DWARAKA DOSS GOVERDHAN DOSS VAISHNAV COLLEGE (AUTONOMOUS)

College with Potential for Excellence

Linguistic Minority Institution, Affiliated to University of Madras

DEPARTMENT OF PHYSICS (SHIFT II)

OUTCOME BASED EDUCATION SYLLABUS

B.Sc. (PHYSICS with Computer Applications)

2021–2022 BATCH onwards

"Gokulbagh" 833, E.V.R. PERIYAR HIGH ROAD, ARUMBAKKAM, CHENNAI – 600106, TAMILNADU.

Ph: 2363 5101, E-mail: www.dgvaishnavcollege.edu.in

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Institution

VISION

To impart knowledge by escalating to active learning from rote learning that

- Ignites Wisdom
- Challenges Status Quo
- Strengthens Social Equality
- Elevates Human Values and Universal Oneness
- Recognizes Indian Tradition and Culture

MISSION

- Curriculum that makes student competent to contribute economically and intellectually
- Offer an environment of learning that encourages innovation and excellence
- Promote research and development
- Best of facilities with the Best of technology
- Provide an environment for all round growth of the student
- Quality in every activity undertaken by the student and the faculty
- Instilling pride in serving the society and in being the citizen of this country

DEPARTMENT OF PHYSICS (SHIFT II)

VISION

- Provide online education as a means of increasing efficiency, increasing student learning.
- Seek support for our research and graduate programs through research grants and contracts.
- Create a strong sense of belonging, pride, and common purpose within and between our students, and our faculty.
- Offer professional development opportunities like interview skills, certificate courses within the college and connect students to professional organizations.
- Engage alumni to interact with the students to share their experiences and provide moral support. The Physics association of the Department is OMICRON. The objectives of this association are to develop a scientific aptitude in the students, to promote close understanding of the subject through discussions, to provide opportunities to get in touch with the latest developments in Physics, by arranging seminars.
- The Physics Department with the objective of developing the academic and cultural talents of the students, improving their capabilities to work as a team and raising their level of self-confidence in interacting with fellow students and peers organizes every year an Intercollegiate competition.
- In order to give practical exposure to students, the Department every year arranges for Industrial visit/Educational tour to various places.

MISSION

M1	The mission of the B.Sc. (PHYSICS WITH COMPUTER APPLICATIONS) Degree Program of Department of Physics is to provide undergraduate students an understanding of the fundamental physical concepts in Physics as well as to have a foothold in Computer Science.
M2	The Department provides an environment which fosters curiosity and excitement about the physical world. To prepare undergraduate Physics majors for post-graduate studies or technical careers, and expand their career goals.
M3	To educate students to be successful, ethical, and effective problem-solvers and life-long learners who will be positive, creative, sharing, and apply their knowledge to benefit humanity.

PROGRAM EDUCATION OBJECTIVES (PEOs)

PEO1	Graduate will come dual professionals both in Physics and Computer Science, as the design of the course meets the specified needs of both the fields
PEO2	The students will develop laboratory techniques, mathematical knowledge and computer skills
PEO3	Graduates are motivated to seek higher studies, pursue research and entrepreneurship
PEO4	Graduates will understand the societal and environmental issues and be responsible members of the society
PEO5	Graduate acquire competencies and perspective to realise their dreams

PEO TO MISSION STATEMENT MAPPING

MISSION STATEMENTS	PEO1	PEO2	PEO3	PEO4	PEO5
M1	3	3	3	2	2
M2	3	3	3	2	2
M3	3	3	3	2	2

CORRELATION: 3 - STRONG 2 - MEDIUM 1 - LOW

PROGRAM OUTCOMES (PO) IN RELATION TO GRADUATE ATTRIBUTES

PROGRAMME OUTCOMES

At the completion of the B.Sc. Physics with Computer Applications program, the students of our Department will be able to:

PO1	Acquired knowledge of Physics in different branches – Properties of Matter and Mechanics, Heat and Thermodynamics, Acoustics, Atomic Physics, Solid State Physics etc.,
PO2	The concepts in Physics are realised as real time applications, applied in the fields of Optics, Nuclear Physics, Thermal Physics, Solid State Physics, etc.
PO3	Electronics is studied exhaustively as Basic Electronics, Integrated Electronics, Digital Electronics so that students are employable in the semiconductor/digital/mobile/computer-based industries.
PO4	To introduce students with the architecture and operation of microprocessors. To familiarize the students with the programming and interfacing of microprocessors.
PO5	General Practical's for I, II, III year of B.Sc. (PCA), Basic Electronics, Applied Electronics Practical's for III B.Sc. (PCA) sharpens the skills of the students and the theoretical aspects of Physics concepts are made understandable.
PO6	Studying Web Design, C++, Operating Systems, Database Management Systems using VB and Programming in Java gives the students the requisite knowledge of computer language programming techniques leading to definite employment in computers.
PO7	Students study Mathematics as an Allied paper, hence demonstrate the ability to explain and apply mathematics to represent key aspects of Physics through graphs.
PO8	The student has acquired knowledge of Electricity, Electromagnetism and electromagnetic waves. In Nuclear Physics the atom, the atomic core, nuclear power, ionizing radiation and radioactivity, binding energy and decay, ionizing radiation, fission and fusion.
PO9	Topics like the wave nature of light, the particle-wave duality, time dilatation, length contraction, relativistic momentum, addition of velocity, postulates of quantum mechanics, Schrodinger equation, particle in a box, in a quantum well, Orbital angular momentum operators, their commutation relations are studied to appreciate the significance of Physics
PO10	To appreciate the contributions of Physics in our present day-to-day life. The necessity of the development of Physics to understand global change and sustainability.
PO11	To be an ethical and professional person in the context of global, economic, environmental and societal realities while addressing relevant contemporary issues.

Mapping of POs TO PEOs

PEO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
PEO 1	3	3	3	3	3	3	3	3	3	2	2
PEO 2	3	3	3	3	3	3	3	3	3	2	2
PEO 3	3	3	3	3	3	3	3	3	3	2	2
PEO 4	3	3	3	3	3	3	3	3	3	2	2
PEO 5	3	3	3	3	3	3	3	3	3	2	2

3 - Strong Correlation 2 - Medium Correlation 1 - Low Correlation

PROGRAM SPECIFIC OUTCOMES

PSO1: Students will demonstrate an understanding of core knowledge in Physics namely Electromagnetism, Quantum Mechanics, Thermal Physics, etc., and be able to apply this knowledge to analyse a variety of physical phenomena.

PSO2: Students obtain proficiency in Mathematics needed for a proper understanding of Physics.

PSO3: Students develop strong technical skills because they are trained in programming languages.

PSO4: Students develop problem solving skills, which makes their conceptual foundation in the subject strong.

PSO 5: Students acquire the required skills to compete for higher studies or employment entrepreneurship.

DEPARTMENT OF PHYSICS (SHIFT II)

ELIGIBILITY FOR ADMISSION

Candidates for admission to the first year of the Degree of Bachelor of Science course in PHYSICS WITH COMPUTER APPLICATIONS shall be required to have passed the Higher Secondary Examinations (Academic or Vocational Stream) conducted by the Government of Tamil Nadu or an Examination accepted as equivalent thereof by the Syndicate of the University of Madras with Mathematics/Physics as a subject of study.

DURATION OF THE COURSE

(a) Each academic year shall be divided into two semesters. The first academic year shall comprise the first and second semesters, the second academic year the third and fourth semesters and the third academic year the fifth and sixth semester respectively.

(b) The odd semesters shall consist of the period from June to November of each year and the even semesters from December to April of each year. There shall be not less than 90 working days for each semester.

B.Sc. PHYSICS WITH COMPUTER APPLICATIONS CURRICULUM

The Course of Study shall comprise the study of Part-I to Part-V Courses:
PART – I: TAMIL/OTHER LANGUAGES
PART – II: ENGLISH
PART – III: CORE COURSES Comprising the study of (A) Main Subjects; (B) Allied Subjects; (C) Subject Electives.
(A) MAIN SUBJECTS: B.Sc. Degree Course in Physics with Computer Applications
(B) ALLIED SUBJECT: Mathematics
(C) SUBJECT ELECTIVES: Digital Electronics and Microprocessor Fundamentals
PART – IV: ELECTIVES
(a) Those who have not studied Tamil up to XII Std. and taken a Non-Tamil Language under Part-I shall take Tamil comprising of two course (level will be at 6th Standard).
(b) Those who have studies Tamil up to XII Std. and taken a Non-Tamil Language under Part-I shall take Advanced Tamil comprising of two courses.
(c) Others who do not come under a + b can choose non-major elective comprising of two courses.
SKILL BASED SUBJECTS
Soft Skills
Environmental Studies
PART – V: EXTENSION ACTIVITIES
Value Education

ELIGIBILITY FOR THE AWARD OF DEGREE

A candidate shall be eligible for the award of the Degree only if he /she has undergone the prescribed course of study in a College affiliated to the University for a period of not less than three academic years, passed the examinations all the Six Semesters prescribed earning 140 Credits (in Parts-I, II, III, IV & V).

SCHEME OF EXAMINATION

As per the University Regulation the following split up of marks for Theory and Practical are to be followed.

(i) THEORY AND PRATICAL PAPER:

Sl. No.	Paper	Internal	External	Total
1.	Theory	40	60	100
2.	Practical	40	60	100

(ii) INTERNAL ASSESSMENT MARKS (40) FOR THEORY: CIE -

Continuous Internal Evaluation (40 Marks)

Bloom's Category	Tests	Attendance	Choice of Department	Choice of Department
Marks (out of 50)	**20**	**5**	**5**	**10**
Remember			5	
Understand		5		
Apply	10			5
Analyze	5			
Evaluate	5			
Create				5

ESE - Semester End Examination (100 Marks; weightage 60%)

Bloom's Category	**Weightage %**
Remember	20
Understand	20
Apply	30
Analyse	15
Evaluate	10
Create	5

SCHEME OF SEMESTER I

BSc PHYSICS WITH COMPUTER APPLICATION

Sl. NO	Course category	Course Code	Course	Credit Distribution				Overall Credits	Total Contact Hours/Week	Marks		
				L	T	P	S			CIE	SEE	Total
1	Bachelors		Language – Paper I	4	0	0	0	3	4	40	60	100
2			English – Paper I	4	0	0	0	3	4	40	60	100
3			PCA Core 1 – Mechanics & Properties of Matter	4	3	0	0	4	7	40	60	100
4			Allied Paper I– Mathematics	4	3	0	0	5	**7**	40	60	100
5			PCA Core Practical I	0	0	4	0	Practical Examination at the end of Semester II (4 hours)				
6			1 (a) Basic Tamil I/(b) Adv. Tamil/(c) Non-Major Elective	2	0	0	0	2	2	40	60	100
7			2. Skill Based Elective I	2	0	0	0	3	2	40	60	100
Total								**20**	**30**	**280**	**420**	**700**

SCHEME OF SEMESTER II

BSc PHYSICS WITH COMPUTER APPLICATION

Sl. NO	Course Category	Course Code	Course	Credit Distribution				Overall Credits	Total Contact Hours/Week	Marks		
				L	T	P	S			CIE	SEE	Total
1	Bachelors		Language – Paper II	4	0	0	0	3	4	40	60	100
2			English – Paper II	4		0	0	3	4	40	60	100
3			PCA Core 2 – Basic Electronics	4	3	0	0	4	**7**	40	60	100
4			Allied Paper II – Mathematics	4	3	0	0	5	**7**	40	60	100
5			PCA Core Practical I	0	0	4	0	4	3+1	40	60	100
6			1 (a) Basic Tamil I/(b) Adv. Tamil/(c) Non-Major Elective	2	0	0	0	2	2	40	60	100
7			2. Skill Based Elective II	2	0	0	0	3	2	40	60	100
Total								**24**	**30**	**280**	**420**	**700**

SCHEME OF SEMESTER III

BSc PHYSICS WITH COMPUTER APPLICATION

Sl. NO	Course Category	Course Code	Course	Credit Distribution				Overall Credits	Total Contact Hours/Week	Marks		
				L	T	P	S			CIE	SEE	Total
1	Bachelors		PCA Core 3 – Mathematical Physics	4	0	0	0	4	4	40	60	100
2			PCA Core 4 – Electricity and Electromagnetism	4	0	0	0	4	4	40	60	100
3			*CC 1 – Web Design*	5	0	0	0	4	5	40	60	100
4			*CC 2 – Programming in C++*	5	0	0	0	4	5	40	60	100
5			PCA Core Practical II	0	0	3	0	Practical Examination at the end of Semester IV (3 hours)				
6			*CCP 1 – Web Design Programming*	3	0	0	0	4	3	40	60	100
7			*CCP 2 – Programming in C++*	3	0	0	0	4	3	40	60	100
8			Soft Skill III	2	0	0	0	3	2	40	60	100
9			Environmental Studies	1	0	0	0	Exam conducted at the end of Semester IV (1 hour)				
Total								**27**	**30**	**280**	**420**	**700**

SCHEME OF SEMESTER IV

BSc PHYSICS WITH COMPUTER APPLICATION

Sl. NO	Course Category	Course Code	Course	Credit Distribution				Overall Credits	Total Contact Hours/ Week	Marks		
				L	T	P	S			CIE	SEE	Total
1	Bachelors		PCA Core 5 – Optics	5	0	0	0	4	5	40	60	100
2			PCA Core 6 – Quantum Mechanics	6	0	0	0	4	6	40	60	100
3			*CC 3 – Operating System*	5	0	0	0	4	5	40	60	100
4			*CC 4 – Database Management Systems*	5	0	0	0	4	5	40	60	100
5			PCA Core Practical II	0	0	3	0	4	3	40	60	100
6			*CCP 3 – Practical RDBMS using VB*	0	0	3	0	4	3	40	60	100
7			Soft Skill IV	2	0	0	0	3	2	40	60	100
8			Environmental Studies	1	0	0	0	2	1	40	60	100
Total								**29**	**30**	**320**	**480**	**800**

SCHEME OF SEMESTER V

BSc PHYSICS WITH COMPUTER APPLICATION

Sl. NO	Course Category	Course Code	Course	Credit Distribution				Overall Credits	Total Contact Hours/ Week	Marks		
				L	T	P	S			CIE	SEE	Total
1	Bachelors		PCA Core 7 – Thermal Physics & Acoustics	5	0	0	0	4	5	40	60	100
2			PCA Core 8 – Solid State Physics	5	0	0	0	4	5	40	60	100
3			PCA Open Elective – I Space Science/ Optics and Photonics	4	0	0	0	5	4	40	60	100
4			*CC 5 – Programming in JAVA*	4	0	0	0	4	4	40	60	100
5			*CCP 4 – JAVA Programming Lab*	0	0	3	0	4	3	40	60	100
6			PCA Core Practical III (General)	0	0	3	0	Practical Examination at the end of Semester VI (9 hours)				
7			PCA Core Practical IV (Electronics)	0	0	3	0					
8			PCA Core Practical V (Applied)	0	0	3	0					
9			Value Education	0	0	0	0	2	-	40	60	100
Total								**23**	**30**	**240**	**360**	**600**

SCHEME OF SEMESTER VI

BSc PHYSICS WITH COMPUTER APPLICATION

Sl. NO	Course Category	Course Code	Course	Credit Distribution				Overall Credits	Total Contact Hours /Week	Marks		
				L	T	P	S			CIE	SEE	Total
1	Bachelors		PCA Core 9 – Nuclear and Particle Physics	4	0	0	0	4	4	40	60	100
2			PCA Core 10 – Atomic Physics	4	0	0	0	4	4	40	60	100
3			PCA – Elective I – Integrated Electronics/ Bio-Physics/Applied Physics	6	0	0	0	5	6	40	60	100
4			PCA – Elective II – Microprocessor Fundamentals/ Physics of Materials/ Introduction to Astrophysics and Astronomy	6	0	0	0	5	6	40	60	100
5			*CC 6 – Digital Electronics (handled by Physics Department)*	4	0	3	0	4	4	40	60	100
6			PCA Core Practical III (General)	0	0	2	0	4	2	40	60	100
7			PCA Core Practical IV (Electronics)	0	0	2	0	4	2	40	60	100
8			PCA Core Practical V (Applied)	0	0	2	0	4	2	40	60	100
9			Extension Activities	0	0	0	0	1	0	40	60	100
Total								**35**	**30**	**360**	**540**	**900**

FIRST SEMESTER

CORE 1 – MECHANICS AND PROPERTIES OF MATTER

Course Code	**:**	**Credits**	**: 04**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

The students will be introduced to forces, angular momentum, velocity and acceleration. The course provides the students about the knowledge of moment of inertia and center of mass. Students will be able to articulate and describe relative motion, Inertial and non-inertial frames, Newton's laws of motion, conservation laws, hydrodynamics and elasticity of the materials.

Course Outcomes: At the end of the Course, the Student will be able to:

CO 1	Understand the basics of Newtonian mechanics, displacement, velocity, acceleration and Newtons laws of motion
CO 2	Analyze and differentiate the simple and compound pendulum. Understand the dynamics of a system of particles
CO 3	In hydrodynamics the derivation of Euler's equation, Bernoulli's theorem and its applications.
CO 4	Understand the concept of surface tension, viscosity and its variation with temperature
CO 5	Know the three types of strain and derive the relation between elastic constants
CO 6	Determination of the rigidity modulus of the rod using static torsion method
CO 7	Understand the inertial frames, Galilean invariance and postulates of special theory of relativity
CO 8	Realize the consequences of Lorentz transformation, significance of mass-energy relation and four vectors Establish the non-existence of the hypothesized stationary ether through the null result of Michelson-Morley experiment

Mapping of Course Outcomes to Program Outcomes:

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

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

S. No	CONTENTS OF MODULE	Hrs	Cos
1	**Introduction to Newtonian Mechanics** 1.1 Displacement – velocity – acceleration – displacement time graph – velocity time graph 1.2 acceleration–time graph 1.3 velocity and acceleration in Cartesian, polar, spherical, cylindrical coordinate systems 1.4 Momentum – Galileo's concept of inertia 1.5 Newton's laws of motion – friction – impulse – impact 1.6 laws of impact – direct impact between two smooth spheres 1.7 oblique impact between two smooth spheres – loss of kinetic energy 1.8 reduced mass – problems	**18**	**CO1**
2	**Two Body Central Force Problem & Rigid Body Dynamics** 2.1 System of particles – center of mass – two body central force problem 2.2 Kepler's law of planetary orbits – escape velocity – orbital velocity 2.3 Equation of motion of the CM 2.4 conservation of linear, angular momentum and energy 2.5 variable mass system 2.6 Compound pendulum – theory – determination of g and k	**18**	**CO2**

	2.7 Equivalent simple pendulum – reversibility of centers of oscillation and Suspension		
3	**Hydrodynamics** 3.1 Kinematics of moving fluids – equation of continuity 3.2 Euler's equation 3.3 Bernoulli's theorem and its applications – Venturimeter – Torricelli's theorem 3.4 Surface tension – Excess pressure-Variation of Surface Tension with temperature 3.5 Determination of S.T by Jaeger's method 3.6 Viscosity – definition – coefficient of viscosity – critical viscosity 3.7 Poiseuille's formula 3.8 Variation of viscosity with temperature – applications	**18**	**CO3, CO4**
4	**Elasticity** 4.1 Hooke's law, Stress strain diagram 4.2 Elastic moduli – relation between elastic constants 4.3 Poisson's ratio – Poisson's ratio in terms of elastic constants 4.4 Work done in stretching and twisting a wire 4.5 twisting couple on a cylinder 4.6 Rigidity modulus by static torsion 4.7 Torsional pendulum – rigidity modulus and moment of inertia	**18**	**CO5, CO6**
5	**Special Theory of Relativity** 5.1 Inertial frames and Galilean invariance 5.2 Michelson – Morley experiment 5.3 Postulates of special theory of relativity 5.4 Lorentz transformations 5.5 Length contraction and time dilation 5.6 Variation of mass with velocity – relativistic velocity addition theorem, mass-energy equivalence 5.7 Introduction to Minkowski space – four vectors	**18**	**CO7, CO8**

TEXT BOOKS:

1. Brij Lal and N. Subramaniam (1994). *Properties of Matter* (6th edn), S. Chand & Co., New Delhi, ISBN no. 9788121902809
2. R. Murugesan (2001). *Properties of Matter* (5th edn), S. Chand & Co., New Delhi, ISBN no. 9788121906050
3. Murugesan (2001). *Modern Physics* (11th edn), S. Chand & Co., New Delhi, ISBN no. 978-81-219-0320-2

REFERENCE BOOKS:

1. Narayanamoorthy (2001), *Mechanics – Part I and II*, National Publishing Company.
2. D.S. Mathur (2001). *Mechanics* (2nd edn), S. Chand & Co., ISBN no.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury (2003). *Concepts of Modern Physics* (6th edn), Tata McGraw-Hill, ISBN no. 9780070151550

E-RESOURCES

https://physicscatalyst.com/heat/thermal_prop_rev.php
http://www.physics.usyd.edu.au/super/physics_tut/worksheets/regPofM.pdf
https://www.indiastudycenter.com/Other/Syllabus/maduniv/under-graduate-courses/bachelor-of-science/Physics/Properties-of-Matter.asp
http://www.upcollege.org/uploads/Physics.pdf
https://www.bscphysicsnotes.online/
https://latestcontents.com/bsc-physics-mechanics-notes/

SECOND SEMESTER

CORE 2 – BASIC ELECTRONICS

Course Code	**:**	**Credits**	**: 04**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

The objective of the course is to appraise the students about the significance of electronics industry. To understand the significance and principles of semiconductor diodes, transistors, their characteristics and how they will operate. Teach the students about the circuit connection. To gain knowledge about oscillators and op-amps Knowledge about resistance inductor, capacitor and their graphical relationship. To understand the characteristics of FET, SCR and UJT.

Course Outcomes: At the end of the Course, the Student will be able to:

CO 1	Understand the concept of band gap energy and classification of materials based on it. Explain the characteristics of P-N junction diode and apply it to construct Half-wave and Full-wave rectifier
CO 2	Analysis the transistor characteristics in CE and CB mode. To analyse the working of RC coupled, Class A and Class B power amplifier
CO 3	Acquire knowledge about the concept of feedback and explain phase shift and Wien's bridge oscillators
CO 4	Design wave shaping circuits such as clippers, clampers and multivibrators
CO 5	Analyse the characteristics of special semiconductor devices such as FET, UJT and SCR and understand its real-time applications

Mapping of Course Outcomes to Program Outcomes:

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

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

S. No	CONTENTS OF MODULE	Hrs	COs
1	**Introduction to Semiconductors and Semiconductor Diodes** 1.1 Classification of materials based on band gap – Conductors, Insulators and Semiconductors 1.2 Intrinsic and extrinsic semiconductors 1.3 P-N junction, V–I characteristics 1.4 half wave rectifier – efficiency 1.5 full wave rectifier – efficiency 1.6 filter circuits – Low, High pass filters 1.7 band pass filters	**20**	**CO1**
2	**Transistors and its Applications** 2.1 Introduction to Transistors 2.2 Transistor action CB mode and CE mode operation and its characteristics 2.3 Analysis of CE amplifier using h parameters 2.4 Expression for current gain, voltage gain 2.5 Input impedance, output impedance and power gain 2.6 RC coupled amplifier and frequency response 2.7 Classification of amplifiers and class A power amplifier 2.8 Push pull, class B power amplifier	**20**	**CO2**
3	**Feedback Oscillators**	**20**	**CO3**

	3.1 Concept of Feedback, Positive and negative feedback 3.2 Barkhausen condition for oscillators 3.3 Expression for frequency of oscillation Hartley Oscillator – Problems 3.4 Phase shift oscillator – Problems 3.5 Wein's bridge oscillator – Problems		
4	**Wave Shaping Circuits and Multivibrators** 4.1 Introduction to Clipping circuits 4.2 Positive clipper, Biased clipper and combination clipper 4.3 Clamping circuits – Positive clamper, Negative clamper 4.4 Integrating and differentiation circuits 4.5 Multivibrator – Astable 4.6 Monostable multivibrator	**20**	**CO4**
5	**Special Semiconductor Devices and Applications** 5.1 Field effect Transistor (FET) – Characteristics 5.2 Unijunction Transistor (UJT) – Characteristics 5.3 UJT as Saw tooth generator 5.4 SCR characteristics 5.5 SCR as a switch 5.6 Problems	**10**	**CO5**

TEXT BOOKS:

1. Albert Malvino and David J Bates (2017). *Electronic Principles* (7th edn), McGraw Hill India, ISBN no. 0070634246
2. Paul Horowitz (1989). *The Art of Electronics* (2nd edn), Cambridge University Press, ISBN no. 978-0-521-37095-0
3. David A. Bell (2004). *Electronic Devices and Circuits* (1st edn), Prentice Hall of India, ISBN no. 9780195693409

REFERENCE BOOKS:

1. Metha (2009). *Principles of Electronics* (3rd edn), S. Chand, ISNB no: 9789352837946
2. R. Boylestad, L. Nashelsky (2002). *Electronic Devices and Circuit Theory* (11th edn), Prentice Hall, ISBN no: 9789332542600.
3. C.M. Kachhava (2003). *Solid State Physics, Solid State Device and Electronics* (1st edn), New Age International, ISBN no: 9788122415001

CORE PRACTICAL I

Course Code :		**Credits**	**: 04**
L:T:P:S	**: 3:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

Experiment is the supreme judge of every physical theory by Lev. Landau. The student should understand that experimental work does not merely means taking simply certain set of observations. The aim or objective of the experiment and how it is to be performed is perceived. A thorough understanding of the underlying physical principles is, therefore, the first prerequisite for an experimenter. The success of any experiment lies entirely on the possible accuracy and reliability of measurements and observations.

The experiments undertaken in the syllabi of Physics Practical I are design to achieve definite quantitative results like

1. *Determination of physical constants, such as surface tension, viscosity of water, Young's modulus, Rigidity modulus, Refractive index of a liquid.*
2. *Measurement of a quantity or parameter connected with a particular body, like focal length of a lens, temperature coefficient of resistance, specific heat capacity of the given solid, liquid.*
3. *Comparison of two quantities, such as viscosities of two liquids, relative density of solid and liquid.*
4. *Testing of quantitative laws like stretched vibrations of a string etc.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	By getting the focal length the property of reversibility in thin lenses is understood proving that the image distance and object distance is interchangeable.
CO2	Determining the Young's modulus and Rigidity modulus correlates to the Physics concept of the property of elasticity. The measurement of surface tension and viscosity of water relates to the theory of properties of liquids.
CO3	Perform the procedure as per standard value and calculate the data to obtain quantitative result.
CO4	Develop the skill of interpreting the results and understand the applications of the experiments.

Mapping of Course Outcomes to Program Outcomes:

CO/PO/PSO	PO							PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	3	3	2	3	2	3	3	2	3	2	2	3
CO2	3	3	3	2	3	3	2	3	3	3	3	3
CO3	3	2	3	3	3	2	3	3	2	3	3	3
CO4	3	3	3	2	3	3	3	3	3	3	3	3

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

CONTENTS OF MODULE	Hrs	COs
LIST OF EXPERIMENTS 1. Young's modulus – Uniform bending – Optic lever 2. Rigidity modulus and moment of Inertia – Torsional pendulum (with identical masses) 3. Sonometer – Verification of laws and frequency of tuning fork 4. Specific heat capacity of liquid – Method of mixtures (Half-time correction) 5. Focal length, power of a concave lens 6. Spectrometer – Refractive index of a liquid – hollow prism 7. P.O. Box – Temperature coefficient of resistance of a coil 8. Comparison of viscosities of two liquids 9. Young's modulus – Non-uniform bending – Pin & microscope 10. Rigidity modulus – Torsional pendulum (without masses) 11. Surface tension and interfacial surface tension – drop weight method 12. Coefficient of viscosity of liquid (radius of capillary tube by Mercury pellet method) 13. Sonometer – Relative density of a solid and liquid 14. Specific heat capacity of a liquid – Method of cooling 15. Focal length of a convex lens 16. Potentiometer – Internal resistance of Cell	**60**	**CO1, CO2, CO3, CO4**

TEXT BOOKS:

1. D. Chattopadhyay, P.C. Rakshit, and B. Saha (2002). *An Advanced Course in Practical Physics* (6th edn), Books and Allied, Kolkata, ISBN no: 8187134208.
2. Balasubramanian. S, Ranganathan. R, Srinivasan M.N (2017). *A Textbook of Practical Physics* (2nd edn), S. Chand and Sons Pvt. Ltd, ISBN no: 81-8054-744-7
3. C.C. Ouseph, U.J. Rao, V. Vijayendran (2015). *Practical Physics* (1st edn), Viswanathan. S Printers and Publishers Pvt. Ltd., ISBN-13: 978-8187156215

REFERENCE BOOKS:

1. C.L. Arora (1985). *B.Sc. Practical Physics* (1st edn) Chand Publishing, ISBN no: 9788121909099
2. P.R. SasiKumar (2011). *Practical Physics* (1st edn), PHI Learning Pvt. Ltd, Delhi, ISBN no: 9788120344341

E-RESOURCES

https://www.vlab.co.in/broad-area-physical-sciences
https://www.vlab.co.in/ba-nptel-labs-physical-science

THIRD SEMESTER

CORE 3 – MATHEMATICAL PHYSICS

Course Code	**:**	**Credits**	**: 04**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

The purpose of the course is to introduce students to methods of mathematical physics and to develop required mathematical skills to solve problems in quantum mechanics, electrodynamics and other fields of theoretical physics problems.

Course Outcomes: At the end of the Course, the Student will be able to:

CO 1	Evaluate the understanding of basic concept of linear vector space
CO 2	Identify a range of matrix methods that are essential for solving advanced problem in theoretical Physics.
CO 3	Apply special function skills to solve problems in Physics.
CO 4	Remember various processes involved in understanding the vector analysis to solve the equations of motion.
CO 5	Understand and evaluate the elementary complex analysis

Mapping of Course Outcomes to Program Outcomes:

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

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

S. No	CONTENTS OF MODULE	Hrs	COs
1	**Linear Vector Space** 1.1 Axioms of vector space – examples – linear independence of vectors 1.2 Dimension of LVS – basis – dual space – inner product – orthonormality 1.3 Gram–Schmidt orthogonalization 1.4 Completeness – linear transformations – operators – orthogonal and unitary transformation.	18	CO1
2	**Matrices** 2.1 Matrix as representation of operators 2.2 Types of matrices – real, symmetric, skew symmetric, orthogonal matrices 2.3 Characteristic equation of a matrix 2.4 Eigen values and Eigen vectors – Hermitian and unitary matrices – properties of their Eigen values and Eigen vectors 2.5 Diagonalisation of matrices – power of matrix – matrix exponential 2.6 Cayley–Hamilton theorem – matrices in physics: 2.7 Rotation matrix – Pauli matrices.	18	CO2
3	**Special Functions** 3.1 General differential equation in self-adjoint form 3.2 Sturm–Liouville equation – linear independence of solutions – Wronskian 3.3 Different cases of S-L equation: sine cosine functions 3.4 Bessel equations – application in vibrations of membrane 3.5 Legendre equations – applications in electrostatics 3.6 Hermite polynomials – applications in harmonic oscillator.	18	CO3
4	**Vector Analysis** 4.1 Scalar and vector fields 4.2 Gradient, divergence and curl of scalar, vector field 4.3 Irrotational and Solenoidal vector fields 4.4 Equations of accelerated motion in the vector notation in Cartesian coordinate systems 4.5 Equations of accelerated motion in the vector notation in polar coordinate systems	18	CO4

5	**Elementary Complex Analysis** 5.1 Functions of a complex variable 5.2 Continuity and differentiability 5.3 Single and multivalued functions 5.4 Analytic function – Cauchy–Riemann conditions (necessary and sufficient). 5.5 Cauchy–Riemann conditions in the polar (r,θ) coordinates.	**18**	**CO5**

TEXT BOOKS:

1. Sathya Prakash (1996). *Mathematical Physics* (2nd edn), Sultan Chand and Sons, New Delhi. ISBN no: 8180549283
2. E. Kreyszig (2011). *Advanced Engineering Mathematics* (10th edn), Wiley. ISBN no: 8126554231
3. Mary L Boas (2006). *Mathematical Methods in Physical Sciences* (3rd edn), Wiley, ISBN no: 8126508105

REFERENCE BOOKS:

1. A.W. Joshi (2008). *Matrices and Tensors in Physics* (2nd edn), New Age International, ISBN no: 978-0470274262
2. B.D. Gupta (1996). *Mathematical Physics* (4th edn), Vikas Publishing House Pvt. Ltd., New Delhi, ISBN no: 9788125930969
3. V. Balakrishnan (2017). *Mathematical Physics* (1st edn), Ane Books, ISBN no: 9386761114

E-RESOURCES

https://www.physics.uu.se/digitalAssets/405/c_405910-l_1-k_notes_v3_0.pdf
http://www.freebookcentre.net/physics-books-download/Mathematical-Physics-Lecture-Notes.html
http://people.uncw.edu/hermanr/phy311/MathPhysBook/index.htm
https://www.maths.ed.ac.uk/~jmf/Teaching/Lectures/PoMP.pdf

CORE 4 – ELECTRICITY AND ELECTROMAGNETISM

Course Code :	**Credits : 04**
L:T:P:S : 4:0:0:0	**CIA Marks : 40**
Exam Hours : 03	**ESE Marks : 60**

LEARNING OBJECTIVES:

Electricity and electromagnetism are essential not only to Physics, but to all scientific disciplines. Much of the high-technology laboratory equipment of any area of Science is largely based on the concepts of this unit. Knowledge of the ideas here will aid the student in fully understanding the interplay of electric and magnetic forces is the basis for electric motors, generators, and many other modern technologies, including the production of electromagnetic waves.

Course Outcomes: At the end of the Course, the Student will be able to:

CO 1	In Electrostatics, study the properties and boundary conditions obeyed by Electric field, mathematical techniques to obtain electric field and their applications as Conductors, Capacitors, Dielectrics
CO 2	Understand the foundations of magnetostatics, properties and boundary conditions obeyed by magnetic field, vector potential, magnetisation and applications
CO 3	Acquire knowledge about AC and DC circuits and their applications
CO 4	Understand Faraday's laws of electrolysis, self and mutual induction, measurement of horizontal and vertical component of Earth's magnetic field, Ballistic galvanometer and Induction coil
CO 5	Understand the mathematical framework of Maxwell's equations, Electromagnetic waves, Scalar and Vector potential, Poynting's theorem, Hertz Experiment

Mapping of Course Outcomes to Program Outcomes:

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

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

S. No	CONTENTS OF MODULE	Hrs	COs
1	**Electrostatics** 1.1 Coloumb's law, Electric intensity and electric potential 1.2 Divergence and Curl of Electric field, Electric images 1.3 Conductors – surface charge-force on a conductor 1.4 electric intensity and potential due to an earthed conducting sphere 1.5 electric dipole – potential and intensity due to a dipole 1.6 energy of a charged capacitor – loss of energy due to sharing of charges 1.7 Polarization –Dielectrics – Electric Displacement 1.8 Gauss law in presence of dielectrics	**20**	**CO1**
2	**Magnetostatics** 2.1 Lorentz force, Biot Sarvat law, Magnetic field due to steady current. 2.2 Divergence and Curl of Magnetic field, Magnetic vector potential, Boundary conditions. 2.3 Ampere's law, Force and torque on current loop in presence of magnetic field. 2.4 Effect of magnetic field on atomic orbits 2.5 Magnetization	**20**	**CO2**
3	**DC and AC Circuits** 3.1 **DC Circuits:** Growth and Decay of current in circuit containing resistor and inductor, resistor and capacitor, LCR circuit. 3.2 **DC Circuits**: Condition for discharge to be oscillatory, Frequency of oscillation. 3.3 **AC Circuits:** AC Voltage and Current, Power factor, AC circuit containing LCR Circuit 3.4 **AC Circuits:** Series and Parallel resonant circuits, Single phase, Three phase, Electrical fuses, Circuit breakers	**20**	**CO3**
4	**Electromagnetic Induction and Its Applications** 4.1 Faraday's laws of Electromagnetic induction 4.2 Determination of coefficient of self-inductance of solenoid 4.3 Mutual inductance, Experimental determination of absolute mutual inductance of a solenoid, Coefficient of coupling 4.4 Horizontal and Vertical component of Earth's magnetic field 4.5 Calibration of Ballistic Galvanometer 4.6 Induction coil and its uses	**20**	**CO4**
5	**Maxwell's equations and Electromagnetic Theory** 5.1 Faraday's law – Displacement current 5.2 Maxwell's equations in differential and integral form	**10**	**CO5**

	5.3 Scalar and Vector potentials 5.4 Derivation of Maxwell's equations in free space, Energy density of EM wave, Poynting's theorem 5.5 Hertz experiment 5.6 Problems		

TEXT BOOKS:

1. Brijlal and Subrahmanyam (2000). *Electricity and Magnetism* (2nd edn), S. Chand & Co., New Delhi, ISBN no: 978-1107014022
2. D. Chattopadhyay and P.C. Rakshit (2001). *Electricity & Magnetism* (1st edn), Books and Allied (P) Ltd, ISBN no: 9788173812514
3. Edward M. Purcell, David J. Morin (2013). *Electricity and Magnetism* (3rd edn), Harvard University, Massachusetts. ISBN no: 978-1-107-01402-2

REFERENCE BOOKS:

1. R. Murugeshan (2008). *Electricity and Magnetism* (10th edn), S. Chand & Co., New Delhi, ISBN no: 9789352534319
2. K.K. Tewari (2002). *Electricity & Magnetism* (11th edn), S. Chand & Co., New Delhi. ISBN no: 8121908558
3. D.J. Griffiths (2003). *Introduction to Electrodynamics* (4th edn), Prentice Hall of India, New Delhi, 2003, ISBN no: 9780138053260

E-RESOURCES

NPTEL – Introduction to Electricity and Magnetism – Prof. Manoj Harbola – Department of Physics – IIT Kanpur
NPTEL – Electromagnetic Theory – Prof. D.K. Ghosh – Department of Physics – IIT Bombay.
NPTEL – Electromagnetic field for EEE students – Dept of Electrical Engineering – IIT Madras
For the Love of Physics – Prof. Walter Lewin
Fundamentals of Physics – Prof. R. Shankar, Department of Physics – Yale University
Khan Academy

FOURTH SEMESTER

CORE 5 – OPTICS

Course Code :		**Credits**	**: 04**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

To gain knowledge of geometrical and physical optics. Understand the natural behaviour of aberration in lenses and methods to rectify it. Theoretically obtain the relevant equations supporting the different properties of light like Interference, diffraction, polarization and realise it valuable use in our daily lives. Study the theory and experiment of interference using Air wedge, Newton's rings and Michelson interferometer. The theory and experimental past of diffraction by Fresnel's and Fraunhofer methods, production of polarization of light is discussed. To gain overall knowledge in LASERS.

Course Outcomes: At the end of the Course, the Student will be able to:

CO 1	To understand the defects in lenses and methods to rectify them
CO 2	Interference and related experiments
CO 3	Diffraction and experimental explanations
CO 4	Understand the concept of Polarisation and optical activity
CO 5	Principle of LASER and its applications

Mapping of Course Outcomes to Program Outcomes:

CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO 1	3	3	3	2	3	3	2	3	3	3	3	2
CO 2	3	2	3	2	3	3	3	3	3	3	3	3
CO 3	3	3	3	2	3	3	2	2	3	2	3	2
CO 4	3	2	3	3	3	3	3	3	3	2	3	2
CO 5	3	3	3	2	3	3	3	3	3	3	3	2

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

S. No	CONTENTS OF MODULE	Hrs	Cos
1	**Geometrical Optics** 1.1 Spherical aberration in lenses 1.2 Methods of minimizing spherical aberration 1.3 Condition for minimum spherical aberration in the case of two lenses separated by a distance 1.4 Chromatic aberration in lenses 1.5 Condition for achromatism of two thin lenses (in and out of contact). 1.6 Dispersion produced by a thin prism 1.7 Achromatic prisms. 1.8 Combination of prisms to produce– dispersion without deviation – Deviation without dispersion	**18**	**CO1**
2	**Interference** 2.1 Theory of interference 2.2 Analytical treatment 2.3 Expression for intensity 2.4 Condition for maxima and minima in terms of phase and path difference 2.5 Air wedge – Determination of diameter of thin wire 2.6 Test for optical flatness – Haidinger's fringes 2.7 Michelson's interferometer 2.8 Determination of wavelength of light and thickness of thin transparent material	**18**	**CO2**
3	**Diffraction** 3.1 Fresnel diffraction 3.2 Diffraction at a circular aperture and straight edge 3.3 Fraunhofer diffraction – Single slit, Double slit 3.4 Theory of plane transmission grating, normal incidence 3.5 Dispersive power of grating 3.6 Rayleigh's criterion for resolution 3.7 Resolving power of telescope and microscope 3.8 Resolving power of prism and grating 3.9 Problems	**18**	**CO3**
4	**Polarisation** 4.1 Double refraction 4.2 Principle and Construction of Nicol prism 4.3 Huygens explanation of double refraction in uniaxial crystals	**18**	**CO4**

	4.4 Quarter wave plate and Halfwave plate 4.5 Production and detection of plane, elliptically and circularly polarized light 4.6 Babinet's compensator 4.7 Optical activity, Fresnel's explanation of optical activity 4.8 Specific rotation – Laurent's half shade polarimeter		
5	**Laser Fundamentals** 5.1 Fundamental characteristics of lasers 5.2 Two-Level Laser, Three Level Laser 5.3 Quasi Three and four level lasers 5.4 Properties of laser 5.5 Laser modes – Resonator configuration 5.6 Q-switching and mode locking 5.7 Cavity damping 5.8 Types of lasers – Gas lasers 5.9 solid lasers 5.10 liquid lasers 5.11semiconductor lasers	**18**	**CO5**

TEXT BOOKS:

1. N. Subrahmanyam, Brij Lal and M.N. Avadhanulu (2006). *A Text Book of Optics*, S. Chand & Co., New Delhi, ISBN no: 9788121926119
2. R. Murugeshan and KiruthigaSivaprasath (2006). *Optics and Spectroscopy*, S. Chand & Co., New Delhi, ISBN no: 978-8121914413
3. D.R. Khanna and H.R. Gulati (1979). *Optics*, S. Chand & Co., New Delhi, ISBN no: 8180450821

REFERENCE BOOKS:

1. Aruldhas (2005), *Molecular Structure and Spectroscopy*, Prentice Hall, New Delhi, ISBN no: 8120317491, 9788120317499
2. AjoyGhatak (1998). *Optics* (3rd Ed), Tata McGrawHill Publishing Co. Ltd., New Delhi, ISBN no: 0070585830, 9780070585836
3. D. Halliday, R. Resnick and J. Walker (2001). *Fundamentals of Physics Extended* (6th Ed), New York, ISBN no: 978-1-119-30685

E-RESOURCES

https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod2.pdf
https://youtu.be/_JOchLyNO_w – How LASER work
https://youtu.be/5b6MDuU1J8U – Nicol Prism
https://youtu.be/4bCUTLWyicM – Diffraction through an aperture.

CORE 6 – QUANTUM MECHANICS

Course Code	**:**	**Credits**	**: 04**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

Understand the inconsistencies in Classical Physics. To become familiar with Blackbody radiation and hence be aware how quantum theory emerged. Gain a clear knowledge about wave properties of particles, De Broglie waves and its implications on the uncertainty principle. Study the Bohr Atom model in detail and understand about atomic excitations have grasped the idea of wave mechanics and gain the concept of Eigen values, Eigen functions. Learn the basic postulates of quantum mechanics. To find solution to Schrödinger's equation for many systems such as particle in a box, Hydrogen Atom and familiarize with different quantum numbers. Finally apply the formulation of Quantum Mechanics, through exactly solvable problems.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Find out the inconsistencies in Classical Physics while trying to understand microscopic physics
CO2	Recall different laws related to Black Body Radiation – Einstein's Theory of Specific Heat – Limitations of Bohr's Model
CO3	Compute the wavelength of matter waves
CO4	List out different experimental evidences for wave nature of particles.
CO5	Explain the postulates of Wave Mechanics and use Schrodinger's equation to compute Eigen values of physical observables
CO6	Evaluate the Commutation relations of angular momentum operators and Identify Pauli matrices
CO7	Solve the Schrodinger's equation for standard potentials like Hydrogen Atom

Mapping of Course Outcomes to Program Outcomes:

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

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

S. NO	CONTENTS OF MODULE	Hrs	COs
1	**Origin of Quantum Theory** 1.1 Interpretation of Rayleigh – Jean Law – Wien's Displacement Law – Ultraviolet Catastrophy 1.2 Derivation of Planck's Radiation Law 1.3 Results of Lummer – Pringsheim experiment 1.4 Interpretation of Dulong – Petit Law 1.5 Dulong Petit law as special case of Einstein's Theory – Modification of Einstein's theory by Debye (no derivation) – 1.6 Limitations of Rutherford Model 1.7 Bohr's Explanation of spectrum of Hydrogen	18	CO1, CO2
2	**Wave Nature of Matter** 2.1 Dual Nature of Radiation and Matter – Matter waves – de Broglie's Principle and expression 2.2 Experimental evidences: Davisson and Germer's experiment – G.P. Thompson's experiment 2.3 Phase and group velocity – Velocity of Matter waves – wave packet 2.4 Heisenberg's Uncertainty Principle-Gamma microscope 2.5 Electron microscope.	18	CO3, CO4
3	**Schrodinger Equation**	18	CO5

	3.1 Basic postulates of wave mechanics 3.2 properties of wave function – probability interpretation of wave function – normalization of wave function 3.3 linear operators – self adjoint operators – expectation value 3.4 Eigen values and Eigen functions – commutativity and compatibility		
4	**Angular Momentum in Quantum Mechanics** 4.1 Orbital angular momentum operators and their commutation relations 4.2 Separation of three-dimensional Schrodinger equation into radial and angular parts 4.3 Elementary ideas of spin angular momentum of an electron – Pauli's matrices.	**18**	**CO6**
5	**Solutions of Schrodinger Equation** 5.1 Free particle solution – particle in a box 5.2 potential well of finite depth (one dimension) 5.3 linear harmonic oscillator 5.4 rigid rotator 5.5 Hydrogen atom	**18**	**CO7**

TEXT BOOKS:

1. SatyaPrakash, Swati Sabja (2012). *Quantum Mechanics* (1st edn), KedarNath, RamNath & Co., ISBN no: 9788190701174
2. David Griffiths (2004). *Introduction to Quantum Mechanics* (2nd edn), Prentice Hall of India, ISBN no: 978-9332542891
3. V. Murugan (2004). *Quantum Mechanics* (1st edn), Pearson Education India, ISBN no: 9788131773628

REFERENCE BOOKS:

1. H.C. Verma (2012). *Quantum Physics* (2nd edn), TBS Publications, ISBN no: 978-8192571409
2. R. Murugeshan and Kiruthiga Sivaprasath (2016). *Modern Physics* (18th edn), S. Chand & Co., ISBN no: 9789352533107
3. P.M. Mathews and K. Venkatesan (2017). *A Textbook of Quantum Mechanics* (2nd edn), McGraw Hill., ISBN no: 978-0070146174

E-RESOURCES

https://nptel.ac.in/courses/115101107/
https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2013/index.htm
https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2016/index.htm
https://nptel.ac.in/courses/122/106/122106034/

CORE PRACTICAL II

Course Code	**:**	**Credits**	**: 04**
L:T:P:S	**: 3:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

As a student of Physics, one has to be very attentive and eager to look into its cause and effect, which gives rise to, what we call it as phenomenon. Each and every phenomenon in Physics is governed by certain laws. These laws are to be verified in the laboratory by experiments. In fact, the laws of Physics have already been verified and the physical constants have also been determined more accurately. The purpose of doing laboratory experiments by the students is to afford an opportunity to familiarize themselves with various instruments, which they read in theory and to culture the habit of taking readings carefully, so as to get the results nearer to the already determined standard values with least error. The student is made to understand the physical principles underlying the experiment undertaken. The experiments can be categorized into following categories:

1. *Determination of parameters like Young's modulus, Rigidity modulus, λ of composite light, g and k, m and B_H, μ of a glass prism.*
2. *Measurement of a property like Thermal conductivity of a bad conductor by Lee's disc method, Temperature coefficient of resistance of a coil, Carey Foster's bridge , Ac frequency.*
3. *Measurement of property of a device like Frequency of the vibrator by Melde's string, Calibration of ammeter, Figure of merit of table galvanometer.*
4. *Electronics experiments like Basic logic gates – AND, OR, NOT gates using diodes & transistors.*

Course Outcomes: At the end of the Course, the Student will be able to:

CO 1	Deduce the figure of merit of the given devices such as ammeter and galvanometer
CO 2	Measure specific resistance, refractive index, Young's modulus, Rigidity modulus, temperature coefficient of resistance etc., as per the standard procedure
CO 3	Ability to do the calculations on the data collected and compare with the standard values as required. Infer the correctness of the results from the experiment
CO 4	Plotting of graphs by means of which it is clear that the manner in which one quantity called the dependent variable changes in a given physical process, when certain arbitrary values are given to a second quantity, called the independent variable, all other factors being assumed to remain unchanged
CO 5	A thorough understanding of the underlying physical principles

Mapping of Course Outcomes to Program Outcomes:

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

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

CONTENTS OF MODULE	**Hrs**	**COs**
1. Young's modulus – cantilever – depression – Static method-Scale and telescope 2. Basic logic gates – AND, OR, NOT gates using diodes & transistors. 3. Rigidity modulus – Static torsion 4. Spectrometer – Grating N and λ – normal incidence method 5. Compound pendulum – g and k 6. Melde's string – Frequency of the vibrator 7. Thermal conductivity of a bad conductor – Lee's disc method 8. Spectrometer – Grating N and λ – minimum deviation method 9. Air wedge – Thickness of a wire 10. m and B_H – deflection magnetometer–Tan C position and vibration magnetometer 11. Carey Foster's bridge – Temperature coefficient of resistance of a coil 12. Potentiometer – Determination of specific resistance of the coil. 13. Potentiometer – Calibration of ammeter 14. Figure of merit of table galvanometer 15. Sonometer – A.C. Frequency – Using steel wire 16. Spectrometer – μ of a glass prism – i–d curve	**60**	**CO1, CO2, CO3, CO4, CO5**

TEXT BOOKS:

1. Agrawal, Jain & Sharma (2008), *B.Sc. Physics Practicals* (1st edn), Krishna Prakashan Media, ISBN no: 978-93-89242-92-8
2. A. B. Dr. BHISE , R. B. BHISE (2016), *Introduction to Practical Physics* (1st edn), ISBN 9789351644620

REFERENCE BOOKS:

1. Harnam Singh (2011). *B.Sc. Practical Physics* (1st edn), S. Chand Publishers, ISBN no: 9788121904698
2. C.L Arora (2011). *B.Sc. Practical Physics* (1st edn), S. Chand Publishers. ISBN no: 9788121909099.

E-RESOURCES

https://pdf.wecabrio.com/bsc-second-year-physics-practical.pdf

FIFTH SEMESTER

CORE 7 – THERMAL PHYSICS & ACOUSTICS

Course Code :		**Credits**	**: 04**
L:T:P:S	**: 5:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

The aim of this paper is to expose the students to the fundamentals of Thermal Physics and Sound. Comprehend the basic concepts of thermodynamics, first, second law of thermodynamics, entropy and their physical interpretations. Learn about the real gas equations, Van der Waal equation of state, the Joule-Thompson effect. The working of various heat engines and determination of their efficiency is realised. Analyse waves and oscillations. Study the basic properties and production of ultrasonics by different methods. This umbrella-subject is typically designed for under graduate students and functions to provide a general introduction to sound and heat.

Course Outcomes: At the end of the Course, the Student will be able to:

CO 1	Concept of temperature, its measurement, knowledge in specific heat capacity of solids, liquids and gases. Understanding the benefits of low temperature physics
CO 2	Become familiar with various thermodynamic process and work done in each of this process. Have a clear understanding about reversible and irreversible process, working of a Carnot engine, and knowledge
CO 3	Derive the expression of thermal conductivity and know the various laws related to black body radiation
CO 4	Attain the scientific knowledge about wave motion
CO 5	Familiarise with important terms in acoustics like intensity, loudness, reverberation, etc., Gain knowledge about production, detection, properties and uses of ultrasonic waves

Mapping of Course Outcomes to Program Outcomes:

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

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

S. No	CONTENTS OF MODULE	Hrs	COs
1	**Thermometry, Calorimetry and Low temperature Physics** 1.1 Platinum resistance thermometer – Calendar and Griffith's bridge 1.2 Thermistor 1.3 Specific heat capacity of solids – Dulong and Petit's law 1.4 Specific heat capacity of liquid – method of mixtures – Barton's correction 1.5 Specific heat capacity of gases – C_p and C_v by Regnault's and Callendar & Barne's methods. 1.6 Joule–Kelvin effect – theory of porous plug experiment 1.7 Liquefaction of gases – Linde's method of liquefying air 1.8 Revision & Tests	**18**	**CO1**
2	**Thermodynamics** 2.1 Thermodynamic equilibrium 2.2 Zeroth law of thermodynamics 2.3 First law of thermodynamics 2.4 Reversible and irreversible processes 2.5 Second law of thermodynamics 2.6 Carnot's engine 2.7 Petrol and diesel engines 2.8 Thermodynamic scale of temperature 2.9 Entropy – temperature entropy diagram for Carnot's cycle 2.10 Third Law of thermodynamics – Nernst's heat theorem	**18**	**CO2**

	2.11 Revision & Tests		
3	**Conduction and Radiation** 3.1 Thermal conductivity 3.2 Thermal conductivity of a good conductor – Forbe's method 3.3 Thermal conductivity of a bad conductor – Lee's disc method 3.4 Blackbody radiation – Wien's law – Stefan's law 3.6 Newton's law of cooling from Stefan's law 3.7 Solar constant – determination of solar constant 3.8 Pyrometry – Polarising optical pyrometer-Water flow pyroheliometer	**18**	**CO3**
4	**Waves and Oscillations** 4.1 Wave motion – transverse and longitudinal waves 4.2 Wave velocity and particle velocity 4.3 Differential equation of wave motion 4.4 Stationary waves – properties of stationary waves 4.5 Doppler Effect – Problems based on Doppler Effect. 4.6 Simple harmonic motion – general equation of simple harmonic motion – Differential equation of SHM 4.7 Graphical representation of SHM – Combination of two SHMs in a straight line – Lissajous's figures – Free, damped, forced oscillations and resonance	**18**	**CO4**
5	**Acoustics and Ultrasonics** 5.1 Intensity of sound – Decibel and Bel – Loudness of sound 5.2 Reverberation – Sabine's reverberation formula 5.3 Acoustic intensity 5.4 Factors affecting the acoustics of Buildings 5.5 Acoustics aspects of halls and auditoriums 5.6 Ultrasonic waves, Production of ultrasonic waves – piezo electric crystal method – Magnetostriction effect 5.9 Application of ultrasonic waves 5.10 Revision & Tests	**18**	**CO5**

TEXT BOOKS:

1. Brijlal, Subramanyam N (2003). *Heat & Thermodynamics* (3rd edn), S. Chand & Co, ISBN no: 9788121904179
2. Murugeshan R, Kiruthiga Sivaprasath (2013). *Thermal Physics* (2nd edn), Sultan Chand & Sons, ISBN no: 9788121923910

3. Khanna V.R, Bedi R.S (2007). *Text Book of Sound* (1st edn), Kedharnaath Publishers, ISBN no: 9788172014031

REFERENCE BOOKS:

1. Mathur D.S (2010). *Heat & Thermodynamics* (5th edn), Sultan Chand & Sons, ISBN no: 8180542599
2. Bajaj N.K (1988). *Waves and Oscillations* (1st edn), Tata McGraw Hill Education,
3. ISBN no: 9780074516102
4. Ghosh S (1996). *Text Book of Sound* (1st edn), S. Chand & Co, ISBN no: 9789385676154

E-RESOURCES

https://circuitglobe.com/platinum-resistance-thermometer.html
https://thefactfactor.com/facts/pure_science/chemistry/physical-chemistry/dulong-petits-law-atomic-mass/12628/
https://courses.lumenlearning.com/introchem/chapter/the-three-laws-of-thermodynamics/
https://www.livescience.com/50776-thermodynamics.html
https://keydifferences.com/difference-between-conduction-convection-and-radiation.html
http://minerva.union.edu/newmanj/Physics100/Color,%20Eye,%20&%20Waves/oscillations_and_waves.htm
https://www.austincc.edu/mmcgraw/files_2425/Chap_15Ha-Oscillations.pdf
http://digirit.weebly.com/uploads/1/6/6/5/16653588/acoustics__ultrasonics.pdf

CORE 8 – SOLID STATE PHYSICS

Course Code	**:**	**Credits**	**: 04**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

Understand the basic concepts of crystal structure, its classifications force between atoms and bonding between molecules Differentiate between conductors, insulators and super conductivity. To analyze the crystal structure using X-ray diffraction methods. To acquire knowledge on the basics of magnetic phenomena on materials hence the various types of magnetization. To learn the properties of superconducting materials.

COURSE OUTCOMES: At the end of the Course, the Student would be able to:

CO 1	Understand the basic concepts of force between atoms and bonding thereby distinguish materials based on the type of bonding
CO 2	Importance of dielectric constant. Realising that the factors dielectric constant & relative permittivity are key to the operation of capacitors and the determination of the levels of capacitance achievable
CO 3	acquired knowledge on the nature of magnetic materials
CO 4	clear understanding about x-ray diffraction, understand the defects in solids
CO 5	Expected to gain knowledge of superconductivity, its underlying principles and its applications in modern world

Mapping of Course Outcomes to Program Outcomes:

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

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

S. No	CONTENTS OF MODULE	Hrs	COs
1	**Crystal Structure** 1.1 Crystal lattice – primitive and unit cell 1.2 Seven classes of crystal 1.3 Bravais lattice 1.4 Miller indices 1.5 Structure of crystals 1.6 Simple cubic 1.7 Hexagonal close packed structure 1.8 Face centred cubic structure 1.9 Body centered cubic structure 1.10 Sodium chloride structure 1.11 Zinc blende structure 1.12 Diamond structure	**18**	**CO1**
2	**Diffraction of X-rays and Defects in Solids** 2.1 X ray diffraction 2.2 Bragg's law in one dimension 2.3 Experimental methods 2.4 Laue method 2.5 Powder crystal method 2.6 Rotating crystal method 2.7 Defects in solids 2.8 Point defects – Frenkel and Schottky defects, equilibrium concentrations 2.9 Line defects – edge dislocation and screw dislocation 2.10 Surface defects – grain boundary 2.11 Effects of crystal imperfections	**18**	**CO2**
3	**Chemical Bonds and Superconductivity** 3.1 Interatomic forces 3.2 Different types of chemical bonds 3.3 Ionic bond, cohesive energy of ionic crystals and Madelung constant 3.4 Covalent bond 3.5 Metallic bond 3.6 Van der Waal's bond 3.7 Hydrogen bond 3.8 Superconductivity – general properties	**18**	**CO3**

	3.9 Type I and II superconductors 3.10 Meissner effect 3.11 BCS theory 3.12 Applications of superconductors		
4	**Dielectric Materials** 4.1 Dielectric materials 4.2 Polarization, susceptibility and dielectric constant 4.3 Local field or internal field 4.4 Clausius–Mossoti relation 4.5 Sources of polarizability 4.6 Electronic polarizability 4.7 Ionic polarizability 4.8 Orientational polarizability 4.9 Frequency and temperature effects on polarization 4.10 Dielectric breakdown 4.11 Properties of different types of insulating materials	**18**	**CO4**
5	**Magnetic Materials** 5.1 Different types of magnetic materials 5.2 Classical theory of diamagnetism (Langevin theory) 5.3 Langevin theory of paramagnetism 5.4 Weiss theory of paramagnetism 5.5 Heisenberg interpretation on internal field 5.6 Quantum theory of ferromagnetism 5.7 Antiferromagnetism – Hard and soft magnetic materials	**18**	**CO5**

TEXT BOOKS:

1. S.O. Pillai (2002). *Solid State Physics* (7th edn), New Age International (P) Ltd., ISBN no: 812241508
2. R.L. Singhal (2003). *Solid State Physics* (2th edn), Kedarnath Ram Nath & Co., Meerut, ISBN no: 9788190701150
3. P. K. Palanisamy (2004). *Solid State Physics* (1st edn), Scitech Publication (India) Pvt. Ltd., Chennai, ISBN no: 978-8188429271

REFERENCE BOOKS:

1. V. Raghavan (2004). *Materials Science and Engineering* (6th edn), Prentice Hall of India Private Limited, New Delhi, , ISBN no: 9788120350922
2. M. Arumugam (2002). *Materials Science* (2nd edn), Anuradha Agencies Publishers, ISBN no: 9788187721055
3. A. J. Dekker (1985). *Solid State Physics* (1st edn), Macmillan India, , ISBN no: 9780333918333

E-RESOURCES

https://nptel.ac.in/courses/115/105/115105099/
https://nptel.ac.in/courses/115/104/115104109/
https://nptel.ac.in/courses/115105099/
https://nptel.ac.in/courses/115106061/
https://nptel.ac.in/courses/115/101/115101012/
Khan academy
https://www.studocu.com/en-gb/document/university-of-kent/electromagnetism-optics/lecture-notes/lecture-notes-lecture-part-7-dielectrics/771477/view
https://www.askiitians.com/iit-jee-electrostatics/dielectrics-and-polarisation/#Introduction-to-Dielectrics-and-Polarisation

OPEN ELECTIVE I – SPACE SCIENCE

Course Code	**:**	**Credits**	**: 05**
L:T:P:S	**: 5:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

This course aims to explain the formation of solar systems and it also demonstrates formation of stars and in additional it also describe origin of galaxies and apprise the creation of universe.

COURSE OUTCOMES: At the end of the Course, the Student would be able to:

CO1	Understand the basic concepts to space
CO2	Discuss the laws of solar system
CO3	Demonstrate formation of stellar objects
CO4	Analyze evolution and origin of galaxies
CO5	Summarize the basic laws of space science and formation of universe

Mapping of Course Outcomes to Program Outcomes:

CO/PO/PSO		**PO**											**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**	**4**	**5**
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	2	3	3	3	3	3	3	3	2	3	3	3	3	3	2
CO3	3	3	3	2	3	3	3	2	3	3	3	3	2	3	3	3
CO4	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	2	2	3	3	3	2	3	3	3	3	2	3

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

S. NO	CONTENTS OF MODULE	Hrs	COs
1	**Introduction** 1.1 Introduction to Space Science 1.2 Its application 1.3 Historical development	**18**	**CO1**
2	**Solar System** 2.1 Nebular theory of formation of our Solar System 2.2 Solar wind and nuclear reaction as the source of energy 2.3 Sun and Planets – Brief description about shape size 2.5 Period of rotation about axis and period of revolution 2.6 Distance of planets from sun-Bode's law 2.7 Kepler's Laws of planetary motion – Newton's deductions from Kepler's Laws – Newton's Law of gravitation 2.8 Correction of Kepler's third law 2.9 determination of mass of earth 2.10 Brief description of Asteroids – Satellites – Comets	**18**	**CO2**
3	**Stars** 3.1 Stellar spectra and structure, stellar evolution, nucleo – synthesis and formation of elements. 3.2 Classification of stars: Harvard classification system, 3.3 Hertzsprung-Russel diagram 3.4 Luminosity of star 3.5 Variable stars 3.6 Composite stars (white dwarfs, Neutron stars, black hole, star clusters, supernova and binary stars) 3.7 Chandrasekhar limit	**18**	**CO3**
4	**Galaxies** 4.1 Galaxies and their evolution and origin 4.2 Active galaxies 4.3 Quasars.	**18**	**CO4**
5	**Creation of Universe** **5.1** Early history of the universe 5.2 Big-Bang and Hubble expansion model of the universe 5.3 cosmic microwave background radiation 5.4 dark matter and dark energy	**18**	**CO5**

TEXT BOOKS:

1. Baidyanath Basu, T. Chattopadhyay, S.N Biswas (2010). *An Introduction to Astrophysics* (2nd edn), PHI, ISBN no: 9788120340718

2. Abhyankar, K.D. (1999). *Astrophysics of the Solar System* (2nd edn), Universities Press, ISBN no: 9788173713811

3. Kitchin C.R. (1998). *Astrophysical Techniques* (5th edn), Bristol & Philadelphia Institute of Physics Publishing, ISBN no: 9781420082432

REFERENCE BOOKS:

1. Longair M. S. (1992). *High Energy Astrophysics* (2nd edn), Cambridge University Press, ISBN no: 9780521756181
2. Kutner, Marc L (2003). *Astronomy: A Physical Perspective* (2nd edn), Wiley, ISBN no: 9780521529273
3. Gehrels, Tom. (2007). *Survival through Evolution from Multiverse to Modern Society* (1st edn), Surge Publishing, Charleston, SC, USA, ISBN no: 1-4196-7055-7

E-RESOURCES

http://en.wikibooks.org/wiki/Astronomy (Book on 'Introduction to Astrophysics')
http://en.wikipedia.org/wiki/Ionosphere (Book on Ionosphere).
http://www.nineplanets.org (Material on planets and solar system objects).
http://www-ssg.sr.unh.edu/406/index.html (Astronomy material).
http://ocw.mit.edu/ocwweb/web/home (on – line courses of MIT).
http://www-istp.gsfc.nasa.gov/Education/Intro.html (The Exploration of the Earth's Magnetosphere).

SIXTH SEMESTER

CORE 9 – NUCLEAR AND PARTICLE PHYSICS

Course Code :		**Credits**	**: 04**
L:T:P:S	**: 5:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

Analyze the ideas of basics of nucleus and their energy. To study the various nuclear models and understand the historical evolution of the present-day nuclear model. Solve problems in radioactivity. Realize the procedures for nuclear fission and fusion. To understand the elementary concepts of the elementary particles.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand the Nuclear properties and different Nuclear Models
CO2	Evaluate problems in Half life and Mean life period and also to find the age of Earth
CO3	Understand the working of Radiation Detectors and Particle Accelerators
CO4	Compare between different Nuclear reactors and appreciate their applications
CO5	Distinguish the interaction, isospin and strangeness of different elementary particles
CO6	Solve problems under Nuclear Reactions

Mapping of Course Outcomes to Program Outcomes:

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

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

S. No	CONTENTS OF MODULE	Hrs	COs
1	**General Properties of Nuclei** 1.1 Nuclear Size, Charge, Mass 1.2 Determination of Nuclear Radius-Mirror Nucleus Method 1.3 Mass Defect and Binding Energy-Packing Fraction 1.4 Nuclear Spin – Magnetic Dipole Moment – Electric Quadrupole Moment 1.5 Nuclear Models – Liquid Drop Model 1.6 Weizacker Semi Empirical Mass Formula 1.7 Shell Model and Magic Numbers 1.8 Collective Model-Nuclear Forces 1.9 Meson Theory of Nuclear Force (Qualitative)	**18**	**CO1**
2	**Radioactivity** 2.1 Natural Radioactivity – Law of Disintegration 2.2 Half Life and Mean Life Period – Units of Radioactivity 2.3 Transient and Secular Equilibrium – Radiocarbon Dating – Age of Earth 2.4 Alpha Rays – Characteristics – Geiger Nuttal Law 2.5 α-ray Spectra – Gamow's Theory of α – Decay (Qualitative Study) 2.6 Beta Rays –Characteristics – Beta Ray Spectra 2.7 Neutrino Hypothesis – Violation of Parity Conservation 2.8 Experimental Verification with CO^{60} – Gamma Rays and Internal Conversion 2.9 Nuclear Isomerism	**18**	**CO2**
3	**Radiation Detectors and Particle Accelerators** 3.1 Principle and Working Of Ionisation Chamber 3.2 GM Counter – Quenching and Resolving Time 3.3 Scintillation Counter 3.4 Photo Multiplier Tube 3.5 Thermoluminescence – Thermoluminescence Dosimetry (TLD) 3.6 Linear Accelerator 3.7 Cyclotron 3.8 Synchrocyclotron 3.9 Betatron	**18**	**CO3**
4	**Nuclear Reactions** 4.1Conservation Laws – Nuclear Reaction Kinematics 4.2 Q-Value – Threshold Energy 4.3 Radioisotopes and Its Uses	**18**	**CO4**

	4.4 Classification of Neutrons – Nuclear Fission – Chain Reaction 4.5. Critical Mass and Size – Nuclear Reactor 4.6 Breeder Reactor – Transuranic Elements 4.7. Nuclear Fusion 4.8 Thermonuclear Reaction 4.9 Sources of Stellar Energy		
5	**Elementary Particles** 5.1 Classification of Elementary Particles 5.2 Fundamental Interaction 5.3 Elementary Particle Quantum Numbers 5.4 Isospin and Strangeness 5.5 Conservation Laws and Symmetry 5.6 Basic Ideas About Quark 5.7 Quark Model	**18**	**CO5, CO6**

TEXT BOOKS:

1. Krane K.S. (1987). *Introductory Nuclear Physics*, Wiley, ISBN no: 9780471805533
2. Devanathan V (2016). *Nuclear Physics*, Narosa Publishing House, ISBN no: 9788184871043
3. Griffiths D, Harper, Row (1987). *Introduction to Elementary Particle Physics*, Wiley, ISBN no: 047160386

REFERENE BOOKS:

1. Roy R.R, Nigam B.P. (2008), *Nuclear Physics* (1st edition), New Age Intl. ISBN no: 9788122434101
2. Tayal D.C. (1988). *Nuclear Physics* (Fifth Edition), Himalaya Publishing House, ISBN no: 9789350978306
3. Ghoshal (1994). *Atomic and Nuclear Physics*, S. Chand & Co, ISBN no: 9788121904131

E-RESOURCES

https://www.springer.com/gp/physics/particle-nuclear-physics
https://nptel.ac.in/courses/115/103/115103101/
https://onlinecourses.nptel.ac.in/noc20_ph19/preview
https://iopscience.iop.org/book/978-0-7503-1140-3
https://physics.uiowa.edu/research/nuclear-and-particle-physics

CORE 10 – ATOMIC PHYSICS

Course Code :		**Credits**	**: 04**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

Understand the properties of positive rays, comprehend how the charge, mass of any nucleus is determined using various spectrograph. Analyse the relationship between various types of couplings. Describe theories explaining the structure of atoms and the origin of the observed spectra. Identify atomic effect such as Zeeman effect and Stark effect. List different types of atomic spectra. Explain the observed dependence of atomic spectral lines on externally applied electric and magnetic field. Understand the properties of x-rays.

Course Outcomes: At the end of the Course, the Student will be able to:

CO 1	Acknowledge electric and magnetic fields and positive rays
CO 2	Recognize photoelectric emission, photo electric equation. Reach a conclusion how photoelectric emission is extrapolated in the construction of photoelectric cells, photo emissive cells, photo voltaic cells and photo conducting cells
CO 3	Reason Pauli's exclusion principle in L-S and J-J coupling
CO 4	Make out the experimental arrangement for the normal Zeeman effect. Deduce anomalous Zeeman effect, Paschen–Back effect, Stark effect
CO 5	Distinguish between characteristic X-ray spectrum and continuous X-ray spectrum Realise the volume of uses of X-rays. Derive the necessary expression to understand the significance of Compton effect

Mapping of Course Outcomes to Program Outcomes:

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

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

S. No	CONTENTS OF MODULE	Hrs	COs
1	**Discharge Phenomenon through Gases** 1.1 Detection of charged particles in electric and magnetic fields 1.2 Determination of e/m 1.3 Dunnington's method 1.4 Positive rays and its properties 1.5 Dempster's mass spectrographs 1.6 Bain bridge's mass spectrograph	**18**	**CO1**
2	**Photo-electric Effect** 2.1 Richardson and Compton experiment 2.2 Laws of photoelectric emission 2.3 Einstein photo electric equation 2.4 Millikan's experiment 2.5 Verification of photoelectric equation 2.6 Photoelectric cells 2.7 Photo emissive cells 2.8 Photo voltaic cells 2.9 Photo conducting cells 2.10 Photo multiplier	**18**	**CO2**
3	**Atomic Structure** 3.1 Vector atom model 3.2 Pauli's exclusion principle 3.3 Explanation of periodic table 3.4 Various quantum numbers 3.5 Angular momentum and magnetic moment 3.6 Coupling schemes – LS and JJ coupling 3.7 Special quantization 3.8 Bohr magneton 3.9 Stern and Gerlach experiment	**18**	**CO3**
4	**Effect of Atoms in Electric and Magnetic Fields** 4.1 Zeeman effect – experimental arrangement for the normal Zeeman effect 4.2 Lorentz's classical theory of normal Zeeman effect 4.3 Larmor's theorem 4.4 Quantum mechanical explanation of the normal Zeeman effect 4.5 Anamalous Zeeman effect 4.6 Paschen–Back effect 4.7 Stark effect	**18**	**CO4**

5	**X-rays** 5.1 Introduction 5.2 Characteristic X-ray spectrum 5.3 Continuous X-ray spectrum 5.4 X-ray absorption 5.5 Moseley's law 5.6 Bragg's law 5.7 Bragg's spectrometer 5.8 Uses of X-rays 5.9 Compton effect – experimental verification of Compton effect	**18**	**CO5**

TEXT BOOKS:

1. N. Subrahmanyam and Brijlal (2000). *Atomic and Nuclear Physics* (2nd edn), S. Chand & Co., New Delhi, ISBN no: 9788121904148
2. D.L. Sehgal, K.L. Chopra and N.K. Sehgal (1991). *Modern Physics* (9th edn), Sultan Chand & Sons Publication, New Delhi, ISBN no: 9788180549526
3. J.B. Rajam (2004). *Atomic Physics* (20th edn), S. Chand and Co., New Delhi, ISBN no: 978-8121918091

REFERENCE BOOKS:

1. R. Murugeshan and Kiruthiga Sivaprasad (2008). *Modern Physics* (18th edn). S. Chand & Co., New Delhi, ISBN no: 9789352533107
2. Arthur Beiser (1969). *Perspectives of Modern Physics* (1st edn), Tata McGraw Hill, New Delhi, ISBN no: 07085047X
3. J.H. Hamilton and Yang (1996). *Modern Physics* (1st edn). McGraw Hill Publication, ISBN no: 978-0071148832

E-RESOURCES

https://nptel.ac.in/courses/115/105/115105100/
https://nptel.ac.in/courses/113/106/113106069/
Khan academy

ELECTIVE I – INTEGRATED ELECTRONICS

Course Code	**:**	**Credits**	**: 05**
L:T:P:S	**: 5:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

Realize that the operational amplifiers are the work horse of the Electronics industry. To understand the innumerable applications of op-amp as an analog and digital device. Rationalize circuits using Op-Amp for making Summing, subtracting, differentiators and integrators. Surmise criterion for Oscillations in Oscillators and evaluation of frequency of oscillators. The applications of Timer 555 in timing circuits, the importance and construction of semiconductor memories is to be comprehended.

Course Outcomes: At the end of the Course, the Student will be able to:

CO 1	Acquire knowledge of Operational Amplifiers and its applications
CO 2	Applying Op-Amp to solve simultaneous equations and second order differential equations. Learn how the op-amp is used to construct oscillators to generate Square wave and Sine wave
CO 3	Acquire the knowledge of principle, construction and working of D/A convertor and A/D converter
CO 4	Express the internal architecture of 555 Timer, and familiarize with the working Timer 555 as an Astable, Monostable multivibrator and Schmitt trigger
CO 5	Understand and necessitate that the semiconductor memories like RAM, ROM, EPROM, EEPROM are applicable in today's digital world

Mapping of Course Outcomes to Program Outcomes:

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

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

S. No	CONTENTS OF MODULE	Hrs	COs
1	**OP-AMP Fundamentals Applications** 1.1 Op-AMP, block diagram, symbol and terminals 1.2 Op-AMP characteristics and parameters, comparators 1.3 Inverting and Non inverting amplifier 1.4 Unity follower, Integrator, Differentiator 1.5 Summing, Difference amplifier and Averaging amplifier	**20**	**CO1**
2	**Analog Computation and Waveform Generation** 2.1 Solving simultaneous equation 2.2 Solving second order differential equation 2.3Square wave generation (astable operation) 2.4 Sine wave generation – Wien's bridge oscillator	**20**	**CO2**
3	**D/A and A/D Convertors** 3.1 Introduction-Block diagram 3.2 D/A convertor – Binary weighted resistor 3.3 D/A convertor – R – 2R ladder method 3.4 A/D convertor – Counter type 3.5 A/D convertor successive approximation type 3.6 Accuracy and Resolution	**20**	**CO3**
4	**555 Timer and its Applications** 4.1 555 Timer – Internal block diagram 4.2 555 Time – Astable multivibrator 4.3 555 Time – Monostable multivibrator 4.4 555 Time – Schmitt trigger	**10**	**CO4**
5	**Semiconductor Memories** 5.1 Classification based on principle of operation 5.2 ROM organization 5.3 PROM, EPROM, EEPROM 5.4 Random Access Memory, Static RAM, Dynamic RAM 5.5 Memory parameters	**20**	**CO5**

TEXT BOOKS:

1. Vijayendran V (2009). *Introduction to Integrated Electronics Digital and Analog* (1st edn), Viswanathan, S., Printers & Publishers Pvt Ltd, ISBN no: 8187156058
2. Millman J, Halkias C.C. (1991). *Integrated Electronics: Analog and Digital Circuits and Systems* (48th edn), Tata McGraw Hill, ISBN no: 9780074622452
3. Dean K.J. (1967) *Integrated Electronics* (15th edn), Chapman & Hill, ISBN no: 9780412087103

REFERENCE BOOKS:

1. Carr J.J. (1990). *Integrated Electronics Operational Amplifiers and Linear ICs with Applications* (5th edn), Harcourt Brace Jovanovich, ISBN no: 9780155413603
2. Gayakwad RA (2002). *Op-amps and Linear Integrated Circuits* (5th edn), Prentice-Hall of India Private. Limited, ISBN no: 9788120320581
3. Choudhury D.R., Jain S (1991). *Linear Integrated Circuits* (15th edn), Wiley Ltd, ISBN no: 9780470217054

ELECTIVE II – MICROPROCESSOR FUNDAMENTALS

Course Code	**:**	**Credits**	**: 05**
L:T:P:S	**: 5:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

To enable the students to understand organization, architecture of Intel microprocessor 8085, its architecture, pin diagram, timing diagram, instruction set and programming in a lucid and comprehensive manner. To understand data transfer schemes and develop skill in writing programs for 8085.

COURSE OUTCOMES: At the end of the Course, the Student will be able to

CO 1	Familiar with the general architecture of a microcomputer system and architecture & organization of microprocessor 8085
CO 2	Recognize the instruction set of microprocessors 8085
CO 3	Describe the memory interfacing to 8085 microprocessors
CO 4	Explain the concept of interrupts in 8085 microprocessors
CO 5	Acquire basic knowledge on Programmable peripheral interface 8255 and explain modes of operation of 8255

Mapping of Course Outcomes to Program Outcomes:

CO/PO/PSO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	1	**2**	**3**	**4**	**5**
CO 1	3	2	3	2	3	3	3	3	3	2	3	2
CO 2	3	2	3	3	2	3	2	3	2	3	3	3
CO 3	3	3	2	3	3	2	3	3	3	2	3	2
CO 4	3	3	3	2	3	3	2	3	3	2	2	2
CO 5	3	2	3	2	2	3	3	2	3	3	3	2

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

S. No	CONTENTS OF MODULE	Hrs	COs
1	**Architecture** 1.1 Architecture of 8085 1.2 Registers, flags, ALU 1.3 Address and data bus, demultiplexing address/data bus 1.4 control and status signals, control bus 1.5 Programmer's model of 8085 1.6 Pin out diagram – functions of different pins	**18**	**CO1**
2	**Programming Techniques** 2.1 Instruction set of 8085 2.2 Data transfer and arithmetic instructions 2.3 Logic and branching instructions 2.4 Machine control group of instructions 2.5 Addressing modes, register indirect, direct addressing modes. 2.6 Immediate and implied addressing modes	**18**	**CO2**
3	**Interfacing Memory to 8085** 3.1 Assembly language & machine language 3.2 Programming techniques: addition, subtraction 3.3 Multiplication and division 3.4 Ascending, descending order, largest and smallest (single byte). 3.5 Memory interfacing – interfacing 2kx8 ROM and RAM 3.6 Timing diagram of 8085 (MOV R_d, R_s – MVI R_d, data(8))	**18**	**CO3**
4	**Interfacing I/O Ports to 8085** 4.1 Programmable peripheral interface 8255 4.2 8255 – pin out functions, block diagram 4.3 control word 4.4 Modes of operation of 8255 4.5 Interface, I/P&O/P port to 8085 4.6 Flashing LEDs	**18**	**CO4**
5	**Interrupts** 5.1 Interrupts in 8085 5.2 Hardware and software interrupts 5.3 RIM instructions 5.4 SIM instructions, priorities 5.5 Simple polled data transfer 5.6 Interrupt controlled data transfer	**18**	**CO5**

TEXT BOOKS:

1. R.S. Gaonkar (1992). *Microprocessor Architecture Programming and Application with 8085/8080A* (1st edn). Wiley Eastern Ltd., ISBN no: 978-0852262979
2. V. Vijayendran (2003). *Fundamental of Microprocessor* 8085. S. Viswanathan Publishers, Chennai, ISBN no: 9788187156130
3. B. Ram (1993). *Fundamentals of Microprocessors and Microcomputers* (4th edn). Dhanpat RAI Publication, ISBN no: 978-9383182107

REFERENCE BOOKS:

1. Aditya Mathur (1987). *Introduction to Microprocessor* I (3rd edn). Tata McGraw Hill Publishing Company Ltd., ISBN no: 978-0074602225
2. Dougles V. Hall (1983). *Microprocessor and Digital System* (2nd edn), McGraw Hill Company, ISBN no: 9780070255524
3. Senthil Kumar Saravanan, Jeevananthan (2010). *Microprocessors and Microcontrollers* (2nd edn). Oxford Univ Press, ISBN no: 9780199466597

E-RESOURCES

http://www.engj.ulst.ac.uk/sidk/eeellla/lecture-series//microprocessor
https://youtu.be/ii7PCV2zvms
https://youtu.be/zAXAb_ttazY
https://www.youtube.com/watch?v=LxDSPFj4wgA

Computer Core 6 – DIGITAL ELECTRONICS

Course Code :		**Credits**	**: 04**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

Digital Electronics is the foundation of modern computers and digital communications. This is a comprehensive course on understanding digital electronics. The course is to learn the digital format of data and codes. The course will help the student understand Number Systems, Numeric codes, Logic Gates, Combinational Circuits, Sequential Circuits and IC technology. Simplification and construction of digital circuits by employing Boolean algebra is done. Sequential systems are constructed by choosing flip-flop as a building bock and understanding how counters provide a memory is addressed. In addition, the fabrication of IC's will be discussed.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Identify and realise that different number system with different number bases play a very important part in the computer
CO2	Construct basic logic gate using NAND and NOR gates. To use Boolean Algebra to design digital circuits and also minimization of gates by using Boolean laws
CO3	Simplify digital circuits using Karnaugh Map and create circuits requiring lesser gates
CO4	Justify that encoder, decoder, multiplexer as well as demultiplexer are combinational logic circuits as their output at any time depends upon the combination of the input signals present at that instant only
CO5	To reach a conclusion that Flip-flops is a data storage element and are fundamental building blocks of digital electronics systems used in computers, communications. Identify different types of flip-flops and what led to the development of these flip-flops.
CO6	Using flip-flops to construct different types of Registers and Counters and conclude how useful sequential circuits are
CO7	Elucidate the fabrication steps involved in IC production

Mapping of Course Outcomes to Program Outcomes:

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

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

S. NO	CONTENTS OF MODULE	Hrs	COs
1	**Digital Fundamentals** 1.1 Number systems – binary, octal and hexadecimal 1.2 Binary arithmetic operations – addition, subtraction, multiplication and division. Subtraction using 1's and 2's complement. BCD codes 1.3 Basic logic gates – NAND and NOR as universal gates 1.4 Sum of products and product of sums. 1.5 Laws of Boolean algebra 1.6 DeMorgan's theorems	**18**	**CO1, CO2**
2	**Combinational Logic Design** 2.1 Karnaugh map representation and simplification, pair, quad, octet (limited to four variables) 2.2 Half and full adders, half and full subtractors, BCD adder 2.3 Multiplexers, demultiplexers, decoders, encoders 2.4 Code converters (BCD-to-binary, binary-to-BCD converters)	**18**	**CO3, CO4**
3	**Sequential Circuits** 3.1 Introduction to sequential circuits 3.2 flip flops: types of flip flops: – 1-bit memory – latch 3.3 R-S flip flop – J-K flip flop – race-around condition – 3.4 master-slave flip flop – T and D flip flops	**18**	**CO5**
4	**Registers and Counters**	**18**	**CO6**

	4.1 Registers: modes of operation – shift right register – shift left registers 4.2 Universal shift register 4.3 Counters (4 bit): ripple (or) asynchronous counters 4.4 Synchronous counters – up–down counters 4.5 Decade counter – BCD counter 4.6 Applications of counters		
5	Introduction to IC Technology 5.1 Basic fabrication steps: epitaxial growth, oxidation 5.2 Photolithography 5.3 Etching, diffusion, ion implantation 5.4 Film deposition and metallization 5.5 Fabrication of diodes and transistor	**18**	**CO7**

TEXT BOOKS:

1. V. Vijayendran (2005). *Introduction to Integrated Electronics.* S. Viswanathan Printers and Publishers Pvt. Ltd., Chennai, ISBN no: 9788187156055
2. Jain and Anand (1996). *Digital Electronics Practice Using Integrated Circuits* (4th edn). Tata McGraw Hill, ISBN no: 9780074516928
3. J. Millman and C. Halkias (2001). *Integrated Electronics* (2nd edn). Tata McGraw Hill, New Delhi, ISBN no: 9780070151420

REFERENCE BOOKS:

1. A.P. Malvino and D.P. Leach (1992). *Digital Principles and Application* (4th edn), Tata McGraw Hill, ISBN no: 978-0-07-014170-4
2. M Morris Mano (2004). *Digital Logic and Computer Design* (1st edn). Pearson Education, ISBN no: 978-8177584097
3. Anil K Maini (2007). *Digital Electronics*. Wiley Publications, ISBN no: 978-0-470-51051-3

E-RESOURCES

https://nptel.ac.in/courses/108/105/108105113/
https://nptel.ac.in/courses/117/106/117106086/

CORE PRACTICAL III

Course Code :		**Credits**	**: 04**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

This laboratory-based course provides the "hands on" experience in a number of experimental techniques, and develops competence in handling instruments like spectrometer, potentiometer, ballistic galvanometer, magnetometer both deflection and vibration type typically used in Physics. The course assumes a familiarity with properties of matter, optics, magnetism and Electricity. Practical work facilitates learning in the classroom. Using the practical activity can help structure a lesson and improve engagement and knowledge retention. From the observed data students are encouraged to use the graph form to analyse the results and report their findings. With clear objectives and step-by-step guidance, students can grow in confidence, gaining understanding and skills that will not only enable them to work as scientists, but develop critical thinking skills helping them to become confident, independent learners.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Identify that Interference phenomena is responsible for the formation of Newton's rings. Use the spectrometer to find the Refractive index of a glass by method of i-i´ realise that RI depends upon the combination of raw materials used, together with the nature of the manufacturing process
CO2	Methodology to determine the Young's modulus by Koenig's method and Optic lever – Telescope arrangement. Correlate the experimental techniques with the relevant theory contained in Properties of Matter. Understand the necessity to record the data with high precision to result in highly accurate results
CO3	Acknowledge that the current produces a magnetic field and use it to determine the approximate (*indicative*) the value of the earth's magnetism by experiment namely Field along the axis of the coil using Deflection magnetometer and Vibration magnetometer
CO4	Ballistic Galvanometer is the device that is employed for assessing the amount of charge flow that is developed from the magnetic flux. It genuinely operates as an integrator calculating the amount of charge expelled from it which can be realised from experiments like Figure of merit, Internal resistance of a cell, Comparison of capacitances, Comparison of EMFs, Absolute capacitance of a capacitor – B.G.

Mapping of Course Outcomes to Program Outcomes:

CO/PO/PSO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	3	2	2	1	2	3	1	3	2	2	2	2	3
CO2	3	3	3	2	3	3	2	3	3	3	3	3	3
CO3	3	3	3	2	3	3	2	3	3	3	3	3	3
CO4	3	3	3	2	3	3	2	3	3	3	3	3	3

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

Sl. No.	CONTENTS OF MODULE	Hrs	COs
1.	Young's modulus – Koenig's method – Non-uniform bending.	30	CO1, CO2, CO3, CO4
2.	Young's modulus – Non-uniform bending – optic lever – scale and telescope.		
3.	Newton's Rings – R_1 R_2 and μ of a long focus convex lens.		
4.	Spectrometer i–i′ curve fixing i.		
5.	Spectrometer – Cauchy's constants.		
6.	Field along the axis of a circular coil – Deflection magnetometer – B_H and M.		
7.	Field along the axis of a circular coil – Vibration magnetic needle.		
8.	EMF of thermocouple – Potentiometer (199P method).		
9.	EMF of thermocouple – Potentiometer (108P method).		
10.	Calibration of high range voltmeter – Potentiometer.		
11.	Figure of merit – B.G.		
12.	Internal resistance of a cell – B.G.		
13.	Comparison of capacitances – B.G.		
14.	Comparison of EMFs – B.G.		
15.	Absolute capacitance of a capacitor – B.G.		
16.	Series resonance circuit – LCR – finding L, resonant frequency, bandwidth, Q.		
17.	Spectrometer – Narrow angled prism.		

TEXT BOOKS:

1. D. Chattopadhyay, P.C. Rakshit, and B. Saha (2002). *An Advanced Course in Practical Physics* (6th edn), Books and Allied, Kolkata, ISBN no: 8187134208.
2. C. C. Ouseph, U. J. Rao, V. Vijayendran (2015). *Practical Physics* (1st edn), Viswanathan. S Printers and Publishers Pvt. Ltd., ISBN-13 : 978-8187156215

REFERENCE BOOKS:

1. C.L Arora (2011). *B.Sc. Practical Physics* (1st edn), S. Chand Publishers. ISBN no: 9788121909099.
2. Harnam Singh (2011). *B.Sc. Practical Physics* (1st edn), S. Chand Publishers, ISBN no: 9788121904698
3. P.R. SasiKumar (2011). *Practical Physics* (1st edn), PHI Learning Pvt. Ltd, Delhi, ISBN no: 9788120344341
4. Balasubramanian. S, Ranganathan. R, Srinivasan M. N, (2017). *A Textbook of Practical Physics* (2nd edn), S. Chand and Sons Pvt. Ltd, ISBN no: 81-8054-744-7

CORE PRACTICAL IV ELECTRONICS

Course Code :		**Credits**	**: 04**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

To gain practical knowledge by applying the experimental methods to correlate with the theory of Diodes, Transistors. To acquire the knowledge of handling, and testing the active and passive components for the construction of various electronic circuits. To construct circuits that will function as oscillators and correlate with theory that the tank circuit is responsible in determining the frequency in Hartley, Colpitts's oscillator. An introduction to logic gates and their application in construction of combinational circuits like Half adder, Full adder Half subtractor, full subtractor and sequential logic circuits like 4-bit ripple counter is reinforced.

COURSE OUTCOMES: At the end of the Course, the Student will be able to

CO1	Understand the properties and applications of semiconductor diodes in the form of Half wave, Full wave Bridge rectifier, Zener Regulated power supply
CO2	Understand the properties and working of transistors in CB and CE mode. Understand and analyse the biasing technique in emitter follower
CO3	Construct Hartley, Colpitts's oscillator circuits using transistors, obtain the frequency of oscillation and identify that they are sinusoidal, audio-frequency oscillators
CO4	Identify the IC chips of NAND and NOR are universal building block in digital circuits

Mapping of Course Outcomes to Program Outcomes:

CO/PO/PSO	**PO**								**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**	**4**	**5**
CO1	3	2	2	1	2	3	1	3	2	2	2	2	3
CO2	3	3	3	2	3	3	2	3	3	3	3	3	3
CO3	3	3	3	2	3	3	2	3	3	3	3	3	3
CO4	3	3	3	2	3	3	2	3	3	3	3	3	3

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

Sl. No.	CONTENTS OF MODULE	Hrs	Cos
1.	Full wave rectifier	**30**	**CO1, CO2, CO3, CO4**
2.	Bridge rectifier		
3.	Zener regulated power supply – 9V – Regulation characteristics		
4.	Transistor characteristics – CB mode		
5.	Transistor characteristics – CE mode		
6.	Single stage RC coupled amplifier – gain – Frequency response.		
7.	Emitter follower		
8.	Hartley oscillator		
9.	Colpitt's oscillator		
10.	Transistor – Astable multivibrator		
11.	Regulated power supply – IC 7805		
12.	NAND/NOR universal building blocks		
13.	De Morgan's theorem – Verification		
14.	Half adder – Full adder using IC – XOR, AND and OR gates.		
15.	Half subtractor, full subtractor using IC – XOR, AND and OR gates		
16.	4-bit ripple counter using IC 7473		
17.	Decade counter – IC 7490		

TEXT BOOKS:

1. R K Shukla (2007), *Practical Physics* (1st edn), New Age International (P) Limited, Publishers, ISBN no: 9788122417487
2. Dr. A. B. Bhise, Dr. R. B. Bhise (2018). *Practical Physics For B.Sc. Part - I & II* (3rd edn), Nirali Prakashan, ISBN no: 9789351647591
3. D. Chattopadhyay, P.C. Rakshit, and B. Saha (2002). *An Advanced Course in Practical Physics* (6th edn), Books and Allied, Kolkata, ISBN no: 8187134208
4. C. C. Ouseph, U. J. Rao, V. Vijayendran (2015). *Practical Physics* (1st edn), Viswanathan S Printers and Publishers, Pvt. Ltd., ISBN-13: 978-8187156215

REFERENCE BOOKS:

1. G. L. Squires (2001). *Practical Physics* (4th edn), Cambridge University Press, ISBN no: 9781139632720
2. C.L Arora (2011). *B.Sc. Practical Physics* (1st edn). S. Chand Publishers. ISBN no: 9788121909099.
3. Harnam Singh (2011). *B.Sc. Practical Physics* (1st edn), S. Chand Publishers, ISBN no: 9788121904698
4. P.R. SasiKumar (2011). *Practical Physics* (1st edn), PHI Learning Pvt. Ltd, Delhi, ISBN no: 9788120344341
5. Balasubramanian. S, Ranganathan. R, Srinivasan M. N. (2017). *A Textbook of Practical Physics* (2nd edn), S. Chand and Sons Pvt. Ltd, ISBN no: 81-8054-744-7

CORE PRACTICAL V APPLIED ELECTRONICS

Course Code :		**Credits**	**: 04**
L:T:P:S	**: 4:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

In Applied Electronics theory paper a number of circuits highlighting the various applications of op-amp is studied which is practically realised in the Applied electronics lab which helps to gain practical knowledge by applying the experimental methods to correlate with the theory .Operational Amplifiers for used in the construction of various electronic circuits like adders, subtractors, square wave generator, Wien's bridge oscillator, Phase Shift oscillator. Students study that ADCs and DACs function as interfaces between a completely digital system, like a computer, and the analog world. In a telecommunications system, where the usual output is audible speech if such an analog output is desired, then we need to convert the digital signal back to an analog form so the method D/A conversion by 4-bit binary weighted resistor method reflects on the above. Timer 555 is used in everything from toys to spacecraft. Due to its versatility, availability, and low cost it remains a favourite. Using TIMER 555 the circuit of Schmitt trigger and square wave generator is constructed. Realize the practical application for a RC time constant. The course objective is to introduce the basic concepts of microprocessor and to develop in students the assembly language programming skills and real time applications of Microprocessor.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Use operational amplifier to realise mathematical operations like addition and subtraction of voltages establishing the versality of op-amps
CO2	Realise the application of op-amp in the construction of oscillators like Wein's bridge, square wave oscillator, phase shift oscillators. Observe the calculated frequency of oscillation matches with the theoretical frequency
CO3	To become familiar with the Instruction set of Intel 8085 microprocessor. To provide practical hands on experience with Assembly Language Programming. Write algorithms draw flow charts and realize Programs using Microprocessor 8085 instruction set
CO4	Schmitt Triggers constructed using TIMER 555 is a fundamental circuit with several uses. One is signal processing and the hysteresis curve is a proof
CO5	On completion of the experiment D/A by binary weighted resistor method the importance, significance and the various terms like full scale voltage, accuracy, resolution of D/A converters is comprehended

Mapping of Course Outcomes to Program Outcomes:

CO/PO/PSO	PO								PSO				
	1	2	3	4	5	6	7	8	1	2	3	4	5
CO1	3	2	2	1	2	3	1	3	2	2	2	2	3
CO2	3	3	3	2	3	3	2	3	3	3	3	3	3
CO3	3	3	3	2	3	3	2	3	3	3	3	3	3
CO4	3	3	3	2	3	3	2	3	3	3	3	3	3

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

Sl. No.	CONTENTS OF MODULE	Hrs	Cos
1.	OP Amp – IC 741 – Inverting amplifier, non-inverting amplifier, unity follower	**30**	**CO1, CO2, CO3, CO4**
2.	OP Amp – Summing and difference amplifier		
3.	Op Amp – Differential amplifier – CMRR.		
4.	OP Amp – AC frequency response		
5.	OP Amp – Square wave generator		
6.	OP Amp – Wien's bridge oscillator		
7.	OP Amp – Phase Shift oscillator		
8.	555 Timer – Astable multivibrator		
9.	555 Timer – Schmitt trigger		
10.	D/A convertor – 4-bit binary weighted resistor method		
11.	µp – 8085 8-bit addition, multiplication		
12.	µp – 8085 8-bit subtraction, division		
13.	µp – Sorting in ascending order – 8-bit data		
14.	µp – Sorting in descending order – 8-bit data		
15.	µp – Finding the largest number in an array		
16.	µp – Finding the smallest number in an array		

TEXT BOOKS:

1. D. Chattopadhyay, P.C. Rakshit, and B. Saha (2002). *An Advanced Course in Practical Physics* (6th edn), Books and Allied, Kolkata, ISBN no: 8187134208
2. C. C. Ouseph, U. J. Rao, V. Vijayendran (2015). *Practical Physics* (1st edn), Viswanathan. S Printers and Publishers, Pvt. Ltd., ISBN-13: 978-8187156215
3. C.L Arora (2011). *B.Sc. Practical Physics,* (1st edn) S. Chand Publishers. ISBN No. 9788121909099.

REFERENCE BOOKS:

1. Willam H. Gothmann (2000). *Digital Electronics: An Introduction to Theory and Practice* (2nd edn), Prentice Hall of India Pvt Ltd, ISBN no: 9788120303485
2. Virendhra Kumar (2002). *Digital Electronics Theory and Experiments* (1st edn), New Age International Publishers, NewDelhi, ISBN no: 978-81-224-3892-5
3. S. Salivahanan, S. Arivazhagan (2000). *Digital Circuit and Design* (3rd edn), Vikas Publishing House PVT Limited, ISBN no: 9788125920632
4. Lab Manual, Prepared by Department Staff, Department of Physics, DGVC

ENVIRONMENTAL STUDIES

COURSE CODE:

OBJECTIVES:

Environmental education should be compulsory. Environmental education should take into account the historical perspective, the current and the potential historical issues. Environmental education should emphasise the importance of sustainable development i.e., economic development without degrading the environment. Environmental education should emphasise the necessity of seeking in environmental planning. Environmental education should lay more stress on practical activities and first-hand experiences.

OUTCOME:

1. Demonstrate a general understanding of the breadth and interdisciplinary nature of environmental issues.
2. Denote a general understanding of the qualitative and quantitative research methods to gain empirical evidence bearing on evaluation of environmentally sustainable alternatives
3. Reveal depth of critical analysis and writing of environmental problems that span popular, grey and primary publications.
4. Recall the ability to locate, interpret and apply published research and lessons from successful projects to a focused environmental solution with potential regional stakeholders.
5. Conduct and present (orally and in writing) independent research that is consistent with the highest standards and practices of research in environmental science.

EXTENSION ACTIVITY

COURSE CODE:

OBJECTIVE:

To enrich the students to handle the social relation to the public and government higher secondary students. To acquire the knowledge to solve the environmental issues. To able to handle the classes for higher secondary students both theory and practical. To create the awareness to eradicate the plastics and planted the seed saplings to our environment. To create the interest in the students about environment by planting saplings for their birthday occasion. Value Education is to teach universal values like moral values, patience, honesty, etc., to the students. The purpose of value education is the development of the personality of the student. The student should develop in all dimensions so that they can serve the nation more democratic, cohesive, socially and responsibly. The full development of student's personality in its physical, mental, emotional and spiritual aspects. Development of good manners, responsibility, way of thinking and living should be developing at the democratic level. Developing patience, honesty, moral values etc.

COURSE OUTCOME:

1. Able to handle the social relation between the public and students.
2. Familiarize the students to handle the environmental issues.
3. According to the need for higher secondary students, educate the school students both theory and practical.
4. Eradicate the plastics in and around the school and college.
5. The value education helps the student to develop
    - ✓ **Character development**
    - ✓ **Personality development and**
    - ✓ **Citizenship education**

Non-Major Elective 1 – DIGITAL ELECTRONICS

Course Code :		**Credits**	**: 05**
L:T:P:S	**: 2:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

Students will be able to articulate the different number system like binary octal and hexadecimal. Establish the relation Boolean Algebra and Logic Gates and effectively apply the Boolean laws as well as Karnaugh map to achieve Gate Level Minimization.

Course Outcomes: At the end of the Course, the Student will be able to:

CO 1	Review of Number Systems and Codes: Binary, Octal and hexadecimal conversions
CO 2	Solving problems to perform binary addition and subtraction by1's complement and 2's complement method
CO 3	Identify basic logic Gates. Justified that Universal Gates are NAND and NOR because the construction of all other gates are realised
CO 4	Recall laws of Boolean algebra, De Morgan's Theorem and construction of Truth Tables
CO 5	Calculate the Min term and Max term to simplify Boolean expressions using Karnaugh Map

Mapping of Course Outcomes to Program Outcomes:

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

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

S. No	CONTENTS OF MODULE	Hrs	COs
1	Review of Number Systems and Codes: Binary, Octal and hexadecimal conversions	**8**	**CO1**
2	Binary addition and subtraction – 1's complement and 2's complement arithmetic	**8**	**CO2**
3	Basic Logic Gates: Basic Gates and realization NAND and NOR as universal gates	**8**	**CO3**
4	Boolean Algebra: Rules and laws of Boolean algebra – De-Morgan's Theorems – Boolean Expressions and Truth Tables	**8**	**CO4**
5	Minterm and Maxterms – Simplification of Boolean Expressions using Karnaugh Map	**8**	**CO5**

TEXT BOOKS:

1. Floyd T.L. (2011). *Digital Fundamentals* (10th edn), Pearson Education, ISBN No: 9780132359238
2. C.H. Roth and L.L. Kimney (2013). *Fundamentals of Logic Design* (7th edn), Cengage Learning, ISBN no: 781285633022
3. Donald P. Leach, Albert Paul Malvino and GoutamSaha (1986). *Digital Principles and Applications* (8th edn), Mc Graw Hill. ISBN no: 9789339203405

REFERENCE BOOKS:

1. Mano M.M. (2007). *Logic and Computer Design Fundamentals* (4th edn), Pearson Education, ISBN no: 978-1-292-02468-4
2. R.J. Tocci, N.S. Widmer (2011). *Digital Systems, Principles and Applications* (11th edn), Pearson Education, ISBN no: 0135103827
3. John F. Wakerly (2005). *Digital Design: Principles and Practices* (4th edn), Pearson, ISBN no: 8131713660

E-RESOURCES

https://en.wikipedia.org/wiki/Digital_electronics
https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
https://learnabout-electronics.org/Digital/dig10.php
https://www.allaboutcircuits.com/textbook/digital/
https://www.javatpoint.com/digital-electronics

Non-Major Elective 2 – LASER PHYSICS

Course Code	**:**	**Credits**	**: 05**
L:T:P:S	**: 2:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

This introductory course is intended for students across all disciplines to understand the basic principles of how lasers work and discern their main features. It also presents the different types of lasers available today. The lesson plan is designed such that to begin with the process of stimulated emission, metastable state is explained necessary to understand the fundamental working of the laser, next the different types of laser available and their construction is discussed, followed by an account of the wide range applications in various fields like industry, medicine and communication. So finally, the students will be able to articulate on fundamentals, production and applications of LASER.

Course Outcomes: At the end of the Course, the Student will be able to:

CO 1	Identify that the process of population inversion, optical pumping are necessary for the functioning of LASER
CO 2	Analyze the different types of LASER
CO 3	Comprehend the industrial applications of LASER
CO 4	Assimilate the medicinal applications of LASER and appreciate how it useful to the society
CO 5	Envision how LASER is revolutionising the field of Communication

Mapping of Course Outcomes to Program Outcomes:

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

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

S. No	CONTENTS OF MODULE	Hrs	COs
1	1.1 Fundamentals of LASER 1.2 Spontaneous emission, stimulated emission 1.3 meta stable state, Population inversion, pumping 1.4 Laser Characteristics	**8**	**CO1**
2	2.1 Helium – Neon Laser 2.2 Ruby Laser 2.3 CO_2 Laser 2.4 Semiconductor Laser	**8**	**CO2**
3	3.1 Industrial Applications of LASER 3.2 Laser cutting, welding drilling 3.3 Hologram 3.4 Recording and reconstruction of hologram	**8**	**CO3**
4	4.1 Lasers in Medicine 4.2 Lasers in Surgery 4.3 Lasers in ophthalmology 4.4 Lasers in cancer treatment	**8**	**CO4**
5	5.1 Lasers in Communication 5.2 Optic fiber communication 5.3 Total internal reflection 5.4 Block diagram of fiber optic communication system 5.5 Advantages of fiber optic communication	**8**	**CO5**

TEXT BOOKS:

1. N. Avadhanulu (2013). *An introduction to LASERS*, S. Chand & Company, ISBN no: 9788121920711
2. William T. Silfvast (2008). *Laser Fundamentals*, Cambridge University Press, New Delhi, ISBN no: 978-0521541053
3. K. Thyagarajan and A.K. Ghatak (1984). *Laser Theory and Application*, MacMillan India Ltd, ISBN no: 978-1-4419-6442-7

REFERENCE BOOKS:

1. Pradip Narayan Ghosh (2018). *Laser Physics and Spectroscopy Book*, CRC Press, ISBN no: 9781138588271
2. William T. Silfvas (1996). *Laser Fundamentals Book*, Cambridge U.P., New York, ISBN no: 978-0521541053
3. Colin Webb and Simon Hooker (2010). *Laser Physics Book*, Oxford University Press, ISBN no: 9780198506911

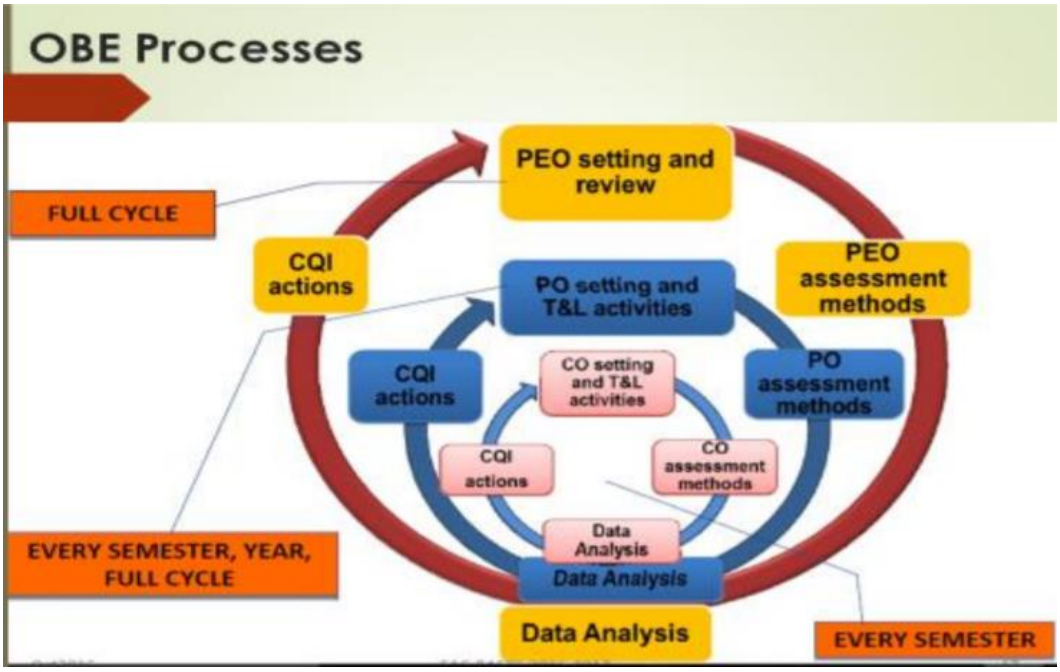
APPENDIX A

Outcome Based Education (OBE)

Outcome-based education means starting with a clear picture of what is important for students to be able to do, then organising the curriculum, instruction and assessment to make sure that this learning ultimately happens

OBE means clearly focusing and organizing an educational system around what is essential for all students to be able to do successfully at the end of their learning experiences.

Students need to achieve by gaining Knowledge, Skill and Ability. For this to happen it is necessary to organize the curriculum, instruction, and assessment and make sure the learning ultimately happens.



APPENDIX B

Graduate Attributes

Graduate Attributes are the qualities, skills and understandings that the students should develop during their time with the Institution. These generic graduate attributes outline the overarching capabilities that will be developed by students. These qualities are intended to equip graduates to be global citizens, and effective members of society.

Intellectual rigour: a commitment to excellence in all scholarly and intellectual activities, including critical judgement.

Knowledge of the discipline: command of a discipline to enable a smooth transition and contribution to professional and community settings.

Communication and social skills: the ability to communicate and collaborate with individuals, and within teams, in professional and community settings.

Lifelong learning: the ability to be responsive to change, to be inquiring and reflective in practice, through information literacy and autonomous, self-managed learning.

Ethical practice: a commitment to sustainability and high ethical standards in social and professional practices.

Creativity: an ability to develop creative and effective responses to intellectual, professional and social challenges.

Cultural competence: an ability to engage with diverse cultural and Indigenous perspectives in both global and local settings.

APPENDIX C

Bloom's Taxonomy

REMEMBERING: recall of information

arrange; cite; collect; define; describe; duplicate; enumerate; find; identify; locate; memorize; record; recognize; match; relate; select; name; label; list; order; quote; recall; repeat; reproduce; select; show; state

UNDERSTANDING: demonstration of comprehension

associate; classify; compare; contrast; convert; describe; estimate; explain; extend; generalize; give examples; identify; interpret; justify; locate; outline; paraphrase; predict; recognize; report; restate; review; select; summarize; trace; translate

APPLYING: applying knowledge in a new context

apply; calculate; chart; choose; classify; complete; compute; construct; contribute; develop; discover; dramatize; employ; experiment; extend; illustrate; implement; instruct; interpret; modify; operate; participate; practice; predict; show; solve; teach; text; use

ANALYZING: supporting assertions through the use of evidence and arguments identifying causes and patterns

advertise; analyze; break down; categorize; classify; collect; compare; connect; contrast; correlate; criticize; diagram; differentiate; distinguish; divide; establish; explain; identify; illustrate; infer; investigate; order; outline; prioritize; question; select; separate; verify

EVALUATING: coming to a judgement on the value of information or the validity of arguments

appraise; argue; assess; choose; conclude; convince; criticize; critique; debate; decide, defend; determine; discriminate; evaluate; grade; integrate; interpret; judge; justify; predict; prioritize; rate; recommend; reframe; score; select; support; value

CREATING: combining or grouping knowledge to come to new conclusions

adapt; anticipate; arrange; assemble; collect; combine; compile; construct; decide; design; develop; facilitate; formulate; generate; generalize; imagine; incorporate; individualize; integrate; invent; modify; negotiate; organize; plan; propose; rearrange; reconstruct; reorganize; revise; select; structure; substitute; validate

[Verbs correlating to Bloom's Taxonomy drawn from http://www.coun.uvic.ca/learn/program/hndouts/bloom.html]

APPENDIX D

ELECTIVE I – BIO-PHYSICS

Course Code	**: 1537413**	**Credits**	**: 05**
L:T:P:S	**: 5:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

This course is designed as a broad introduction into the field of biophysics for graduate students with the background in chemistry, physics, computer science, and biology. The goal of the course is to present the concepts of physical chemistry and map their application on a rapidly expanding interdisciplinary interface, combining biology, chemistry, and physics. The course aims to balance the need for rigorous mathematical treatment with the simplicity of presentation. Students who successfully passed this course will have understood the basic terms and concepts of Biophysics. They will be able to describe biophysical phenomena with simple physical models. They will master the complex experimental setups in modern experimental Biophysics. They should be able to describe biological phenomena with physical models of different complexity. They will learn to work with a tidy and complete recording of measurement data. They will be able to set-up, run and evaluate complex experiments as well as to report the results in a clear manner.

Course Outcomes: At the end of the Course, the Student will be able to:

CO 1	Learn about Interactive Potentials for strong and weak bonds, non-central forces, bond energies and spring constants
CO 2	Explore the techniques and methods available such as X-ray diffraction and molecular structure, nuclear magnetic resonance, Scanning Tunnelling Microscopy, optical tweezers and Atomic Force Microscopy
CO 3	Learn important topics like Biological Polymers, Biological Membranes, Nerve Signals and Vertebrate Heart
CO 4	Master the concepts of Chemical Spectroscopy such as Absorption, Atomic and Molecular energy levels, Raman spectra, Electronic energy spectra of polyatomic molecules, UV absorption by proteins and nucleic acids. Understand Laser and its applications
CO 5	Comprehend the chemical and analytical applications of Radiation and Traces in the Health Industry.

Unit 1: Energies, Forces and Bonds

Interactive Potentials for strong and Weak Bonds, Non central forces, Bond Energies and Spring constants.

Unit 2: Techniques and Methods

X-ray diffraction and Molecular structure, Nuclear Magnetic Resonance, Scanning Tunnelling Microscopy, Atomic Force Microscopy, Optical Tweezers.

Unit 3: Physics of Membranes, Nerves and Heart

(a) Biological Polymers & Biological Membranes – Nucleic Acids – DNA and RNA – Proteins, Proteins folding Biological Membranes – Membrane Chemistry and Structure, Membrane Physics, Excitable Membranes, diffusion and Mobility of ions, Resting Potential.

Nerve Signals – Passive Response, Nerve impulses, Nervous System Memory

(b) Vertebrate heart – Role of the vertebrate circulatory system, blood pressure, the vertebrate heart, the heart sequence, Electrocardiography, Heart as a pump.

Unit 4: Chemical Spectroscopy

Absorption, spectroscopy and Molecular structure, Atomic and Molecular energy levels, vibration of polyatomic molecules, Raman spectra, characteristics bond frequency, Electronic energy level, Electronic energy spectra of polyatomic molecules, UV absorption by proteins and nucleic acids. Photoacoustic spectroscopic technique and its application to Biomolecules. Laser and its applications.

Unit 5: Radiation, Health and Traces

Absorption of radiation by body tissues, Damage because of neutrons, Radio dose units, Relativge Biological Effectiveness (RBE), Radiation detection and measurements. Radioactive Traces, Requirements of a Tracer, Application of Traces. **Chemical applications:** Tracer method and its limitations, Rate of chemical exchange reaction **Analytical applications**: Neutron activation analysis, Analysis with ion beams, PIXE technique.

TEXT BOOKS:

1. Rodney Cottouill (2002). *Biophysics – an Introduction*. John Wiley & Sons Ltd, 2002, ISBN no: 978-0-471-48538-4
2. Gerhart Friedlander, Joseph W. Kennedy, Edward S. Macias& J.M. Miller Jones (1981), *Nuclear and Radiochemistry* (3rd edn), Wiley & Sons, ISBN no: Q-471-86255-X
3. P. Narayanan (2016), *Essentials of Biophysics* (2nd edn), New Age International (P) Ltd., ISBN no: 9788122420807

REFERENCE BOOKS:

1. L. Stanford (1975). *Foundations of Biophysics* (1st edn), Academic Press, ISBN no: 9780126633504
2. Glaser, Roland (2012). *Biophysics-An Introduction* (1st edn), Springer Publications, ISBN 978-3-642-25212-9
3. Hoppe W., Lohmann W., Markl H., Ziegler H. (1983). *Biophysics* (1st edn), Springer Publications, ISBN 978-3-642-68877-5

ELECTIVE I – APPLIED PHYSICS

Course Code	**: 1537413**	**Credits**	**: 05**
L:T:P:S	**: 5:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

The students will be able to apply principles to model and solve representative problems analytically and computationally, at an introductory level from the primary physical theories (classical mechanics, quantum mechanics, special relativity, thermodynamics, electromagnetism and optics), and at an advanced level in classical mechanics, electrostatics and optics/electrodynamics. They will gain knowledge to design and conduct experiments, build scientific equipment, write scientific programs to simulate physical systems, and analyze data. They will develop skills to communicate professionally to a technical audience both orally and in writing. They will also be able to understand scientific ideas by reading books and journal articles. They will understand scientific ethical practices and demonstrate them in the conduct of scientific research. They should also be able to conduct experimental, theoretical or computational research under the direction of a mentor to contribute to the generation of new knowledge or technologies and prepare to do this professionally.

Course Outcomes: At the end of the Course, the Student will be able to:

CO 1	Recognize and present real-life examples of the concept and interrelate some of them
CO 2	Describe the link between Physics and the technology
CO 3	Identify technological applications of the topics covered in syllabus
CO 4	Understand the benefits of the course and potential to find his/her area of specialization

Unit 1: Semiconductors

Elemental and compound semiconductors – Energy bands – Direct and indirect semiconductors – Electrons and holes – Effective mass – Intrinsic materials – Extrinsic materials – Fermi level – Electron and hole concentration at equilibrium – Temperature dependence of carrier concentrations – Compensation and space charge neutrality -Conductivity and mobility – Hall effect in semiconductors

Unit 2: Lasers & Its Applications

Basic principle – Induced absorption – Spontaneous and induced emissions – Ruby and He-Ne lasers – Semiconductor laser – Characteristics of laser light and its applications based on these characteristics – (e.g., in industry, science, medicine, communications, surveying, holography, fusion reactors, isotope separation, etc.)

Unit 3: Fibre Optics

Basic principle – Fibre construction – and dimensions – Light propagation in fibres – Numerical aperture of fibres – Step index and graded index fibres – Signal distortion in optical fibres- Transmission losses – Light wave communication in optical fibres – Advantages of optical fibres over conventional system of communication.

Unit 4: Particles and Waves

Mechanism of x – ray production (continuous and characteristic x – rays, DuaneHunt limit) – Compton effect – Pair production – Phase and group velocities – Uncertainty principle – Quantum Mechanics: Introduction to quantum mechanics – Wave function – Conditions necessary for physically acceptable wave function – Probability density and probability – Schrödinger equation (time dependent and steady state or time independent forms) – Eigen values and Eigen functions – Expectation values – Particle in a box

Unit 5: Statistical Mechanics

Statistical distributions – Maxwell–Boltzmann statistics – Molecular energies in an ideal gas – Quantum statistics – Specific heats of solids – Free electron in a metal – Electron – energy distribution

TEXT BOOKS:

1. Ben G. Streetman (2000). *Solid State Electronic Devices* (5th edn), Prentice-Hall of India Private Limited, New Delhi, ISBN no: 10: 0130255386
2. Arthur Beiser (2003). *Concepts of Modern Physics* (6th edn), Mc. Graw Hills Inc. International Edition, ISBN no: 0-07-115096-X
3. M.R. Wehr, J.A. Richards Jr. and T.W. Adair III (1984). *Physics of the Atom* (4th edn), Addison Wesley/Narosa, ISBN no: 9780201088786

REFERENCE BOOKS:

1. M.R. Srinivasan (1996) *Physics for Engineers* (2nd edn), New Age International (P) Limited Publishers, ISBN no: 9788122426038
2. Dale Ewen, Neill Schurter, and P. Erik Gundersen (1997). *Applied Physics* (11th edn), Pearson Publications, ISBN no: 9780137715695
3. Richard Feynmann (1964). *The Feynmann Lectures on Physics* (2nd edn), Addison–Wesley, ISBN no: 978-8185015828

ELECTIVE II – PHYSICS OF MATERIALS

Course Code	**: 37625**	**Credits**	**: 05**
L:T:P:S	**: 5:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

Students will demonstrate an understanding of core graduate-level theoretical knowledge in materials science. Provides an overview of Materials Science and Engineering as a basis for understanding how structure/property/processing relationships are developed and used for different types of materials. Illustrates the role of materials in modern society by case studies of advances in new materials and processes. Students will demonstrate written and oral communication skills in communicating materials science – and physics-related topics. Students will demonstrate an understanding of the impact of physics and science on society.

Course Outcomes: At the end of the Course, the Student will be able to:

CO 1	Gain knowledge on phase diagrams and various material processing methods
CO 2	Explain the necessary understanding on various advanced materials
CO 3	An idea about various characterizations like XRD, Electron Microscopy, Atomic Force Microscopy
CO 4	Describe why each of the fundamental properties of materials covered in the course (stress, strain, elastic constant, creep, fatigue, wear, hardness, Poisson's ratio, toughness, ductility, flexural strength, impact strength, elongation) are important
CO 5	To research current applications of materials understand limitations of those materials, evaluate future trends in those applications

TEXT BOOKS:

1. Balasubramaniam R. (2014). *Callister's Materials Science and Engineering* (2nd edn), Wiley India Pvt. Ltd, ISBN no: 8126541601
2. Kasap S.O. (2007). *Principles of Electronic Materials and Devices* (3rd edn), McGraw-Hill Education, ISBN no: 9780072393422
3. Wahab M.A. (2009). *Solid State Physics: Structure and Properties of Materials* (3rd edn), Narosa Publishing House, ISBN NO: 978-8184874938.

REFERENCE BOOKS:

1. Donald Askeland (2010). *Materials Science and Engineering* (1st edn), Brooks/Cole ISBN no: 978813151255
2. Raghavan V (2015). *Materials Science and Engineering* (5th edn), PHI Learning, ISBN no: 13: 978-81203509225
3. Smith W.F., Hashemi J. & Prakash R. (2014). *Materials Science and Engineering* (5th edn), Tata Mcgraw Hill Education Pvt. Ltd., ISBN no: 978-0073529240

ELECTIVE II –
INTRODUCTION TO ASTRONOMY AND ASTROPHYSICS

Course Code	**: 37625**	**Credits**	**: 05**
L:T:P:S	**: 5:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

Students will know the positions in the night sky of key objects and have a basic knowledge of celestial motions and phenomena. They will be able to describe the basic structure and content of the Solar System. They will know how the fundamental properties of the Sun and stars are measured. They will be aware of the challenges surrounding the detection of extra-solar planets and of the physical requirements for extra-terrestrial life. They will know the characteristics of our Galaxy and be able to compare and contrast its properties to other galaxies. They will know, and be able to apply, the fundamental principles of optical telescopes and of other types of telescope. They will be familiar with the Big Bang theory of the creation and expansion of the Universe. Students will be able to apply the basic principles of physics and astronomy to the solution of a range of problems. They will know how to produce a well-structured solution, with clearly explained reasoning and appropriate presentation.

Course Outcomes: At the end of the Course, the Student will be able to:

CO 1	Understand Kepler's Laws, Sky coordinates, phases of the Moon, the Moon's orbit and eclipses and Planetary motions.
CO 2	Learn about the formation of Solar System and the various types of planets and atmospheres in the cosmos
CO 3	Understand how galaxies are formed, the various of galaxies, the Big Bang. Learn about the history and fate of the universe
CO 4	Explore the vast array of astronomical techniques and tools available at our disposal. Understand the techniques in use to detect dark matter
CO 5	Learn about the structure and evolution of Stars, White Dwarfs and Chandrasekar Limit, Virial Theorem, stages of nuclear burning, Schonberg-Chandrasekar limit and supernovas

Unit 1: Sky Coordinates and Motions:

Earth Rotation – Sky coordinates – seasons – phases of the Moon – the Moon's orbit and eclipses – timekeeping (sidereal vs synodic period); Planetary motions – Kepler's Laws – Gravity; Light & Energy – Telescopes – Optics – Detectors

Unit 2: Planets

Formation of Solar System – planet types – planet atmospheres – extrasolar planets; Stars: Measuring stellar characteristics (temperature, distance, luminosity, mass, size) – HR diagram – stellar structure (equilibrium, nuclear reactions, energy transport) – stellar evolution;

Unit 3: Galaxies

Our Milky Way – Galactic structure – Galactic rotation – Galaxy types – Galaxy formation; Cosmology: Expansion of the Universe – redshifts – supernovae – the Big Bang – history of the Universe – fate of the Universe

Unit 4: Astronomical Techniques

Telescopes and Detectors – optical, infrared, radio, x-rays, gamma-rays, neutrinos and cosmic rays; Gravitational radiation; Detection of dark matter and Dark Energy Astronomy from Space; Imaging – focal plane imagers, PSF and deconvolution, interferometry Photometry, Spectroscopy, Polarimetry, Astrometry; Solar telescopes; Surveys, Astronomical databases, Virtual Observatory

Unit 5: Structure and Evolution of Stars

Mechanical, Thermal and Nuclear time scales – Hydrostatic equilibrium (Newtonian and Relativistic) – Polytropic Equation of State – Lane Emden Equation – Degenerate matter Equation of State – White Dwarfs and Chandrasekhar limit – Virial Theorem – Radiative Equilibrium – Schwarzschild convection criterion – nuclear energy generation – stages of nuclear burning — Schonberg-Chandrasekhar limit – Hayashi tracks – Horizontal branch – giant and asymptotic giant branches – planetary nebula formation – supernovae.

TEXT BOOKS:

1. Carroll, Bradley W, Ostlie, Dale A (2003). *An Introduction to Modern Astrophysics* (1st edn), Addison-Wesley, ISBN no: 978-0805304022
2. Frank Shu (1981). *The Physical Universe* (2nd edn), University Science Books, ISBN no: 0935702059
3. Martin Harwit (1998) *Astrophysical Concepts* (2nd edn), Springer, ISBN no: 978-0-387-33228-4

REFERENCE BOOKS:

1. T. Padmanabhan (2006). *Invitation to Astrophysics* (2nd edn), World Scientific Publishing Co, ISBN no: 9789812566386
2. Malcolm Longair (2012). *High Energy Astrophysics* (2nd edn), Cambridge University Press, ISBN no:9781139170505
3. Sparke and Gallaghar (2007). *Galaxies in the Universe: An Introduction* (2nd edn), Cambridge University Press, ISBN no: 978-0-521-85593-8

OPEN ELECTIVE I – OPTICS AND PHOTONICS

Course Code	**:**	**Credits**	**: 05**
L:T:P:S	**: 5:0:0:0**	**CIA Marks**	**: 40**
Exam Hours	**: 03**	**ESE Marks**	**: 60**

LEARNING OBJECTIVES:

This course provides students with a working knowledge of optics and photonics, including wave optics, Physical optics and introductory laser Physics. It also provides a basis for further study in photonics. This course explains the optics of periodic media and demonstrate working of lasers and also describe fiber optics and apprise the photonic devices.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand the basic concepts of Fourier optics
CO2	Discuss the periodic media and coatings
CO3	Demonstrate working of laser beams
CO4	Analyze the fiber and integrated optics
CO5	Demonstrate the concepts photonic device and also summarize the basic understanding of Fourier optics and functioning of devices

Mapping of Course Outcomes to Program Outcomes:

CO/PO/PSO		**PO**										**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**	**4**	**5**
CO1	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO2	2	2	3	2	3	3	3	3	2	2	3	3	3	3	3	3
CO3	3	3	3	2	3	3	3	3	3	3	2	3	2	2	3	2
CO4	3	2	3	3	23	2	3	3	3	2	3	3	3	3	3	3
CO5	3	3	3	3	2	2	3	3	3	2	3	3	3	3	2	3

STRONGLY CORRELATED – 3, MODERATELY CORRELATED – 2, WEAKLY CORRELATED – 1

S. No	CONTENTS OF MODULE	Hrs	COs
1	**Fourier Optics** 1.1 Diffraction integral 1.2 Fourier transformation in beam propagation 1.3 Fresnel and Fraunhoffer approximations 1.4 Fourier filtering – Image processing 1.5 Abbe principle of image formation 1.6 principle of phase contrast microscope 1.7 Holography 1.8 principles of recording and reconstruction	**20**	**CO1**
2	**Optics of Periodic Media** 2.1 Multilayer dielectric interference coatings and their applications 2.2 Photonic crystals 2.3 Bragg reflectors	**10**	**CO2**
3	**Lasers** 3.1 Optical amplification and lasers 3.2 Characteristics of laser radiation 3.3 Liquid and solid state Laser 3.4 Optics of Gaussian beams 3.4 Laser applications in medicine and surgery	**20**	**CO3**
4	**Fibre and Integrated Optics** 4.1 Guided modes 4.2 Attenuation and dispersion in optical fibers 4.3 Application in sensors and communication	**20**	**CO4**
5	**Photonic Devices** 5.1 Photonic devices based on acousto-optics 5.3 Electro-optics and magneto-optics-Intensity, phase and frequency modulation 5.5 Frequency shifters 5.6 Optical diode and isolator 5.7 Directional coupler 5.8 Spatial light modulator	**20**	**CO5**

TEXT BOOKS:

1. Buck J.A. (2004). *Fundamentals of Optical Fibres* (2nd edn), John Wiley & Son, ISBN no: 978-0-471-22191-3
2. Joannopoulos, Johnson, Winn, Meade (2007). *Photonic Crystals* (2nd edn), Princeton Univ. Press. ISBN No: 978-0-691-12456-8
3. Hawker & Latimer (1995). *Lasers, Theory and Practice* (1st edn), Prentice Hall. ISBN no: 978-0135214930

REFERENCE BOOKS:

1. Joseph Verdey (1995). *Laser Electronics* (3rd edn), Prentice Hall, ISBN no: 0-13-706666-X
2. Yariv A, Holt (1991). *Optical Electronics* (4th edn), Rinehart & Winston, ISBN no: 9781600490132
3. Graham Smith F, Terry A King, Dan Wilkins (2007). Optics and Photonics (2nd edn), Wiley, ISBN no: 978-0-470-01784-5