals.	3	5
	19	Various sources of carbon waste eg., industrial emissions, biomass residue, manure, garbage which are of environmental concern.	4	5
	20	Integration of Circular economy and Sustainable Development.	3	5
	21	Possible supply chain scenarios for conversion of waste carbon to valuable products.	2	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Explain the role of nanotechnology for sustainable energy and conversion of energy directly or indirectly and describe nanoscale catalysts used to enhance the production rate.	U	PSO-1,2
CO-2	Discuss and analyse synthesis and characterisation of nanomaterials for photocatalysis	U, An	PSO-2,3,4
CO-3	Cite the various methods for hydrogen production and summarise knowledge about photochemical and photocatalysts and analyse techniques used to hydrogen storage.	R, U, An	PSO-3,5,6
CO-4	Describe, demonstrate and analyse CO2 capturing and circular economy for sustainable development.	U, Ap, An	PSO-2,3,5,6,7
CO-5	Analyse and appraise and integrate circular economy for sustainable development.	An, E	PSO-4,5,6,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ENVIRONMENTAL SUSTAINABILITY OF NANOMATERIALS

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Explain the role of nanotechnology for sustainable energy and conversion of energy directly or indirectly and describe nanoscale	PO1.3.4. 5.6.8 / PSO1,2	U	F, C	L	-

	catalysts used to enhance the production rate.					
CO-2	Discuss and analyse synthesis and characterisation of nanomaterials for photocatalysis	PO1,2,3, 4,5,6,8 / PSO 2,3,4	U, An	F, C	L	-
CO-3	Cite the various methods for hydrogen production and summarise knowledge about photochemical and photocatalysts and analyse techniques used to hydrogen storage.	PO1,2,3, 4,7 / PSO 3,5,6	R, U, An	F, C, P	L	-
CO-4	Describe, demonstrate and analyse CO2 capturing and circular economy for sustainable development.	PO1,2,3, 4,5,7,8 / PSO 2,3,5,6,7	U	F, C	L	-
CO-5	Analyse and appraise and integrate circular economy for sustainable development.	PO1,2,3, 4,5,6,7,8 / PSO4,5,6 ,7	U, An	F, C	L	-

CO-6	Explain the role of nanotechnology for sustainable energy and conversion of energy directly or indirectly and describe nanoscale catalysts used to enhance the production rate.	PO1.3.4. 5.6.8 / PSO 1,2	R, U, An	F, C, P	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	2	-	-	-	-	-	2	2	-	-	-	-	-	2
CO-2	-	2	2	1	-	-	-	-	2	2	1	-	-	-	-
CO-3	-	-	2	-	2	2	-	-	-	2	-	2	2	-	-
CO-4	-	1	2	-	2	2	2	-	1	2	-	2	2	2	-
CO-5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	-	-	✓
CO-3	-	✓	-	✓
CO-4	-	✓	-	✓
CO-5	✓	-	-	-
CO-6	✓	-	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK7DSEPHY402**				
Course Title	**FRONTIERS OF SPACE SCIENCE, TECHNOLOGY AND PROGRAMMING**				
Type of Course	**DSE**				
Semester	**VII**				
Academic Level	**400 - 499**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 Hrs	-	-	4 Hrs
Pre-requisites	Basic knowledge about plasma physics and various frames of references				
Course Summary	This course provides fundamentals of space science engineering, general relativity and gravitational waves and basic ideas of MATLAB/ OCTAVE tool for space data analysis.				

BOOKS FOR STUDY:

1. Introduction to Space Science, Ji Wu, Springer
2. An overview of gravitational waves: Theory, sources and detection, Gerard Auger and Eric Plagnol, World Scientific, 2017
3. General Relativity and Cosmology, S.K. Srivastava, PHI, 2008)
4. Physics of the Space Environment, Gombosi, T. I., Cambridge University Press, 1998
5. High Energy Cosmic Rays, Todor Stanev, Second Edition, Springer, 2010
6. MATLAB and Design Recipes for Earth Sciences, Martin H. Trauth, Elisabeth Sillmann, First Edition, Springer, 2013;

BOOKS FOR REFERENCE:

1. Scientific Computing with MATLAB and Octave, AlfioQuarteroni, FaustoSaleri, Paola Gervasio, Third Edition, Springer, 2010;
2. Fundamentals of Special and General Relativity, K.D. Krori, PHI, 2010;
3. Essential MATLAB and Octave, JesúsRogel-Salazar, CRC press, 2015

WEB RESOURCES:

1. NPTEL online course for MATLAB: https://onlinecourses.nptel.ac.in/noc21_ge10/preview
2. https://www.space.com/32644-cosmic-rays.html

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Space Science and Space Technology (Book 1: Chapter 5, 6, 8, 15)**	**18**	
	1	Definition of Space Technology, Definition of Space Science	1	1
	2	Space System engineering: System Components of Space Systems Engineering-Satellite/Spacecraft System, The Launch Vehicle System, The Launch Site System, Tracking, Telemetry and Control (TT&C) System	6	1
	3	Ground Application System, Science Data Reception, Ground Station for Science Data Reception, Spacecraft Pass Time and Downlink	5	1
	4	Scientific Data Pre-handling/processing, Science Data Classification and Distribution, Data Policy, Science Data Archiving	4	1
	5	Fundamentals of Spacecraft Orbit Dynamics: Spacecraft Orbit Dynamics-Examples of Commonly Used Orbits	2	1
II		**General relativity (Book 3)**	**05**	
	6	Fundamentals of General theory of relativity, Equivalence principle, Observational evidence to general theory of relativity, gravitational redshift	5	2
III		**Gravitational waves (Book 2: Chapter 1, 3, 7)**	**09**	

	7	What is a Gravitational Wave? Gravitational waves v/s electromagnetic waves, The propagation of gravitational waves	3	3
	8	The detection of gravitational waves, The generation of gravitational waves,	3	3
	9	The energy carried away by gravitational waves, Astrophysical sources of gravitational waves.	3	3
IV	**Cosmic rays (Book 4: Chapter 13, Book 5: chapter 3 & 5)**		**16**	
	10	Galactic cosmic rays(GCRs),Basic principles of propagation of GCRs, solar cycle modulation of GCRs	4	4
	11	Diffusion theory of cosmic ray modulation, Interstellar pick up particles and anomalous cosmic rays	4	4
	12	Acceleration of Cosmic Rays-Stochastic acceleration of charged particles, particle accelerations at astrophysical shocks.	4	4
	13	Cosmic rays at the top of the atmosphere, CR detectors, geomagnetic field effects.	4	4
V*	**Introduction to Octave (Book 6: chapter 4)**		**12**	
	14	Octave as a visualization tool: The MATLAB/ Octave environments, Essentials, Data storage and handling	6	5
	15	Data structures and classes of objects, Scripts and functions	**4**	5
	16	Basic visualization tools.	**2**	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Define and discuss space science and space technology along with system components of space systems engineering	R, U	PSO-3,7
CO-2	Explain the fundamentals of general theory of relativity.	U	PSO-3

CO-3	Describe the basics of gravitational waves and to explore the astrophysical sources of gravitational waves	U	PSO-3
CO-4	Correlate solar cycles with cosmic ray cycles and to investigate on anomalous cosmic rays and interstellar pickup particles	An	PSO-3
CO-5	Explain the essentials necessary for Octave programming to interpret and evaluate the method of writing Octave scripts for data analysis	U, Ap, E	PSO-3,5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: FRONTIERS OF SPACE SCIENCE, TECHNOLOGY AND PROGRAMMING

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Define and discuss space science and space technology along with system components of space systems engineering	PO 1/ PSO 3,7	R, U	F,C	L	-
CO-2	Explain the fundamentals of general theory of relativity.	PO 1/ PSO 3	U	F,C	L	-
CO-3	Describe the basics of gravitational waves and to explore the astrophysical sources of gravitational waves	PO 1/ PSO 3	U, Ap	F,C	L	-

CO-4	Correlate solar cycles with cosmic ray cycles and to investigate on anomalous cosmic rays and interstellar pickup particles	PO 1,2,3/ PSO 3	An	C,P	L	-
CO-5	Explain the essentials necessary for Octave programming to interpret and evaluate the method of writing Octave scripts for data analysis	PO 1,7/ PSO 3,5	U,Ap, E	F,C,P	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	-	-	2	-	-	-	2	-	2	-	-	-	-	-	-
CO-2	-	-	2	-	-	-	-	-	2	-	-	-	-	-	-
CO-3	-	-	2	-	-	-	-	-	2	-	-	-	-	-	-
CO-4	-	-	2	-	-	-	-	-	1	2	2	-	-	-	-
CO-5	-	-	2	2	2	-	2	2	2	-	-	-	-	-	3

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	-	-	✓
CO-5	✓	✓	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK3DSEPHY207</td></tr>
<tr><td>Course Title</td><td colspan="5">ELECTRODYNAMICS</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSE</td></tr>
<tr><td>Semester</td><td colspan="5">III</td></tr>
<tr><td>Academic Level</td><td colspan="5">200 - 299</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>3 Hrs</td><td>-</td><td>2 Hrs</td><td>5 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Basics of electrostatics</td></tr>
<tr><td>Course Summary</td><td colspan="5">This course isrecommended for students pursuing the interdisciplinary major pathway.
This course aims to provide a strong foundation to the principles of electrostatics and magnetostatics and equip the students to be familiar with the theoretical basis of electrodynamics. The course also provides hands on experience in handling different electrical circuits.</td></tr>
</table>

BOOKS FOR STUDY:

1. Electrodynamics: David J Griffith, PHI, 3rd Edn.
2. Electricity and Magnetism:Murugesan, S.Chand & Co.
3. Electricity and Magnetism: K.K.Tiwari, S.Chand & Co. 4. Principles of lectromagnetics: Matthew N.O. Sadiku and S. V. Kulkarni, Oxford University Press, 6th Edn.

BOOKS FOR REFERENCE:

1. Electricity and Magnetism: E.M. Purcell, Berkley Physics course, Vol.2, MGH
2. Classical Electromagnetic Theory, Jack Vanderlinde, Second Edition, Kluwer Academic Publishers, 2004

3. Classical Electrodynamics: Walter Greiner, Springer International Edn.
4. Electricity and Magnetism: Muneer H. Nayfeh & Norton K. Bressel, John Wiley & Sons
5. Electricity and Magnetism: J.H. Fewkes & John Yarwood, University Tutorial Press
6. Electromagnetic waves and radiating systems: Jordan & Balmain, PHI
7. Electromagnetics: B.B.Laud, Wiley Eastern Ltd., 2ndEdn.
8. Introduction to electrodynamics: Reitz & Milford Addison Wesley
9. Electromagnetic theory fundamentals: Bhag Guru and Huseyin Hizirogulu, Cambridge University Press, 2nd Edn.
10. Electricity and Magnetism: D.C.Tayal, Himalaya Publishing Co.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**ELECTROSTATIC FIELD**	**9**	
	1	Coulomb's law, Electric field due continuous charge distribution	2	1
	2	Field lines, flux, Gauss's law, Divergence and Curl of electrostatic fields.	2	1
	3	Electric potential, Poisson's and Laplace's equations, Potential of a localized charge distribution.	2	1
	4	Work and Energy in Electrostatics: The work done to move a charge, Energy of a point charge distribution, The energy of a continuous charge distribution	2	1
	5	Electrostatic boundary conditions	1	1
II		**ELECTROSTATIC FIELD IN MATTER**	**9**	
	6	Polar and Nonpolar molecules, Induced dipole and polarizability. Alignment of polar molecules in uniform and nonuniform electric field.	2	2
	7	Polarization in a Dielectric Material, The field of a polarized object: Bound and Free Charges, Bound Charge Density, Physical interpretation of bound charges	3	2

	8	Electric displacement, Gauss's law in presence of dielectric.	2	1, 2
	9	Boundary conditions, Linear Dielectrics	2	2
III	**MAGNETOSTATICS**		**9**	
	10	Lorentz Force, Electric Current- surface current density, volume current density, Equation of continuity.	2	3
	11	The Biot- Savarts law, Applications-Magnetic field due to long wire and circular loop	2	3
	12	Magnetic flux, Gauss's law in magnetism, Divergence of B (Physical interpretation only)	1	3
	13	Ampere's circuital theorem, Curl of B (Physical interpretation only), Applications- Magnetic field due to Solenoid and Toroid	2	3
	14	Magnetic vector potential.	1	3
	15	Boundary conditions	1	3
IV	**ELECTROMAGNETIC INDUCTION**		**9**	
	16	Electromagnetic Induction, Faraday's law, Lenz's law, Motional e m f, Induced electric field	2	4
	17	Self - inductance and Mutual inductance, back e m f	1	4
	18	Maxwell's equation, correction of Ampere's circuital theorem,	2	4
	19	Waves in one dimension: Wave equation of electromagnetic waves in vacuum, propagation of electromagnetic waves through vacuum and linear dielectric media	3	4
	20	Monochromatic planes waves, Energy and Momentum in EM waves	1	4
V*	**ALTERNATING CURRENT**		**9**	
	21	Description of A.C, mean and rms value of A.C, complex representation of A.C Circuits-Phasor diagram	2	5

	22	A.C circuit containing -Resistance only, Inductor only, capacitance only	2	5
	23	Circuit containing resistance and inductance in series, circuit containing resistance and capacitance in series, circuit containing inductor and capacitance in series	2	5
	24	LCR in series. Resonance, Sharpness of resonance, Quality factor	2	5
	25	Power in A.C circuit, Choke coil	1	5

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Potentiometer- Resistivity	6
2	Potentiometer –Calibration of ammeter	6
3	Carey Foster’s Bridge-Resistivity	6
4	Carey Foster’s Bridge-Temperature coefficient of resistance.	6
5	Mirror galvanometer-figure of merit.	6
6	BG- Absolute capacity of a condenser	6
7	Conversion of galvanometer into ammeter and calibration using digital Multimeter	6
8	Circular coil-Calibration of ammeter.	6
9	Absolute determination of m and B_h using box type and Searle’s type vibration magnetometers	6
10	Searle’s vibration magnetometer-comparison of magnetic moments.	6
11	Potentiometer – Calibration of high range voltmeter	6
12	Potentiometer - Reduction factor of TG	6
Part B* – At least One Experiment to be performed		
13	. Potentiometer –Calibration of low range voltmeter	6

14	Study of network theorems-Thevenin's & Norton's theorems and maximum power transfer theorem	6
15	Thermo emf- Measurement of thermo emf of thermocouple (Seebeck effect)	6
16	Circular coil-Study of earth's magnetic field using compass box.	6
17	Conversion of galvanometer into voltmeter and calibration using digital Multimeter.	6

COURSE OUTCOMES

CO No	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify the principles of electrostatics and apply it to the solutions of problems relating to electric field and electric potential and boundary conditions	U, Ap	PSO-1,2
CO-2	Identify the mechanism of polarization and its various effects in dielectric, by applying the principles of electrostatics.	U, Ap	PSO-1,2
CO-3	Identify the principles of magnetostatics and apply it to the solutions of problems relating to magnetic field and boundary conditions.	U, Ap	PSO-1,2
CO-4	Recognize the concepts related to Faraday 's law, induced emf, Maxwell 's equations and compare the properties of electromagnetic waves in vacuum, and matter	U, Ap	PSO-1,2
CO-5	Summarize the basic concepts of Alternating Current, its complex representation and analyse the behaviour of current and voltage through different A.C circuits.	R, U, An	PSO-1,2,6
CO-6	Analyse the principle of Electromagnetism through hands-on experimentation	U, Ap, An	PSO-1,2,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ELECTRODYNAMICS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Identify the principles of electrostatics and apply it to the solutions of problems relating to electric field and electric potential and boundary conditions	PO-1,2/PSO-1,2	U, Ap, An	F, C	L	-
CO-2	Identify the mechanism of polarization and its various effects in dielectric, by applying the principles of electrostatics.	PO-1,2/PSO-1,2	U, Ap, An	C	L	-
CO-3	Identify the principles of magnetostatics and apply it to the solutions of problems relating to magnetic field and boundary conditions.	PO-1,2/PSO-1,2	U, Ap, An	C	L	-
CO-4	Recognize the concepts related to Faraday 's law, induced emf, Maxwell 's equations and	PO-1,2/PSO-1,2,6	U, Ap, An	F, C, P	L	-

	compare the properties of electromagnetic waves in vacuum, and matter						
CO-5	Summarize the basic concepts of Alternating Current, its complex representation and analyse the behaviour of current and voltage through different A.C circuits.	PO-1,2/PSO-1,2,6	R, U, An	F, C, P	L	-
CO-6	Analyse the principles of Electromagnetism through hands-on experimentation	PO-1,2,4,6/PSO-1,2,7	U, Ap, An	P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	3	3	-	-	-	-	-	2	2	-	-	-	-	-	-
CO-2	3	3	-	-	-	-	-	2	2	-	-	-	-	-	-
CO-3	3	3	-	-	-	-	-	1	2	-	-	-	-	-	-
CO-4	3	3	-	-	-	-	-	2	2	-	-	-	-	-	-
CO-5	3	3	-	-	-	2	-	2	1	-	-	-	-	-	-
CO-6	2	2	-	-	-	-	3	2	1	-	1	-	1	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	-	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	✓	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK5DSEPHY307</td></tr>
<tr><td>Course Title</td><td colspan="5">MODERN OPTICS</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSE</td></tr>
<tr><td>Semester</td><td colspan="5">V</td></tr>
<tr><td>Academic Level</td><td colspan="5">300 - 399</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>3 Hrs</td><td>-</td><td>2 Hrs</td><td>5 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">-</td></tr>
<tr><td>Course Summary</td><td colspan="5">This course isrecommended for students pursuing the interdisciplinary major pathway.
Optics, a branch of physics dedicated to the study of light, delves into a myriad of phenomena such as interference, where light waves interact to form distinct patterns of constructive and destructive interference. Diffraction, another fundamental aspect, elucidates the bending of light waves around obstacles or through small apertures, altering their propagation paths. Furthermore, dispersion unveils the separation of light into its constituent wavelengths. Finally, polarization explores the alignment of light waves along specific planes, influencing various optical properties.</td></tr>
</table>

BOOKS FOR STUDY:

1. Optics and spectroscopy: R.Murugesan and K Sivaprasad, S. Chand & Co., 2010
2. Text Book of Optics: Subramaniam&Brijlal
3. Optics by AjoyGhatak 7th edition

BOOKS FOR REFERENCE:

1. Basic optics: principles and concepts: Avijit Lahiri, Elsvier
2. Optics: Eugene Hecht, Addison-Wesley 2002
3. Lasers-Principles, types and applications, K R Nambiar

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Interference of light**	**9**	
	1	The principle of superposition - coherent sources – superposition of waves from coherent and incoherent sources, Young's double slit experiment	2	1
	2	Analytical treatment of Interference	2	1
	3	Interference by division of amplitude -interference in thin films (reflection only), colours in thin films, air wedge testing of optical flatness	3	1
	4	Newton's rings (reflected system)-refractive index of a liquid	2	1
II		**Fresnel Diffraction**	**9**	
	5	Introduction, Huygens theory, Fresnel and Fraunhofer diffractions.	1	1,2
	6	Fresnel diffraction: Fresnel's assumptions, Half-period zones, - explanation of rectilinear propagation of light	2	1,2
	7	Diffraction at a straight edge	2	2
	8	Zone plate-Comparison between zone plate and convex lens.	2	2
III		**Fraunhofer diffraction**	**9**	
	9	Introduction, Diffraction at a single slit	1	2
	10	Diffraction through a circular aperture	2	2
	11	Diffraction through double slits and N-slits	2	2
	12	Diffraction grating	2	2
	13	Limit of resolution, Rayleigh's criterion for resolution	2	2

IV	**Polarisation and Dispersion**		**9**	
	14	Polarization, Plane polarized light, Malus law	1	4
	15	Polarization by reflection, Brewster's law	1	4
	16	Double refraction, positive and negative crystals, Nicol prism-construction, Nicol prism as a polarizer and analyzer	3	4
	17	Quarter and half wave plates. Theory- production and analysis of plane, circularly and elliptically polarized light.	3	4
	18	Dispersion: Normal and anomalous dispersion-Cauchy's relation (Qualitative ideas only).	1	3
V*	**Lasers and Optical fibre**		**9**	
	19	Laser beam characteristics, spatial and temporal coherence (qualitative ideas)	1	5
	20	Basic principle of laser operation	2	5
	21	Basic Principles of Optical fibre, Optical fibre types, Numerical Aperture, Advantages of optical fibre communication	2	5
	22	Ruby laser , He-NE laser	3	5
	23	Application of lasers and optical fibre communications.	1	5

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Spectrometer-A, D and n of a solid prism	6
2	Spectrometer –Dispersive power and Cauchy's constants	6
3	Spectrometer Grating—Normal incidence- N & wavelength	6
4	Spectrometer-i-d curve	6
5	Spectrometer- Hollow prism	6

6	Liquid lens-refractive index of liquid and lens	6
7	Newton's Rings—Reflected system	6
8	Air wedge-diameter of a wire	6
9	Method of parallax: optical constants of convex lens • using mirror and mercury • using mirror and water	6
10	Method of parallax: refractive index of a liquid	6
Part B* – At least One Experiment to be performed		
11	• Laser beam characteristics • Diffraction grating • Diffraction at different types of slits and apertures	6
12	Refractive index of liquids and liquid mixtures using Abbe's refractometer	6
13	Determination of numerical aperture of multimode optical fiber	6

COURSE OUTCOMES

CO No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe the different basic phenomena of light such as Interference, Diffraction, Dispersion and Polarization	U	PSO-1,2,3
CO-2	Relates diffraction theory in Rayleigh's criterion for resolution and in finding resolving power of diffraction grating	U, Ap	PSO-1,2,3
CO-3	Explain the phenomenon- dispersion	U	PSO-1,2,3
CO-4	Differentiate the different types of polarizations, its theory and the production/analysis methods and apply the concept in studying Nicol prism, quarter wave and half wave plates	U, Ap, An	PSO-1,2

CO-5	Explain the basic constituents of a laser, optical fiber, different types and working	U	PSO-1,2
CO-6	Apply various optical instruments and techniques to analyse and manipulate light, including lenses, mirrors, prisms, and optical fibers.	U, Ap	PSO-2, 7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: MOREN OPTICS

Credits: 3:0:1 (Lecture:Tutorial:Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Describe the different basic phenomena of light such as Interference, Diffraction, Dispersion and Polarization	PO-1, 2 PSO-1,2,3	U	F, C	L	-
CO-2	Relates diffraction theory in Rayleigh's criterion for resolution and in finding resolving power of diffraction grating	PO-1, 2 PSO-1,2,3	U, Ap	C,P	L	-
CO-3	Explain the phenomenon-dispersion	PO-1, 2 PSO-1,2,3	U	F, C	L	-
CO-4	Differentiate the different types of polarizations, its	PO-1, 2 PSO-1,2	U,Ap, An	F, C	L	-

	theory and the production/analysis methods and apply the concept in studying Nicol prism, quarter wave and half wave plates					
CO-5	Explain the basic constituents of a laser, optical fiber different types and working	PO-1, 2 PSO-1,2	U	F, C	L	-
CO-6	Apply various optical instruments and techniques to analyse and manipulate light, including lenses, mirrors, prisms, and optical fibers.	PO-1, 2 PSO-2,7	U, Ap	F, C,P	T	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	2	1	-	-	-	-	3	2	-	-	-	-	-	-
CO-2	2	2	3	-	-	-	-	3	2	-	-	-	-	-	-
CO-3	1	2	1	-	-	-	-	3	2	-	-	-	-	-	-
CO-4	3	1	-	-	-	-	-	3	2	-	-	-	-	-	-
CO-5	3	2	-	-	-	-	-	3	2	-	-	-	-	-	-
CO-6	-	2	-	-	-	-	2	3	2	-	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	-	-	✓
CO-3	✓	-	-	✓
CO-4	✓	-	✓	✓
CO-5	✓	✓	-	-
CO-6	✓	-	-	-

University of Kerala

Discipline	**PHYSICS**				
Course Code	**UK6DSEPHY308**				
Course Title	**ATOMIC AND MOLECULAR SPECTROSCOPY**				
Type of Course	**DSE**				
Semester	**VI**				
Academic Level	**300 - 399**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 Hrs	-	-	4 Hrs
Pre-requisites	1. Basic knowledge about atoms and molecules. 2. Basic knowledge about electromagnetic spectrum and quantum theory. 3. Basic ideas about Bohr model of atom and structure of hydrogen atom. 4. Basic ideas about influence of electric and magnetic fields on charges. 5. The student should have a fundamental understanding of atomic structure				
Course Summary	This course isrecommended for students pursuing the **interdisciplinary major pathway**. The course has the following major objectives: The course introduces students to the basic physics of atoms, molecules, their spectra and the interaction of light with matter including the study of influence of electric and magnetic fields on atoms with the help of Zeeman and Stark effect. The students are expected to learn spin of electrons, space quantisation, and effect of nuclear motion on atomic spectra, Raman effect, rotational, vibrational and electronic spectra of diatomic molecules. The last module comprises of the properties of nucleus and nuclear models.				

BOOKS FOR STUDY:

1. G Aruldas: "Molecular structure and Spectroscopy" Prentice Hall of India, 2002.
2. Modern Physics: R. Murugesan, S Chand & Co., Reprint, 2002
3. Atomic Physics: J B Rajam, S Chand & Co., 1980.
4. C N Banwell and E.M. McCash: "Fundamentals of Molecular Spectroscopy", Tata McGrow Hill., 1983.
5. Concepts of Modern Physics: Arthur Beiser, Mc Graw Hills, Fifth Edition, 1995

BOOKS FOR REFERENCE:

1. Straughan and Walker (Eds): "Spectroscopy"- Vol. I and II (Chapman and Hall)
2. G.M. Barrow: "Introduction to molecular Spectroscopy", (McGraw Hill)
3. Modern Physics: G Aruldas and P Rajagopal, PHI, New Delhi, 2005.
4. Atomic Physics: Christopher J Foot, Oxford Master series in Physics,2005
5. J.M. Hollas, Modern Spectroscopy, Fourth Edition, John Wiley &Sons (2004)
6. Suresh Chandra, Molecular Spectroscopy, Narosa Publishing Co (2009)
7. H E White, Introduction to Atomic Spectroscopy McGraw-Hill Inc. 1st Edition. (1934).
8. D.N. Satyanarayana, Vibrational Spectroscopy-Theory and applications, New Age International Pvt Ltd (2004)
9. J.L. McHale, Molecular Spectroscopy, Pearson education Inc (2008).

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I	**Atomic Spectra & Atoms in External Fields (Book2 chapter 4 and Book3)**		**12**	
	1	Hydrogen atom spectrum	1	1
	2	Stern Gerlach experiment, Vector atom model	2	1
	3	Quantum states of electron in atoms	2	1
	4	Spin-orbit coupling (LS and JJ coupling schemes)	1	1
	5	Fine structure – Spectroscopic terms and selection rules	2	1
	6	Hyperfine structure	1	1
	7	Normal Zeeman effect	2	1

	8	Elementary Ideas of Anomalous Zeeman effect, Paschen Back effect and Stark effect	1	1
II	**Microwave & Infrared Spectroscopy (Book1 chapters 6 and 7 and Book4 chapters 2 and 3)**		**13**	
	9	Classification of molecules, Rotational spectra of diatomic molecules, Intensity of spectral lines, Effect of isotopic substitution	3	1,2
	10	The non-rigid rotor	1	1,2
	11	Rotational spectra of polyatomic molecules – Linear, symmetric top and asymmetric top molecules	2	1,2
	12	Microwave Oven	1	1,2
	13	Vibrational energy levels of diatomic molecules-harmonic oscillator and anharmonic oscillator (Morse Curve)	2	1,3
	14	IR spectra of vibrating diatomic molecule, selection rule	1	1,3
	15	Diatomic Vibrating rotator – selection rules, P, Q, R branches. Linear and symmetric top molecules	3	1,3
III	**Electronic Spectroscopy of Molecules (Book1 chapter 9 and Book4 chapter 6)**		**10**	
	16	Vibrational coarse structure: Progression and sequences	2	1
	17	The Franck-Condon principle	1	1
	18	Dissociation energy and dissociation products.	2	1
	19	Rotational fine structure of electronic vibration transitions	3	1
	20	Fortrat diagram, Pre-dissociation (elementary ideas)	2	1
IV	**Raman Spectroscopy (Book1 chapter 8 and Book4 chapter 4)**		**13**	
	21	Quantum and Classical theory of Raman effect	3	4
	22	Pure rotational Raman Spectrum –linear, Symmetric and Spherical top molecule	3	4
	23	Vibrational Raman Spectra, mutual exclusion principle	2	4
	24	Instrumentation and methods: Raman spectrometer	2	4

	25	Structure determination from Raman and IR spectroscopy	3	4
V*	**Properties of Nuclei and Nuclear Models (Book:5 - Chapter: 11)**		**12**	
	26	Constituents of nucleus and their Intrinsic properties	2	5
	27	Binding energy, binding energy versus mass number curve, nuclear stability	2	5
	28	Nuclear forces- properties	1	5
	29	Meson theory	2	5
	30	Liquid drop model -semiempirical mass formula and significance of various terms	2	5
	31	Assumptions of Shell model-evidence for nuclear shell structure, nuclear magic numbers	2	5
	32	Collective model	1	5

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify and describe the rotational, vibrational and electronic energy states of various types of molecules and the interaction of electromagnetic radiation with molecules.	R, U	PSO-1,2
CO-2	Define and describe the microwave spectra of the molecule and compute various parameters	R, U, Ap	PSO-1,2
CO-3	Outline and explain the IR spectra of molecule and manipulate information about the molecule.	R, U, Ap	PSO-1, 2
CO-4	Describe, explain and construct molecular structure from combined analysis of Raman and IR spectra	R, U, Ap	PSO-1,2
CO-5	Identify nuclear constituents and general properties of nuclei and distinguish different nuclear models	U	PSO-1

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: ATOMIC AND MOLECULAR SPECTROSCOPY

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Identify and describe the rotational, vibrational and electronic energy states of various types of molecules and the interaction of electromagnetic radiation with molecules.	PO1,3,4, 5,6,8/ PSO-1,2	R, U	F, C	L	-
CO-2	Define and describe the microwave spectra of the molecule and compute various parameters	PO1,3,4, 5,6,8/ PSO-1,2	R, U, Ap	F, C	L	-
CO-3	Outline and explain the IR spectra of molecule and manipulate information about the molecule.	PO1,3,4, 5,6,8/ PSO-1,2	R, U, Ap	F, C	L	-
CO-4	Describe, explain and construct molecular structure from combined analysis of Raman and IR spectra	PO1,3,4, 5,6,8/ PSO-1,2	R, U, Ap	F, C	L	-
CO-5	Identify nuclear constituents and general	PO 1/ PSO 1	U	F, C	L	-

	properties of nuclei and distinguish different nuclear models					

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	2	1	-	-	-	-	-	2	-	2	2	2	2	-	2
CO-2	2	2	-	-	-	-	-	2	-	3	2	2	3	-	2
CO-3	2	1	-	-	-	-	-	2	-	2	2	2	3	-	2
CO-4	2	1	-	-	-	-	-	3	-	2	2	2	2	-	3
CO-5	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	✓	-	-

University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK7DSEPHY403</td></tr>
<tr><td>Course Title</td><td colspan="5">MATHEMATICAL PHYSICS</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSE</td></tr>
<tr><td>Semester</td><td colspan="5">VII</td></tr>
<tr><td>Academic Level</td><td colspan="5">400 - 499</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 Hrs</td><td>-</td><td>-</td><td>4 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">1. Need an understanding of vectors, Fourier series, Partial and Ordinary differential equations.</td></tr>
<tr><td>Course Summary</td><td colspan="5">This course isrecommended for students pursuing the interdisciplinary major pathway.
By the end of the course, students will have developed advanced mathematical skills and a solid foundation in the mathematical techniques essential for tackling complex problems in theoretical and applied Physics. They will be well-equipped to pursue further studies or research in areas such as quantum field theory, general relativity, condensed matter Physics, and mathematical Physics.</td></tr>
</table>

BOOKS FOR STUDY:

1. G.B. Arfken and H.J. Weber, Mathematical methods for Physcisits,6th Edition, Elsevier, 2005.
2. C. Harper, Introduction to Mathematical Physics, Prentice Hall ,1986.
3. B.S. Rajput, Mathematical Physics, 16th edition, Pragati Prakashan, 2003.
4. Daniel Fleisch, A Student's guide to Vectors and Tensors, Ist Edition, Cambridge University Press, 2012.
5. A.W. Joshi, Matrices and Tensors in Physics,3rd Edition, New Age International Pub, 2003.

BOOKS FOR REFERENCE:

1. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
2. W.W. Bell, Special Functions for Scientists and Engineers, Dover Publications (2004)
3. H.K. Dass and R. Verma, Mathematical Physics, S. Chand & Co Pvt Ltd (1997)
4. B.D. Gupta, Mathematical Physics, 4th Edition, Vikas Publishing House (2004)
5. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
6. Mathematics for Physicists, P. Dennery and A. Krzywicki, 1967, Dover Publications.

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Probability (Book 1,3)**	**10**	
	1	Definitions and simple properties of probability-random variables	1	1
	2	Chebychev inequality and moment generating function	2	1
	3	Discrete and continuous probability distributions- Binomial distributions- Poisson distributions- Gauss Normal distribution	4	1
	4	Error Analysis	1	1
	5	Least square fitting- Chi-square- Student ‘t’ distributions	2	1
II		**Differential equations and Special Functions (Book 1,3)**	**16**	
	6	Second Order linear ODEs- singular points	1	2
	7	Series solution- Frobenius method and its applications to differential equations	2	2
	8	Legendre, Bessel (first and second kind), Hermite and Laguerre Differential Equations	6	2
	9	Properties -Rodrigues Formula (Derivations not needed), Generating Function	4	2
	10	Orthogonality and recurrence relations of Legendre, Bessel, Hermite and Laguerre.	3	2

III	**Integrals Transforms (Book 1,2,3)**		**16**	
	11	Fourier Transforms- Fourier Integral theorem	1	3
	12	**Fourier sine and cosine transform**	1	3
	13	Examples: Fourier transform of single pulse, trigonometric, exponential and Gaussian Functions.	2	3
	14	Inverse Fourier transform and Convolution theorem	2	3
	15	Properties of Fourier transforms (translation, change of scale, complex conjugation, One dimensional Wave Equations	2	3
	16	Laplace Transform (LT) of Elementary functions.	1	3
	17	Properties of LTs: Change of Scale Theorem, Shifting Theorem	1	3
	18	LTs of Derivatives and Integrals of Functions	2	3
	19	Derivatives and Integrals of LTs	1	3
	20	LT of Unit Step function, Periodic Functions	1	3
	21	Convolution Theorem and Inverse LT	2	3
IV	**Some Special Integrals (Book 1)**		**06**	
	22	Gamma Functions, Expression of Integrals in terms of Gamma Functions	2	4
	23	Dirac delta function and properties, Laplace and Fourier transform of Dirac delta function.	2	4
	24	Green Function and general properties.	2	4
V*	**Tensor Analysis (Book 4, 5)**		12	
	25	Coordinate transformation, Contravariant and mixed tensors	2	5
	26	Addition, Subtraction, Outer product, Inner product and Contraction	2	5

	27	Symmetric and antisymmetric tensors. Quotient law	1	5
	28	Metric tensor, Raising and lowering of indices	1	5
	29	Tensor derivatives, The Christoffel symbols and their transformation laws	2	5
	30	Covariant derivative of tensors	1	5
	31	Equation of Geodesic	1	5
	32	Riemannian curvature tensor	2	5

COURSE OUTCOMES

CO No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Develop a strong foundation in Probability and apply its applications in Physics.	Ap, An	PSO-1,2,7
CO-2	Able to solve second-order linear ODEs with singular points, applying series solutions using the Frobenius method, and understanding the properties and applications of special functions such as Legendre, Bessel, Hermite, and Laguerre functions.	Ap.An	PSO-1,2,7
CO-3	Acquired skills to solve complex problems involving differential equations and system analysis using transform techniques.	U,Ap	PSO-1,2,7
CO-4	Understand and apply Gamma function, Green function and Dirac Delta function to express integrals, analyse distributions and solve differential equations.	U,Ap	PSO-1,2,7
CO-5	Understanding basic tensor operations, using tensor notation, and Apply of tensor calculus in studying physical systems.	U, Ap	PSO-1,2,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: MATHEMATICAL PHYSICS

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Develop a strong foundation in Probability and its applications in Physics.	PO 1,2/ PSO 1,2,7	Ap, An	C,P	L	-
CO-2	Able to solve second-order linear ODEs with singular points, applying series solutions using the Frobenius method, and understanding the properties and applications of special functions such as Legendre, Bessel, Hermite, and Laguerre functions.	PO 1,2/ PSO 1,2,7	Ap.An	C,P	L	-
CO-3	Acquired skills to solve complex problems involving differential equations and system analysis using transform techniques.	PO 1,2/ PSO 1,2,7	U,Ap	C,P	L	-
CO-4	Understand and apply Gamma function, Green function and Dirac Delta function to express integrals,	PO 1,2,6/ PSO 1,2,7	U,Ap	F,C,P	L	-

	analyse distributions and solve differential equations.					
CO-5	Understanding basic tensor operations, using tensor notation, and Apply of tensor calculus in studying physical systems.	PO 1,2,6/ PSO 1,2,7	U, Ap	F,C,P	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	3	3	-	-	-	-	3	3	3	-	-	-	-	-	-
CO-2	3	3	-	-	-	-	3	3	3	-	-	-	-	-	-
CO-3	3	3	-	-	-	-	3	3	3	-	-	-	-	-	-
CO-4	3	3	-	-	-	-	3	3	3	-	-	-	3	-	-
CO-5	3	3	-	-	-	-	3	3	3	-	-	-	3	-	-

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	✓	✓	-	✓
CO-3	✓	✓	-	✓
CO-4	✓	✓	-	✓
CO-5	✓	✓	-	-

Disclaimer: "Kindly inform us of any typos, spelling mistakes, or other concerns via email, so that they can be considered during the next revision."

Email: fyugpphysicsuk@gmail.com

-End-