B.SC. PHYSICS

Syllabus

AFFILIATED COLLEGES

Program Code: 22C

2020 – 2021 onwards

BHARATHIAR UNIVERSITY

(A State University, Accredited with "A" Grade by NAAC,
Ranked 13th among Indian Universities by MHRD-NIRF,
World Ranking : Times - 801-1000, Shanghai - 901-1000, URAP - 982)

Coimbatore - 641 046, Tamil Nadu, India

Program Educational Objectives (PEOs)	
On obtaining an undergraduate degree the students will be able to,	
PEO1	have strong foundation in basic sciences, mathematics and computational platforms.
PEO2	acquire professional and ethical attitude, develop communicative skills, teamwork spirit, multidisciplinary approach, and an ability to relate and solve scientific/ technical issues.
PEO3	enter into higher studies leading to post-graduate and research degrees.
PEO4	apply and advance the knowledge and skills acquired to become a competent professional in their chosen field.
PEO5	serve the society with scientific advancement and to actively take part in building knowledge-based society.
PEO6	comprehend, analyze, design and create novel products and solutions for the real life problems through good scientific and technical knowledge.
PEO7	become an entrepreneur who can make and sell scientific products in the market.
PEO8	engross in life-long learning to keep themselves abreast of new developments and to face global challenges.

Program Specific Outcomes (PSOs)	
After the successful completion of B.Sc., Physics program, the students are expected to,	
PSO1	realize the role of Physics in day to day life.
PSO2	communicate explicitly and exchange ideas with regard to the impacts of various components of Physics on environment and society.
PSO3	expertise in various domains of Physics.
PSO4	design and develop the skills towards the futuristic needs of the industry/ society utilizing both theoretical and practical knowledge acquired in basic Physics.
PSO5	identify and access the diverse applications of Physics using mathematical concepts enriching towards career opportunities.

Program Outcomes (POs)	
On successful completion of the B. Sc. Physics program, the students will be able to,	
PO1	understand the basic concepts and significance of various physical phenomena.
PO2	transform ideas into action i.e. lab to land.
PO3	acquire a wide range of problem solving skills, both analytical and computational and to apply them.
PO4	develop an independent and self-disciplined specialized learning in tune with the changing socio-technological scenario.
PO5	get motivated to pursue higher education and research activities in Physics to find professional level employment.
PO6	identify, analyse and formulate novel ideas to yield, substantial results in the fields of research utilizing the principles of Physics.
PO7	develop creative thinking and innovative tools.
PO8	communicate effectively in order to acquire employability/ self – employment.
PO9	acquire a broad interdisciplinary knowledge.
PO10	update themselves in the current developments and discoveries related to Physics.

BHARATHIAR UNIVERSITY: : COIMBATORE 641 046

B. Sc. PHYSICS Curriculum (Affiliated Colleges)

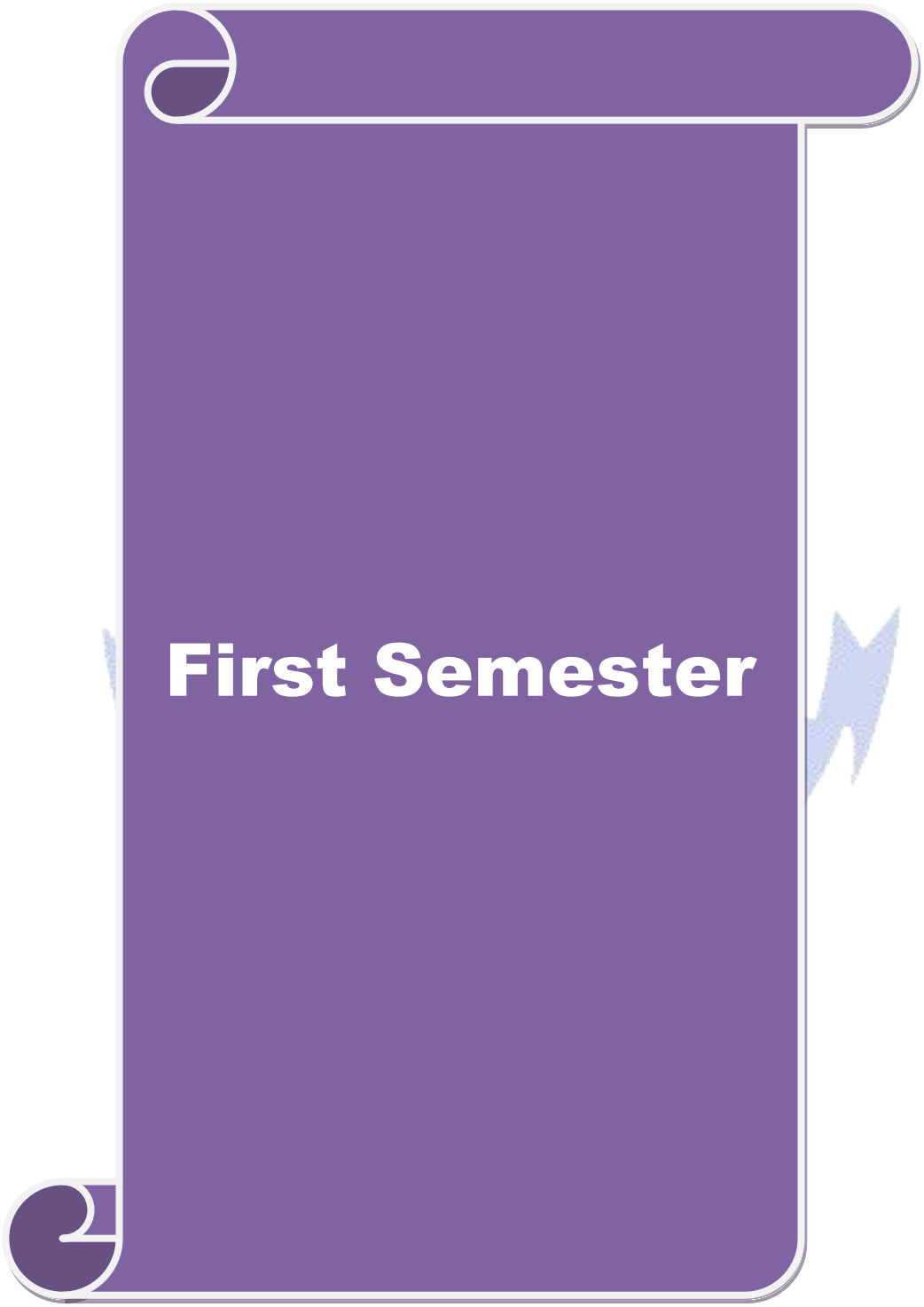
(For the students admitted during the academic year 2020 – 21 onwards)

Part	Course Code	Title of the Course	Credits	Hours/week		Maximum Marks		
				Theory	Practical	CIA	ESE	Total
	FIRST SEMESTER							
I	11T	Language-I	4	6	-	25	75	100
II	12E	English-I	4	6	-	25	75	100
III	13A	Core I – Mechanics, Properties of Matter and Sound	4	6	-	25	75	100
III		Core Practical I	-	-	3	-	-	-
III	1AA	Allied A – Mathematical Paper I *	4	7	-	25	75	100
	(or)							
	1AH	Chemistry Theory I **	3	4	-	20	55	75
III	-	Allied Practical**	-	-	2	-	-	-
IV	1FA	Environmental Studies #	2	2	-	-	50	50
		Total	**18**					**450**
	SECOND SEMESTER							
I	21T	Language-II	4	6	-	25	75	100
II	22E	English-II	4	6	-	25	75	100
III	23A	Core II – Heat and Thermodynamics	4	6	-	25	75	100
III	23P	Core Practical I	4	-	3	40	60	100
III	2AA	Allied A - Mathematical Paper II *	4	7	-	25	75	100
	(or)							
III	2AH	Chemistry Theory II **	3	4	-	20	55	75
III	2PH	Allied Practical**	2	-	2	20	30	50
IV	2FB	Value Education - Human Rights #	2	2	-	-	50	50
		Total	**22**					**550**
	THIRD SEMESTER							
I	31T	Language-III	4	6	-	25	75	100
II	32E	English-III	4	6	-	25	75	100
III	33A	Core III – Optics	4	5	-	25	75	100
III	-	Core Practical II	-	-	2	-	-	-
III	3AA	Allied B - Mathematical Paper I * (or)	4	7	-	25	75	100
III	3AH	Chemistry Theory I **	3	4	-	20	55	75
III	-	Allied Practical**	-	-	2	-	-	-
IV	3ZA	Skill Based Subject – Instrumentation I	3	3	-	20	55	75
IV	3FC	Tamil @ / Advanced Tamil# (OR) Non-major elective - I	2	2	-	-	50	50

		(Yoga for Human Excellence)# / Women's Rights #						
		Total	**20**					**500**
	FOURTH SEMESTER							
I	41T	Language-IV	4	6	-	25	75	100
II	42E	English-IV	4	6	-	25	75	100
III	43A	Core IV – Atomic Physics and Spectroscopy	4	5	-	25	75	100
III	43P	Core Practical II	4	-	2	40	60	100
III	4AA	Allied A - Mathematical Paper II * (or)	4	7	-	25	75	100
III	4AH	Chemistry Theory II **	3	4	-	20	55	75
III	4PH	Allied Practical**	2	-	2	20	30	50
IV	4ZB	Skill based Subject - Instrumentation II	3	3	-	20	55	75
IV	4FE	Tamil @ /Advanced Tamil # (OR) Non-major elective -II (General Awareness #)	2	2	-	-	50	50
		Total	**26**					**650**
	FIFTH SEMESTER							
III	53A	Core V – Mathematical Physics	4	4	-	25	75	100
III	53B	Core VI – Electronics	4	4	-	25	75	100
III	53C	Core VII – Solid State Physics	4	4	-	25	75	100
III	53D	Core VIII – Electricity and Magnetism	4	4	-	25	75	100
III	-	Core Practical III - Electronics	-	-	2	-	-	-
III	-	Core Practical IV - Digital and Micro Processor	-	-	2	-	-	-
III	5EA	Elective –I	4	4	-	25	75	100
III	-	Practical V- C and C++	-	-	3	-	-	-
IV	5ZC	Skill based Subject - Instrumentation III	3	3	-	20	55	75
		Total	**23**					**575**
	SIXTH SEMESTER							
III	63A	Core IX – Quantum Mechanics and Relativity	4	6	-	25	75	100
III	63B	Core X - Nuclear Physics	4	6	-	25	75	100
III	63P	Core Practical III - Electronics	3	-	2	30	45	75
III	63Q	Core Practical IV - Digital and Micro	3	-	2	30	45	75

		Processor						
III	6EA	Elective –II	4	4	-	25	75	100
III	6EB	Elective –III	4	4	-	25	75	100
III	63R	Practical V - C and C++	4	-	3	40	60	100
IV	6ZP	Skill based Subject Practical – Instrumentation	3	-	3	30	45	75
V	67A	Extension Activities @	2	-	-	-	-	50
		Total	**31**					**775**
		Grand Total	**140**					**3500**

*For subjects without practical
** For subjects with practical
@ No University Examinations. Only Continuous Internal Assessment (CIA)
# No Continuous Internal Assessment (CIA). Only University Examinations.


First Semester

SEMESTER I

Course code	13A	MECHANICS, PROPERTIES OF MATTER AND SOUND	L	T	P	C
Core/Elective/SBS		CORE PAPER I	6	0	0	4
Pre-requisite		The students are expected to know the fundamental properties of matter and sound	Syllabus Version		2020-21	

Course Objectives:

The main objectives of this course are to:

1. explore the basic laws governing the behavior of matter in everyday life.
2. demonstrate practical knowledge and skill in understanding the elastic properties of solids.
3. identify the behavior of simple harmonic waves
4. access the importance of Ultrasonics

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	understand and define the laws involved in mechanics.	K1
2	gain deeper understanding of mechanics and its fundamental concepts.	K2
3	understand the concept of properties of matter and to recognize their applications in various real problems.	K3
4	analyze the universal behavior of wave motion.	K4
5	learning the basic concepts of elasticity, surface tension, Gravitation, viscosity, and sound and evaluating their values for various materials.	K5
6	explore the production and application of ultrasonic wave	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Conservation Laws	18 hours

Impulse – Impact – Direct and oblique impact – Final velocity and loss of kinetic energy –Motion of a particle in a vertical circle – friction – Laws of friction – angle of friction – resultant reaction – cone of friction – Equilibrium of a body on a rough inclined plane to the horizontal and when the inclination is greater than the angle of friction.

Unit:2	Motion of Rigid Body	18 hours

Moment of inertia – Parallel and perpendicular axes theorem – M.I. of rectangular Lamina and Triangular lamina – M. I of a solid sphere about an axis through its C.G. – Compound pendulum – torque and angular momentum – Relation – Kinetic rotation – conservation of angular momentum.

Unit:3	Gravitation	18 hours

Kepler's Laws of planetary motion – Laws of gravitation – Boy's method for G –Gravitational potential – Gravitational field at a point due to spherical shell – Variation of 'g' with latitude, altitude and depth. **Elasticity:** Elastic modules – Poisson's ratio – relation between them – Expression for bending moment – determination of Young's modulus by uniform and non-uniform bending – I section girders – Rigidity modulus – Static Torsion – Expression for couple per unit twist – Torsional oscillation.

Unit:4	Surface Tension	16 hours

Definition and dimension of surface Tension – Excess of Pressure over a curved surface – Variation of S.T. with temperature – Jaeger's Experiment. **Viscosity:** Definition – Rotation viscometer-viscosity of gases, Meyer's Modification of Poiseuille's formula – Rankine's method for viscosity of a gas.		
Unit:5	**Sound**	**18 hours**
Simple Harmonic vibration – Progressive waves – properties – Composition of two S.H.M. and beats – stationary waves – Properties Melde's Experiment for the frequency of electrically maintained tuning fork – Transverse and longitudinal modes – Ultrasonics –Properties and application.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**90**

Text Book(s)	
1	Properties of Matter and Acoustics, R. Murugesan, 2nd Edition, S.Chand & Co. Ltd. (2017).
2	Properties of Matter, Brijlal and N.Subrahmanyam, 3rd Edition, S.Chand & Co. (2005).
Reference Books	
1	Elements of Properties of Matter, D.S. Mathur, 11th Edition, S.Chand & Co., (2010).
2	A text book of Sound, Brijlal N.Subramaniam, Vikas Publishing House Pvt. Ltd, 2nd edition, (2010).
3	A Textbook of Sound, M.N.Srinivasan, Himalaya Publishing house, (1991).
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	**https://www.physicstutoronline.co.uk/alevelphysicsnotes/**
2	**https://latestcontents.com/bsc-physics-mechanics-notes/**
3	**www.khanacademy.org/science/physics/elasticity/surface tension**
4	**https://sites.google.com/brown.edu/lecture-demonstrations/home?authuser=0**
Course Designed By: **Mrs.J.Jayachitra.**	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	S	S	L	S	S
CO2	S	S	M	M	S	S	S	L	S	S
CO3	S	S	M	L	S	M	L	M	S	M
CO4	S	S	M	M	S	S	S	L	S	M
CO5	S	S	S	S	S	S	S	M	M	S
CO6	M	M	M	L	S	S	M	L	S	S

*S-Strong; M-Medium; L-Low

Second Semester

SEMESTER II

Course code	23A	HEAT AND THERMODYNAMICS	L	T	P	C
Core/Elective/SBS		CORE PAPER II	6	0	0	4
Pre-requisite		The students are expected to know the fundamental concepts of heat and thermodynamics	Syllabus Version		2020-21	

Course Objectives:

The main objectives of this course are to:

1. investigate the role of various laws of heat and thermodynamics in our daily life
2. substantiate the concepts of heat and thermodynamics experimentally
3. explore the applications of heat engines

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	realise various principles and laws of heat	K2
2	derive expressions and find experimental verifications for the laws studied	K3
3	analyse the applications of heat and thermodynamics in various areas and solve the real life problems.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Calorimetry	17 hours

Definitions – Newton's law of cooling – specific heat of a liquid calendar and Barne's continuous flow method – two specific heats of a gas – specific heat of a gas by Joly's differential steam calorimeter – Regnault's method – Dulong and Petit's law – variation of specific heat and atomic heat with temperature.

Unit:2	Transmission of Heat	17 hours

Conduction: Co-efficient of thermal conductivity – Cylindrical flow of heat – Thermal conductivity of rubber – Lee's disc method for bad conductors. **Radiation:** Black body – Wein's displacement law – Raleigh-Jean's law – Stefan's law – Experimental Determination of Stefan's constant – Mathematical derivation of Stefan's law.

Unit:3	Kinetic Theory of Gases	18 hours

Maxwell's law of distribution of molecular velocities – Experimental verification – equilibrium speed distribution of velocities. Mean free path – transport phenomena – diffusion – viscosity and thermal conduction of gases – Vander walls equation – relation between Vander Wall's constant and critical constants.

Unit:4	Laws of Thermodynamics	18 hours

First law of thermodynamics – Isothermal and Adiabatic process – gas equation during an adiabatic process – Work done in adiabatic expansion of gas – Determination of γ by Clement and Desorme's method – second law of thermodynamics – Carnot's engine- Working – efficiency – Carnot's refrigerator – Carnot's Theorem.

Unit:5	Concept of Entropy	18 hours

Entropy – Change in entropy – Change in entropy in a reversible cycle – Principle of increase of entropy – temperature entropy diagram – Entropy of a perfect gas – Thermo dynamic variables –

Maxwell's thermodynamical relations – Applications: Joule Thomson effect – Temperature of inversion - Claussius and Clapeyron's equation.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**90**

Text Book(s)	
1	Thermal Physics, R. Murugesan, S.Chand&Co (2008).
2	Heat & Thermodynamics, Brijlal & N. Subramaniam, S.Chand&Co (2007)
3	Heat – M. Narayanamurthi and N. Nagaratnam, National Publishers.
Reference Books	
1	Heat and Thermodynamics – Zemansky and R.H. Dcltanann, TMH (2017)
2	Heat and Thermodynamics – D.S. Mathur, S. Chand & Co, Edi (2002).
3	Heat and Thermodynamics – Agarwal, Singhal, Sathyaprakash, KedarNath Ramnath and Co. (2003).
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.askiitians.com/revision-notes/physics/heat-transfer/
2	https://www.askiitians.com/revision-notes/physics/kinetic-theory-of-gases/
3	https://www.askiitians.com/revision-notes/physics/heat-phenomena/
4	https://www.askiitians.com/revision-notes/physics/thermodynamics/
Course Designed By: **Dr P. Sagunthala**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	S	M	S	S	M	M	M
CO2	S	S	S	S	M	M	M	S	M	S
CO3	M	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

SEMESTER I & II

Course code	**23P**	**CORE PRACTICAL I** (Examination at the end of Second Semester)	**L**	**T**	**P**	**C**
Core/Elective/SBS		**CORE PRACTICAL**	**0**	**0**	**3**	**4**
Pre-requisite		Should have the fundamental knowledge of experimental Physics	**Syllabus Version**		**2020 - 21**	

Course Objectives:

The main objectives of this course are to:

1. develop the experimental skills in Mechanics and Properties of matter
2. gain knowledge about the experiments based on Electricity and Magnetism
3. motivate the students to apply the experimental techniques in Optics and Sound.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	analyze the concepts of Viscosity, Surface Tension and Young's Modulus of different substances	K4
2	explore the knowledge of Spectrometer and other Optical instruments	K5
3	realize principles and applications of Potentiometer, Sonometer, Magnetometer and PN junction diode.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

LIST OF EXPERIMENTS (Any twelve experiments)	**84 Hours**

1. Acceleration due to gravity - Compound Pendulum
2. Surface tension of a liquid – Drop Weight Method
3. Viscosity by Capillary flow method
4. Comparison of Viscosities – Capillary Flow Method
5. Rigidity modulus – Static Torsion – Scale and Telescope
6. Young's Modulus – Non- Uniform bending – Pin and Microscope
7. Young's Modulus – Uniform bending – Optic lever
8. Young's Modulus – Cantilever – Dynamic method
9. Frequency of A.C. - Sonometer
10. Frequency of Vibrator - Melde's Strings
11. Refractive index of Solid Prism - Spectrometer
12. Determination of wave length λ - Grating – Minimum deviation - Spectrometer
13. Refractive index of Prism - (i-d) Curve - Spectrometer
14. Refractive index of liquid - Hollow prism – Spectrometer
15. Thickness of Wire - Air Wedge
16. Low range voltmeter Calibration - Potentiometer
17. Low range Ammeter Calibration - Potentiometer
18. Velocity of Sound - Resonance Column apparatus
19. Moment of magnet – Tan C Position
20. Characteristics of a Junction Diode

Contemporary Issues	**6 Hours**

Online workshop, Webinars on Experimental Physics

Total Practical hours: 90

Reference Books	
1	A text book of practical Physics, M.N.Srinivasan, S.Balasubramanian, R.Ranganathan, Sultan Chand&Sons(2017)
2	Practical Physics and Electronics, C.C.Ouseph, U.J.Rao, V.Vijayendran, S.Viswanathan Publishers(2007)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/course.html/physics/experimental physics I, II and III
2	https://nptel.ac.in/courses/115/105/115105110/
3	https://www.youtube.com/playlist?list=PLuiPz6iU5SQ8-rZn_LgLofRX7n8z4tHYK
Course Designed By: **Dr U. Karunanithi**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	M	M	S	M	L	M	S
CO2	S	S	S	M	M	M	L	M	S	S
CO3	M	M	S	S	L	M	S	S	S	M

*S-Strong; M-Medium; L-Low

Third Semester

SEMESTER III

Course code	33A	OPTICS	L	T	P	C
Core/Elective/SBS		CORE PAPER III	4	0	0	4
Pre-requisite		The students should acquire knowledge basic properties of light. They should be familiar with the behaviour of light in different medium.	Syllabus Version		2020-21	

Course Objectives:

The main objectives of this course are to:

1. gain knowledge towards geometrical and physical optics
2. provide a good platform in the field of Optics
3. provide a basic knowledge on the behavior of light energy and their propagation
4. inspire the concepts of LASER and their applications.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	remember the behavior of light on passing through lens, prism, thin film and grating	K1
2	understand the phenomena of light like Interference, diffraction, polarization and population inversion	K2
3	analyze and apply the concepts of dispersive power, refractive index, resolving power, double refraction, specific rotation and optical pumping for different materials	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Geometrical Optics	10 hours

Aberrations - Spherical aberrations in lens - coma - Astigmatism - chromatic aberration - dispersion by a prism - Cauchy's dispersion formula - dispersive power, achromatism in prism - deviation without dispersion - chromatic aberrations in a lens - circle of least confusion - achromatic lens - condition for achromatism of two thin lenses separated by a finite distances.

Unit:2	Physical Optics - Interference	12 hours

Fresnel's Biprism – Interference in thin films due to reflected light – Fringes due to wedge shaped thin film – Newton's rings – Refractive index of the Liquid – Michelson interferometer – Determination of a wave length of monochromatic light – difference in Wave length between two neighboring spectral lines – Fabry Perot Interferometer.

Unit:3	Diffraction	12 hours

Fresnel's assumptions – rectilinear propagation of light – half period zone – Zone Plates – Action and Construction – comparison with a convex lens – Fresnel and Fraunhofer diffraction – Fraunhofer diffraction at a Single light – Diffraction grating – Resolving power & Dispersive power of Grating.

Unit:4	Polarization	12 hours

Double Refraction – Huygen's explanation --Optic axis in the plane of incidence, inclined and perpendicular to the crystal surface – Production and Detection of Plane, Circularly and Elliptically Polarized light – Optical Activity – Fresnel's explanation – Specific rotation – Half Shade Polarimeter.

Unit:5	**Quantum Optics**	**12 hours**
Light quanta and their origin – Resonance radiation – Metastable states – Population Inverse – Optical pumping – Spontaneous and Stimulated emission – Einstein's coefficient – Ruby, He- Ne, CO_2 laser – Resonant cavities – elements of non-linear optics – second harmonic generation– threshold condition for laser – Stimulated Raman scattering.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60**

Text Book(s)	
1	A Text book of Optics, Brijlal & Subramaniam, S. Chand Limited (2001)
2	Modern Physics, R Murugesan, S. Chand Publishing, 18th Edition (2017)
Reference Books	
1	Optics and Spectroscopy, R Murugesan, S. Chand Publishing, 5th Edition (2013)
2	Optoelectronics, Ajoy Kumar Ghatak,K. Thyagarajan, Cambridge University Press (1989).
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.youtube.com/watch?v=ML7HcZo6IaE
2	https://www.khanacademy.org/science/physics/light-waves/introduction-to-light-waves/v/polarization-of-light-linear-and-circular
3	https://nptel.ac.in/courses/104/104/104104085/

Course Designed By: **Dr. K. Selvaraju**

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	S	M	M	M	S
CO2	S	M	S	M	S	M	M	M	S	S
CO3	M	M	M	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

SEMESTER III

Course code	3ZA	INSTRUMENTATION - I	L	T	P	C
Core/Elective/SBS		SKILL BASED SUBJECT	3	0	0	3
Pre-requisite:		Students should know the importance of measurement and accuracy	Syllabus Version		2020-21	

Course Objectives:

The main objectives of this course are to:

1. understand the basic principles of measurement devices, their performance under various external conditions and sources of error in measurement.
2. enable students to select appropriate standards of measurement and methods of calibration.
3. select an appropriate transducer for basic temperature, pressure and flow measurement.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	use the concepts of measurement.	K1
2	understand a typical instrument design.	K2
3	apply statistical error analysis for measurement	K3
4	choose a transducer/sensor for typical measurement of temperature, pressure and flow.	K4
5	evaluate the performance and reliability of measurement devices available in market.	K5
6	design a basic measurement device.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Basic Concept of Measurement	7 hours

Introduction – System configuration – Problem Analysis – Basic Characteristics of measuring devices – Calibration. **Transducers:** Capacitive transducers – Piezoelectric transducers – Photoelectric effect – Photoconductive transducers – Ionization transducers – Hall Effect transducers – Digital displacement transducers.

Unit:2	Performance Characteristics of an Instrumentation system	9 hours

Introduction – Generalized measurement – Zero order system – first and second order system – Dead time element – Specification and testing of dynamic response.

Unit:3	Pressure Measurement	9 hours

Mechanical Pressure measurement devices – Bourdon tube Pressure gauge – The Bridgeman Gauge – Dead weight tester – Low Pressure measurement – The McLeod gauge – Pirani thermal Conducting gauge – The Knudsen gauge.

Unit:4	Flow Measurement	9 hours

Positive displacement methods – Flow Obstruction methods – Flow measurement by drag effects – Hot wire and Hot film anemometers – Magnetic flow meters

Unit:5	Measurement of Temperature	9 hours

Temperature scales – The ideal gas thermometer – temperature measurements by mechanical effects - temperature measurements –Thermistors-Thermoelectric effects.

Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**45**

Text Book(s)

1	Instrumentation Devices and Systems, C.S. Rangan, G. R. Sarma and V. S. Mani, 2nd Edition, Tata McGRaw Hill, New Delhi (1983)
2	Experimental Methods for Engineers, J. P. Holman, 7th Edition, McGRaw Hill, New Delhi, (2007)

Reference Books

1	H. S. Kalsi, Electronic Instrumentation, 3rd edition, Tata McGraw Hill, New Delhi (2012)
2	Measurement System Applications and Design, E.O. Doebalin, 5th edition, McGraw Hill International, (2007)
3	Transducers and Instrumentation, D. V. S. Murthy, 2nd edition, Prentice Hall of India (2010)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Static and dynamic measurement https://youtu.be/DFdTRPUwK_I
2	Pressure measurement https://youtu.be/sHmjE21Fp9w
3	Temperature measurement Lecture Series on Industrial Automation and Control by Prof. S. Mukhopadhyay, Department of Electrical Engineering, IIT Kharagpur. https://youtu.be/As5kzxkyT24
4	NPTEL https://www.youtube.com/watch?v=3eYmFjHnQjY&list=PLbRMhDVUMngcoKrA4sH-zvbNVSE6IpEio
5	Open courseware- University of Malaysia, Pahang http://ocw.ump.edu.my/course/view.php?id=272

Course Designed By: **Mrs J.Jayachitra, Dr.L.Priya**

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	S	M	M	L	S	S
CO2	S	S	S	M	M	M	M	L	S	S
CO3	S	S	S	M	S	M	M	M	S	S
CO4	S	S	S	S	S	S	M	M	S	S
CO5	S	M	S	M	M	S	S	M	M	M
CO6	M	S	S	M	M	S	S	S	M	M

*S-Strong; M-Medium; L-Low

Fourth Semester

SEMESTER IV

Course code	43A	ATOMIC PHYSICS AND SPECTROSCOPY	L	T	P	C
Core/Elective/SBS		CORE PAPER IV	4	0	0	4
Pre-requisite		The students should have the awareness on structure of atoms, photoelectric effect and on X rays	Syllabus Version		2020-21	

Course Objectives:

The main objectives of this course are to:

1. provide a detailed study of atom
2. learn the impact of magnetic fields on spectra
3. study the concept of photo electric cells

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	analyse various types of spectrographs to study about the positive rays	K4
2	explain magneto optical properties of materials	K5
3	find applications of photo electrical cells and X Rays	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Positive Rays	11 hours

Positive rays – Discovery – Properties – Positive ray analysis – Thomson's Parabola method – action of Electric and Magnetic fields – Determination of e/m – determination of mass – discovery of stable isotopes– Limitations – Dempster's mass spectrograph –Aston's mass spectrograph- mass defect and packing fraction – polarization of X –rays – scattering of X- rays (Thomson's formula).

Unit:2	Structure of the Atom	12 hours

The Bohr atom model – Critical Potentials – Method of excitation of atoms – Experimental determination of critical potentials by Davison and Goucher's method - Sommerfield's relativistic model– Vector atom model – Quantum numbers associated with Vector atom model – coupling schemes (LS, JJ coupling) – Pauli's exclusion principle – Periodic classification of elements.

Unit:3	Magneto Optical Properties of Spectrum	12 hours

Magnetic dipole moment due to orbital motion of the electron – Magnetic dipole moment due to spin – The Stern and Gerlach experiment – Optical spectra – Fine Structure of the sodium D line – Zeeman effect – Experiments – Lorentz classical theory – Expression for the Zeeman shift – Larmor's theorem – Quantum mechanical explanation of the normal Zeeman effect – Anomalous Zeeman effect – Paschen – Back effect – Stark effect.

Unit:4	Photoelectric Effect	11 hours

Introduction – Richardson and Compton experiment – Relation between Photoelectric current and retarding potentials – Relation between velocity of Photo electrons and the frequency of light – Laws of Photoelectric emission – Failure of electromagnetic theory – Einstein's Photo electric equation – Experimental verification – Millikan's Experiments – Photo electric cells – Photo emissive cell – Photo Voltaic cell – Photo conductive cell – Applications of Photo electric cells.

Unit:5	X-Ray Spectra	12 hours

X-ray – Coolidge tube – Properties – X-ray Spectra – Continuous and characteristics X-ray

spectrum – Mosley's law (Statement, Explanation and Importance) – Compton effect – Expression for change of wave length - X-ray diffraction-Bragg's law- Bragg's spectrometer- Powder crystal method – **Quantum theory**: The distribution of energy in the spectrum of a black body – its results - Planck's hypothesis – derivation of Planck's law of radiation.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60**

Text Book(s)

1	Modern Physics, Murugesan R. and Kiruthiga Sivaprasath. S. Chand and Company, 18th edition (2016).

Reference Books

1	Modern Physics, Sehgal D.L. Chopra K.L. and Sehgal N.K. Sultan Chand & Sons, 9th edition, (2004)
2	Atomic Physics, Rajam J B, S. Chand and Company Ltd, New Delhi, 20th edition (2009).

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.askiitians.com/revision-notes/physics/atomic-physics/
2	https://nptel.ac.in/courses/115/101/115101003/
3	https://www2.physics.ox.ac.uk/sites/default/files/2011-10-19/atomic_physics_lectures_1_8_09_pdf_pdf_18283.pdf

Course Designed By: **Dr N. Sasi**

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	S	M	M	M	M	S
CO2	S	M	S	S	M	M	S	M	M	M
CO3	M	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

SEMESTER III & IV

Course code	**43P**	**CORE PRACTICAL II** (Examination at the end of Fourth Semester)	**L**	**T**	**P**	**C**
Core/Elective/SBS		**CORE PRACTICAL**	**0**	**0**	**2**	**4**
Pre-requisite		Should have the fundamental knowledge of Physics	**Syllabus Version**		**2020 - 21**	

Course Objectives:

The main objectives of this course are to:

4. develop the experimental skills in Mechanics and Properties of matter
5. gain knowledge about the experiments based on Electricity and Magnetism
6. motivate the students to apply the experimental techniques in Optics.

Expected Course Outcomes**:**

On the successful completion of the course, student will be able to:

1	apply the concepts of Specific heat capacity and Young's Modulus of different substances	K3
2	acquire the knowledge of Physical optics using Spectrometer	K4
3	evaluate principles and applications of Potentiometer, Magnetometer and BG.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

LIST OF EXPERIMENTS (Any twelve experiments)	**56 hours**

1. Rigidity Modulus – Torsional Pendulum – With & Without symmetrical masses
2. Specific heat capacity – Newton's Law of cooling – Spherical Calorimeter
3. Determination of wave length λ - Grating – Normal Incidence - Spectrometer
4. Refractive index of Prism - (i – i') curve - Spectrometer
5. Determination of Cauchy's constants - Spectrometer
6. Dispersive Power of Prism - Spectrometer
7. Refractive index of a lens - Newton's rings
8. Comparison of magnetic moments – Deflection magnetometer – Tan A position
9. Magnetic field intensity - Field along the axis of a circular coil
10. Young's Modulus – Cantilever – Depression – Pin and Microscope
11. Young's Modulus – Koenig's Method – Non-Uniform bending
12. Young's Modulus – Koenig's Method – Uniform bending
13. Specific resistance of a wire - Potentiometer
14. EMF of a thermocouple - Potentiometer
15. Calibration High range voltmeter - Potentiometer
16. Temperature Coefficient of Resistance - Thermistor - Carey Foster's Bridge
17. Characteristics of Zener diode
18. Figure of Merit – Charge sensitivity - Ballistic Galvanometer
19. Comparison of Mutual Inductance - BG
20. Determination of High Resistance by leakage- BG

Contemporary Issues	**4 hours**

Online workshop, Webinars on Experimental Physics

Total Practical Hours:	**60**

Reference Books	
1	A text book of practical Physics, M.N.Srinivasan, S.Balasubramanian, R.Ranganathan, Sultan Chand&Sons(2017)
2	Practical Physics and Electronics, C.C.Ouseph, U.J.Rao, V.Vijayendran, S.Viswanathan Publishers(2007)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/course.html/physics/experimental physics I, II and III
2	https://nptel.ac.in/courses/115/105/115105110/
3	https://www.youtube.com/playlist?list=PLuiPz6iU5SQ8-rZn_LgLofRX7n8z4tHYK
Course Designed By: **Dr. U. Karunanithi**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	S	M	S	M	M	M	S
CO2	S	M	S	M	S	S	M	L	M	S
CO3	M	S	S	S	L	M	S	S	S	M

*S-Strong; M-Medium; L-Low

SEMESTER IV

Course code	4ZB	INSTRUMENTATION II	L	T	P	C
Core/Elective/SBS		SKILL BASED SUBJECT	3	0	0	3
Pre-requisite		Students should know the importance of measurements in large scale	Syllabus Version		2020-21	

Course Objectives:

The main objectives of this course are to:

1. make the students to understand the principles of measurements in industry conditions
2. make students to understand the process of vibration sensing
3. select an appropriate air pollution and sampling techniques

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	use thermal and nuclear radiation detectors	K1
2	understand the high temperature process in transient and industrial conditions	K2
3	use adequate equipment to determine the state of pollution in the environment	K3
4	design and use simple instrumentation for measurement of mechanical properties	K4
5	understand the living conditions in industrial areas	K5
6	apply modelling concepts for the prediction and determination of random vibrations	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Temperature Measurement by Radiation	9 hours

Effects of heat transfer and temperature measurements – Transient response of thermal systems – Thermocouple compensation – Temperature measurement flow in high speed flow. **Thermal and transport property Measurement:** Thermal conductivity measurements – Thermal conductivity of liquids and gases – measurement of Viscosity–Gas diffusion – Calorimetry.

Unit:2	Force, Torque and Strain Measurements	9 hours

Introduction – Mass balance measurements – Elastic elements for force measurements – Torque Measurement – Stress and Strain measurements – Electrical resistance – strain gauges.

Unit:3	Vibration	9 hours

Random Vibration – Shock – Analysing vibration sensing devices – Generalized second order system – Absolute displacement – Absolute velocity and acceleration vibrating sensing devices – Velocity transducer –bonded strain gauge accelerometers–Piezoelectric accelerometers- Digital accelerometer.

Unit:4	Thermal and Nuclear Radiation Measurements	9 hours

Introduction – Detection of thermal radiation – Measurement of emissivity – Reflectivity and Transmittivity measurements – Solar radiation measurements – Detection of Nuclear radiation – The Geiger Muller counter– Scintillation counter.

Unit:5	Air Pollution Sampling and Measurements	7 hours

Introduction – Units of pollution measurements – Air pollution standards – General air sampling –

Train gas sampling techniques – Particulate sampling techniques – Sulphur dioxide measurements.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**45**

Text Book(s)	
1	Instrumentation Devices and Systems, C.S. Rangan, G. R. Sarma and V. S. Mani, 2nd Edition, Tata McGRaw Hill, New Delhi (1983)
2	Experimental Methods for Engineers, J. P. Holman, 7th Edition, McGRaw Hill, New Delhi (2007)
Reference Books	
1	Measurement System Applications and Design, E.O. Doebalin, 5th edition, McGraw Hill International (2007)
2	Transducers and Instrumentation, D. V. S. Murthy, 2nd edition, Prentice Hall of India (2010)
3	Mechanical and Industrial Measurement, R. K. Jain, Khanna Applications (2013)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	Thermal radiation detector https://www.youtube.com/watch?v=QiOfz1-_7uw
2	Nuclear Security and Safeguards Education Portal- youtube channel- https://youtu.be/Me7XA2vv4F4
3	Nuclear Detector https://chem.libretexts.org/Bookshelves/General_Chemistry/Book%3A_ChemPRIME_(Moore_et_al.)/19%3A_Nuclear_Chemistry/19.10%3A_Instruments_for_Radiation_Detection#:~:text=Perhaps%20the%20most%20common%20instrument,to%20discover%20the%20atomic%20nucleus).
4	Air pollution http://web.iyte.edu.tr/~serifeyalcin/lectures/chem201/cn_8.pdf
Course Designed By: **Mrs. J.Jayachitra, Dr.L.Priya**	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	L	L	M	M	M	M	L	M	S
CO2	S	S	L	M	S	S	L	L	L	M
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	M	M	M	S	S	M	L	S
CO5	S	S	S	L	M	S	M	M	S	S
CO6	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Fifth Semester

SEMESTER V

Course code	53A	MATHEMATICAL PHYSICS	L	T	P	C
Core/Elective/SBS		CORE PAPER V	4	0	0	4
Pre-requisite		Should have the basic knowledge of Mathematics and Mechanics	Syllabus Version		2020 - 21	

Course Objectives:

The main objectives of this course are to:

1. enable the students to acquire the problem solving ability
2. apply the equations for the situation of different physical problems.
3. motivate the students to apply the mathematical principles of in their day–to–day life.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	derive Lagrange's and Hamilton's equations	K2
2	apply Lagrange's and Hamilton's equations to physical problems	K3
3	analyze gamma and beta functions and their applications	K3
4	solve problems on Matrices and apply them to relevant problems	K4
5	apply Stoke's and Gauss theorems to suitable physical problems	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Classical Mechanics - I	12 -- hours

Constraints and Degrees of Freedom – Generalized coordinates – Generalized displacement – Velocity – Acceleration – Momentum – Force – Potential Energy – D'Alembert's Principle – Lagrangian equation from D'Alembert's principle – Application of Lagrange's equation of motion to Linear Harmonic Oscillator, Simple Pendulum and Compound Pendulum.

Unit:2	Classical Mechanics – II	12 hours

Phase Space – Hamiltonian function – Hamiltonian Principle – Hamilton's canonical equations of motion- Physical significance of H – Applications of Hamiltonian equations of motion to Simple Pendulum, Compound Pendulum and Linear Harmonic Oscillator.

Unit:3	Special Functions	12 hours

Definition – The Beta function – Gamma function – Evaluation of Beta function – Other forms of Beta function – Evaluation of Gamma function – Other forms of Gamma function – Relation between Beta and Gamma functions – Problems.

Unit:4	Matrices	10 hours

Introduction – special types of Matrices – Transpose of a Matrix – The Conjugate of a Matrix – Conjugate Transpose of a Matrix – Symmetric and Anti symmetric – Hermitian and skew Hermitian – Orthogonal and Unitary Matrices – Properties – Characteristic equation – Roots and characteristic vector – Diagonalization of matrices – Cayley–Hamilton theorem –Problems

Unit:5	Vector Calculus	12 hours

∇ Operator – Divergence – Second derivative of Vector functions or fields – The Laplacian Operator – Curl of a Vector – Line Integral – Line Integral of a Vector field around an infinitesimal rectangle – Curl of Conservative field – Surface Integral – Volume Integral (without problem) – Gauss's Divergence theorem and it's proof - Simple problems – Stoke's theorem and its proof - Simple problems.

Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture Hours	**60**

Text Book(s)

1	Mathematical Physics, B.D. Gupta-Vikas Publishing House, 4 th Edition (2006)
2	Classical Mechanics, S.L.Gupta, V. Kumar&H.V.Sharma, PragatiPrakashan (2017)

Reference Books

1	Mathematical Physics, Sathya Prakash, Sultan Chand, 6th edition (2014)
2	Mathematical Physics Rajput, Pragathi Prakasan Pub., (2017)
3	Mathematical Physics, H.K. Dass, S. Chand & Co., Eighth edition (2018)
4	Classical Mechanics, J.C.Upadhyaya, Himalaya Publishing House(2012)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/course.html/Physics/Introduction to classical mechanics
2	https://nptel.ac.in/course.html/Physics/Integrals and vector calculus
3	https://nptel.ac.in/course.html/Physics/Matrix analysis and with applications

Course Designed By: **Dr. U. Karunanithi**

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	L	M	S	M	M	S	M	M
CO2	S	S	M	S	M	S	L	M	S	M
CO3	S	M	M	S	S	M	L	M	S	S
CO4	S	S	L	M	S	M	M	M	S	S
CO5	S	S	M	L	M	S	S	M	M	S

*S-Strong; M-Medium; L-Low

SEMESTER V

Course code	53B	ELECTRONICS	L	T	P	C
Core/Elective/SBS		CORE PAPER VI	4	0	0	4
Pre-requisite		Should have the basic knowledge of Semiconducting devices	Syllabus Version		2020 - 21	

Course Objectives:

The main objectives of this course are to:

1. acquire knowledge and apply it to various electronic instruments.
2. gain knowledge about the development of the electronic instruments.
3. motivate the students to apply the principles of electronics in their day-to-day life.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	differentiate between different types of amplifiers and their applications	K2
2	design different types of oscillators	K3
3	apply switching ideas to various devices	K3
4	analysing the power electronic devices and their uses	K4
5	design operational amplifier circuits and to analyse their properties	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create;

Unit:1	Amplifiers	12 hours

Voltage and power amplifiers: Classification of amplifiers – Transistor amplifiers in cascade– Power amplifiers – Class A power amplifier – Push Pull connection – push pull class B Power amplifier – Characteristics of an amplifier. **Feedback amplifiers:** feedback and related terms- block diagram of a feedback amplifier- Transfer gain of an amplifier with feedback- Emitter follower circuit.

Unit:2	Oscillators	11 hours

Introduction - Types of oscillators - Fundamental principle of oscillator - Concept of feedback oscillator -Tuned collector oscillator - Analysis - Hartley oscillators – Analysis – Colpitt's oscillator – Analysis - Phase shift oscillator-Analysis - Wien bridge oscillator - Analysis - Crystal oscillator – Analysis.

Unit:3	Solid state switching circuits	12 hours

Introduction - switching circuit- electronic switches - important terms - switching action of a transistor – multivibrators – types of multi vibrators –transistor astable multivibrator – transistor mono stable multivibrator - Differentiating circuit - Integrating circuit - Clipping circuits – Clamping Circuits - basic idea of a clamper- Positive clamper – negative clamper.

Unit:4	Power Electronics	12 hours

Introduction - power electronics - The Triac – Construction - Operations – Characteristics - Applications. The Diac – Operations – Applications of Diac – Lamp dimmer – heat controller. Unijunction transistor – Construction – Operations - equivalent circuit of UJT –Characteristics of UJT - advantages of UJT – applications of UJT – UJT relaxations Oscillator - UJT over voltage detector.

Unit:5	Operational Amplifier	11 hours

Differential amplifier – Basic circuit – Operation – CMRR -Operational amplifier – Characteristics

– Circuit symbol - Frequency response - Slew rate – Applications - Inverting amplifier - Non inverting amplifier - Adder - Subtractor - Integrator- Differentiator.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60**

Text Book(s)	
1	Foundations of Electronics, D Chattopadhyaya & P C Rakshit, New Age Intrenational Publishers, Second Edition (2005)
2	Principles of Electronics, V K Mehta, Rohit Mehta, S. Chand Company, Eleventh revised Edition (2015)
Reference Books	
1	A textbook of Applied Electronics, R S Sedha, S. Chand Company, First Edition (2010)
2	Integrated Electronics, Jacob Millman and Christos C. Halkias, Tata McGraw Hill Publishing Company, Second edition (2015)
3	Electronic devices and Circuits, S. Salivahanan and N. Sureshkumar, Tata McGraw Hill Publishing Company, Fourth edition (2016)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/course.html/Electronics/Basic electrnics
2	https://www.askiitians.com/revision-notes/physics/solid-and-electronic-device/
3	https://nptel.ac.in/course.html/electronics/operational amplifier
Course Designed By: **Dr. U. Karunanithi**	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	L	M	S	M	L	S	M	M
CO3	S	S	M	S	M	S	M	L	S	M
CO3	S	M	M	S	S	M	L	M	S	S
CO4	S	S	L	M	S	M	M	M	S	S
CO5	S	S	M	L	M	S	S	M	M	S

*S-Strong; M-Medium; L-Low

SEMESTER V

Course code	53C	SOLID STATE PHYSICS	L	T	P	C
Core/Elective/SBS		CORE PAPER VII	4	0	0	4
Pre-requisite		The students should know the fundamentals on kinds of bonds and classification of solids	Syllabus Version		2020-21	

Course Objectives:

The main objectives of this course are to:

1. learn about the crystal structure and properties of solids.
2. know about bond theory and optical properties of solids.
3. gain knowledge on magnetic, electric and dielectric materials and their application.
4. understand the superconducting process for the fabrication of new devices.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	choose the right material for a given application based on Fermi level concept	K3
2	analyze the magnetic materials for utilization in varied fields.	K4
3	design new components or devices using dielectrics and superconductors.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Crystallography	12 hours

Distinction between crystalline and amorphous solids – Different features of the crystal – Crystal lattice – Basis – Crystal structure – Unit cell – Number of lattice points per unit cell- Bravais lattices – Miller indices – Elements of Symmetry – Structure of KCl and NaCl crystal – Atomic Packing – Atomic radius –-Lattice constant and density- Crystal structure (sc; hcp; fcc;bcc.)

Unit:2	Bond Theory of Solids	10 hours

Classification of solids – Basics of Bond theory – Optical properties of solids – Specific heat capacity of solids – Dulong and Pettit's law – Einstein's theory of specific heat of solids – Fermi levels .

Unit:3	Magnetic Properties of Materials	12 hours

Introduction – Langevin's theory of diamagnetism –Langevin's theory of Paramagnetism – Ferromagentism – Weiss theory of Ferromagentism –Nuclear magnetic resonance – Ferroelectricity – Ferroelectric crystals – Quantum theory of paramagnetism – Cooling by adiabatic demagnetization of a paramagnetic salt.

Unit:4	Free Electron Theory	12 hours

Free electron theory – Drude Lorentz theory – Explanation of Ohm's law – Electrical conductivity – Thermal conductivity – Wide-Mann and Franz ratio – Sommerfield model – Schotcky effect – Hall effect – Hall voltage and Hall coefficient – Mobility and Hall angle – Importance of Hall effect – Experimental determination of Hall coefficient.

Unit:5	Dielectrics and Super Conductivity	12 hours

Dielectrics- Dielectric constant and displacement vector- Clausiss Mossotti relation- Atomic or molecular polarizability – Types of polarizability -Super conductivity – Phenomena – magnetic properties – Super conductor – Meissner effect – Experimental facts – Isotopes effect – Thermodynamic effect.

Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60**

Text Book(s)	
1	Solid State Physics Gupta and Kumar, K. Nath & Co. (2018)
2	Modern Physics R Murugesan , S Chand Publishing; Eighteenth edition (2016)
Reference Books	
1	Introduction to Solid State Physics Charles Kittel, Wiley (2019)
2	Solid State Physics A J Dekker, Macmillan (2011)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://youtu.be/RImqF8z91fU
2	https://nptel.ac.in/courses/115/105/115105099/

Course Designed By: **Mr J.William Charles**

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	M	M	S	M
CO2	M	M	S	S	M	S	S	M	M	S
CO3	M	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

SEMESTER V

Course code	53D	ELECTRICITY AND MAGNETISM	L	T	P	C
Core/Elective/SBS		CORE PAPER VIII	4	0	0	4
Pre-requisite		The students are supposed to have the basic knowledge of electricity and magnetism	Syllabus Version		2020-21	

Course Objectives:

The main objectives of this course are to:

1. make the students familiar with the laws of electricity and magnetism and their verifications
2. understand the properties of electric and magnetic materials
3. acquire experimental skills to construct technically useful devices.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	define and derive the laws of electricity and magnetism	K2
2	update the knowledge of properties and magnetism	K3
3	expertise the skills to manufacture devices	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Gauss Theorem and its Applications	12 hours

Gauss theorem – applications of Gauss theorem: Electric intensity at a point due to a charged sphere – Electric intensity at a point near an infinite charged conductor - Electric intensity at a point between two parallel plane charged conductors - Electric intensity at a point outside two parallel plane charged conductors - Energy stored in unit volume of an electric field. **Capacitors:** Introduction – principle of a capacitor – capacitance of a spherical capacitor – outer sphere earthed – inner sphere earthed – cylindrical capacitor – capacity of a parallel plate capacitor – effect of a dielectric – capacitors in series and parallel – Guard-Ring condenser – mica capacitor – uses of capacitors.

Unit:2	Magnetic Properties of Materials	12 hours

Electron theory of magnetism; dia, para, ferromagnetism and their properties magnetic field B; magnetization M; magnetic field intensity H; magnetic susceptibility and magnetic permeability; magnetic materials and magnetization; magnetic hysterisis – area of the hysterisis loop; determination of susceptibility: Guoy's method – magnetic circuits –comparison of electrical circuit with magnetic circuit.

Unit:3	Thermo Electricity	11 hours

Seebeck effect – Laws of thermo e.m.f – Peltier effect; Peltier Co- efficient – determination of Peltier co-efficient – thermo dynamical consideration of Peltier effect – Thomson effect – Thomson Co-efficient – e.m.f generated in a thermocouple taking both Peltier effect and Thomson effect in the metals – Thermo electric power – Application of thermodynamics to Thermocouple – Thermoelectric diagrams and their uses.

Unit:4	Helmholtz Equation of Varying Current	11 hours

Growth and decay of current in an inductive – resistive circuit – charging and discharging of a capacitor through a resistance – growth of charge in a circuit with inductance, capacitance and resistance (LCR) - torque on a current loop in a magnetic field – Theory of Ballistic

Galvanometer – correction for damping – current and voltage sensitivities.		
Unit:5	**Dynamics of Charged Particles**	**12 hours**
Motion of charged particle in uniform electric field – longitudinal – transverse – motion of charged particle in alternating electric field – motion of charged particle in uniform constant magnetic field – Motion of charged particle in crossed electric and magnetic field. **Electromagnetic Induction:** A conducting rod moving through a uniform magnetic field – inductance in series – inductance in parallel – self-inductance of co-axial cylinders – self-inductance of toroidal coil of rectangular cross section – self -inductance of toroidal coil of circular cross section.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60**

Text Book(s)	
1	Electricity and Magnetism, Brijlal and Subramaniam, Educational and University Publishers (1984)
2	Electricity and Magnetism, R. Murugesan, S.Chand&Co (2017)
Reference Books	
1	Electricity and Magnetism, D.N. Vasudeva, S.Chand&Co, twelfth edition (2007)
2	Electricity and Magnetism, Nagarathanam and Lakshminarayanan,
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	**https://www.askiitians.com/revision-notes/physics/current-electricity.html**
2	**https://www.askiitians.com/revision-notes/physics/electromagnetic-induction-and-alternating-current/**
Course Designed By: **Dr P. Sagunthala and Dr. K.A.Vijayalakshmi**	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	M	S	S	M	M	S
CO2	S	M	M	M	S	M	M	S	S	M
CO3	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

SEMESTER V

Course code	5ZC	INSTRUMENTATION III	L	T	P	C
Core/Elective/SBS		SKILL BASED SUBJECT	3	0	0	3
Pre-requisite		The students should be able to distinguish between analog and digital measurement and their importance	Syllabus Version		2020-21	

Course Objectives:

The main objectives of this course are to:

1. give an insight into the working of digital and analog techniques used in measurement devices.
2. enable the students to use electronic testing instruments.
3. introduce medical instrumentation.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	understand the principles of biomedical instruments.	K1
2	enable the students to understand the working of basic electromagnetic and electronic instruments.	K2
3	appropriately chose electronic components.	K3
4	carry out minimal testing and maintenance of lab equipment.	K4
5	troubleshoot simple electronic circuits using multi meters and oscilloscopes.	K5
6	interpret results of Biomedical measurement.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Data Acquisition and Conversion	7 hours

Introduction – Signal conditioning of the inputs – Single channel data acquisition systems – Data conversion – Digital to Analog converter – Analog to Digital converter.

Unit:2	Basic meter movements	9 hours

Permanent magnetic moving coil movements – Practical PMMC movements — Moving ion type instrument – Concentric vane repulsion type (Moving ion type) – Display devices: LED – LCD.

Unit:3	Digital Instruments	9 hours

Introduction – Digital Multi meter – Digital panel meters – Digital frequency meters – Digital Measurement of time – Universal counter – Digital measurement of frequency – Digital Tacho meter.

Unit:4	Oscilloscope	9 hours

Introduction – Basic principles – CRT features – Basic principles of signal displays – Block Diagram of oscilloscope – Simple CRO – Vertical amplifier – Horizontal deflecting system – Delay line in triggered sweep – CRT connection.

Unit:5	Biomedical Instrumentation	9 hours

Basics of Biomedical Instrumentation system – Blood flow measurement – magnetic blood flow rate – Ultrasonic meter – ECG-EEG-EMG –X-ray Imaging and CT scan- MRI scan.

Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**45**

Text Book(s)

1	Instrumentation Devices and Systems, C.S. Rangan, G. R. Sarma and V. S. Mani, 2nd Edition, Tata McGRaw Hill, New Delhi (1983)
2	Electronic Instrumentation, H. S. Kalsi, , 3rd edition, Tata McGraw Hill, New Delhi (2012)
3	Electronics in Medicine and Biomedical Instrumentation, N. K. Jog, 2nd Edition, Prentice Hall India, New Delhi (2013)

Reference Books

1	Measurement System Applications and Design, E.O. Doebalin, 5th edition, McGraw Hill International (2007)
2	Transducers and Instrumentation, D. V. S. Murthy, 2nd edition, Prentice Hall of India (2010)
3	Biomedical Instrumentation and Measurements, Leslie Crombwell, Fred.J.Weibell, Trich.A.Pfeiffer, Prentice Hall of India (1997).

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	PMMC https://youtu.be/n1MinLtvnPY
2	NPTEL Play list https://www.youtube.com/watch?v=3eYmFjHnQjY&list=PL227ZNwByTlTGq1atJsFst_qnEptI870O
3	Biomedical instrumentation- nptel -youtube channel https://www.youtube.com/watch?v=f949gpKdCI4&list=PLCDqPRbvMlPCt0pnGB-I5ftPSGCMOuDv0

Course Designed By: **Mrs J.Jayachitra, Dr.L.Priya**

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	L	L	M	S	M	M	M	S	S
CO2	S	S	L	S	S	S	S	M	M	M
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	M	S	S	M	M	S	M
CO5	S	S	M	M	M	L	M	M	L	M
CO6	S	L	L	M	S	M	L	M	S	S

*S-Strong; M-Medium; L-Low

Sixth Semester

SEMESTER – VI

Course code	**63A**	**QUANTUM MECHANICS AND RELATIVITY**	**L**	**T**	**P**	**C**
Core/Elective/SBS		**CORE PAPER IX**	**6**	**0**	**0**	**4**
Pre-requisite		The students are expected to have the knowledge of particle nature and wave nature of matter	**Syllabus Version**		**2020-21**	

Course Objectives:

The main objectives of this course are to:

1. understand the wave property of matter
2. acquire knowledge of uncertainity principle and its applications
3. apply the concept of relativity to solve various physical problems

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	acquire the knowledge of wave nature of matter and its experimental verification	K2
2	understand Heisenberg uncertainity principle and apply it to verify problems in atomic and nuclear Physics	K3
3	Identify the reason behind various physical problems using relativity and to solve them	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Wave Properties of Matter**	**17 hours**

Introduction – de Broglie wavelength – Phase velocity – Expression for Phase velocity – Group velocity – Analytical treatment – Expression for group velocity – Relation between group velocity (v_g) and phase velocity (v_p) – Velocity of de Broglie wave – (i)Phase velocity (v_p) – (ii)Group velocity (v_g). Verification of de Broglie relation – Davisson and Germer's experiments – G P Thomson's experiment.

Unit:2	**Uncertainty Principle**	**17 hours**

Introduction – Uncertainty Principle – Elementary proof between – Displacement and Momentum – Energy and Time – Physical Significance of Heisenberg's Uncertainty Principle – Illustration – Diffraction of electrons through a slit – Gamma ray microscope thought experiment – Applications – Non-existence of free electrons in the nucleus – Size and Energy in the ground state of Hydrogen atom.

Unit:3	**Schrödinger's Wave Equation**	**18 hours**

Introduction – Wave function for a free particle – Schrödinger's one dimensional wave equation – Time-dependent and Time independent – Limitations of wave function – Normalization of wave function – Operators – Eigen function – Eigen Value – Eigen equation – Operator for Momentum, Kinetic Energy and Total Energy – Postulates of Quantum Mechanics – Orthogonality of Energy Eigen function – Proof – Ehrenfest's theorem – Statement and proof.

Unit:4	**Spherical Symmetrical systems**	**18 hours**
Three dimensional Schrödinger's wave equation –Hydrogen atom – Wave equation for the Motion of an electron – Separation of variables – Azimuthal wave equation and its solution – Radial wave equation and it's solutions – Polar wave equation and its solution – Ground size of the Hydrogen atom.		
Unit:5	**Relativity**	**18 hours**
Galilean Transformation equation – Ether Hypothesis – Michelson-Morley experiment – Explanation of the Negative results – special theory of Relativity – Lorentz transformation equation – Length contraction – Time dilation – Addition of Velocities – Variation of Mass with velocity – Mass energy equivalence.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**90**

Text Book(s)	
1	Elements of Quantum Mechanics, Kamal Singh, S.P Singh, S.Chand&Co (2005)
2	Quantum Mechanics, S.P Singh, M. K Bagde, S.Chand&Co, second edition (2004).
3	Modern Physics, R Murugesan, S.Chand&Co (2016)
Reference Books	
1	Quantum Mechanics, Sathya Prakash, C.K.Singh, Kedar Nath Ram Nath&Co.(1997)
2	Quantum Mechanics, Schiff, Tata McGraw-Hill, second edition, (1968).
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.youtube.com/playlist?list=PLbMVogVj5nJTDMhThY9xu2Tvg0u1RPuxO
2	https://medium.com/predict/what-is-quantum-mechanics-what-is-theory-of-relativity-fdbe87eb9c79
3	https://www.askiitians.com/revision-notes/physics/special-theory-of-relativity/

Course Designed By: **Dr P. Sagunthala**

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**O9**	**O10**
CO1	S	M	M	M	M	M	S	M	M	M
CO2	S	S	S	M	S	S	M	M	S	S
CO3	M	S	S	S	S	S	S	S	S	S

SEMESTER VI

Course code	63B	NUCLEAR PHYSICS	L	T	P	C
Core/Elective/SBS		CORE PAPER X	6	0	0	4
Pre-requisite		The students should have knowledge about the basic constituents of atoms. They should be familiar with the structure of atoms and nucleus.	Syllabus Version		2020-21	

Course Objectives:

The main objectives of this course are to:

1. acquire the knowledge to understand about nucleus and nucleus structure.
2. familiarize with different types of radiation detectors and particle accelerators
3. study the radioactivity phenomenon of nucleus
4. motivate the students to analyze the energy released by the nucleus during fission and fusion process
5. acquire the basic knowledge of cosmic rays and elementary particles.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	understand the General properties of Nucleus	K2
2	analyze the construction and working of radiation detectors	K4
3	device instruments utilizing the behavior of nuclear particles	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Introduction to the Nucleus	16 hours

General properties of Nucleus (Size, Mass, Density, Charge, Spin, Angular momentum, Magnetic dipole moment) – Binding energy – BE/A and stability of Nucleus – Packing fraction – Nuclear stability – Nuclear forces – Definition – Properties – Meson theory – Model of Nuclear Structure – The Liquid Drop model – Semi-Empirical mass formula – The Shell model – Evidence for Shell model –The collective model.

Unit:2	Detector and Particle Accelerators	18 hours

Interaction between the energetic particles and matter – Heavy charged particles – Electrons – Gamma ray-Ionization chamber – Solid State detector – GM counter – Wilson Cloud chamber – Nuclear emission – Linear accelerators – Cyclotron – Betaron.

Unit:3	Radioactivity	18 hours

Natural Radioactivity – Alpha, Beta and Gamma rays – Properties – Determination of e/m of Alpha particle – Determination of Charge of Alpha particle – Determination of e/m of Beta particle – determination of Wavelength of Gamma rays (Dumond Spectrometer) – Origin of Gamma rays – Laws of Radioactivity – Soddy-Fajan's displacement law – Law of Radioactive disintegration – Half life period – Mean life period (Definitions, Expression) – Units of Radioactivity – Artificial Radioactivity – Preparation of radio elements – Application of radio isotopes.

Unit:4	Nuclear Fission and Fusion Reactions	18 hours

Nuclear fission – Energy released in Fission – Bohr and Wheelers theory of Nuclear fission – Chain reaction – Multiplication factor – Critical size – Natural Uranium and chain reactions – Atom Bomb – Nuclear reactor – Nuclear fusion – Source of Stellar energy – Carbon Nitrogen cycle

– Proton-Proton cycle – Hydrogen bomb – Controlled thermo nuclear reactions.		
Unit:5	**Cosmic Rays and Elementary Particles**	**18 hours**
Cosmic rays – Origin of cosmic rays – Latitude effect – Azimuthal effect – Attitude effect – Seasonal, Diagonal changes – Primary and Secondary Cosmic rays – cascade theory of shower – Pair production and Annihilation – Van Allen Belts – Elementary particles – Introduction – particles and antiparticles – Antimatter – The fundamental interactions – The Quark model.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**90**

Text Book(s)	
1	Modern Physics, R Murugesan, S. Chand Publishing, 18th Edition (2017).
2	Nuclear Physics, D C Tayal, Publisher Himalaya Publishing House (2009).
Reference Books	
1	Concept of Modern Physics, Arthur Beiser, McGraw-Hill, (2007).
2	Introduction to Modern Physics, F K Richtmyer Etal, McGraw-Hill; 6th edition (1969).
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/115/104/115104043/
2	https://nptel.ac.in/courses/115/103/115103101/
3	https://www.youtube.com/watch?v=xrk7Mt2fx6Y
Course Designed By: **Dr. K. Selvaraju**	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	M	M	M	S	M	M
CO2	M	S	S	M	L	M	S	M	S	S
CO3	S	M	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

SEMESTER V&VI

Course code	**63P**	**CORE PRACTICAL III ELECTRONICS** (Examination at the end of Sixth Semester)	**L**	**T**	**P**	**C**
Core/Elective/SBS		**CORE PRACTICAL**	**0**	**0**	**2**	**3**
Pre-requisite		Should have the fundamental knowledge of Basic Electronics	**Syllabus Version**		**2020 - 21**	

Course Objectives:

The main objectives of this course are to:

1. transform the principles of Basic Electronics into Experimental techniques
2. gain knowledge about different electronic gadgets.
3. motivate the students to apply the principles of electronics in their day-to–day life.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	design different types of Power supplies, Amplifiers and Oscillators	K4
2	to analyze the characteristics of various Electronic devices like BJT, UJT, LDR, and Solar cell	K4
3	acquire the knowledge of the characteristics of an operational amplifier	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

LIST OF EXPERIMENTS (Any twelve experiments)	**56 hours**

1. Logic Gates using diodes and transistor.
2. Bridge rectifier with Zener voltage regulator
3. Regulated Power Supply - IC
4. Dual Power Supply
5. Voltage Doubler
6. Characteristics of Transistor - CE mode
7. Differentiating and Integrating Circuits.
8. Clipping and Clamping Circuits
9. R.C. Coupled Amplifier –Single stage - Transistor
10. Emitter Follower
11. Series and Parallel resonance circuits
12. Hartley Oscillator – Solid State
13. Colpitt's Oscillator – Solid State
14. Square wave generator using IC 555 Timer
15. Astable Multivibrator
16. Study of Solar Cell
17. Study of LDR
18. Characteristics of UJT
19. Inverting and Non inverting amplifiers - Op-amp (IC 741)
20. Adder and Subtractor circuits - Op-amp (IC 741)

Contemporary Issues	**4 hours**

Online workshop, Webinars on Experimental Electronics

Total Practical Hours:	**60**

Reference Books

1	Practical Physics and Electronics, C.C.Ouseph, U.J.Rao, V.Vijayendran, S.Viswanathan Publishers(2007)

2	A text book of practical Physics, M.N.Srinivasan, S.Balasubramanian, R.Ranganathan, Sultan Chand&Sons(2017)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.slideshare.net/mobile/sunilrathore77398/basicanalogelectronics
2	https://www.slideshare.net/mobile/PatruniChidanandaSas/basics-of-electronics-53962342
Course Designed By: **Dr. U. Karunanithi**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	S	S	M	L	M	S	M
CO2	S	S	M	S	S	L	M	S	S	S
CO3	M	M	S	S	L	M	S	S	S	M

*S-Strong; M-Medium; L-Low

SEMESTER V&VI

Course code	**63Q**	**DIGITAL AND MICROPROCESSOR** (Examination at the end of sixth semester)	**L**	**T**	**P**	**C**
Core/Elective/SBS		**CORE PRACTICAL IV**	**0**	**0**	**2**	**3**
Pre-requisite		Should have the fundamental knowledge of Digital Electronics and Microprocessors	**Syllabus Version**		**2020 - 21**	

Course Objectives:

The main objectives of this course are to:

1. understand the principles and applications of Digital Electronics
2. gain knowledge about the development of the Microprocessors.
3. motivate the students to apply the principles of Digital Electronics in their day–to–day life.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	analyze the different types of digital circuits and their applications	K4
2	realize the applications of registers in computers	K5
3	update the knowledge of Microprocessor programming	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

LIST OF EXPERIMENTS — **56 hours**

(Any twelve experiments by choosing **at least five** from each division)

I. DIGITAL ELECTRONICS

1. Verification of truth tables of logic gates using IC's: OR, AND, NOT, XOR, NOR and NAND.
2. NAND as universal building block- AND, OR, NOT and Ex-OR
3. NOR as universal building block- AND, OR, NOT and Ex-NOR
4. Verification of De Morgan's theorem.
5. Boolean Algebra – problem solving
6. Study of RS Flip-Flop.
7. Half adder and Half Subtractor
8. Full adder
9. Full Subtractor.
10. 4 Bit – Binary Adder/ Subtractor using 7483

II. MICROPROCESSORS

11. 8085 ALP for 8 bit Addition and Subtraction
12. 8085 ALP for 8 bit addition with carry and subtraction with borrow
13. 8085 ALP for 8 Bit Multiplication
14. 8085 ALP for 8 Bit Division
15. 8085 ALP for One's Complement, Masking off most significant 4 bits and setting bits.
16. 8085 ALP for Two's compliment Addition and Subtraction
17. 8085 ALP for finding the biggest number element in the array and Sum of the elements in the array.
18. 8085 ALP for arranging Ascending and Descending order of the given set of numbers
19. 8085 ALP for conversion of Hexadecimal into Decimal number.

20. 8085 ALP for conversion of Hexadecimal into Binary number.	
Contemporary Issues	**4 hours**
Online workshop, Webinars on Experimental Digital Electronics and Microprocessors	
Total Practical Hours:	**60**

Reference Books

1	Practical Physics and Electronics, C.C.Ouseph, U.J.Rao, V.Vijayendran, S.Viswanathan Publishers(2007)
2	A text book of practical Physics, M.N.Srinivasan, S.Balasubramanian, R.Ranganathan, Sultan Chand&Sons(2017)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	http://www.sircrrengg.ac.in/images/Others/CSE/MP-LAB-MANUAL.pdf
2	https://www.youtube.com/playlist?list=PL_pGb42kre_QXwuaizYb21tSYpoHyXsCQ

Course Designed By: **Dr. U. Karunanithi**

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	M	L	S	M	S	M
CO2	S	M	M	S	S	L	S	M	S	S
CO3	S	M	S	M	L	M	M	S	S	M

*S-Strong; M-Medium; L-Low

SEMESTER V&VI

Course code	**63R**	**C AND C++ PROGRAMMING** (Examination at the end of sixth semester)	**L**	**T**	**P**	**C**
Core/Elective/SBS		**PRACTICAL V**	**0**	**0**	**3**	**3**
Pre-requisite		Should have the fundamental knowledge of C and C++ Programming	**Syllabus Version**		**2020 - 21**	

Course Objectives:

The main objectives of this course are to:

1. Develop Programming concepts in C and C++
2. Apply Programming concepts of C and C++ to various programmes
3. Write C and C++ programmes for Physics oriented problems.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Write and execute programmes in C and C++	K3
2	Analyze the programming concepts for Physics problems	K4
3	Evaluate the solutions for different Mathematical problems	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

LIST OF EXPERIMENTS (Any twelve experiments by choosing **at least five** from each division)	**84 hours**

I. PROGRAMMING IN C

1. Write a C program to convert integer in the range 1 to 100 into words.
2. Write a C program that uses functions to compare two strings input by user. The program should state whether the first string is less than, equal or greater than the second string.
3. Write a C program to compare two files printing the character position where they are equal and where they differ.
4. Write a C program for Matrix addition
5. Write a C program for Matrix multiplication.
6. Write a C program to convert Celsius scale into Fahrenheit scale.
7. Write a C program to find resultant value of the three resistances R_1, R_2 and R_3 connected in (i) series and (ii) parallel.
8. Write a C program to calculate refractive index of the material of the prism.
9. Write a C program to measure resonant frequency of the LCR series circuit.
10. Write a C program to calculate De Broglie wavelength of a material for the given value of momentum p.

PROGRAMMING IN C++

11. Write a C^{++} program to read any two numbers through the key board and to perform simple arithmetic operations (Use Do While loop).
12. Write a C^{++} program to display the name of the day in a week, depending upon the number entered through the keyboard using Switch – case statement.
13. Write a C^{++} program to perform Matrix addition.
14. Write a C^{++} program for matrix multiplication.
15. Write a C^{++} program to find the inverse of a matrix.

16. Write a C^{++} program to find the modulus of the given number.
17. Write a C^{++} program to compare two files printing the character position where they are equal and where they differ.
18. Write a C^{++} program to find resultant value of three capacitances C_1, C_2 and C_3 connected in (i) series and (ii) parallel.
19. Write a C^{++} program to measure the resonant frequency of the LCR parallel circuit.
20. Write a C^{++} program to estimate the half-life period of a radioactive substance for the given value of decay constant λ.

Contemporary Issues	**6 hours**
Online workshop, Webinars on C and C++ programming	
Total Practical Hours:	**90**

Reference Books

1	Programming in ANSI C by E. Balagurusamy, Tata McGraw Hill, sixth Edition(2012)
2	Object Oriented Programming with C++ by E. Balagurusamy, Tata McGraw Hill, Sixth Edition (2013)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/course.html/computerscience and engineering//C, C++ programming
2	https://www.geeksforgeeks.org/introduction-to-c-programming-language/

Course Designed By: **Dr. U. Karunanithi**

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	M	S	L	M	S	M	S	M
CO2	M	S	S	M	S	L	S	M	S	S
CO3	S	M	S	M	L	M	M	S	S	M

*S-Strong; M-Medium; L-Low

SEMESTER VI

Course code	6ZP	INSTRUMENTATION PRACTICALS	L	T	P	C
Core/Elective/SBS		SKILL BASED SUBJECT	0	0	3	3
Pre-requisite		Should have the fundamental knowledge in Instrumentation	Syllabus Version		2020 - 21	

Course Objectives:

The main objectives of this course are to:

1. acquire the knowledge in working with different laboratory instruments.
2. service laboratory instruments like spectrometer, telescope etc.
3. examine some of the simple house hold instruments like iron box, mixie etc. and rectify the problems.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	service and rectify the defects in laboratory instruments	K5
2	service and rectify the defects in simple house hold devices.	K5
3	device new instruments applying the knowledge of instrumentation.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

LIST OF EXPERIMENTS (Any twelve experiments)	**42 hours**

1. Construction and Service of Power supply - 2, 4, 6 Volts
2. Regulated power supply construction and service – (+5V & - 12V)
3. Dual power supply construction and service - (- 12V) – 0 - (+12V)
4. Regulated power supply construction and service – (+ 12V & - 5V)
5. Servicing - Microscope
6. Servicing - Telescope
7. Servicing - Spectrometer
8. Servicing - Galvanometer,
9. Servicing - Voltmeter
10. Servicing - Ammeter.
11. Servicing - UPS
12. Servicing – Stop clock and Stop watch
13. Servicing – Physical Balance
14. Servicing – Mixie
15. Servicing – Resistance box and Capacitance box
16. Servicing – Signal Generators
17. Fixing and servicing a B.G.
18. Cutting, drilling, polishing and trimming.
19. Servicing – Iron Box
20. Conversion of Galvanometer to an ammeter and volt meter

Contemporary Issues	**3 hours**

Expert lectures, online seminars - webinars

Total Practical Hours:	**45**

Reference Books

1	Laboratory Instrumentation, Mary C. Haven, Gregory A. Tetrault, Jerald R. Schenken, John Wiley & Sons,(1994).

2	Principles and Applications of Laboratory Instrumentation, Sheshadri Narayanan, ASCP Press, (1989).
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.macallister.com/parts-service/maintenance-tips/
2	https://www.youtube.com/playlist?list=PLOU3kcAncZZtRFMLCFMyxEp_JYZIOLkbM
3	https://www.slideshare.net/mobile/selvaprakash549/maintenance-and-repair-strategies
Course Designed By: **Dr. U. Karunanithi**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	M	M	S	M	L	M
CO2	M	S	M	S	S	L	M	S	M	S
CO3	S	M	S	M	L	M	M	S	S	M

*S-Strong; M-Medium; L-Low


Elective
Course

LIST OF ELECTIVE PAPERS
SEMESTER V

Course code	5EA	PRINCIPLES OF PROGRAMMING CONCEPTS AND C PROGRAMMING	L	T	P	C
Core/Elective/SBS		ELECTIVE PAPER – I A	4	0	0	4
Pre-requisite		The students are expected to procure foundational knowledge on programming concepts and C programming	Syllabus Version		2020-21	

Course Objectives:

The main objectives of this course are to:

1. develop logics which will aid in developing programs and applications
2. solve problems using functional and object-oriented paradigm
3. use ideas from various paradigms when programming in a language of different paradigm

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	design features of programming languages, and justify their own design decisions	K2
2	critically evaluate what paradigm and language are best suited for a new problem	K5
3	use C programming to solve Physics problems.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Constants, Variables and Data types	10 hours

Introduction – character sets – constants – keywords – identifiers – variables – data types – declaration of variables – assigning values to variables – defining symbolic constants.

Unit:2	Operators and Expressions	12 hours

Arithmetic operators – relational operators – logical operators – assignment operators – increment and decrement operators – conditional operators – special operators – arithmetic expression – evaluation of expression. – Precedence of arithmetic operators – type conversion in expression – operator precedence and associativity – mathematical functions.

Unit:3	Input and Output Operations	12 hours

Reading and writing character – formatted input and output – decision making: IF statement: Simple IF, IF... ELSE, Nesting of IF… ELSE and ELSE IF Ladder – Switch Statement – ?: operator – go to statement – while, do – while statement – For loop.

Unit:4	Arrays	12 hours

Introduction – One dimensional array – declaration of array – Initiating on two and multidimensional arrays – declaring and initializing string variables – reading strings from terminal – writing strings on the screen.

Unit:5	User Defined Functions	12 hours

Need for user defined functions – A multifunction program – The form of C Functions - RETURN values and their Types - Calling a function - Call by Value - Call by Reference- Recursive functions.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars - webinars

	Total Lecture hours	**60**
Text Book(s)		
1	Programming in ANSI C, E. Balagurusamy, TMH (2008)	
2	The C Programming Language, Brian Kernighan, Dennis Ritchie, Prentice Hall, (1978)	
Reference Books		
1	Programming in C by Ashok N. Kamthane First Indian Print, Pearson (2004).	
2	Computing Fundamentals and C Programming, E. Balagurusamy, TMH(2011)	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.programiz.com/c-programming	
2	https://www.geeksforgeeks.org/c-language-set-1-introduction/	
3	https://beginnersbook.com/2014/01/c-tutorial-for-beginners-with-examples/	
Course Designed By: **Dr P. Sagunthala and Dr. V. Kalaiselvi**		

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	M	S	M	S	M	S	S
CO2	M	S	M	M	M	M	S	S	M	S
CO3	S	S	S	S	M	S	M	M	S	S

*S-Strong; M-Medium; L-Low

SEMESTER V

Course code	5EA	ENERGY PHYSICS	L	T	P	C
Core/Elective/SBS		ELECTIVE PAPER - I B	4	0	0	4
Pre-requisite		The students should know the fundamental principle of motor and classification of energy	Syllabus Version		2020-21	

Course Objectives:

The main objectives of this course are to:

1. learn about the production of electricity.
2. know about fibre optical communication system.
3. gain knowledge on atomic, molecular energy and thermal energy.
4. understand the non-conventional energy resources and utilization.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	understand the heating effect of current and application of it.	K2
2	select the correct material for making waveguide based on basic optical laws.	K3
3	understand Maxwell's law of equipartition of energy.	K2
4	analyze the distribution of energy in the thermal spectrum.	K4
5	Calculate effective utilization of solar radiation, power in the wind and tidal energy	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Electrical Energy	12 hours

Principle of production of A.C. – A.C generators – D.C generators –D.C Motors. Heat developed in current carrying conductor – Application of heating effect – Electric heater or stove – Electric radiation and Electric Iron – Electric welding and electric furnace – Carbon arc – Electric Lamp – Efficiency of a Lamp – Measurement of Electric Power.

Unit:2	Optical Energy	12 hours

Characteristics of Light – Light sources – LED, LASER – optical fibre – Light propagation through optical fibres: Basic optical laws used in optical fibres – Optical parameters of optical fibres: Acceptance angle and Numerical aperture – Types of optical fibres: Based on material, Number of modes and refractive index profile – Fibre optical communication system – Block Diagram – Source – Transmitter – Optical fibre – Receiver.

Unit:3	Atomic And Molecular Energy	12 hours

Degrees of freedom – Number of Degrees of Freedom of Mono, Di and Tri Atomic system – Maxwell's Law of equipartition of Energy – Molar Specific heat capacity at constant volume and constant pressure – Total Internal Energy and Ratio of Heat capacities in monoatomic gas, Diatomic gas, Non Linear and Linear type of Tri atomic gas molecular system.Gas and Vapour Distinction – Measurement of saturated and unsaturated vapour Pressure: Regnault's statistical method – Their characteristics – Graphical Illustration of Gas laws.

Unit:4	Thermal Energy	12 hours

Definition of Total thermal Energy density - Spectral Energy density – Spectral Emissive power – Emissivity – Emissive power – Absorptive power – Reflective power – Kirchoff's Law of radiation and its proof – verification of Kirchoff's Results: Ritche's Experiment. Distribution of Energy in the

thermal spectrum – Lummer and Pringsheim Experiment and its Results – Wien's Displacement Law and Radiation Law – Rayleigh Jean's Law Planck's Radiation Law – Deduction of Wien's Law and Rayleigh – Jean's Law from Planck's law. Solar constant – Temperature of sun – Disappearing filament optical Pyrometer - **Pyrheliometers**: Angstrom Pyroheliometer – Water flow Pyrohelio meter.

Unit:5	**Nonconventional Energy**	**10 hours**

Solar Energy: Solar radiation – Solar radiation outside the earth's atmosphere Solar radiation at the earth's surface – Solar Thermal Energy – Solar Thermal devices and systems: Solar water heater – Sub components of solar water heater – Solar Cooker and its merits and demerits. **Wind Energy**: Power in the wind – Types of wind energy systems –Horizontal axis wind Turbine – Vertical axis wind Turbine. **Ocean Energy**: Tidal Energy – Ocean Thermal Energy Conversion (OTEC) – Closed Cycle OTEC system – Open Cycle OTEC System.

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars - webinars

	Total Lecture hours	**60**

Text Book(s)

1	Renewable Energy Environment and Development - Maheshwar Dayal. Konark Publishers, (1989)
2	Engineering Physics - I- G. Senthil Kumar, VRB Publishers, (2011)

Reference Books

1	Solar Energy Utilization - G.D. Rai Khhanna Publishers, (1995)
2	Engineering Physics - II- M. Arumugham, Anuradha Publishers (2010)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.askiitians.com/revision-notes/physics/heat-phenomena/
2	https://www.askiitians.com/revision-notes/physics/thermodynamics/

Course Designed By: **Mr. J. Williams Charles**

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	M	M	S	M	M	S	M
CO2	M	S	S	S	M	S	S	M	S	M
CO3	S	M	M	S	S	M	M	S	M	S
CO4	S	S	M	M	M	M	M	S	S	M
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

SEMESTER V

Course code	5EA	AGRICULTURAL PHYSICS	L	T	P	C
Core/Elective/SBS		Elective Paper I C	4	0	0	4
Pre-requisite		Students should possess the fundamental knowledge on agronomy which is described using physical sciences.	Syllabus Version		2020-21	

Course Objectives:

The main objectives of this course are to:

1. have knowledge of physical phenomena in agricultural environment.
2. evoke logical thinking in the field of farming.
3. improve practical knowledge of the student.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	understand the role of physics in daily life.	K2
2	introduce technological applications into agriculture.	K3
3	explore the physical properties of soil and water.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Soil Physics	12 hours

Mechanical composition of soil – physical properties of soil, pore space, bulk density, particle density – classification – significance of clays – plasticity, shrinkage, flocculation and deflocculation – Soil structure – soil colour – Thermal properties of soil and soil temperatures – types of soil water – its retention, movement – viscosity, swelling – soil moisture losses – Elementary ideas of soil water conservation.

Unit:2	Water Physics	10 hours

Water qualities – Rain fall – Ground water – surface water pollution – instrumentation and sampling – water quality monitoring

Unit:3	Electric Power	12 hours

Principle of production of A.C. – Average value of A.C. voltage or current – R.M.S. value of alternating voltage or current – power consumed in A.C. Circuits – kilo watt hour – A.C. generator – Three phase A.C. – Distribution of three phase A.C. Three phase power system – The choke- The transformer – Transmission of electric power over long distances.

Unit:4	Hygrometry and Pumps	12 hours

Absolute Humidity – Relative Humidity – Dew point, Daniell's Hygrometer, Regnault's hygrometer. Advantages of Regnault's hygrometer – wet and Dry and Bulb hygrometer. Water pumps – common pump – force pump – Fire engine, inflator (or) compression pump – pressure after n strokes – Exhaust pump (or) common air pump.

Unit:5	Solar Collector and Applications	12 hours

Solar Air heaters- Application of solar air heaters. Solar Drying with various driers – Heating and Drying of Agricultural products – Theory of solar drying – moisture content and its measurement – solar ponds – Application of solar ponds – Solar pumping – Solar pump system components –

Turbine driven pump – Application of solar energy to agricultural crops.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
Total Lecture hours		**60**

Text Book(s)	
1	The Nature and Properties of Soil, H.O. Buckman, Brady, Macmillan, (1967).
2	Soil Physics, H. Kohnke, McGraw-Hill, (1968).
3	Systematic Hydrology, John C. Rodda, Richard A. Downing, Frank M. Law, Newnes-Butterworths, (1976).
Reference Books	
1	Electricity and Magnetism, R. Murugesan, S.Chand, (2017).
2	Hydrostatics, A. S. Ramsey, Cambridge University Press, (2017).
3	Solar energy Utilization, G.D. Rai, Khanna Publisers, (1987).
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/soil-physics
2	https://www.sciencedirect.com/science/article/pii/S1631071304002780
3	https://www.sciencedirect.com/topics/engineering/solar-energy-application
Course Designed By: **Dr P. Sagunthala**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	M	M	M	M	S	M	S	M
CO2	M	S	S	S	S	S	M	S	M	M
CO3	M	S	S	M	S	M	S	S	S	S

*S-Strong; M-Medium; L-Low

SEMESTER VI

Course code	6EA	DIGITAL AND MICROPROCESSOR	L	T	P	C
Core/Elective/SBS		ELECTIVE II A	4	0	0	4
Pre-requisite		The students should have basic understanding in functioning of digital circuits and micro processors	Syllabus Version		2020-2021	

Course Objectives:

The main objectives of this course are to:

1. give description for the students in order to make use of digital devices and microprocessors
2. learn the concepts of logic circuits and to construct the logic circuit for any Boolean equation
3. acquire basic knowledge of binary addition
4. understand the action of flip flops.
5. learn basic programming with microprocessor 8085.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	draw and construct the logic circuit for any Boolean equation.	K2
2	apply the Karnaugh Map to simplify Boolean equation and draw a simplified circuit	K3
3	understand the function of data processing and arithmetic circuits	K4
4	understand the Mnemonics and Opcodes in the Microprocessor	K4
5	develop programming skills using the basic concepts.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Logic Circuits	12 hours

Boolean algebra – NOT operation – OR operation – AND operation – Boolean equations with Logic circuits – Boolean laws & Theorems – Basic laws – De Morgan's theorems – Duality theorems – Sum of Product method – Truth table to Karnaugh Map – Pairs, Quads and Octets – Karnaugh simplification – Product of Sum method.

Unit:2	Data Processing Circuits	12 hours

Multiplexer – Demultiplexer – 1 to 16 decoders – BCD to Decimal decoders - Seven segment decoder – Encoders - Parity generator – checkers – Read Only Memory – Programmable array logic. **Number systems and codes:** Binary to Decimal conversion – Decimal to Binary conversion – Octal numbers – Hexadecimal numbers – The ASCII code – The Excess 3 code – The Gray code.

Unit:3	Arithmetic Circuits	12 hours

Binary addition - Binary Subtraction – Unsigned Binary numbers – sign magnitude numbers –2's complement representation – 2's complement Arithmetic – Arithmetic building blocks – The Adder – Subtractor. **Flip – Flops:** RS flip flop – Clocked RS flip flop – D flip flop – Edge triggered D flip flop – JK flip flop – JK Master Slave flip flop – Schmitt trigger

Unit:4	Microprocessor and Data Representation	12 hours

Basic concepts – what is Microprocessor, 4, 8, 16, 32 – Organization of Microprocessor – Microprocessor Programming – Instruction – Machine and Mnemonic codes – Machine and Assembly Language Programming – High level Language programming – Representation of Integers – Positive integers – Maximum Integer – Negative Number representation – Minimum Integer - Representation of Real numbers – Conversion of Real numbers.		
Unit:5	**Programming a Microprocessor**	**10 hours**
Organization of 8085 – Data and Address buses addressing – The I/O devices – Register in 8085 – Instruction types – Classification of Instruction – Addressing modes – Programming the 8085 – The Programming concepts– Simple programs with 8085 – addition, subtraction, multiplication, and division.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60**

Book(s) for Study

1	Digital Principles and Applications – Albert Paul Malvino& Donald P Leach,TMH, Fourth Edition (2006)
2	Introduction to Microprocessors, Aditya P Mathur TMH, 6th Edition (2006)

Book(s) for Reference

1	Integrated Electronics – Millmann& Halkias, TMH, (2017)
2	Microprocessors Architecture Applications and Programming, R.S.Goenkar, Penaram International(1999)

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.tutorialspoint.com/microprocessor/microprocessor_overview.html
2	https://www.geeksforgeeks.org/introduction-of-microprocessor/

Course Designed By: Dr L.Chandra Naagarajan

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	L	S	M	L	S
CO2	M	S	S	S	S	S	M	S	S	L
CO3	S	M	S	M	L	M	S	S	M	S
CO4	L	L	M	L	M	S	S	L	S	M
CO5	M	S	M	S	S	M	L	S	S	S

*S-Strong; M-Medium; L-Low

SEMESTER VI

Course code	6EA	OPTICAL FIBRES AND FIBRE OPTIC COMMUNICATION SYSTEMS	L	T	P	C
Core/Elective/SBS		ELECTIVE II B	4	0	0	4
Pre-requisite		The students must know the basic optical laws and properties of optical fibre.	Syllabus Version		2020-2021	

Course Objectives:

The main objectives of this course are to:

1. learn about the propagation of light waves in an optical fibre.
2. know about fibre fabrication and cables.
3. gain knowledge on fibre losses and dispersion.
4. understand the structures of light sources for optical fibre optic communication.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	understand the fibre classification.	K2
2	test the cables during installation of cable based on cable selection criteria.	K3
3	analyze the attenuation and dispersion in an optical fibre.	K4
4	calculate the efficiency, modulation bandwidth and spectral emission of light sources.	K5
5	use the knowledge to make varied link and networking.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Fibre Classification	12 hours

Propagation of light waves in an optical fibre – Acceptance angle and Acceptance cone of a fibre – Numerical Aperture (NA) – NA of a graded Index Fibre – Mode of propogation. Fibres – classification – stepped index fibre – stepped index monomode fibre – Graded index multimode fibre – Comparison of step and graded index fibres.

Unit:2	Fibre Fabrication and Cables	12 hours

Classification of Techniques – External chemical vapour deposition – Characteristics – Internal chemical vapour deposition (1^{st} method only) – Characteristics – Phasil system Fibre cable construction – losses incurred during installation of cable – Testing of cables – cable selection criteria.

Unit:3	Fibre Losses and Dispersion in Optics	12 hours

Attenuation in optic fibre – Rayleigh Scattering losses – Absorption losses – Bending losses – Radiation induced losses – Inherent defect losses – Core and Cladding losses. Dispersion in an Optical Fibre – Inter-modal dispersion – Material Chromatic Dispersion – Dispersion Power penalty – Total Dispersion delay.

Unit:4	Light Sources For Optical Fibres	10 hours

LED – The process involved in LEDs – Structures of LED – Fibre – LED Coupling – Modulation bandwidth and Spectral Emission of LEDs.

Unit:5	Applications	12 hours

Introduction – Video Link Satellite Link – Computer Link – Nuclear Reaction Link – Community Antenna Television – Switched Star CATV – Networking		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60**

Text Book(s)	
1	Optical Fibres and Fibre Optic Communication Systems, Subir Kumar Sarkar, S. Chand Limited, (2007)
2	Fiber Optics Communication, D.C.Agarwal, S.Chand (2010)
3	Optical fiber Communication, Keiser, McGraw Hill (2010)
Reference Books	
1	Optical Fibres and Fibre Optic Communication Systems, R.K.Puri and V.K.Babbar, S. Chand & CO
2	Introduction to Fiber Optics, Ajoy Ghatak, K. Thyagarajan, Cambridge (2009)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/115/107/115107095/
2	https://www.youtube.com/playlist?list=PLq-Gm0yRYwTgr7v3HhdrI_Kcc38369fw-
Course Designed By: **Mr. J. William Charles**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	M	S	M	S	M	M	S	S
CO2	M	S	M	M	S	S	S	M	M	M
CO3	S	M	S	S	M	M	M	M	S	M
CO4	S	S	M	M	S	S	S	S	S	S
CO5	S	S	S	M	M	S	S	S	S	S

*S-Strong; M-Medium; L-Low

SEMESTER VI

Course code	6EA	BIO PHYSICS	L	T	P	C
Core/Elective/SBS		ELECTIVE PAPER – II C	4	0	0	4
Pre-requisite		The students are expected to have basic knowledge in the area of biophysics.	Syllabus Version		2020-21	

Course Objectives:

The main objectives of this course are to:

1. deal with how physics applies to the processes of biology.
2. discover how to modify micro-organisms for producing bio fuel.
3. replace bio-electricity in the place of coal and petroleum products for producing electricity.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	understand interactions between various systems of cells.	K2
2	provide life-saving treatment methods like radiation therapy.	K4
3	find powerful vaccines against infectious diseases.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Structure of Biomolecules	12 hours

Introduction - Atomic structure - Hydrogen atom - Bonds between atoms and molecules - secondary or weak bonds - Bond energy - Disulphate bonds – Peptide bond - Structure of Proteins - Molecular weight determination - Kinetic methods - Static methods - Structure of nucleic acids - DNA - RNA.

Unit:2	Kinetics of Molecules I	10 hours

Diffusion: Factors affecting diffusion·- Simple diffusion – Fick's law of diffusion - Diffusion of electrolytes - Biological significance of diffusion. **Osmosis:** Osmosis - Osmotic pressure - Laws of osmosis - osmometry - osmotic pressure of electrolytes. **Filtration:** Filtration - Passage of fluid though blood vessels - Formation of Urine- Dialysis Principle of dialysis in artificial kidney - kinds of dialysis.

Unit:3	Kinetics of Molecules II	12 hours

Adsorption: Adsorption - Factors affecting adsorption - Adsorption of ions by Solids and Liquids - adsorption of Gases by solids - Biological significance of adsorption. **Hydrotropy**: Hydrotropy - Biological importance of hydrotropy. **Precipitation:** Precipitation - Biological significance. **Colloids:** Types of colloids - characteristics of colloids - stability of colloids - Gel - Emulsions - Techniques for the separation of colloids - Biological importance of colloids – Gibb's Donnan Equilibrium.

Unit:4	Optical Techniques in Biological Studies	12 hours

Characteristics of light- compound· microscope - Ultraviolet microscope - Electron microscope Transmission electron microscope - Scanning Electron microscope - Monochromator - Light sensitive detectors- Spectrophotometer - Atomic absorption flame photometer - Electromagnetic radiation Spectroscopy - Ultraviolet, visible, infrared and fluorescent spectroscopy - Atomic absorption and emission spectroscopy - mass spectroscopy - Raman spectroscopy – X-ray diffraction crystallography.

Unit:5	Bioelectricity and Radiation Biology	12 hours
Membrane potential - Resting membrane potential - Action potential and nerve impulse conduction Rate of nerve impulse conduction- Recording of nerve impulses by C.R.O - Resting membrane potential -.J Injury potential- Monophasic and diphasic action potentials - Radioactivity - Natural radioactivity Artificial or induced radioactivity - Radioactive disintegration - units of Radioactivity.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60**

Text Book(s)	
1	Biophysics: Principles and Techniques, M.A. Subramanian, MJP Publishers, (2015).
2	Principles of biophysics, Dr S. Palanichamy, Dr.M. Shanmugavelu, Palani Paramount Publications, (1996).
Reference Books	
1	Biophysics, S. Thiravia Raj, Saras Publication, (2009).
2	Basic Biophysics for Biologist, M. Daniel, Agro-Bios, (1998).
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.sciencedirect.com/topics/earth-and-planetary-sciences/biophysics
2	https://onlinecourses.nptel.ac.in/noc20_ph02/preview
Course Designed By: **Dr. P. Sagunthala**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	M	M	S	M	M	M	S	M
CO2	M	S	S	M	S	S	S	M	S	S
CO3	M	S	S	S	S	S	M	S	S	S

*S-Strong; M-Medium; L-Low

SEMESTER VI

Course code	6EB	Object Oriented Programming with C++	L	T	P	C
Core/Elective/SBS		ELECTIVE III A	4	0	0	4
Pre-requisite		The students are expected to possess fundamental knowledge in object-oriented programming with C++	Syllabus Version		2020-21	

Course Objectives:

The main objectives of this course are to:

1. understand how C++ improves C with object-oriented features.
2. learn how to write inline functions for efficiency and performance.
3. learn the syntax and semantics of the C++ programming language.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	understand the concept of data abstraction and encapsulation	K2
2	learn how to design C++ classes for code reuse.	K6
3	learn how to use exception handling in C++ programs.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Tokens, Expressions and Control Structures	12 hours

Structure of C++ Program – Tokens – Keywords – Identifiers and constant basic data types – user defined data types – derived data types – symbolic constants – type compatibility – declaration of variables – dynamical initialization of variables – reference variables – operator in C++ - scope resolution operators.

Unit:2	Functions in C++	12 hours

The main function – function prototyping – call be reference – inline functions-Function overloading – Math library functions – specifying a class – defining member functions– C++ program with class – making an outside function Inline- Nesting of member functions – Static Data members – Static member functions – Friendly functions.

Unit:3	Constructors	12 hours

Constructors – Parameterized constructors – Multiple constructors in a class - Constructors with Default Arguments – copy constructor – Dynamic Constructors

Unit:4	Destructors	12 hours

Destructors - Defining Operator Overloading – Overloading unary operators – Overloading Binary operators – Rules for overloading operators.

Unit:5	Inheritance	10 hours

Inheritance - Defining derived classes – single Inheritance - Multilevel inheritance – Multiple Inheritance - Hierarchical Inheritance

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars - webinars

Total Lecture hours	60

Text Book(s)	
1	Object Oriented Programming with C++, E. Balagurusamy, TMH Publications (2019).
2	Programming with C++, John R. Hubbard, TMH Publications, (2002).
Reference Books	
1	The C++ Programming Language, Bjarne Stroustrup, Addison – Wesley, (1985).
2	Programming: Principles and Practice Using C++, Bjarne Stroustrup, Addison- Wesley Professional, (2008)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.programiz.com/c-programming
2	https://www.geeksforgeeks.org/c-language-set-1-introduction/
3	https://beginnersbook.com/2014/01/c-tutorial-for-beginners-with-examples/
Course Designed By: **Dr P. Sagunthala and Dr. V. Kalaiselvi**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	M	S	M	M	S	M	M	M
CO2	S	S	S	S	S	M	S	M	M	M
CO3	M	S	S	S	S	S	S	S	S	M

*S-Strong; M-Medium; L-Low

SEMESTER VI

Course code	6EB	GEOPHYSICS	L	T	P	C
Core/Elective/SBS		ELECTIVE PAPER – III B	4	0	0	4
Pre-requisite		Students are expected to have fundamental knowledge in the field of natural science concerned with the physical properties of Earth.	Syllabus Version		2020-21	

Course Objectives:

The main objectives of this course are to:

1. study the physical properties of earth and how it works.
2. study various features of earth using gravity, magnetic, electrical and seismic methods.
3. understand all physical parameters of the geothermal field.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	study the genesis and the propagation of seismic waves in geological materials.	K2
2	apply different techniques to solve complex problems and evaluate large areas of subsurface rapidly.	K5
3	do modeling and calculations using computers.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Seismology	10 hours

Introduction – Seismology –P waves, S waves, their velocities - Time distance curves and the location of epicenters - Effect of boundaries - Major discontinuities and resulting phase of seismic waves - Derivation of properties from the velocities.

Unit:2	Surface Waves and Seismometry	12 hours

Surface waves: Rayleigh waves and Love waves - Study of earth by surface waves.

Seismometry: Horizontal seismograph and seismography equation – Strain seismograph.

Unit:3	Earthquakes and Gravity	12 hours

Earthquakes: Focus, magnitude, frequency - Detection and prediction.

Gravity: The potential (Laplace's equation and Poisson's equation) - Absolute and relative measurements of gravity - Hammond Faller method - Worden gravimeter.

Unit:4	Geomagnetism and Internal Structure of the Earth	12 hours

Geomagnetism: Fundamental equations - Measurements: method of Gauss, saturation induction magnetometers, proton precession magnetometers, alkali vapour magnetometers - Theories of earth's magnetism - Causes of the main field -Dynamo theories. **Internal structure of the earth**: The core variation of mechanical properties with depth - Materials and equation of state of the interior of the earth.

Unit:5	Geochronology and Geothermal Physics	12 hours

Geochronology: Radioactivity of the earth - Radioactive dating of rocks and minerals Geological time scale - The age of the earth. **Geothermal physics**: Flow of heat to the surface of the earth - Sources of heat within the earth - Process of heat transport – Internal temperature of the earth.

Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60**

Text Book(s)

1	Introduction To Geophysics Mantle Core And Crust, G. D. Garland, Philadelphia, W.B.Saunders, (1971).
2	Physics of the Earth and Planets, A. H. Cook, McMillan, (1973).

Reference Books

1	Fundamentals of Geophysics, William Lowrie, Andreas Fichtner, Cambridge University Press, (1997).
2	Exploration Geophysics, Mamdouh R. Gadallah, Ray Fisher, Springer Science & Business Media, (2008).

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/content/storage2/courses/105101083/download/lec5.pdf
2	https://www.youtube.com/playlist?list=PLfk0Dfh13pBPXtgn8BT-dpkfaWMRusJwI

Course Designed By: **Dr. P. Sagunthala**

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	M	S	M	M	S	M
CO2	M	S	M	S	S	M	M	S	M	S
CO3	M	S	S	M	S	S	S	S	M	S

*S-Strong; M-Medium; L-Low

SEMESTER VI

Course code	**6EB**	**INDUSTRY AUTOMATION & ITS APPLICATIONS (INDUSTRY 4.0)**	**L**	**T**	**P**	**C**
Core/Elective/SBS		**Elective Paper III C**	**4**	**0**	**0**	**4**
Pre-requisite		The students are expected to know the fundamental concepts about windows, internet and their application.	**Syllabus Version**		**2020-21**	

Course Objectives:

The main objectives of this course are to:

1. explore the idea of office maintenance using computers.
2. discuss and develop practical skills in using internet and Google apps.
3. identify the internet of things and get awareness regarding hacking.

Expected Course Outcomes:

On the successful completion of the course, students will be able to:

1	understand the basics of windows and internet of things.	K1
2	be aware of ethical Hacking.	K2
3	practice Google apps and recognize their applications in day-to-day life	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Windows**	**12 hours**

UNIT–I: Definition of Operating System, Functions of OS, and types of OS. Desktop icons and their functions: My computer, My documents, My Network Place, Recycle Bin, Files, Folder, Local Disk Drive, CD/DVD Drive, Pen Drive, SD Card. **Basics of Networks:** LAN, WAN, MAN, Wireless, Home Networks, Connection-oriented and connectionless services, DNS – E-mail.

Unit:2	**Ethical Hacking**	**12 hours**

Introduction to Ethical Hacking – Hacker and Cracker. Fundamentals of Computer Fraud - Foot printing and scanning – Malware Threats: Viruses and Worms, Trojans, Spyware, Malware Counter measures. **Connectivity Ports:** PS/2 keyboard and mouse port, USB OTG, Ethernet port, serial port, parallel port, HDMI port, VGA port, display port, USB A-Type, USB B-Type, USB C-Type, Type A Mini and micro port, Type B Micro.

Unit:3	**Internet of Things**	**12 hours**

Introduction, Definition & characteristics of IOT, IOT in everyday life, Internet of everything. **IOT Applications**: Satellite system, Smart signals in cities and location sharing, smart satellites and radar, IOT in education. Development of India in IOT: Solar Plant System, ATM chip card system, IOT in health care industry, IOT in Wireless Devices. **Challenges in IOT**: Big Data Management, Connectivity challenges

Unit:4	**Google Apps for Education**	**12 hours**

Basics of Google Docs, Google Sheets, Google Slides, Google Drive.

Unit:5	**Google Applications**	**10 hours**

Basics of Google Play store, Google Calendar, Google Contacts, and Google Meet.
Social Media Applications: WhatsApp, Telegram, Facebook, Twitter, YouTube, Instagram.

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars - webinars

Total Lecture hours	**60**

Text Book(s)

1	Quick Course in Microsoft Office- Joyce Cox & Polly Urban, GOLGOTIA Publications. .
2	Internet of Things-A hands on Approach , Arshdeep Bahga, Vijay Madisetti, Universities press
3	Ethical Hacking: A Beginners Guide to Learning the World of Ethical Hacking, Lakshay Eshan, Shockwave Publishing (2018)
4	The Google Apps Guidebook: Lesson, Activities and Projects Created by Students for Teachers Paperback, Kern Kelley, Tech Sherpas, (August 2, 2016)
Reference Books	
1	PC Software for Windows Made Simple, R.K. Taxali, Tata McGrawHill Publishing Company, (1998).
2	Internet of Things, Srinivasa K.G., Siddesh G.M.,Hanumantha Raju R., Cengage Learning India Pvt. Ltd (2018)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	Google Docs: https://www.youtube.com/watch?v=xJiUTXGv3PE&vl=en
2	Google Sheet : https://www.youtube.com/watch?v=FIkZ1sPmKNw
3	Google Calendar and Google Meet : https://youtu.be/PKuBtQuFa-8
4	IOT : https://www.youtube.com/watch?v=UrwbeOIlc68
Course Designed By: **Dr. S. Prasath**, Coordinator, E-learning cell, Nandha Arts & Science College, Erode	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	M	S	S	S	L	S	S
CO2	S	S	M	M	S	S	S	L	S	S
CO3	S	S	M	L	S	M	L	M	S	M

*S-Strong; M-Medium; L-Low

Value Added Course

VALUE ADDED COURSE I

Value added course	**OPTOELECTRONICS**	**L**	**T**	**P**	**C**
		30	**0**	**0**	**4**
Pre-requisite	Students are expected to possess some basic knowledge in the field of Semiconductor technology.	**Syllabus Version**		**2020-21**	

Course Objectives:

The main objectives of this course are to:

1. understand the optical process in a semiconductor.
2. understand the basic optoelectronics devices-LED, OLED, photo detector and photovoltaic devices.
3. be familiar with recent trends in optoelectronics.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	describe basic laws and phenomena that define behaviour of optoelectronic devices.	K1
2	describe the development and application of optoelectronic systems	K2
3	interpret the acquired data and measured results.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Module:1	**2 hours**
Electron - hole pair formation and recombination, absorption in semiconductor direct and indirect band gap semiconductors.	
Module:2	**2 hours**
Effect of electric field on absorption, Franz-Keldysh effect in semiconductors.	
Module:3	**2 hours**
Light Emitting Diodes — Materials for light emitting diodes, Principle of action of LED, expression for light power in terms of photon energy, homo structured LED and Hetero junction LED, drawbacks of homo structured LED.	
Module:4	**2 hours**
Types of LED structures—planar, dome type, surface emitter, edge emitter, super luminescent structure.	
Module:5	**2 hours**
Performance characteristics of LED—Optical output power-current characteristics, forward current voltage characteristics.	
Module:6	**2 hours**
Performance characteristics of LED—Optical output power-current characteristics, forward current voltage characteristics, Modulation bandwidth, power bandwidth product, Lifetime, Rise time/fall time, reliability,	
Module:7	**2 hours**
Internal quantum efficiency, advantages / disadvantages of using LED. Numerical problems	
Module:8	**2 hours**
Organic light emitting diodes (OLED), The principle of OLED, characterisation, structure,	

efficiency, multilayer OLED.	
Module:9	**2 hours**
Important parameters of photo detectors, Detector responsivity, spectral response range, response time, quantum efficiency, capacitance, noise characteristics.	
Module:10	**2 hours**
Absorption of radiation—absorption coefficient, mention of expression for photocurrent, long wavelength cut off, direct and indirect absorption T.	
Module:11	**2 hours**
Types of photodiodes—Junction photodiodes, pin diode, avalanche photodiodes, CCD photodetectors; Comparison of different detectors, Photomultiplier tubes.	
Module:12	**2 hours**
Phototransistors—characteristics. Photo conductive detectors—expression for photoconductive gain. Numerical problems.	
Module:13	**2 hours**
Solar cell—IV characteristics, efficiency, materials	
Module:14	**2 hours**
Organic photovoltaic diodes (OPVD)—fundamental process, exciton absorption, exciton dissociation	
Module:15	**2 hours**
Charge transport, charge collection, characterisation. numerical problems	
Total Lecture hours	**30**
Text Book(s)	
1	Fibre Optics Communications, Harold Kolimbiris, Prentice Hall, (2004).
2	Optical Fibre Communications, Keiser G, McGraw Hill, (2000).
Reference Books	
1	Fibre Optic Communication, Agarwal D C, Wheeler Publications, (1996).
2	Optical Communication, Katiyar S, S K Kataria and Sons, (2010).
3	Optoelectronics and Photonics: Principles and Practices, Kasap S O, Pearson, (2013).
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/115/102/115102026/
2	https://moodle.usth.edu.vn/course/view.php?id=362#section-1
3	https://www.classcentral.com/course/swayam-semiconductor-optoelectronics-10043
Course designed by: **Dr. S. Krishnaveni**	

VALUE ADDED COURSE II

Value added course	**NON – DESTRUCTIVE TESTING**	**L**	**T**	**P**	**C**
		30	**0**	**0**	**4**
Pre-requisite	Students should be aware of some fundamental principles of non – destructive testing and thermography.	**Syllabus Version**		**2020-21**	

Course Objectives:

The main objectives of this course are to:

1. learn the fundamentals of NDT and its applications which will be used for solving problems in industries to produce flawless components.
2. acquire the knowledge about different types of Non-Destructive testing methods and to apply those principles to identify defects in various products produced in industries.
3. study and understand various Non-Destructive evaluations, testing methods, theories and their industrial applications.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	understand the magnetic testing methods and interpretation of results and applications.	K2
2	understand the application of Thermography, eddy current testing method, ultrasonic and acoustic emission testing.	K3
3	understand the instrumentation of various Radiography and testing techniques such as Fluoroscopy, Xerography, Computed Radiography and Computed Tomography.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Module:1	**2 hours**
Introduction of materials testing -Classification of materials tests – Overview of non-destructive testing methods.	
Module:2	**2hours**
Various NDT methods- selection of NDT methods-Visual Inspection.	
Module:3	**2hours**
Introduction-principle-types of visual testing- Experiments used in visual inspection -Applications.	
Module:4	**2 hours**
Liquid Penetrant Testing – Principles - Testing Process - penetrant materials – Developers.	
Module:5	**2 hours**
Penetrant testing methods- Interpretation of results- Applications.	
Module:6	**2 hours**
Magnetic Particle Testing- Magnetic testing methods-Interpretation and evaluation of test indications. - Application of Magnetic particle Inspection.	
Module:7	**2 hours**
Thermography principles- Contact and non-contact inspection methods-Techniques for applying liquid crystals-Advantages and limitation.	
Module:8	**2 hours**

Infrared radiation and infrared detectors-Generation of eddy currents, Properties of eddy currents	
Module:9	**2 hours**
Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.	
Module:10	**2 hours**
Ultrasonic and acoustic emission testing - Basics of ultrasonic waves- Principle- Equipment for ultrasonic testing- Testing methods.	
Module:11	**2 hours**
Ultrasonic transducers- Mode of displays- Application.	
Module:12	**2 hours**
Introduction- Basic principle- Instrumentation of acoustic emission testing- Modes- Four channel data acquisition- Applications.	
Module:13	**2 hours**
Radiography testing - Principle-Equipment of Radiography Testing-film and film less techniques-types and use of filters and screens.	
Module:14	**2 hours**
Characteristics of films -graininess, density, speed, contrast-characteristic curves- Radiographic techniques.	
Module:15	**2 hours**
Fluoroscopy- Xerography-Computed Radiography- Computed Tomography.	
Total Lecture hours	**30**

Text Book(s)

1	Practical Non-Destructive Testing, Baldev Raj, T.Jayakumar, M.Thavasimuthu, Narosa Publishing House, (2014).
2	Non-Destructive Testing Techniques, Ravi Prakash, New Age International Publishers, (2010).

Reference Books

1	Handbook of Non-destructive evaluation, Charles, J. Hellier, McGraw Hill Professional, (2001).
2	Introduction to Non-destructive testing: a training guide, Paul E Mix, Wiley, 2nd Edition New Jersey, (2005).

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/113/106/113106070/

Course designed by: **Dr. D.M.Suresh and Dr. K Saravana kumar**

VALUE ADDED COURSE III

Value added course	**Biomedical instrumentation**	**L**	**T**	**P**	**C**
		30	**0**	**0**	**4**
Pre-requisite	Students are expected to have some basic knowledge in the field of physiology, operations and instruments used in medical field.	**Syllabus Version**		**2020-21**	

Course Objectives:

The main objectives of this course are to:

1. understand the working principles of Biomedical Instruments.
2. find applications of various biomedical instruments.
3. impart the knowledge of electronics on various biomedical instruments.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	study the safety instrumentation against radiation, physiological effects due to current passage and electrical accidents in the hospitals.	K1
2	analyse the theory of Bio-Telemetry, its problems and uses.	K4
3	evaluate the advances in biomedical instrumentation such as lasers in medicine, endoscope, CT scan, ultrasonic imaging, MRI and biofeedback instrumentation	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Module:1	**2 hours**

Physiological Assist Devices: -Introduction – pacemakers – pace maker batteries.

Module:2	**2 hours**

Artificial heart valves – nerve and muscle stimulators.

Module:3	**2 hours**

Heart lung machine – kidney machine.

Module:4	**2 hours**

Operation theatre equipment: Introduction – surgical diathermy – ventilators – anesthesia machine.

Module:5	**2 hours**

Cardiac output measurements – pulmonary function analysers – gas analysers.

Module:6	**2 hours**

Blood gas analysers – oxymeters – elements of intensive care monitoring.

Module:7	**2 hours**

Bio-Telemetry: Elements of bio-telemetry system.

Module:8	**2 hours**

Design of a bio-telemetry system – radio telemetry system.

Module:9	**2 hours**

Problems in implant telemetry – uses of bio-telemetry.

Module:10	**2 hours**

Safety instrumentation Introduction – radiation safety instrumentation.

Module:11	**2 hours**

Physiological effects due to 50 Hz current passage – electrical accidents in hospitals.

Module:12	**2 hours**
Devices to protect against electrical hazards – hospital architecture.	
Module:13	**2 hours**
Advances in bio-medical instrumentation: Introduction – computers in medicine – lasers in medicine.	
Module:14	**2 hours**
Endoscopes – cryogenic surgery – CT scan – ultrasonic imaging.	
Module:15	**2 hours**
MRI – biofeedback instrumentation – biomaterials.	
Total Lecture hours	**30**

Text Book(s)	
1	Biomedical instrumentation, M. Arumugam, AnuradhaPublicatios, (2009).
2	Introduction to biomedical electronics, Joseph Dubovy, Tata McGraw Hill Company (1978).
Reference Books	
1	Biomedical Instrumentation and Measurements, Leslie Cromwell, Fred J. Weibell And Erich A. Pfeiffer, Measurements Prentice Hall of India (1997).
2	Handbook of biomedical instruments, Khandpur. R.S, Tata McGraw Hill Company (2003).
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/108/105/108105101/
2	https://onlinecourses.nptel.ac.in/noc20_ee41/preview
3	https://www.classcentral.com/course/bioengineering-20126
Course designed by: **Dr. P. Sagunthala and Dr. K Saravana kumar**	

VALUE ADDED COURSE IV

Value added course	**Modern Display Devices and Storage Materials**	**L**	**T**	**P**	**C**
		30	**0**	**0**	**4**
Pre-requisite	Students are expected to know some basic concepts of display devices, its usage and about some storage materials.	**Syllabus Version**		**2020-21**	

Course Objectives:

The main objectives of this course are to:

1. acquire knowledge about different types of electronic devices and about some storage materials.
2. understand the selection process which will be used in industries.
3. create various electronic and optoelectronic devices using suitable materials.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	evaluate display performances which are necessary to appropriately select a LCD in clinical situations.	K1
2	present information in visual or tactile form.	K2
3	apply these concepts for electronic visual displays.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Module:1	**2 hours**
Selection of materials for different devices: Selection Criteria- Operating Parameters-Manufacturing Process-Functional Requirements-Cost consideration.	
Module:2	**2 hours**
Engineering Requirements-Types of Materials-Examples of selection criteria.	
Module:3	**2 hours**
Modern Engineering materials: Metallic Glasses-Structure-Preparation-Properties-Applications.	
Module:4	**2 hours**
Shape memory alloys- Introduction-Structural Changes-General Characteristics-Characterization Techniques-Commercial SMAs-Applications.	
Module:5	**2 hours**
IC Packaging Materials. Introduction-IC packing-Package type-Package materials.	
Module:6	**2 hours**
Display Devices: Introduction-Electroluminescence process- LED materials.	
Module:7	**2 hours**
Fabrication of LED - Applications - Active and passive display devices.	
Module:8	**2 hours**
Liquid crystals-Types -General features of liquid crystals-liquid crystal display systems-TN-LED (twisted nematic liquid crystal display) - merits and Demerits**.**	
Module:9	**2 hours**
Magnetic Data Storage Devices: Basics of magnetic materials and their parameters - Memory concepts	
Module:10	**2 hours**

Magnetic surface storage devices-magnetic Disc Memories	
Module:11	**2 hours**
Flexible disc storage systems-Floppy disks- Magnetic Tapes and drives-Magnetic Bubble materials	
Module:12	**2 hours**
Rare earth garnets-Magnetic Bubble memories - Charge Couple devices – Applications**.**	
Module:13	**2 hours**
Optical Data Storage Devices: Principle-Disc data storage- Structure and operating principle of CD-ROM.	
Module:14	**2 hours**
Magneto-optical storage system (recording and reading) - Data storage and retrieval methods.	
Module:15	**2 hours**
Holography data storage-principle-storing and retrieving digital data-Applications of Holography.	
Total Lecture hours	**30**

Text Book(s)	
1	Semiconductor Physics and Optoelectronics, V.Rajendran, J.Hemalatha, M.Stalin Mano Gibson, Vikas Publishing House PVT Ltd, (2003).
2	A Text book of Material Science, K.G.Aswani, S. Chand & Company ltd, (2001).
Reference Books	
1	Material science, O.P.Khanna, Dhanpat Rai Publications, (2004).
2	Semiconductor Physics and Optoelectronics, M.Arumugam, Anuradha Agencies,(2003).
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.slideshare.net/mobile/thesaifeye/material-handling-storage-system
2	https://www.slideshare.net/mobile/jerinmartin/display-devices-44886026
Course designed by: **Dr. D.M.Suresh and Dr. K Saravana kumar**	

Allied Course

BHARATHIAR UNIVERSITY, COIMBATORE
ALLIED PHYSICS PAPERS FOR B. Sc., MATHS / CHEMISTRY
2020-2021 BATCH AND ONWARDS

SEMESTER I / III

Course code	**1AF/ 3AF**	**ALLIED PHYSICS-I**	**L**	**T**	**P**	**C**
Allied Paper			**4**	**0**	**0**	**4**
Pre-requisite		The students are expected to know the fundamental of properties of matter, heat and electricity.	**Syllabus Version**		**2020-21**	

Course Objectives:

The main objectives of this course are to:

1. understand the behavior of matter in everyday life.
2. acquire .skill of solving related problems.
3. get clear idea about properties of matter, electricity and magnetism.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	understand and define the laws involved in gravitation and elasticity.	K2
2	develop the knowledge about heat and thermodynamics, sound and spectroscopy.	K3
3	understand the concept of properties of matter and to recognize their applications in various real problems.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit: I	**Properties of Matter**	**12 hours**

Gravitation: Newton's law of Gravitation - Determination of G by Boy's method - mass and density of earth – acceleration due to gravity - Determination of g by compound pendulum.
Elasticity: Basic concepts – bending of beams – depression of cantilever- Determination of Y by uniform and non- uniform bending method- Torsion in a wire- Determination of rigidity modulus by torsional pendulum.

Unit: II	**Heat and Thermodynamics**	**12 hours**

Vanderwaal's equation of state - critical constants of a gas - derivation of critical constants in terms of Vanderwaal's constants – Joule-Thomson effect – Porous plug experiment – liquefaction of gases: liquefaction of helium – K-Onnes method – properties of liquid Helium I and II. **Sound**: Doppler effect – derivation and applications – Frequency of A.C by Sonometer – Ultrasonics: production – Piezoelectric method, properties and applications

Unit: III	**Atomic Spectroscopy**	**12hours**

Pauli's exclusion principle - Some examples of electronic configuration with their modern symbolic representation – Optical spectra - Fine structure of sodium D line - Zeeman effect – Experimental arrangement, Expression for Zeeman Shift. **X-Rays**: Introduction – Production - Coolidge tube – Bragg's law – derivation – X-Ray spectra – Continues – Characteristic – Moseley law and its importance.

Unit: IV	**Electricity**	**12 hours**

Conversion of galvanometer into ammeter and voltmeter – Ballistic Galvanometer – principle-construction – theory – figure of merit — current and voltage of sensitiveness – measurement of

Thermo EMF and resistance by potentiometer – applications of electromagnetic induction – Transformers: Theory, energy loss and applications		
Unit: V	**Magnetism**	**10 hours**
Magnetic properties of materials: Magnetic induction B – Magnetisation M – Magnetising field H – Relation between – B, H and M – Magnetic susceptibility – Magnetic permeability – Properties of dia, para and ferro magnetic materials – Curie temperature – Energy loss due to hysteresis – importance of hysteresis curves – magnetic circuit.		
Unit: VI	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60**

Text Book(s)	
1	Properties of Matter and Acoustics, R. Murugesan, 2nd Edition, S.Chand & Co. Ltd. Reprint (2017).
2	Modern Physics, R.Murugesan, Kiruthiga Sivaprasath, Twelth Revised Edition, S.Chand & Co. Ltd. Reprint (2006).
3	Heat and Thermodynamics, Brijlal N.subramaniyam, S.Chand & Co. LtdReprint(2006).
4	Electricity and magnetism , R. Murugesan ,Revised edition , S.Chand & Co Reprint (2014)
,	
Reference Books	
1	Heat Thermodynamics and Satistical Physics, Brijlal N.subramaniyam,P.S.Hemme, S.Chand & Co,Revised edition (2007).
2	Thermodynamics and Statistical Physics, Agrawal Prakash, Pragati Prakashan, 27th edition (2015)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.physicstutoronline.co.uk/alevelphysicsnotes/
2	https://www.askiitians.com/revision-notes/physics/atomic-physics/
3	www.khanacademy.org/science/physics/elasticity/surface tension
4	https://sites.google.com/brown.edu/lecture-demonstrations/home?authuser=0
Course Designed By: **Dr. P. Sagunthala, Dr. P. Yasotha**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	M	M	S	S	S	L	S	S
CO2	S	S	M	S	L	M	S	M	M	S
CO3	M	S	S	L	S	M	L	M	S	M

*S-Strong; M-Medium; L-Low

SEMESTER II / IV

Course code	**2AF/ 4AF**	**ALLIED PHYSICS-II**	**L**	**T**	**P**	**C**
Allied paper			**4**	**0**	**0**	**4**
Pre-requisite		The students are expected to know the fundamentals of Nuclear Physics, Lasers, Semiconductors and electronics.	**Syllabus Version**		**2020-21**	

Course Objectives:

The main objectives of this course are to:

1.gain a well understanding of various physics concepts involved in day-to-day life.
2.aquire knowledge in physics concepts and problem solving skills
3.developing skills to meet competitive exams

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Acquire knowledge on basic concepts of photoelectric effect and fission, fusion and to get clear idea on wave mechanics.	K1
2	Understand the features of Nuclear forces, photo electric cells, semiconductor diodes and their fundamental concepts.	K2
3	Understand the concept of Laser properties, digital electronics and to recognize their applications in real life.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit: I	**Modern Physics**	**12 hours**

Photo electric effect – Laws of photo electric effect – Einstein's photo electric equation – verification of Einstein's photo electric equation by Millikan's experiment – photo electric cells – applications. **Wave mechanics:** De Broglie matter waves – determination of De Broglie wave length – Experimental study of De Broglie matter wave by G.P. Thomson experiment.

Unit: II	**Nuclear Physics**	**11 hours**

Characteristics of nuclear forces – nuclear structure by liquid drop model – Binding energy – mass defect – particle accelerators – cyclotron and betatron – artificial transmutations by α – particles - nuclear Fission and nuclear Fusion – elementary particles – Leptons, Mesons and Baryons

Unit: III	**Laser Physics**	**11 hours**

Purity of spectral lines – Coherence length and time – spontaneous and induced emissions – population inversion – meta stable state – conditions for laser actions – Ruby laser – Helium – neon laser – applications of lasers – Raman effect – Raman shift – stokes and anti-stokes lines – Laser Raman Spectrometer.

Unit: IV	**Semiconductor Physics**	**12 hours**

Volt – Ampere Characteristics of P-N junction Diode – Zener diode – applications of Zener diodes – photo diode-Principles of LED– Frequency Modulation and Amplitude modulation – basic principles of antennas – block diagram of Superhetrodyne receiver – block diagram of monochrome TV receiver – basic principles and applications of RADAR

Unit: V	Digital Electronics	12 hours
Integrated Electronics Steps in fabrication of Monolithic IC's – General applications of IC's. **Analog and digital computers** – organization of digital computers – number systems – conversion of binary into decimal – conversion of decimal to binary – binary addition and subtraction – Basic logic gates – NAND and NOR as an universal logic gates – Demorgan's theorems – Boolean algebra – applications of Demorgans theorems – Half adder and full adder circuits.		
Unit: VI	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**60**

	Text Book(s)
1	Modern Physics, R.Murugesan , Kiruthiga Sivaprasath, Twelth Revised Edition, S.Chand & Co. Ltd. Reprint (2006)
2	Principles of Electronics, V.K. Metha , Reprint, S.Chand & Co (2000)
	Reference Books
1	A Text Book of electronics, R.S Sedha, S.Chand & Co. Ltd. Reprint (2008).
2	Modern Physics, Sehgal.Choppa, Sehgal, S.Chand & Co
	Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
1	https://www.askiitians.com/revision-notes/physics/atomic-physics/
2	https://www.askiitians.com/revision-notes/physics/nuclear-physics/
3	https://www.askiitians.com/revision-notes/physics/solid-and-electronic-device/
Course Designed By: **Dr. P. Sagunthala and Dr. P. Yasotha**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	M	S	S	S	L	S	S
CO2	S	M	S	M	M	S	S	L	M	S
CO3	M	S	M	L	S	M	L	M	S	M

SEMESTER I&II / SEMESTER III&IV

Course code	2PF/4PF	ALLIED PHYSICS PRACTICALS	L	T	P	C
Allied Practicals		(Examination at the end of II/ IV semester)	0	0	2	3
Pre-requisite		Should have the fundamental knowledge of Basic Experiments in physics	Syllabus Version		2020 - 21	

Course Objectives:

The main objectives of this course are to:

1. Understand the basics of Experimental techniques and to apply it
2. Gain knowledge about different light and optical properties..
3. Motivate the students to apply the principles of physics in their day-to–day life.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	attain skill to Understand the usage of basic laws and theories to determine various properties of the materials given.	K3
2	to analyze the characteristics of various diodes and construct power supply.	K4
3	acquire the knowledge of the potentiometer and to apply it for various experiments.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

LIST OF EXPERIMENTS (Any twelve experiments)	**56 hours**

1. Acceleration due to gravity-Compound pendulum method
2. Moment of inertia – Torsional pendulum method
3. Young's modulus - Uniform bending - Optic lever method
4. Young's modulus - Non-uniform bending - Pin and microscope
5. Rigidity modulus – Static torsion method.
6. Frequency of A.C - Sonometer
7. Thermal conductivity - Lee's disc method.
8. Refractive index of a solid prism – Spectrometer
9. Refractive index of a liquid prism – Spectrometer
10. (i-d) curve - solid prism - Spectrometer
11. Wavelength of spectral lines – Grating - Minimum deviation - Spectrometer
12. Radius of curvature of lens - Newton's rings method.
13. Viscosity of highly viscous liquid – Stoke's method.
14. Surface tension - Drop weight method
15. Low range voltmeter calibration - Potentiometer
16. Low range ammeter calibration - Potentiometer
17. Construction of IC regulated power supply
18. Characteristics of PN Junction diode
19. Characteristics of Zener diode
20. Verification of truth tables of logic gates

Contemporary Issues	**4 hours**

Online workshop, Webinars on Experimental Electronics

Total Practical Hours: 60

Reference Books

1	Practical Physics and Electronics, C.C.Ouseph, U.J.Rao, V.Vijayendran, S.Viswanathan Publishers (2007)

2	A text book of practical Physics, M.N.Srinivasan, S.Balasubramanian, R.Ranganathan, Sultan Chand&Sons (2017)
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/115/105/115105110/
2	https://www.youtube.com/playlist?list=PLuiPz6iU5SQ8-rZn_LgLofRX7n8z4tHYK
3	https://www.slideshare.net/mobile/sunilrathore77398/basicanalogelectronics
Course Designed By: **Dr. P. Sagunthala and Dr. P. Yasotha**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	S	S	M	L	M	S	M
CO2	S	S	M	S	S	L	M	S	S	S
CO3	M	M	S	S	L	M	S	S	S	M

*S-Strong; M-Medium; L-Low

Annexure

B. Sc. PHYSICS

Syllabus
(With effect from 2020 – 21)

Program Code:

DEPARTMENT OF PHYSICS
Bharathiar University
(A State University, Accredited with "A" Grade by NAAC and 13th Rank among Indian Universities by MHRD-NIRF)
Coimbatore 641 046, INDIA

LIST OF ELECTIVE PAPERS (Colleges can choose any one of the papers from each section as electives)		
Elective – I	**A**	Principles of Programming Concepts and C Programming
	B	Energy Physics
	C	Agricultural Physics
Elective – II	**A**	Digital and Microprocessor
	B	Optical Fibers and Fiber Optic Communication Systems
	C	Bio-Physics
Elective - III	**A**	Object Oriented Programming with C++
	B	Geo Physics
	C	Industry Automation & Its Applications **(Industry 4.0)**

LIST OF VALUE ADDED COURSES (OPTIONAL)

(Only Internal and no external exam – 100 Marks)

- OPTOELECTRONICS
- NON–DESTRUCTIVE TESTING
- BIOMEDICAL INSTRUMENTATION
- MODERN DISPLAY DEVICES AND STORAGE MATERIALS

MARKS DISTRIBUTION (EXTERNAL AND INTERNAL (CIA))

I. THEORY

TOTAL MARKS	EXTERNAL		INTERNAL	Overall Passing Minimum (Internal + External)
	Max. Marks	Passing Minimum	Max. Marks	
100	75	30	25	40
75	55	22	20	30

S. No	Theory – CIA Breakups		
	Maximum Marks	25	20
1	Tests (one best test out of two of 2 hours each)	10	8
2	End semester model test (3 hours)	10	8
3	Assignments- 2 No.s	5	4

II. PRACTICALS

TOTAL MARKS	EXTERNAL		INTERNAL	Overall Passing Minimum (Internal + External)
	Max. Marks	Passing Minimum	Max. Marks	
100	60	24	40	40

75	45	18	30	30
50	30	12	20	20

S. No	Practical – CIA Breakups			
	Maximum CIA Marks	**40**	**30**	**20**
1.	Minimum 10 experiments to be completed.	20	15	8
2.	Tests: One best test out of two tests.	15	10	7
3.	Record	5	5	5

QUESTION PAPER PATTERN

The following question paper patterns shall be followed for OBE pattern syllabi for the candidates admitted from the academic year 2020-21 wherever applicable otherwise provided in syllabi itself.

Maximum 75 Marks – wherever applicable			
SECTION A	Multiple choice questions with four options	10*1=10	10 questions – 2 from each unit
SECTION B	Short answer questions of either / or type	5*5=25	5 questions – 1 from each unit
SECTION C	Essay-type questions of either / or type	5*8=40	5 questions – 1 from each unit

Maximum 55 Marks – wherever applicable			
SECTION A	Multiple choice questions with four options	10*1=10	10 questions – 2 from each unit
SECTION B	Short answer questions of either / or type	5*3=15	5 questions – 1 from each unit
SECTION C	Essay-type questions of either / or type	5*6=30	5 questions – 1 from each unit

The General Awareness paper to have multiple choice questions (with four option) to be evaluated by using OMR. For other courses in Part IV namely, Environmental Studies, Value Education – Human Rights, Yoga for Human Excellence and Women's Rights the question paper pattern should be 5 out of 10. Each question carries 10 marks.