

Programme Objectives

The Master of Science (Applied Physics) Consists of Following 2 Programme part(s) Two year course:

Sr. No.	Programme part Name	Programme part Abbreviation	Examination Pattern
1.	M.Sc. Part-I	M.Sc.-I	Semester: FS/SS
2.	M.Sc. Part-II	M.Sc.-II	Semester: FS/SS

The Master of Science (Applied Physics) is available in following medium of instruction/s:

- 1. English**

M.Sc. (Applied Physics)

Scheme of Teaching and Examination

FIRST SEMESTER OF M.Sc.I

Course No.	Subject	No. Of Periods/week				Paper	Duration (In hrs.)	Examination				Total Marks
		Le.	Tu.	Pr.	Total			Theory (Marks) EA	Theory (Marks) IA	Practical (Marks)	TW & or Viva (Marks)	
APH2101	Mathematical Physics	3	1	-	4	1	3	70	30	-	-	100
APH2102	Mechanics-I (Quantum and Statistical)	3	1	-	4	1	3	70	30	-	-	100
APH2103	Electromagnetic Theory-I	3	1	-	4	1	3	70	30	-	-	100
APH2105	Laboratory Practical	-	-	9	9	-	3	-	-	150	-	150
APH2106	Viva	-	-	-	-	-	-	-	-	-	50	50
APH2119	Classical Mechanics and Computational Techniques	3	1	-	4	1	3	70	30	-	-	100
APH2119 L	Classical Mechanics and Computational Techniques- TW/Viva	-	-	2	2	-	3	-	-	50	-	50
	Total	12	4	11	27	4	18	280	120	200	50	650

*EA= External Assessment, IA= Internal Assessment

SECOND SEMESTER OF M.Sc.I

Course No.	Subject	No. Of Periods/week				Paper			Examination			Total (Marks)
		Le.	Tu.	Pr.	Total		Duration (In hrs.)	Theory (Marks) EA	Theory (Marks) IA	Practical (Marks)	TW & or Viva (Marks)	
APH2201	Mechanics-II Quantum and Statistical	3	1	-	4	1	3	70	30	-	-	100
APH2202	Physics Of Semiconductor Devices	3	1	-	4	1	3	70	30	-	-	100
APH2203	Electromagnetic Theory-II and Crystal Physics	3	1	-	4	1	3	70	30	-	-	100
APH2207	Modern Optics	3	1	-	4	1	3	70	30	-	-	100
APH2213	Electronics-I	3	1	-	4	1	3	70	30	-	-	100
APH2214	Practicals	-	-	8	8	-	-	-		50	-	50
APH2215	TW/Viva	-	-	-	-	-	-	-		-	50	50
	Total	15	5	8	28	5	15	350	150	50	50	600

*EA= External Assessment, IA= Internal Assessment

FIRST SEMESTER OF M.Sc. II

Course No.	Subject	No. Of Periods/week				Paper	Examination					Total (Marks)
		Le.	T u.	Pr.	Total		Duration (In hrs.)	Theory (Marks) EA	Theory (Marks) IA	Practical (Marks)	TW & or Viva (Marks)	
APH2306L	Laboratory Practical	-	-	9	9	-	3	-	-	100	-	100
APH2307L	Viva	-	-	-	-	-	-	-	-	-	50	50
APH2311	Optical, dielectric and Magnetic Properties of Materials	3	1	-	4	1	3	70	30	-	-	100
APH2312	Instrumentation	3	1	-	4	1	3	70	30	-	-	100
APH2313	Electronics-II	3	1	-	4	1	3	70	30	-	-	100
APH2314	Laser and Applications	3	1	-	4	1	3	70	30	-	-	100
APH2315	Nuclear Reactor and Polymer Physics (Elective)	3	1	-	4	1	3	70	30	-	-	100
APH2316L	Computational Techniques and Numerical Analysis (Elective)	-	1	3	4	1	3	-	-	100	-	100
	Total	12/15	5	9/12	29	5	18	350	150	100/200	50	650

SECOND SEMESTER OF M.Sc. II

Course No.	Subject	No. Of Periods/week				Paper	Examination					Total (Marks)
		Le.	Tu.	Pr.	Total		Duration (In hrs.)	Theory (Marks) EA	Theory (Marks) IA	Practical (Marks)	TW & or Viva (Marks)	
APH2406	Project Dissertation	-	-	9	9	1	-	-	-	-	150	150
APH2407 L	Viva	-	-	6	6	-	3	-	-	-	50	50
APH2409	Electron Optics and Applied Optics (Elective)	3	1	-	4	1	3	70	30	-	-	100
APH2411	Crystallization Techniques(Elective)	3	1	-	4	1	3	70	30	-	-	100
APH2412	Physical Techniques in Industry	3	1	-	4	1	3	70	30	-	-	100
APH2413	Non-Destructive testing of Materials	3	1	-	4	1	3	70	30	-	-	100
APH2414	Electronics-III	3	1	-	4	1	3	70	30	-	-	100
APH2415	Fiber Optics and its Applications	3	1	-	4	1	3	70	30	-	-	100
APH2416	Luminescent Materials and Its Application (Elective)	3	1	-	4	1	3	70	30	-	-	100
APH2417	Physics of Nano Materials (Elective)	3	1	-	4	1	3	70	30	-	-	100
	Total	15	5	15	35	6	18	350	150	-	200	700

Bloom's Taxonomy Levels:

1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: MSc. (Applied Physics)

Programme Specific Outcome(PSO)

- PSO1 Learn basics of classical, quantum and statistical mechanics and develop methodology to understand and solve various problems
- PSO2 Basic understanding and application of the electromagnetic theory, modern optics, laser, fiber optics and their applications in imaging, holography and optical instrumentation
- PSO3 Learn mathematical methods and computational techniques used in physical sciences including simulations
- PSO4 Semiconductor devices, electronics and their applications
- PSO5 Learn about various properties of materials, instrumentation, nuclear reactor physics
- PSO6 Advanced understanding and application of physical techniques used in industries at various levels including nondestructive evaluation and device fabrication
- PSO7 Hands-on practice of basics and advanced experiments intended for industrial and research applications
- PSO8 Training and exposure to research problems through project dissertation

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics	Academic Year		2019-20						
M.Sc. (Applied Physics): Regular Programme										
Year	I	Core / Elective / Foundation APH2101:Mathematical Physics	Credits / Hours per week				04			
Semester	I	Year of Introduction: 2007 Year of Syllabus Revision: 2012	Maximum Marks / Grade				100			
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) APH2101 CO1 Understanding of vector calculus CO2 Understanding of complex analysis CO3 Understanding of matrices CO4 Study various differential equations encounter in Physics CO5 study Special Functions of Mathematical Physics CO6 Fourier Series and Integral transform- concept of infinite dimension functional space										
Unit No.	Topic		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	Vector Calculus-1 Coordinate Systems, Curvilinear coordinate system, orthogonal		08	12		CO1	PSO3			

	curvilinear coordinates, rectangular, cylindrical and polar coordinates, differential vector operators, Gradient, Divergence, Laplacian, Curl, Divergence theorem and Stokes theorem						SD	G	PE
2	Vector Calculus-2 Applications of vectors, hydrodynamics, equation of continuity, Euler's equation of motion, Bernoulli's equation, Fourier's heat flow equation, Jacobian	06	12	1,3,4		PSO3			
3	Complex Analysis Complex numbers, Complex functions (polynomials, Exponential, Trigonometric complex functions, Logarithm). Limits and continuity, differentiation, Analytical functions, Cauchy-Riemann conditions, Cauchy's theorem, Cauchy integral formula, Laurent's theorem. Calculus of residues, Evaluation of real definite integrals	08	13	2,3,4	CO2	PSO3			
4	Determinants and matrices Matrices, basic operations, Types of matrices and their properties, symmetric/skew-symmetric, orthogonal matrices, Hermitian/Skew-Hermitian matrices, Unitary matrices, Cramer's law, solution of a set of homogeneous and inhomogeneous equation, development by minors, matrix inversion, Cayley-Hemilton theorem, characterization equation of matrices, eigenvalues and eigenvectors, diagonalization of matrices	08	13	2,4	CO3	PSO3			
5	Differential equations Partial differential equations of theoretical physics, first order differential equations (reading assignment), separation of variables, series solutions.	06	12	1,2,3	CO4	PSO2 PSO1			
6	Special Functions of Mathematical Physics Legendre (equations, polynomials, generating function, recurrence relations, and Rodrigue's formula), Hermite and Bessel (equations, generating function, recurrence relations and properties of the respective functions), application in physics, nonhomogeneous equation Green's function	08	13	1,2	CO4,C O5	PSO2 PSO3			
7	Fourier Series General properties, Fourier coefficient, complex form of Fourier series, Parseval's theorem, Gibbs's Phenomenon, remarks on convergence, extension of the interval, integration and differentiation of Fourier series, applications.	08	12	2,3	CO5,C O6	PSO2 PSO1 PSO3			
8	Integral Transforms Development of Fourier integral, Fourier transform, inversion theorem, Fourier transform of derivatives, convolution theorems, application. Elementary Laplace's transform, Laplace's transform of derivatives, other properties, convolution theorems, inverse Laplace's	08	13	2,3,4	CO6	PSO1 PSO2 PSO3			

	transform, applications.								
Reference Books									
1.	Mathematical methods for physicists :Arfken and Weber, IV edition, Academic Press.								
2.	Mathematical Methods in the Physical Sciences, M.L.Boas, Wiley								
3.	Complex Variables and Applications, J.W. Brown, R. V. Churchill, 8 th Eds, McGraw Hill								
4.	Mathematical Physics, Satya Prakash, S. Chand and Sons								
5.	Mathematical Physics, B.D.Gupta, Vikas Publishing House Pvt.Ltd.								
6.	Mathematical Methods for Physicists: An concise Introduction. T.L.Chow, Cambridge University Press								
7.									

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M.Sc. (Applied Physics): Regular Programme										
Year	I	Core / Elective / Foundation APH2102: Mechanics-I (Quantum & Statistical)	Credits / Hours per week					04		
Semester	I	Year of Introduction: 2007 Year of Syllabus Revision: 2012	Maximum Marks / Grade					100		
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) APH2102 CO1 Understanding the limitation of Newtonian Mechanics and introduction to basic concepts of quantum and statistical mechanics CO2 Learn about the physical interpretation of wave function and Schrodinger equation CO3 Solving the Schrodinger equation for arbitrary potentials CO4 Understand the General formalism of quantum mechanics CO5 Understand basics of Statistical mechanics and thermodynamics CO6 Applications of statistical mechanics to gases and other systems										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G) developmental needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Review of Classical and Quantum Mechanical Concepts: Inadequacy of classical concepts, macroscopic statistical phenomena,		06	10	1,2	CO1	PSO1			

Syllabus of Courses									
	waves, general description of uncertainty principle and application of uncertainty principle.								
2	The Schrödinger Equation: The Schrödinger equation, physical interpretation of the wave function, and admissibility conditions on the wave function, probability current density expectation values, observables, and operators, Ehrenfest's Theorems; the time-independent Schrödinger equation.	08	13	1,2,3	CO2	PSO1	SD	G	PE
3	Using the Schrödinger Equation: Stationary states; the free particle problem; Infinite square well potential; Finite Square well potential, potential steps and potential barrier, quantum tunneling and its applications; delta function potential, the harmonic oscillator, multiple potential wells, splitting of energy levels, energy bands	08	14	3, 4, 5	CO3	PSO1 PSO2 PSO4 PSO7 PSO8			
4	General Formalism: Fundamental postulates of quantum mechanics, hilbert space, representation of the states, dynamical variables, observables and operators, expectation values, adjoint of an operator and self adjointness, the eigenvalue problem: degeneracy, eigenvalues and eigenfunctions of self adjoint operators, Dirac delta function, observables: completeness and normalization of eigenfunctions, closure, physical interpretation of eigenvalues, eigenfunctions and expansion coefficients; momentum eigenfunctions, Dirac notation, wave functions momentum space, the uncertainty principle, commuting observables, removal of degeneracy, evolution of system with time, non-interacting and interacting systems, systems of identical particles.	08	13	1, 2, 3, 4	CO4	PSO1 PSO3			
5	Basics of foundations of statistical Mechanics: Concepts of phase space, Phase trajectory, Volume in phase space, elementary volume in phase space, microstate and macrostate, ensembles and their need, different ensembles used in S.M connection with thermodynamics	06	11	1,2	CO5	PSO1 PSO5			
6	Statistical Thermodynamics: Energy states & energy levels, macrostate and microstates, thermodynamic probability, Bose-Einstein Statistics, Fermi-dirac statistics, Maxwell-Boltzmann statistics, statistical interpretation of energy, BE, FD and classical distribution function and their comparison	08	13	1,2,3	CO5	PSO1 PSO7			
7	Application of Statistics to gases: Monatomic ideal gas, distribution of molecular velocities and its	08	13	2,3,4	CO6	PSO1 PSO7			

	experimental verification, ideal gas in gravitational field, Energy-Equipartition principle, Quantized linear oscillator, Specific Heat of diatomic gas.					PSO8			
8	Application of quantum statistics to other systems: Einstein and Debye theories of specific heat of a solid, blackbody radiation, paramagnetism, negative temperatures, electron gas, thermionic emission & photoelectric emission, Electrical & Thermal conductivity, Semiconductor statistics.	08	13	3,4,5	CO6	PSO1 PSO7 PSO8			

Reference Books

1.	A textbook of Quantum Mechanics, P. M. Mathews and K.Venkatesan, Tata McGraw Hill (2007)
2.	Introduction to quantum mechanics, D. J. Griffiths, Pearson Education International (2005)
3.	Feynman Lecture Series: R P Feynman, R B Leighton and M. Sands (2005)
4.	Quantum mechanics (2nd edition), E. Merzbacher, J. Wiley (1970)
5.	Thermodynamics, Kinetic theory and statistical thermodynamics, Sears and Salinger, Narosa Publishing House, 1989.
6.	Statistical Mechanics & Properties of matter: E. R. Gopal.
7.	Fundamentals of Statistical and thermal Physics : F.Reif.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics	Academic Year	2019-20								
M.Sc. (Applied Physics): Regular Programme											
Year	I	Core / Elective / Foundation APH2103 -Electromagnetic Theory-I	Credits / Hours per week						04		
Semester	I	Year of Introduction Year ofSyllabus Revision	Maximum Marks / Grade						100		
Mode of Transaction		Lectures									
CO1 Understanding of interaction of EM waves with matter CO2 Understanding of EM wave propagation in wave guides CO3 Understanding of EM Propagation CO4 Understanding electrodynamics and limitations of laws of electricity and magnetism CO5 Understanding the concepts of conservation laws and continuity equations for EM waves CO6 Understanding propagation of EM waves in mediums and effect of boundaries on EM waves											
Unit	Topic/Unit		Contact	Weightage	BT	CO	PSO	Element	Relevan	Relation	

No.		Hours	(%)	Level			s of Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop Pment (SD)	ce to Local (L)/ National (N)/ Regional (R)/Glob al (G) develop mental needs	to Gender (G), Environm ent and Sustainabi lity (ES), Human Values (HV)and Profession al Ethics (PE)
1	<i>Electrodynamics and Maxwell's Equations:</i> Ohms law, EMF, Motional EMF, Flux rule, EM induction, Faraday's law, Induced electric field, Pure Faraday field, Quasi-static solution, Induction, Energy in electric and magnetic fields, Limitation of Ampere's law, Charging capacitor, Maxwell's solution and its consequence, displacement current, Maxwell's Equations, Electric and magnetic polarization, boundary conditions	9	15	2,3,4	CO4	PSO2 PSO3 PSO4	In depth practical understa nding of EM waves and its applicati on (SD)	EM waves (light) is used in many applicati ons including measure ment devices, health applicati ons, treatment of diseases etc. (L, N, G)	
2	<i>Conservation Laws:</i> Continuity equation, Local and global conservation of charge, Charge continuity equation, moving charges, Poynting's theorem, Poynting's vector, Energy continuity equation, Scalars, vectors and tensors, Stress tensor, Stress vector, Divergence of stress tensor and its physical meaning, Maxwell Stress Tensor, Total electromagnetic force on charges, Conservation of momentum, Continuity equation for electromagnetic momentum	9	15	2,3,4	CO5	PSO2 PSO3 PSO4			
3	<i>Electromagnetic Waves:</i> Waves as disturbance, Mathematics representation of traveling waves, net force on stretched string, Wave equation, Testing the wave equation, sinusoidal wave, Complex notation, Complex amplitude, Effect of boundary on waves, Wave trains, Complex and Real amplitudes of reflection and transmission, Transverse and longitudinal waves, Polarization of waves, EM waves in vacuum, decoupling E and B fields, Monochromatic plane waves, Transverse nature of EM waves, Relation between E and B fields, Energy and momentum of EM waves, time averaging, intensity, momentum transfer, conductors and insulators, reflection by a perfect conductor-normal incidence, reflection by a perfect conductor-oblique incidence, reflection by a perfect dielectric-normal incidence, reflection by a perfect insulator-oblique incidence	12	20	2,3,4	CO6	PSO2 PSO3 PSO4			

4	<i>Wave guides:</i> Rectangular guides, TM waves in rectangular guides, TE waves in rectangular guides, impossibility of TEM wave in wave guides, TM and TE waves in circular guides, wave impedance and characteristic impedance, transmission line analogy for waveguides, attenuation factor and Q of waveguides.	8	13	1,2,4	CO2	PSO2 PSO3			
5	<i>Interaction of fields and matter:</i> Charge particle equation of motion, force and energy, circular motion in a magnetic field, cross field, motion of a charged particle, space charge limited diode, plasma oscillations, wave propagation in plasma	7	12	2,3,4,5	CO1	PSO2 PSO4			
6	<i>Guided waves:</i> Waves between parallel planes, transverse electrical waves ($E_z=0$), transverse magnetic waves ($H_z=0$), characteristics of TE and TM waves, transverse electromagnetic waves, velocities of propagation, attenuation in parallel plane guides, wave impedance, electric field and current flow within the conductor, transmission lines, circuit representation of the parallel plane transmission line, parallel plane transmission line with loss, E and H about long parallel cylindrical conductors of arbitrary crosssection, transmission line theory, low loss radio frequency and UHF transmission lines, transmission line charts.	15	25	2,3,4	CO3	PSO4			
Reference Books									
1.	Electromagnetic waves and radiating systems :Jordan and Balman (Prentice Hall India)								
2.	Classical Electrodynamics :J.D.Jackson (Wiley Eastern)								
3.	Introduction to electromagnetic fields and waves :Corson and Lorrain (D.B.Taraporwala)								
4.	Introduction to Electrodynamics :Griffith (Prentice Hall India)								
5.	Fundamentals of electromagnetics :WazedMiah (Tata McGraw Hill)								

Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics			Academic Year		2019-20					
M.Sc. (Applied Physics): Regular Programme												
Year		I	Core / Elective / Foundation APH2105 : Laboratory Practical			Credits / Hours per week		09				
Semester		I	Year of Introduction: 2007 Year of Syllabus Revision: 2016			Maximum Marks / Grade		150				
Mode of Transaction			Laboratory Experiments, discussion and viva			PSO7 is common for all experiments						
No.	CO 1 : Understanding of Electronic Instruments CO2 : Working of Devices Experiment				Course Code	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)	
1	Franck Hertz experiment				APH2102	1,2	CO1	PSO1	SD/G			PE
2	Laser Divergence and Gaussian intensity profile				APH2203	2	CO2	PSO2				
3	Dissociation energy of Iodine molecules				APH2102	2,3	CO1	PSO1, PSO2				
4	Spectral Response of photo detector				APH2102	3,4	CO2	PSO4				
5	Determination of Planck’s constant				APH2102	2,3	CO1	PSO1, PSO4				
6	Determination of Lande g factor from Electron Spin Resonance				APH2201	2,3	CO1	PSO1				
7	Fourier Analysis				APH2101	3,4	CO2	PSO2				
8	LCR Damped Harmonic Oscillator				APH2103	2	CO1	PSO4				
9	Diode Characteristics				APH2202	2	CO2	PSO4				
10	Electromagnetic Induction				APH2103	2,3	CO1	PSO2, PSO4				

11	Solar Cell	APH2202	2,3,4	CO1	PSO2, PSO4		
12	High pass – low pass filter	APH2202	2	CO1	PSO4		
13	Statistical Board and its simulation	APH2102	2,3,4	CO2	PSO1, PSO3		
14	GM counter	APH2102	2,3	CO1	PSO1, PSO6		
15	Verification of Fresnel's equations	APH2103	2,3,4	CO2	PSO2		

 The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics		Academic Year		2019-20						
M.Sc. (Applied Physics): Regular Programme										
Year	I	Core / Elective / Foundation APH2119: Classical Mechanics and Computational Techniques	Credits / Hours per week		04					
Semester	I	Year of Introduction: 2007 Year of Syllabus Revision: 2012	Maximum Marks / Grade		100					
Mode of Transaction		Lectures, Tutorials and Laboratory								
Course Outcome (CO) APH2119 CO1 Learning the fundamentals of Lagrange and Hamilton’s formulations for classical mechanics CO2 Understand the Central force problems and inverse square law cases CO3 Learning Legendre transformations CO4Understand the errors, source of error and its effect on any numerical computations and also analysis the efficiency of any n umerical algorithms CO5 Understand how to approximate the functions using interpolating polynomials. CO6To introduce programming languages and techniques used by physical scientists: FORTRAN, SCILAB, MATLAB® etc CO7 The basic syntax and structure of the language is covered with examples drawn from real applications										
Unit No.	Topic		Contact Hours	Weightag : (%)	BT Level	CO	PSO	Element s of Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop ment (SD)	Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G)	Relation to Gender (G), Environ ment and Sustaina bility (ES), Human Values (HV)and Professio nal Ethics(P

[illegible]

Reference Books	
1.	Classical Mechanics: H. Goldstein, C. Poole and J. Safko, 3 rd Edition, Addison Wesley
2.	Numerical Mathematical Analysis: J. B. Scarborough, Sixth Edition, Oxford & IBH Publishers
3.	Modelling and Simulations using SciLab by S L Campbell, J P Chancelier, R Nikoukhah(2006) Springer publications
4	SciLab for very beginners, SciLab Enterprises (2013) (www.scilab.org)
5	Introduction to SciLab, Manual by Consortium SciLab (2010) (www.scilab.org)
6	COMPUTER PROGRAMMING IN FORTRAN 90 AND 95 by V. RAJARAMANPHI Learning Pvt. Ltd.,(1997)
7	Computer oriented Numerical Methods: V. Rajaraman, Prentice Hall of India.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics	Academic Year	2019-20							
M.Sc. (Applied Physics): Regular Programme										
Year	I	Core / Elective / Foundation APH2119L: Classical Mechanics and Computational Techniques TW	Credits / Hours per week					02		
Semester	I	Year of Introduction: 2007 Year of Syllabus Revision: 2012	Maximum Marks / Grade					50		
Mode of Transaction		Tutorials and Laboratory								
Course Outcome (CO) APH2119 L CO1 Learning the fundamentals of Lagrange and Hamilton’s formulations for classical mechanics CO2 Understand the Central force problems and inverse square law cases CO3 Learning Legendre transformations CO4Understand the errors, source of error and its effect on any numerical computations and also analysis the efficiency of any n umerical algorithms CO5 Understand how to approximate the functions using interpolating polynomials. CO6To introduce programming languages and techniques used by physical scientists: FORTRAN, SCILAB, MATLAB® etc CO7 The basic syntax and structure of the language is covered with examples drawn from real applications										
Unit No.	Topic		Contact Hours	Weightag (%)	BT Level	CO	PSO	Element s of Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop ment (SD)	Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G)	Relation to Gender (G), Environ ment and Sustaina bility (ES), Human Values (HV)and Professio nal Ethics(P

									E)
							EMP	N	G
1	Laboratory work: Lab experiments will be set in consonance materials covered in the theory. Implementation of numerical techniques using FORTRAN/SCILAB/MATLAB	30	50	3,4,5,6	CO7	PSO1 PSO2 PSO7 PSO8			
Reference Books									
1.	Classical Mechanics: H. Goldstein, C. Poole and J. Safko, 3rd Edition, Addison Wesley								
2.	Numerical Mathematical Analysis: J. B. Scarborough, Sixth Edition, Oxford & IBH Publishers								
3.	Modelling and Simulations using SciLab by S L Campbell, J P Chancelier, R Nikoukhah(2006) Springer publications								
4	SciLab for very beginners, SciLab Enterprises (2013) (www.scilab.org)								
5	Introduction to SciLab, Manual by Consortium SciLab (2010) (www.scilab.org)								
6	COMPUTER PROGRAMMING IN FORTRAN 90 AND 95 by V. RAJARAMAN PHI Learning Pvt. Ltd.,(1997)								
7	Computer oriented Numerical Methods: V. Rajaraman, Prentice Hall of India.								

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics	Academic Year	2019-20						
M.Sc. (Applied Physics): Regular Programme									
Year	I	Core / Elective / Foundation APH2201: Mechanics-II (Quantum & Statistical)	Credits / Hours per week	04					
Semester	II	Year of Introduction: 2007 Year of Syllabus Revision: 2012	Maximum Marks / Grade	100					
Mode of Transaction		Lectures and Tutorials							
Course Outcome (CO) APH2201 CO1 Understanding the concepts of spin and orbital angular momentum, their applications in solving physics problems CO2 Learn and understand the perturbation theory, apply for physical systems and find relevance with experimental observations CO3 Understand and apply the variational methods for calculating ground state energies of various systems having variety of potentials CO4 Learn and understand the elementary kinetic theory and its application to various physical problems CO5 Applications of random processes in physical systems CO6 Understanding Physics of Polymer and biopolymers and application to real world problems									
Unit No.	Topic/Unit	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G) developmental needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	Angular momentum, spin and the Hydrogen atom: Angular momentum: eigenvalues, eigenfunctions, rotational symmetry	14	20	1,2,3,4	CO1	PSO1			

Syllabus of Courses							SD	G	PE
	of angular momentum; Angular momentum operators in Cartesian and Spherical Polar coordinate systems; eigenvalues, reflection invariance and parity, spin; use of raising and lowering operators to generate spherical harmonics, addition of angular momentum, Clebsch-Gordon coefficients; applications. Symmetry principles and conservation principles; applications, The hydrogen atom: radial wave function, spectrum of hydrogen.								
2	Approximation methods for stationary states: Nondegenerate perturbation theory, degenerate perturbation theory, Electrons in an electromagnetic field: motion of an electron in a uniform static magnetic field, the gauge invariance of the Schrodinger equation; the Stern-Gerlach experiment, the analogy of electron spin and polarization of light; applications, the Zeeman effect, Stark effect.	08	15	2,3,4,5	CO2	PSO1 PSO3 PSO4 PSO8			
3	Variational Principle and Scattering: The variational principle, the ground state of helium, the WKB approximation, tunneling, elementary theory of scattering, phase shifts, partial waves, Born approximation (qualitative); applications in physics; two identical particles scattering; coulomb scattering; applications.	08	15	2, 3, 4,5	CO3	PSO1 PSO2 PSO3 PSO8			
4	Elementary Kinetic theory of transport process: Collision time, scattering cross-section, viscosity, thermal conductivity, self diffusion, electrical conductivity.	08	15	1, 2, 3	CO4	PSO1 PSO3			
5	Fluctuations and Brownian motion: Fluctuations in a canonical and grand canonical ensemble, number fluctuations in quantum gases, fluctuations in microcanonical ensemble, time dependence of fluctuations, power spectrum of fluctuations, Wiener Khinchin theorem, Johnson noise, Nyquist theorem, Shot noise, Simple discussion of Brownian motion, Langevin equation, calculation of mean square displacement, Einstein relation for mobility, Random walk problem.	14	20	1,2,3,4	CO5	PSO1 PSO5			
6	Polymers and Biopolymers, molecular weight distribution in linear condensation polymers, size distribution of polymer molecule, rubber elasticity, polymer solution theory, Helix coil transition in polymer.	08	15	2,3,4,5	CO6	PSO1 PSO5			
Reference Books									
1.	A textbook of Quantum Mechanics, P. M. Mathews and K.Venkatesan, Tata McGraw Hill (2007)								
2.	Introduction to quantum mechanics, D. J. Griffiths, Pearson Education International (2005)								
3.	Feynman Lecture Series: R P Feynman, R B Leighton and M. Sands (2005)								
4.	Quantum mechanics (2nd edition), E. Merzbacher, J. Wiley (1970)								
5.	Thermodynamics, Kinetic theory and statistical thermodynamics, Sears and Salinger, Narosa Publishing House, 1989.								

6.	Statistical Mechanics & Properties of matter: E. R. Gopal.
7.	Fundamentals of Statistical and thermal Physics : F.Reif.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics	Academic Year	2019-20						
M.Sc. (Applied Physics): Regular Programme									
Year	I	Core / Elective / Foundation APH2202:Physics of Semiconductor Devices	Credits / Hours per week	04					
Semester	II	Year of Introduction: 2007 Year of Syllabus Revision: 2012	Maximum Marks / Grade	100					
Mode of Transaction		Lectures and Tutorials							
Course Outcome (CO) APH2202 CO1 Introduction to semiconductors CO2 Understanding of Physical parameters CO3 Understanding of Advanced semiconductor theory CO4 Learning The physics of semiconductor bipolar and unipolar devices CO5 Learning The physics of Photonic and Microwave devices CO6 Understanding the Semiconductor Device fabrication and Integrated circuit fabrication:									
Unit No.	Topic	Contact Hours	Weightag (%)	BT Level	CO	PSO	Element s of Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop ment (SD)	Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G)	Relation to Gender (G), Environ ment and Sustaina bility (ES), Human Values (HV)and Professio nal Ethics (PE)
1	Introduction to Semiconductors:	06	10	1	CO1	PSO1			

	Formation of energy bands, Classification of solids as conductor, semiconductor and insulator, semiconducting materials (elemental, compound,), Charge carrier in semiconductor: electrons and holes, effective mass, intrinsic and extrinsic semiconductors.						SD	G	PE
2	Carrier concentrations: Variation of Fermi level with respect to temperature, electron and hole concentrations at equilibrium, temperature dependence of carrier concentration, conductivity and mobility, effect of temperature and doping on mobility, Measurements: Four probe method for resistivity, Hall effect for carrier concentration and mobility, Hot probe method for type of conductivity, impurity levels.	08	13	1	CO2	PSO1			
3	Excess carrier in semiconductor: Optical absorption, direct and indirect band gap semiconductor, carrier lifetime and photoconductivity: direct recombination of electron and holes, indirect recombination, steady state carrier generation, Quasi-Fermi levels, diffusion of carriers: diffusion process, mechanics of diffusion, Fick's laws, experimental method for diffusion coefficient, diffusivities of impurities in semiconductor and measurement techniques, diffusion and drift of carriers, diffusion and recombination: the continuity equation, steady state carrier injection: diffusion length, the Haynes-Schockley experiment.	08	14	2, 3, 4	CO3	PSO1 PSO2 PSO4 PSO7 PSO8			
4	Bipolar devices: p-n junction diode, basic device technology, depletion region and depletion capacitance, current-voltage characteristic, junction breakdown, transient behaviour, heterojunction, application of diode, BJT: static characteristics, microwave transistor, power transistor, switching transistor, Thyristor: Basic characteristic, Schottky diode and three terminal thyristor, power thyristor, diac and triac, unijunction transistor and trigger thyristor.	08	15	1, 2, 3	CO4	PSO1 PSO3			
5	Unipolar devices: Metal-semiconductor contacts: energy band relation, Schottky effect, current transport process, characterization of barrier height, ohmic contact, JFET, MOSFET: Basic device characteristic	06	10	1,3	CO4	PSO1 PSO5			

	and its parameters and MOSFET structures, MIS diode and CCD: Ideal MIS diode, MOS diode, Charge-Coupled devices.								
6	Photonic devices: LED and semiconductor laser, LED-characteristics, efficiency, heterojunction LED, semiconductor laser-structure, operation and characteristics, photoconductor, photodiode, avalanche photodiode, phototransistor, solar cell and its efficiency	08	15	1,2,3	CO5	PSO1 PSO7			
7	Microwave devices: Tunnel diode-basic characteristics and its application, IMPATT diode static and dynamic characteristic, power and efficiency, IMPATT diode applications.	08	15	2,3	CO5	PSO1 PSO7 PSO8			
8	Semiconductor Device and Integrated circuit fabrication: An overview of the fabrication process, epitaxial growth, oxidation, wafer doping, film deposition, wafer etching, photolithog processing, BJT fabrication sequence.	08	10	2,3,4	CO6	PSO1 PSO7 PSO8			
Reference Books									
1.	Solid state electronic devices : : B.G.Streetman (Prentice Hall, India)								
2.	Physics of semiconductor devices: S.M.Sze (Wiley Eastern)								
3.	Microelectroniccircuits and devices: M.N.Horenstein (Prentice Hall, India)								
4.	Theory and practice of Microelectronics: S.K.Gandhi, John Wiley & Sons Inc								
5.	Semiconductor Physics and Devices, McGraw Hill								

Syllabus of Courses

 THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics	Academic Year	2019-20	
M.Sc. (Applied Physics): Regular Programme				
Year	I	Core / Elective / Foundation APH2203 -Electromagnetic Theory-II And Crystal Physics	Credits / Hours per week	04
Semester	II	Year of Introduction Year of Syllabus Revision	Maximum Marks / Grade	100
Mode of Transaction		Lectures		
CO1-Understanding of function of Antennas CO2- Understanding of ionosphere CO3- Understanding of EM Propagation CO4- Understanding of Imperfections in crystals CO5- Understanding of Phase Transformation in Solids CO6- Understanding of different characterization methods.				

Unit No.	Topic/Unit	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G) developmental needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	<i>Radiation:</i> Potential functions and the EM fields, potential functions for sinusoidal oscillations, oscillating electric dipole, power radiated by a current element, application to short antenna, assumed current distributions, radiations from a quarter wave monopole or half wave dipole, electromagnetic field close to an antenna, solution of the potential equations, far field approximation.	10	16	2,3,4	CO3	PSO4	SD	G	ES
2	<i>Antenna fundamentals:</i> Introduction to network theorems, directional properties of dipole antenna, travelling wave antenna and standing wave antennas, two elementary array, horizontal patterns in broadcast arrays, linear arrays, multiplication of patterns, antenna gain, effective area, antenna temperature and signal to noise ratio.	14	15	1,2	CO1	PSO2, PSO4			
3	<i>Ionosphere:</i> Introduction, the ionosphere, effective e and s of an ionized gas, reflection and refraction of waves by the ionosphere, regular and irregular variation of the ionosphere, attenuation factor for ionospheric propagation.		10	3,4	CO2	PSO2, PSO4			
4	<i>Imperfections in crystals:</i> Point defects, equilibrium concentration of Schottky and Frenkel defects, electrical conduction in ionic crystals, line defects, plasti	10	20	2,4,6	CO4	PSO2, PSO5			

	deformation, slip and slip systems in crystals, shear strength of s crystal, dislocation (edge and screw), Burger's vector and circuit, dislocation climb, macroscopic strain due to dislocation motion, strain energy of screw and edge dislocation, plane defects, block grain boundaries, source of dislocations, Frank-Read source, strengthening mechanism of crystal by dislocation motion.								
5	<i>Nucleation kinetics:</i> Thermodynamics of transformations, homogeneous nucleation rate of homogeneous nucleation, temperature dependence and dependence of nucleation rate.	8	20	1,2,3,4	CO5	PSO7			
6	<i>Experimental methods:</i> Introductory review, optical techniques, powder method, indexing of powder photographs, application of the powder diffraction method, single crystal oscillation and rotation methods, reciprocal lattice coordinates-Bernal chart, experimental techniques, interpretation of oscillation photographs, use of oscillation method, moving methods, double crystal diffractometry, recent advances.	6	10	3,5	CO6	PSO8			
Reference Books									
1.	Electromagnetic waves and radiating systems :Jordan and Balman (Prentice Hall India)								
2.	Classical Electrodynamics :J.D.Jackson (Wiley Eastern)								
3.	Introduction to electromagnetic fields and waves :Corson and Lorrain (D.B.Taraporwala)								
4.	Introduction to Electrodynamics :Griffith (Prentice Hall India)								
5.	Fundamentals of electromagnetics :WazedMiah (Tata McGraw Hill)								
6.	Crystallography for solid state physics :A.R.Verma and O.N.Srivastava (Wiley Eastern)								
7.	Solid State phase transformation :V.Raghavan.								
8.	Introduction to solid state physics : Kittel.								

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	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics		Academic Year				2019-20			
M.Sc. (Applied Physics): Regular Programme										
Year	I	Core / Elective / Foundation APH2207:Modern Optics	Credits / Hours per week				04			
Semester	II	Year of Introduction: 2007 Year of Syllabus Revision: 2012	Maximum Marks / Grade				100			
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) APH2207 CO1 Understanding Geometric Optics CO2 Learning statistical optics CO3 understanding concepts of Nonlinear optics and effects of nonlinear optics CO4 Understanding of Holography CO5 Understanding of Laser CO6 Concept of Measuremnet										
Unit No.	Topic		Contact Hours	Weightag (%)	BT Level	CO	PSO	Element s of Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop ment (SD)	Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G)	Relation to Gender (G), Environ ment and Sustaina bility (ES), Human Values (HV)and Professio nal Ethics (PE)
1	Geometrical optics: Discussion of waves, Snell's laws, matrix formulation of geometrical optics, the translation matrix, the		06	12	1,2,3	CO1	PSO2 PSO1			

	matrix for refraction, matrix for a simple lens, image formation, image formation by thin lens in air, complex systems, image formation using equivalent thin lens formulation, the telescoping system, some comments about the matrix method,						SD	G	PE
2	<i>Geometrical optics(conti)</i> :apertures and stops, the aperture stop, the field stop, field of view, radiometry, photometric unit, exact matrices & aberration, exact matrices, exact matrices for skew rays, aberration, spherical aberration, coma, astigmatism, curvature of field, distortion, chromatic, aberration, use of matrix algebra in lens design, examples of lens design.	08	13	1,2	CO1	PSO2 PSO3			
3	<i>Coherence</i> : Spatial and temporal coherence, coherence length and coherence time, experimental determination of coherence, partial coherence, Quasi-monochromatic light, interference with real optical field, mutual degree of coherence, degree of coherence, properties of $ \gamma_{12}(\tau) $, the van Cittert-Zernike theorem, uniform source, discussion on spatial and temporal coherence, Michelson stellar interferometer.	08	12	2,3	CO2	PSO2 PSO1 PSO3			
4	<i>Nonlinear Optics</i> : Harmonic generation, second harmonic generation, phase matching, third harmonic generation, optical mixing, parametric generation of light, self focussing of light.	08	13	2,3,4	CO3	PSO1 PSO2 PSO3			
5	<i>Holography</i> :Introduction, principles of holography, on-axis and off-axis holography, Gabor holography, off-axis carrier wave holography, holography with diffuse objects, conditions for holographic recording, hologram recording geometries, Fourier transform hologram recording geometry, lensless Fourier transform holograms, image-plane hologram recording geometry, rainbow hologram recording geometry, recording materials, diffraction efficiency for thin holograms, volume hologram, colour holography, applications of holography, holography for display and advertising, 3D imaging applications, imaging through aberrating medium, analysis of aerosol particles, hologram interferometry, real time hologram interferometry, double exposure hologram interferometry.	06	12	1,3,4	CO4	PSO1 PSO2 PSO5			
6	<i>Laser</i> : Basic principles of lasers, population inversion, laser pumping, resonators, vibrational modes of a resonator, number of modes per unit volume, optical resonators, the confocal resonator, various laser systems, the Ruby laser, gas lasers,	08	13	2,5,6	CO5	PSO1 PSO2 PSO6			

	semiconductor lasers, applications of lasers.								
7	<i>Measurement:</i> Introduction, standard of length-meter, measurement of length with light waves, Fizeau and Michelson interferometers, Methods of fringe order measurement, fringe counting, method of exact fractions, errors of measurement, air refraction, phase change on reflection, obliquity and collimation errors, temperature error-thermal expansion gauge block interferometer, laser interferometer, laser interferometer based on doppler shift, angle measurement, measurement on optical components and systems	08	12	2,4	CO6	PSO1 PSO2 PSO7			
8	<i>Measurement(conti)</i> :Measurement of radii of curvature, mechanical methods, optical spherometers, measurement of long radii of curvature, measurement of focal length, measurement of back focal length, measurement of spherical aberration, measurement of longitudinal chromatic aberration(LCA), Interferometric evaluation, Phase-shifting interferometry, image formation in incoherence illumination, measurement of OTF of an optical system.	08	13	3,5	CO6	PSO1 PSO2 PSO5			
Reference Books									
1.	Wave optics and its applications : R.S.Sirohi (Orient Longman)								
2.	Lasers and optical engineering : P. Das (Narosa)								
3.	Introduction to classification and modern optics : Jurgen R Meyer-Arendt (Prentice-Hall)								
4.	Lasers and nonlinear optics : B.B.Laud (Wiley Eastern)								
5.	Contemporary optics : Ghatak and Thyagarajan (Macmillan India)								

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics			Academic Year			2019-20				
M.Sc. (Applied Physics): Regular Programme												
Year	I	Core / Elective / Foundation APH2213: Electronics-I			Credits / Hours per week			04				
Semester	II	Year of Introduction: 2007 Year of Syllabus Revision: 2012			Maximum Marks / Grade			100				
Mode of Transaction		Lectures and Tutorials										
Course Outcome (CO) APH2201												
CO1 Understanding the concepts of active and passive components, Kirchhoff's laws and network theorems.												
CO2 Learn and understand Diodes and its application, BJT and FET												
CO3 Understand and apply the knowledge of BJT to construct small signal amplifiers												
CO4 Learn and understand the elements of feedback and apply it to construct oscillators												
CO5 Learn and understand the basics of power amplifier												
CO6 Understanding of basics of oscilloscope												
Unit No.	Topic/Unit				Contact Hours	Weightage (%)	BT Level	CO	PSO	Element s of Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop ment (SD)	Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G) develop mental needs	Relation to Gender (G), Environ ment and Sustaina bility (ES), Human Values (HV)and Professio nal Ethics (PE)
1	Introduction to Electronic active and passive components, Review of Kirchhoff's laws, Voltage dividers, Current dividers, RC circuits, RC				06	12	1,2,3,4	CO1	PSO4	Emp\SD	R/G	

	analysis, Superposition theorem, Thevenin's theorem, Norton's theorem.						Emp\SD	R/G	PE
2	Rectifier circuits with filters, Diode clipper and clamper circuits, Voltage doublers, Zener diodes, Varactor Diodes, Schottky Diodes, Tunnel Diodes, Metal-Oxide Varistor.	04	08	2,3,4,5	CO2	PSO4 PSO8			
3	Transistor Characteristic (CB, CE, CC) BJT biasing: Purpose of biasing, the dc operating point, base bias, emitter bias, voltage divider bias and collector bias, FET and MOSFET biasing, BJT and MOSFET application	04	10	2, 3, 4,5	CO2	PSO4 PSO8			
4	H-parameters of transistors, CE, CC, CB amplifiers, multistage amplifiers, MOSFET, FET amplification, CS, CD, CG amplifiers, Amplifier frequency response: Miller's Theorem and Decibels, Low-frequency Analysis of a BJT and FET amplifier, Bode Plot, High frequency Analysis of BJT and FET amplifier, Total amplifier response.	08	10	1, 2, 3	CO3	PSO4	Emp\SD	R/G	
5	Classification of Amplifiers, The Feedback concept, the transfer gain with Feedback, Characteristic of Negative Feedback amplifiers, Input and output resistance, Method of analysis of Negative-feedback amplifier, Voltage and current series feedback, Current and Voltage shunt feedback.	08	10	1,2,3,4	CO4	PSO4			
6	Barkhausen criterion tuned oscillators, relaxation oscillators.	10	10	2,3,4,5	CO4	PSO4			
7	Class-A amplifiers, Class-B Push-Pull amplifiers and Class-C amplifiers, Power Devices: Heat Sinks, Power BJT, Power MOSFET.	10	20	1, 2, 3	CO5	PSO4	Emp\SD	R/G	
8	Block diagram of oscilloscope, CRTs, CRT display-screen characteristic, CRT storage-target characteristic, Time base circuit and sensitivity, application of oscilloscope, Special purpose oscilloscopes.	10	20	1, 2, 3	CO6	PSO4	Emp\SD	R/G	
Reference Books									
1.	Electronic devices, T.L.Floyd (Charles E Merrill)								
2.	Microelectronic circuits and devices, M.N.Horenstein (Prentice Hall, India)								
3.	Microelectronics, Millman and Grable (McGraw Hill)								
4.	Electronic circuits-discrete and integrated, D.L.Schilling and C.Belove (McGraw Hill)								
5.	Integrated electronics, Millman and Halkies (McGraw Hill)								

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		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics				Academic Year			2019-20	
		M.Sc. (Applied Physics): Regular Programme								
Year	I	Core / Elective / Foundation APH2214 : Laboratory Practical		Credits / Hours per week				08		
Semester	II	Year of Introduction: 2007 Year of Syllabus Revision: 2016		Maximum Marks / Grade				50		
Mode of Transaction		Laboratory Experiments, discussion and viva			PSO7 is common for all experiments					
No.	CO 1 : Understanding of Electronic Instruments CO2 : Working of Devices Experiment			Course Code	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	Study of various parameters of pn junction diode			APH2202	1,2,3	CO1	PSO4	SD/G		PE
2	Hall Effect			APH2202	2,3,4	CO2	PSO4			
3	Transistor amplifier properties			APH2213	2,3	CO2	PSO4			
4	Indexing of XRD pattern			APH2203	3,4,5,6	CO1	PSO2			
5	Uni-junction Transistor			APH2202	2,3,4	CO1	PSO4			
6	CE Amplifier			APH2213	2,3,4	CO2	PSO4			

7	Four Probe Method	APH2202	3,4,5	CO2	PSO4		
8	Semiconductor Laser diode	APH2207	3,4,5	CO1	PSO2, PSO4		
9	Kirchoff's Current and Voltage Law	APH2213	2,3	CO2	PSO4		
10	Slit width measurement using diffraction	APH2107	3,4,5,6	CO2	PSO2, PSO4		
11	Hartley and Colpitt Oscillators	APH2213	2,3,4	CO1	PSO4		
12	Half wave and full wave rectifiers	APH2213	2,3	CO2	PSO4		
13	Transistor Characteristics	APH2213	2,3	CO1	PSO4		
14	Lateral Shearing Interferometry	APH2207	3,4,5,6	CO2	PSO2		
15	IC Voltage regulator using LM7815	APH2213	3,4,5,6	CO1	PSO4		

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		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics			Academic Year		2020-21		
M.Sc. (Applied Physics): Regular Programme									
Year	II	Core / Elective / Foundation APH2306L : Laboratory Practical		Credits / Hours per week			09		
Semester	I	Year of Introduction: 2007 Year of Syllabus Revision: 2016		Maximum Marks / Grade			100		
Mode of Transaction		Laboratory Experiments, discussion and viva		PSO7 is common for all experiments					
No.	APH2306L : Laboratory Practical CO 1 : Understanding of Electronic Instruments CO2 : Working of Devices Experiment		Course Code	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	Susceptibility Measurement		APH2102	1,2	CO1	PSO1	SD/G		PE
2	Logic Gates		APH2203	2	CO1	PSO2			
3	'Ex-or' Gate		APH2102	2,3	CO2	PSO1, PSO2			

4	TTL	APH2102	3,4	CO1	PSO4		
5	Malu's Law	APH2102	2,3	CO1	PSO1, PSO4		
6	Half adder-Full adder	APH2201	2,3	CO2	PSO1		
7	Simplification of Boolean Algebra	APH2101	3,4	CO2	PSO2		
8	Laser Diffraction	APH2103	2	CO2	PSO4		
9	IC Parameter (TTL/CMOS)	APH2202	2	CO1	PSO4		
10	Flip-Flop	APH2103	2,3	CO2	PSO2, PSO4		
11	Temperature Sensor	APH2202	2,3,4	CO1	PSO2, PSO4		
12	Binary Counters	APH2202	2	CO1	PSO4		
13	Decade Counters	APH2102	2,3,4	CO1	PSO1, PSO3		
14	Shift Register	APH2102	2,3	CO1	PSO1, PSO6		
15	Digital Decade Counter (With seven segment LED)	APH2103	2,3,4	CO2	PSO2		

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics	Academic Year					2020-21			
M.Sc. (Applied Physics): Regular Programme										
Year	II	Core / Elective / Foundation APH-2311: Optical, Dielectric and Magnetic Properties of Materials	Credits / Hours per week					04		
Semester	I	Year of Introduction: 2007 Year of Syllabus Revision: 2012	Maximum Marks / Grade					100		
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) APH-2311 CO1 Understanding the Physics of monatomic and diatomic materials CO2 Learn about the physical interpretation of xerography CO3 Understanding the basics of dielectrics and physics of various mechanisms under a.c. field CO4 Understand the physics of magnetic materials CO5 Learn about the basics of development of superconductors										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G) developmental needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Brilloun Zones, Dispersion relation for monatomicand diatomicunit cells, Accousticand optical modes, forbidden frequencies.		05	09	2,4	CO1	PSO5			
2	Physics of Xerographic Photoreceptors :		10	16	2,3,6	CO2	PSO5			

Syllabus of Courses							SD	G	PE
	Electrostatic process, Charge transfer phenomena in Photo-conductive insulators, Photo-conductive discharge in Xerography, Xerographic developers, Basic requirements of an efficient xerographic plate materials and experimental techniques.								
3	Polarization mechanism in dielectrics, Clausius-Masotti equation, Dielectric losses and relaxation time, Dielectric breakdown, Measurement of dielectric constant, piezoelectric effect, Ferroelectrics, their classification, Ferroelectric Domains, Theories Ferro-electricity.	15	25	2,4,5	CO3	PSO5			
4	Classification of Magnetic materials, phenomena of diamagnetism, Larmor precession and equation of diamagnetic susceptibility, classical and quantum theories of paramagnetism, saturation phenomenon, Weiss and quantum theories of ferromagnetism. Ferromagnetic domains A ferromagnetism, Ferrimagnetism, Ferrites and their application, Magnetic resonance and measurement techniques, Magnetic fluids and their applications.	15	25	2,4,5	CO4	PSO5			
5	The phenomenon of superconductivity; thermal and magnetic properties, isotope effect, Meisener effect, thermodynamics of superconducting transition, Type I & II superconductors, London's equation, BCS theory, Josephson effect, flux quantisation, electron tunneling, application of superconductivity, occurrence of high temperature super-conductivity.	15	25	2,4,5	CO5	PSO5			

Reference Books		
1.	Solid state physics	: A.J.Dekker.
2.	Introduction to solid state physics	: C.Kittel.
3.	Fundamental of solid state physics	: B.S.Saxena, R.C.Gupta, P.N.Saxena.
4.	Applied Solid state science Vol.5 Edited by Raymond Wolfe.	: Advances in materials and devices research

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 The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics	Academic Year	2020-21							
M.Sc. (Applied Physics): Regular Programme									
Year	II	Core / Elective / Foundation APH-2312 Instrumentation	Credits / Hours per week	04					
Semester	I	Year of Introduction: 2007 Year of Syllabus Revision: 2012	Maximum Marks / Grade	100					
Mode of Transaction		Lectures and Tutorials							
Course Outcome (CO) APH-2312									
CO1 Understanding the basic concepts of measurements, transducer classification and performance characteristics									
CO2 Learning and understanding the working of different types of transducers like displacement, strain, vibration, pressure, flow, temperature, force and torque.									
CO3 Understand the working of instrumentation									
Unit No.	Topic/Unit	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G) developmental needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	Basic concepts of measurements.	6	10	2,4	CO1	PSO5	SD	G	PE
2	Transducer classification.	6	5	2	CO1	PSO5			
3	Performance characteristics of an instrumentation system.	6	10	4	CO1	PSO5			
4	Displacement measurement.	6	10	2,6	CO2	PSO5			
5	Strain measurement.	6	5	2,6	CO2	PSO5			
6	Vibration measurement.	5	10	2,6	CO2	PSO5			
7	Pressure measurement.	5	10	2,6	CO2	PSO5			

8	Flow measurement.	5	10	2,6	CO2	PSO5			
9	Temperature measurement.	5	10	2,6	CO2	PSO5			
10	Force and Torque measurements.	5	10	2,6	CO2	PSO5			
11	Instrumentation Amplifiers.	5	10	2,5,6	CO3	PSO5			

Reference Books

1.	Instrumentation; Devices and systems	: C.S.Rangan, G.R.Sarma and V.S.V.Mani ;Tata McGraw Hill Publishing Co. Ltd.
2.	Electronics and Instrumentation	: T.K.Bandopadhyay; New central Book Agency Ltd., Calcutta.
3.	Measurement systems,Application and design	: E.O.Doebelin; McGraw Hill International Edition.

 सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics		Academic Year				2020-21			
M.Sc. (Applied Physics): Regular Programme										
Year	II	Core / Elective / Foundation APH2313: Electronics-II	Credits / Hours per week				04			
Semester	I	Year of Introduction: 2007 Year of Syllabus Revision: 2012	Maximum Marks / Grade				100			
Mode of Transaction		Laboratory and Tutorials								
Course Outcome (CO) APH2313 CO1 Learn basics of number systems and its arithmetic and different codes used in digital electronics CO2 Learn Boolean algebra, it's application and K-map CO3 Learn about different logic families. CO4 Learn about combinational logic design and its implementation CO5 Learn about basics of sequential circuits, latches and flip flop CO6 Learn about Counters and Registers										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G) development needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	Number systems and codes: Decimal numbers, 9's and 10's complements, Binary numbers, Binary arithmetic, 1's and 2's		06	15	1,2,3	CO1	PSO4	Emp/ SD	R,G	

	complements, octal numbers, hexadecimal numbers, conversion of numbers from one system to another system, BCD and Decimal codes.						Emp/ SD	R, G	PE
2	Boolean algebra: Boolean operations, logic expressions, laws of Boolean algebra, De-Morgan's theorems, Boolean expressions for gate networks, Simplification of Boolean expressions, Karnaugh Map.	14	15	1,2,3	CO2	PSO4			
3	Saturating and non-saturating circuits: RTL, DTL, TTL, emitter coupled Logic gates, MOS and CMOS logic gates, comparison of logic families.	10	20	1, 2, 3	CO3	PSO4			
4	Combinational Logic Design: Logic implementation, synthesis of combinational function, Don't care condition, circuit consideration.	10	15	1,2,3,4	CO4	PSO4			
5	Latches and Flip-Flops.	10	15	1,2,3,4	CO5	PSO4			
6	Counters and Registers.	10	20	1,2,3,4	CO6	PSO4			
Reference Books									
1.	Introduction to integrated circuits, V.V.Grinich&H.G.Jackson.								
2.	Digital Electronics, W.H.Gothmanm.								
3.	Integrated electronics, J.Millman&C.C.Halkies.								
4.	Microelectronics, J.Millman&A.Grabel.								
5	Digital Fundamentals, T.L.Floyd.								

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics	Academic Year	2020-21						
M.Sc. (Applied Physics): Regular Programme									
Year	I	Core- / Elective / Foundation APH2207:Laser and its Applications	Credits / Hours per week	04					
Semester	II	Year of Introduction: 2007 Year of Syllabus Revision: 2021	Maximum Marks / Grade	100					
Mode of Transaction		Lectures and Tutorials							
Course Outcome (CO) APH2314 CO1 Understanding interaction of EM radiation with matter, spatial and temporal coherence and their importance. CO2 Understanding emission linewidths and their importance in laser systems. CO3 Understanding cavity radiation, conditions for laser production and cavity modes. CO4 Basic design of lasers, Gas lasers, liquid (dye) lasers, solid state lasers and semiconductor lasers CO5 Understanding of Design and construction of pulsed lasers. CO6 Application of lasers in different research and industrial areas									
Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Element s of Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop ment (SD)	Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G)	Relation to Gender (G), Environ ment and Sustaina bility (ES), Human Values (HV)and Professio nal Ethics (PE)
1	Introduction to lasers, interaction of EM radiation with matter and Emission linewidths:	15	25	2,3,4,5	1,2	2,4,5,6 8			

Syllabus of Courses									
	Diff. b/w normal light source and laser source; Properties of laser light- Monochromaticity, Coherence (Spatial and Temporal) Directionality; Maxwell's equation for dielectric medium; Wave equation and its solution; Plane waves; Phase and Group velocity; Polarization of materials; Wave equation in dielectric mediums; Complex Refractive Index; Dispersion and Absorption; Classical picture of radiating electrons; Rate of spontaneous emission; Harmonic oscillator picture of radiating electron; Collisional decay; Decay time of collisional depopulation; Decay time of lattice relaxation; Line width due to radiative decay; Quantum Mechanical Picture of radiating electron and line broadening; Other line broadening processes; Homogenous and inhomogeneous line broadening; De-phasing collisions; Amorphous Crystal Broadening; Isotope Broadening; Doppler Broadening; Voigt Profile; Comparison of line broadening Processes;						SD, Emp	L, N, G	PE
2	Radiation and Thermal Equilibrium, Conditions for laser production and Laser cavity modes: Thermal equilibrium; Boltzmann Equation for discrete and continuous energy levels; Ratio of populations; Stefan-Boltzmann law; Wein's law; Radiance and irradiance; Cavity radiation; Cavity modes; Rayleigh-Jeans formula; Planck's radiation formula; Cavity radiation and blackbody radiation; Einstein coefficients; Principle of detailed balance; Absorption and gain in homogenous medium; Effect of medium on laser beam; Absorption & Gain in Inhomogeneous Active Medium; Statistical weight and gain; Relationship between gain and absorption coefficients; Population inversion; Saturation intensity; Development and growth of laser beam in homogeneously broadened medium; Dependence of gain on shape of amplifying medium; Growth of beam in gain medium with Doppler broadening; Gain factor; Population Difference; Gain length; Threshold requirements for a laser; Gain duration Laser cavity; Longitudinal modes; Fabry-Perot Resonator; Fabry-Perot Cavity Modes; Longitudinal mode number; Requirement for longitudinal mode development; Transverse modes; Fresnel Kirchhoff diffraction formula; Development of transverse laser modes	15	25	2,3,4,5	3,4,5,6	2,4,5,6 8	SD, Emp	L, N, G	ES
3	Laser Systems: Ruby Laser; Nd:YAG Laser; He-Ne Laser; Carbon dioxide Laser; Semiconductor Junction laser; Argon Ion laser; Organic dye laser; output modification techniques - Mode locking, Q-Switching and Gravity dumping; Pulsed lasers.	15	25	2,3,4,5,6	4,5,6	2,4,5,6 8	SD, Emp, Ent	L, N, G	

4	Applications of Lasers: In Civil and Mechanical Engineering; Electronics and Electrical Engineering; Communications & Information Processing, Printing and Recording; Fabrication of Non-metals; Metal Fabrication; Scientific, Military and Environment; Laser ablation; Optical Tweezers; Chirped pulse amplification; Super resolution microscopy (STED); Optical Frequency Comb; Laser cooling and trapping	15	25	2,3,4,5,6	4,5,6	2,4,5,6 8	SD, Emp, Ent	L, N, G	ES
Reference Books									
1.	Laser Fundamentals: W. T. Silvfast (Cambridge University Press)								
2.	Laser Physics: P. W. Milloni, J. H. Eberly (Wiley)								
3.	Basics of Laser Physics-For Students of Science and Engineering: K. F. Renk (Springer)								
4.	Handbook of laser technology and applications: C. E. Webb, J. D. C. Jones (IoP)								
5.	Applications of Lasers in Manufacturing: U. S. Dixit, S. N. Joshi, J. P. Davim (Springer)								
6.	Lasers: Fundamentals and applications: K. Thyagarajan, A. Ghatak, (Springer)								

Syllabus of Courses

		The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics		Academic Year			2020-21				
M.Sc. (Applied Physics): Regular Programme											
Year	II	Core-/ Elective /Foundation APH2315:Nuclear Reactor Physics and Polymer Physics		Credits / Hours per week			04				
Semester	I	Year of Introduction: 2007 Year of Syllabus Revision: 2012		Maximum Marks / Grade			100				
Mode of Transaction		Lectures and Tutorials									
Course Outcome (CO) APH2315 CO1 Understating of fission barrier and fission process CO2 Neutron and its interaction with matter CO3 Understanding of reactor kinematics,Nuclear reactors and power CO4 Understanding of polymers CO5 Physical properties of polymers CO6 Analysis of polymers											
Unit No.	Topic			Contact Hours	Weightage (%)	BT Level	CO	PSO	Element s of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics

									(PE)
1	Fission barrier and fission process: Mass distribution, neutron-energy distribution, energy distribution and other details about fission.	06	12	1 2 3	Co1	Pso5 Pso7	SD	G	PE
2	Neutron and its interaction with matter: Cross-sections, mean free path, neutron kinematics, log decrement, slowing down power and moderating ratio, slowing down density, neutron flux, resonance escape probability. Neutron multiplication: Fast fission, thermal utilization, n-parameter, six-factor formula.	08	13	2 3 4	Co1 Co2	Pso5 Pso8			
3	Reactor kinetics, neutron life time, reactor with or without delayed neutrons, long term effects, temperature coefficient of reactivity, Poisson and Doppler effects.	08	12	1 2 3	Co2 Co3	Pso5 Pso8			
4	Nuclear reactors and power: fuels, components of nuclear reactor, power reactors, fuel cycles, isotope separation, breeders and doubling time, fuel reprocessing and radioactive waste disposal, reactor accidents and safety, radiation hazards, protection and dosimetry.	08	13	1 4 5	Co3	Pso5 Pso7			
5	Introduction: Fundamental definitions, rise of macromolecular science, molecular forces and bonding in polymers, molecular weight and its distribution, configurational states, homopolymers and copolymers, molecular architecture, common polymers, polymerization.	06	12	1,2, 4	CO4 CO5	PSO5 PSO6			
6	Chain conformations in polymers, experimental determination of dimensions of chain molecules, dimensions of random coil polymers, models to calculate end to end distance for freely jointed chain, measurement of molecular weight end group analysis, colligative property analysis, light scattering, ultracentrifugation, Gel Permeation Chromatography (GPC).	08	13	1,2, 4	CO4 CO5 CO6	PSO5 PSO6			
7	Polymer Analysis-I Thermodynamical methods, thermal transitions, thermal behaviour of polymers, crystallization and melting, optical and electron microscopy, electron microscope and applications,	08	12	1,2,3, 4	CO4 CO5 CO6	PSO5 PSO6			
8	Polymer Analysis-II Spectroscopic methods, Infrared spectrometer, scattering and diffraction methods, x-ray diffractometer, crystal structure of polymers,	08	13	1,2, 3,4	CO4 CO5 CO6	PSO5 PSO6			
Reference Books									

1.	Textbook of Polymer Science : Fred W. Billmeyer, Jr. John Wiley & Sons.
2.	Polymer Physics: Ulf W.Gedde, Chapman and Hall, Springer-Science
3.	Basic Nuclear Engineering -K.S.Ram
4.	Introduction to Nuclear Engineering - J.R.Lamarsh,Publisher: Pearson, 2001

 सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics	Academic Year	2020-21							
M.Sc. (Applied Physics): Regular Programme										
Year	II	Core- / Elective / Foundation APH2316L: Computational Techniques and Numerical Analysis	Credits / Hours per week					04		
Semester	I	Year of Introduction: 2007 Year of Syllabus Revision: 2012	Maximum Marks / Grade					100		
Mode of Transaction		Laboratory and Tutorials								
Course Outcome (CO) APH2316L CO1 Learn various mathematical methods and their applications to solve physical problems CO2 Learn FORTRAN programming and develop codes for the numerical methods learned for various physical problems CO3 Explore the possibility of applying the developed codes for pursuing advanced level studies including research										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	BT Level	CO	PSO	Element s of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G) develop mental needs	Relation to Gender (G), Environ ment and Sustaina bility (ES), Human Values (HV)and Professio nal Ethics (PE)
1	Errors in Numerical Calculations		03	5	1,2,3	CO1	PSO3			
2	Solution of Algebraic and Transcendentalequations		03	5	1,2,3	CO1	PSO3			
3	Interpolation		03	5	1,2,3	CO1	PSO3			
4	Curve fitting (without cubic splines)		02	5	1, 2, 3	CO1	PSO3			

Syllabus of Courses		08	10	1,2,3,4	CO1	PSO3	SD	N, G	PE
6	Matrices and linear systems of equations	03	5	1,2,3,4	CO1	PSO3			
7	Numerical solution of ordinary differential equations	06	10	1,2,3,4	CO1	PSO3			
8	Numerical solution of partial differential equations	02	5	1,2,3,4	CO1	PSO3			
9	FORTTRAN programming	27	45	3,4,5,6	CO2 CO3	PSO3			
10	Use of computers for numerical analysis, Familiarity with operating systems: Windows and Linux.	03	5	1,2,3,4	CO2 CO3	PSO3			
Reference Books									
1.	Introductory methods of Numerical Analysis: S.S.Sastry, Prentice Hall of India.								
2.	Introduction to numerical mathematical methods: J B Scarborough								
3.	Computer Programming in FORTRAN 90 and 95: V Rajaraman, PHI Learning Private Limited								

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics	Academic Year					2020-21			
<u>MSc. (Applied Physics) : Regular Programme</u>										
Year	II	Core / Elective / Foundation APH2406: Project Dissertation	Credits / Hours per week					12		
Semester	II	Year of Introduction: 2007 Year of Syllabus Revision: 2016	Maximum Marks / Grade					150		
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) APH2406 CO1 Understanding of various Field work CO2 Understanding of Research										
Unit No.	Topic		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	Project Dissertation		60	100	1,2,3,4,5,6	CO1 CO2	All PSO1 to PSO8	Emp	N	ES

Syllabus of Courses

 सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics	Academic Year	2020-21						
M.Sc. (Applied Physics): Regular Programme									
Year	II	Core- / Elective / Foundation APH2409: Electron Optics and Applied Optics	Credits / Hours per week 04						
Semester	II	Year of Introduction: 2012 Year of Syllabus Revision: 2021	Maximum Marks / Grade 100						
Mode of Transaction		Lectures and Tutorials							
Course Outcome (CO) APH2409 CO1 Understanding movement of electrons in Electric, Magnetic and Combined/Cross fields CO2 Design of electrostatic lenses, electron multipliers CO3 Design of magnetostatic lenses and electron microscopes CO4 Understanding imaging basics based on Fourier theory and Amplitude, phase and polarization contrast imaging CO5 Understanding working of optical elements, aberrations and design of optical instruments CO6 Understanding working and design of advanced microscopy – Fluorescent, Confocal, STED									
Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	The force acting on a charged particle. Equations of	10	15	2,3,4	CO1	PSO2	Emp, SD	N G	

Syllabus of Courses									
	Analogy between the motion of charged particles in electrostatic fields and propagation of light beams in transparent media, Centred electron-optical systems. The basic equation of electron optics for axially symmetric fields, Focussing in axially symmetric fields. The Helmholtz Lagrange equation. The thin lens, approximation techniques in electron optics, Electronic devices with electrostatic fields								
2	Motion in a uniform magnetic field, Axially symmetric magnetic fields. Short-coil focusing, The electron microscope Motion in a slowly varying magnetic field, Adiabatic invariant, Radiation belts of the Earth, Focussing in crossed electric and magnetic fields, strong focusing.	8	15	3,4,5	CO2 CO3	PSO2	Emp, SD	N G	
3	Motion of charged particles under the effect of a uniform electric field and a uniform magnetic field, General description of the motion of charged particles in combined fields, Mass spectroscopy, Electromagnetic separation of isotopes	6	13	3,4,5,6	CO2 CO3	PSO2 PSO7	Emp, Ent, SD	N G	
4	Fundamental formulae of relativistic dynamics, The cyclotron the betatron, Modern high energy accelerators, Colliding-beam accelerators	6	8	3,4,5,6	CO3	PSO2 PSO7	Emp, Ent, SD	L N G	
5	Basics of Imaging: Light as waves; Quadratic nature of light detectors; Contrast; Amplitude, Phase, Polarization contrast Imaging; Importance of Phase detection; Recording of Phase; Imaging using a lens; Resolution of an Optical Imaging System; Numerical Aperture; Abbe limit; Imaging point object; Spatial Frequency; Fourier Analysis of Imaging; Optical Resolution based on Fourier Theory	7	10	3,4,5,6	1	PSO2 PSO7	Emp, Ent, SD	N, G	
6	Geometrical Optics: Stigmatic System; Wave and Geometrical Optics; Geometrical Optics - Properties; Lenses-Working, Shape, Shape of interface, Maintaining shape of wavefront based on Fermat's principle, focal points, Optical Axis, Real and Virtual Images, Aspherics; Refraction from spherical surfaces; First order optics; Thin lenses; Thin lens equation; optical center; focal plane; Imaging using refracting surfaces; Imaging using lens; Ray diagrams; Lateral and Axial magnification; Thin lens	8	15	2,3,4,5	1,2	PSO2 PSO7	Emp, SD	L, N, G	

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Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics		Academic Year					2020-21		
M.Sc. (Applied Physics): Regular Programme										
Year	II	Core- / Elective / Foundation APH-2411: Crystallization Techniques	Credits / Hours per week					04		
Semester	II	Year of Introduction: 2007 Year of Syllabus Revision: 2012	Maximum Marks / Grade					100		
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) APH2411										
CO1 Understanding the basic concepts in crystal growth										
CO2 Learn about the theory of growth from vapour phase										
CO3 Understanding the mechanism of crystal growth from melt using different growth techniques										
CO4 Learning different epitaxial growth techniques										
CO5 Understand and learning of crystal growth from solution method for industrially important crystals										
CO6 Using and learning the different assessment techniques of crystal perfection and its characterization.										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G) developmental needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	Basic concept in crystal growth: Introduction, methods of growth from melt, solution, vapour solid state, phase relations, growth kinetics, transformation effects.		08	7	2	CO1	PSO7	SD	G	PE

2	Theory of growth from vapour phase: Nucleation and its control, the vapour solid phase transformation. Experimental methods for crystal growth from the vapour phase: comparison of conditions for nucleation control from the vapour and from the melt, Experimental methods to control nucleation, High temperature methods of vapour growth.	12	18	2,4	CO2	PSO7			
3	Crystal growth from melt: Creation, measurement and control of crystal growth, constructional materials, methods of heating, temperature measurement and control, slow movements production, contained crucibles, atmospheres. Bridgman technique, Czochralski technique, Kyropoulos method, Verneuil technique, floating zone technique, zone refining method, growth of important crystals: Si, GaAs, LiNbO ₃ , Superconducting materials (Yttrium barium copper oxide).	13	30	2,3,4	CO3	PSO7			
4	Epitaxial growth: VPE, LPE and MBE, MOCVD methods.	6	10	2,3,4	CO4	PSO7			
5	Crystal growth from solutions: crystal growth from low temperature solutions, solvents-slow cooling, evaporation methods, control perfection, high temperature solution growth by slow cooling, floating zone method Hydrothermal growth.	12	20	2,3,4	CO5	PSO7			
6	Assessment of crystalline perfection: Techniques	9	15	4,5	CO6	PSO7			

	know degree of purity and perfection of crystal optical microscopy, transmission electron micr transmission electron microscopy, x-ray topogr (Lang Technique, Anomalous transmission topo Scanning electron microscopy, EDAX and Auger electron spectroscopy. Structure determinatio crystals: Bragg's x-ray diffractometry, Mass spectroscopy, specialized for some materials lik semiconductors.								
Reference Books									
1.	The growth of crystals from liquids : North Holland Publishing Co.,								
2.	Crystal growth: Theory and Techniques : C.H.L.Goodman Vol.1 Plenum Press London.								
3.	The Art and Science of growing crystals Editor : J.J.Gilman. John Wiley and Sons, Inc,N.Y.								
4.	Crystal growth Edited : Brain R. Pamplin Pergamon Press.								

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics	Academic Year	2020-21							
M.Sc. (Applied Physics): Regular Programme										
Year	II	Core / Elective / Foundation APH-2412 Physical Techniques in Industry	Credits / Hours per week							04
Semester	II	Year of Introduction: 2007 Year of Syllabus Revision: 2012	Maximum Marks / Grade							100
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) APH2412 CO1 Understanding the basic theory of pumping CO2 Learn about the mechanism of gas flow CO3 Understanding the mechanism of production of vacuum using various vacuum pumps CO4 Learning the instrumentation used for measurement of vacuum CO5 Understand basics of small system design for vacuum applications CO6 Study of thin film technology CO7 Learning and understanding the production of high and low temperature measurement and its techniques CO8 Study of Plasma coating and its applications CO9 Applications of Analytical Instruments										
Unit No.	Topic/Unit	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G) developmental needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)	
1	Basic theory of pumping: An elementary vacuum system, exhaust speed, intrinsic(pump) speed, throughput, conductance, fundamental	6	10	2	CO1	PSO6	SD	G	PE	

	equation of vacuum techniques, pump-down time, ultimate pressure.								
2	Mechanism of gas flow: Types of gas flow, conductance of pipe work in vacuum technology for viscous and molecular flow of gas.	6	10	2	CO2	PSO6			
3	Production of vacuum: Mechanical oil sealed rotary pumps, diffusion pump, turbomolecular pump, getter-ion pumps.	8	15	2,3	CO3	PSO6			
4	Measurement of vacuum: McLeod gauge, Pirani gauge, ionization gauges, radiometer gauges, leak detectors.	8	15	2,3	CO4	PSO6			
5	Small system design for vacuum applications of vacuum technology.	4	10	2,3,6	CO5	PSO6			
6	Thin film technology: Methods of production of thin films (vacuum thermal evaporation and physical sputtering process), techniques of measurements of thickness of thin films, applications of thin films (Resistance, capacitors, transistors, cryotron).	8	10	2,3,4	CO6	PSO6			
7	Production of high and low temperature: Principle of cooling, Joule-Thompson effect, isentropic cooling, isenthalpic cooling, liquefaction system for air, oxygen, hydrogen, helium; induction melting furnace, vacuum furnace, arcs and plasma, shock waves.	8	10	2,3,4	CO7	PSO6			
8	Plasma coating & applications.	6	10	3	CO8	PSO6			
9	Analytical Instruments: NMR, EPR, ESR, IR & UV Spectroscopic measurements, etc.	6	10	4	CO9	PSO6			

Reference Books		
1.	Vacuum technology	: A Roth.
2.	Introduction to theory and practice of high vacuum technology	: Ward and Bunn.
3.	Thin film phenomenon	: K.L.Chopra.
4.	Experimental techniques in condensed matter physics at low temp.	: R.Richardson & E Smith.
5.	Handbook of vacuum technology	: Meissel & Glang.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics	Academic Year		2020-21						
M.Sc. (Applied Physics): Regular Programme										
Year	II	Core / Elective / Foundation APH2413: Nondestructive Testing of Materials	Credits / Hours per week					04		
Semester	II	Year of Introduction: 2007 Year of Syllabus Revision: 2016	Maximum Marks / Grade					100		
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) APH2413 CO1 Understanding the need and importance of nondestructive testing in industry and research CO2 Learn various NDT techniques/methods including ultrasonic, eddy current, computed tomography, radiography at basic and advanced level CO3 Apply the methods for rectification of industrial/research problems/challenges										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/ Global (G) developmental needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics (PE)
1	Basic principle, Optical aids used for visual inspection, Applications.		04	10	1,2,3,4	CO1	PSO6			
2	Liquid penetrant testing: Physical principles, procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods, sensitivity, applications and limitations.		04	10	2,3,4,5	CO2	PSO6			

3	Magnetic Particle testing: Principle, magnetizing techniques, procedure used for testing a component, equipment, sensitivity and limitations.	04	10	2, 3, 4,5	CO2 CO3	PSO6	EMP, ENT, SD	N,R,G	ES, PE
4	Eddy current testing: Principle, instrumentation, techniques, sensitivity, applications and limitations.	12	20	2,3,4,5,6	CO2 CO3	PSO6			
5	Radiography: Principle, radiation sources, attenuation in the specimen, radiographic imaging, inspection techniques, applications and limitations, real time holography, and safety.	12	20	2,3,4,5,6	CO2 CO3	PSO6			
6	Ultrasonic testing: Basic properties of sound beam, ultrasonic transducers, inspection methods, techniques, equipment modes of display, applications, advantages and limitations.	12	15	2,3,4,5,6	CO2 CO3	PSO6			
7	Acoustic emission testing: Principle, technique and instrumentation.	06	05	2,3,4,5	CO2	PSO6			
8	Thermography: Principle, detectors and equipment, techniques and applications.			2,3,4,5	CO2	PSO6			
9	Leak testing methods, Leak detection.	02	05	2,3,4	CO2	PSO6			
10	Comparison and selection of NDT methods; defects in materials, selection of method and instrumentation, reliability in NDT.	04	05	4,5,6	CO2 CO3	PSO6 PSO7 PSO8			
Reference Books									
1.	Practical Non destructive testing: Baldev Raj, T. Jayakumar, M. Thavasimuth, Narosa Publishers								
2.	NDE Handbook, Non-destructive examination methods: Knud G. Boving, Jaico Publishing House								
3.	Introduction to Nondestructive Testing: A training guide: Paul E. Mix, Wiley-Interscience Publications								
4.	ASM Handbook of Nondestructive Evaluation and Quality Control: ASM International, The Materials Company								

 THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA सत्यं शिवं सुन्दरम्	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics		Academic Year			2020-21				
M.Sc. (Applied Physics): Regular Programme										
Year	II	Core / Elective / Foundation APH2414: Electronics-III	Credits / Hours per week			04				
Semester	II	Year of Introduction: 2007 Year of Syllabus Revision: 2012	Maximum Marks / Grade			100				
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) APH2414										
CO1 Understanding the need and importance of Operational amplifier, its parameter and application										
CO2 Learn and understand Analog to Digital and Digital to Analog converters										
CO3 Learn basics concepts of microprocessor its programming and application										
CO4 Understanding of semiconductor memory, microprocessor timing and its interfacing										
CO5 Understanding of basics concepts microcontroller and its programming and embedded systems										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G) development needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV) and Professional Ethics

(PE)									
1	Differential Amplifiers, Operational amplifiers and its parameters.	15	30	1,2,3,4	CO1	PSO4	EMP, ENT, SD	N,R,G	PE
2	Applications of OP-AMP's.	08	15	2,3,4,5	CO1	PSO4	EMP, ENT, SD	N,R,G	
3	Analog to digital and Digital to analog converters.	07	05	2, 3, 4,5	CO2	PSO4	EMP, ENT, SD	N,R,G	
4	Basic concepts of a Microprocessor and Programming a Microprocessor	08	15	2,3,4,5,6	CO3	PSO4	EMP, ENT, SD	N,R,G	
5	Semiconductor Memories.	02	04	2,3,4,5,	CO4	PSO4	EMP, ENT, SD	N,R,G	
6	Microprocessor timings.	02	04	2,3,4,5,	CO4	PSO4	EMP, ENT, SD	N,R,G	
7	Interfacing Memory and I/O devices.	02	04	2,3,4,5	CO4	PSO4 PSO7 PSO8	EMP, ENT, SD	N,R,G	
8	Interfacing devices.	02	02	2,3,4,5	CO4	PSO4 PSO7 PSO8	EMP, ENT, SD	N,R,G	
9	Applications of Microprocessor.	06	06	1,2,3,	CO3	PSO4 PSO7 PSO8	EMP, ENT, SD	N,R,G	
10	Introduction to 8051 microcontroller and embedded systems	08	15	2,3,6	CO5	PSO4 PSO7 PSO8	EMP, ENT, SD	N,R,G	
Reference Books									
1.	Introduction to Integrated circuits, V.H.Grinich&H.G.Jackson								
2.	Integrated Electronics, J.Millman&C.C.Halkias								
3.	Introduction to Microprocessors, A.P.Mathur								
4.	OP-AMP's & Linear Integrated circuits, R.Gayakwad								
5.	Microprocessor Architecture programming and applications, R.S.Gaonkar								
6.	Digital Computer Electronics, A.P.Malvino and J.A.Brown								
7.	The 8051 Microcontroller and Embedded Systems, M.A. Mazidi & J.G.Mazidi								
8.	The 8051 Microcontroller Architecture, Programming and Application, K.J.Ayala								

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics	Academic Year					2020-21			
M.Sc. (Applied Physics): Regular Programme										
Year	II	Core / Elective / Foundation APH2415: Fiber Optics and Its Applications	Credits / Hours per week					04		
Semester	II	Year of Introduction: 2007 Year of Syllabus Revision: 2012	Maximum Marks / Grade					100		
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) APH2415 CO1 Understanding the need and importance of optical fiber communication CO2 Learn various aspects of optical fiber communication at basic and advanced level CO3 Study basic principles, theory, construction and working of optical fibers CO3 Apply the methods for rectification of industrial/research problems/challenges										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	BT Level	CO	PSO	Element s of Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop ment (SD)	Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G) develop mental needs	Relation to Gender (G), Environ ment and Sustaina bility (ES), Human Values (HV)and Professio nal Ethics (PE)
1	Fiber materials: Glass fibers, Plastics-Clad-Glass fibers and Plastic fibers. Comparison of optical fiber cables with conventionalmetallic cables and advantages. Elements of an optical fiber. Fiber fabrication; (i) OVPD (ii) MCVD (iii) VAD and (iv) Double-crucible method.		06	10	1,2,3,4	CO1 CO2	PSO2			

2	Measurements: Attenuation measurements, cutback and OTDR techniques. Fiber fault location. Dispersion measurements; Time and Frequency domain dispersion measurements. Refractive Index-profile and Optical source characteristic measurements.	06	10	2,3,4,5	CO2 CO3	PSO2	EMP, ENT, SD	N,R,G	ES, PE
3	Power launching and coupling; Source to fiber power launching, fiber to fiber joints, mechanical misalignment. Splicing techniques; V groove butt splice, fusion splice and Elastic-tune-splice. Optical fiber connectors.	08	10	2, 3, 4,5	CO2 CO3	PSO6			
4	Optical fibers: Structures and wave guiding fundamentals: Optical fiber modes and configurations; fiber types, rays and modes. Step index fiber structure, ray optics representation and wave representation. Mode theory for circular wave guides, wave guide equations. Wave equation for step index fibers, modal equation, modes in step index fibers and power flow in step index fibers. Graded index fiber structure; Graded index numerical aperture, NA, modes in graded index fibers.	10	15	2,3,4,5,6	CO2 CO3	PSO2			
5	Signal degradation in optical fibers; attenuation, attenuation units, absorption, scattering losses, radiation losses, core and cladding losses. Signal distortion in optical waveguides; information capacity determination, group delay, material dispersion, waveguide dispersion and intermodal dispersion. Mode coupling and pulse broadening in graded index waveguides.	08	15	2,3,4,5	CO2 CO3	PSO2			
6	Fiber optics systems and Applications; communication; fundamental receiver operation, digital receiver, performance calculation, pre-amplifier design. Analog receivers, sensors, endoscopy. Transmission link; point to point link, wavelength division multiplexing WDL, data buses, line coding; NRZ codes, RZ-codes, Block codes	06	15	2,3,4,5	CO2 CO3 CO4	PSO2 PSO6 PSO7			
7	Optical sources and detectors: LED structure, surface and edge emitter LEDs. Laser diodes; Fabry-perot and DFB. Physical principle of photodiode, the pin- and Avalanche photo diodes.	16	25	2,3,4,5	CO2 CO3 CO4	PSO2 PSO6			
Reference Books									
1.	Optical Fiber communication: Gerd Keiser, McGraw-Hill International Edition								
2.	Optical Communication Systems: J. Goward								
3.	Fiber optics: A. Lacy, Prentice Hall Inc., Englewood cliff, New Jersey.								
4.	An introduction to Optical Fibers: Allen H Cheren, McGraw-Hill International Editions								
5.	Fiber Optics communication and other applications: Henery Zanger and Cynthis Zanger								

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics	Academic Year	2020-21							
M.Sc. (Applied Physics): Regular Programme										
Year	I1	Core- / Elective / Foundation APH2416: Luminescence and its Application	Credits / Hours per week					04		
Semester	I1	Year of Introduction: 2007 Year of Syllabus Revision: 2012	Maximum Marks / Grade					100		
Mode of Transaction		Lectures								
Course Outcome (CO) APH2416 CO1 Understanding the basics of luminescence, photoluminescence and thermoluminescence CO2 Learn about the absorption, excitation& emission process and instrumentations CO3 Theory of photoluminescence, thermoluminescence and optically stimulated luminescence CO4 Understand the process of electroluminescence and their applications CO5 Understanding of rare earth based phosphors and their application as LED, OLED materials CO6 Applications of phosphors in biological and medical field										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	BT Level	CO	PSO	Element s of Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop ment (SD)	Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G) develop mental needs	Relation to Gender (G), Environ ment and Sustaina bility (ES), Human Values (HV)and Professio nal Ethics (PE)
1	General aspect of Luminescence: Types of Luminescence, Rate and duration of Luminescence, Luminescence yield, Factors influencing		10	16	1,2	CO1	PSO1 PSO2			

	the luminescence and thermoluminescence (TL), Application of fluorescence and phosphorescence, Application of TL in Archeology, Geology, Quality Control in industry, Forensic science, Biology, Biotechnology and radiation dosimetry						Emp& SD	G	PE
2	Instruments to record absorption, fluorescence, phosphorescence and thermoluminescence output, Experimental techniques to prepare powder, single crystal and polycrystalline phosphors from 1) solution, 2) melt and 3) gas phases, Preparation of polymer phosphors.	10	16	3,4	CO2	PSO1 PSO7			
3	Theory of luminescence: Atomic band theory and configuration coordinate models, randall and wilkins theory, Basic of UV – Visible technique, Phosphorescence and thermoluminescence intensities equations, Trapping parameters, Kinetics of luminescence, First & second order kinetics, Thermally stimulated luminescence (TSL), glow curve analysis, Optically stimulated luminescence (OSL).	10	16	1,2	CO3	PSO1 PSO2 PSO3			
4	Electroluminescence: Excitation process-minority carrier injection (inject EL), current application by impact ionization (Avalanche EL), tunneling and exciton formation, EL panel devices; principle, fabrication and operation of AC and DC thin film.	10	16	3,4	CO4	PSO1 PSO2 PSO7			
5	Recent Advancement in photoluminescence, Introduction and Application of rare earth based phosphors, Application of downconversion and long after glow phosphors, basic mechanism and application of upconversion phosphors, luminescence materials for LED, OLED and Organic solar cell.	10	18	2,3,4	CO5	PSO1 PSO2 PSO8			
6	Application of phosphors in biological and medical field: fluorescence microscopy, bio imaging, bio labeling, photodynamic therapy and detection of biothiols.	10	18	2,3,4	CO6	PSO1 PSO7			
Reference Books									
1.	Luminescence materials: D. Curie								
2.	Luminescence of inorganic solids: Paul Goldberg								
3.	TL and Archaeology: M. J. Aitken								
4.	TL Dosimetry: M. Ellanboss								
5.	Thermally stimulated process: R. Chen and P. Krish								

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Applied Physics	Academic Year	2020-21							
M.Sc. (Applied Physics): Regular Programme										
Year	II	Core / Elective / Foundation APH2417: Physics of Nanomaterials	Credits / Hours per week					04		
Semester	II	Year of Introduction: 2007 Year of Syllabus Revision: 2012	Maximum Marks / Grade					100		
Mode of Transaction		Lectures and Tutorials								
Course Outcome (CO) APH2417 CO1 Understanding the fundamentals of nanoscience CO2 Understanding the properties of nanomaterials CO3 Learn about the nanomaterial synthesis CO4 Understanding the Lithography CO5 Understand the various characterization techniques CO6 Applications of nanoscience										
Unit No.	Topic/Unit		Contact Hours	Weightage (%)	BT Level	CO	PSO	Element s of Employa bility (Emp)/ Entrepre neurship (Ent)/ Skill Develop ment (SD)	Relevan ce to Local (L)/ National (N)/ Regional (R)/Glob al (G) develop mental needs	Relation to Gender (G), Environ ment and Sustaina bility (ES), Human Values (HV)and Professio nal Ethics (PE)
1	Introduction to nanomaterials Importance of nanotechnology, Physics of two dimensional systems, Size Quantization, Quantum well, quantum, wire and quantum dot, Conditions for quantum size effects, superlattices, Density of states (DOS), Calculation of surface to volume ratio, Density of states for a one dimensional electron gas Quantum dots,Wave functions and energy levels, Density of states for zero dimensional electrons		10	15	2,4,5	CO1 CO2	PSO1 PSO5 PSO6	Ent, SD	G	PE

2	Nanolithography Introduction to lithography, Types of resist, Lithography using photons (UV, X-ray), Lithography using particle beams	06	10	3,4	CO3 CO4	PSO1 PSO5			
3	Synthesis of nanomaterials-I Synthesis of nanomaterials by Physical routes, Electric Arc Deposition, Chemical Vapour Deposition (CVD) and its variants Electro deposition, Sputter Deposition, High energy ball milling	08	13	2,6	CO3	PSO5 PSO6			
4	Synthesis of nanomaterials-II Synthesis of nanomaterials by Chemical routes, Growth of nanoparticles, Sol Gel Method, Langmuir-Blodgett (L-B) Method, Synthesis of Metal and semiconductor nanoparticles by colloidal route	08	12	2,6	CO3	PSO5 PSO6			
5	Characterization of nanomaterials-I Determination of structure and particle size, Increase in width of XRD peaks, Electron Microscope, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Scanning Probe Microscope (SPM), Atomic Force Microscope (AFM), Scanning Tunneling Microscope (STM)	06	13	1,2	CO5	PSO5 PSO6			
6	Characterization of nanomaterials-II Spectroscopy, Shift in photoluminescence peaks, Variation in Raman spectra, X-ray Photoelectron spectroscopy, Auger Electron Spectroscopy (AES), Magnetic Measurements Vibrating sample Magnetometer	08	12	3,4,5	CO5	PSO5 PSO6			
7	Applications of nanomaterials Quantum well and Quantum wire LASERS, Some Special Nanomaterials: Porous Silicon, aerogels, Zeolites, Self Assembled Monolayers (SAMs), Applications of Nanomaterials	08	13	1,2,3	CO6	PSO5 PSO6			
8	Carbon and its allotropes Fullerenes and carbon nanotubes (CNTs), single wall carbon nanotubes, multiwall carbon nanotubes, preparation, Characteristics and their Applications	06	12	1,2,3	CO1 CO6	PSO5 PSO6			
Reference Books									
1.	Quantum Hetro structure by Mitin, Kochelap and Strosio, Cambridge University Press								
2.	Introduction to Nanotechnology by Poole Jr and Owens, Wiley Interscience								
3.	Nano: The Essentials by T. Pradeep, Tata McGraw-Hill Publishing Co. Ltd, New Delhi								
4.	Nanotechnology: Principles and Practices by Sulbha K. Kulkarni, Capital Publishing Co, New Delhi								
5.	Characterization of nanophase Materials, Z.L.Wang,, Wiley-VCH								
6.	NANOTECHNOLOGY:Basic Calculations for Engineers and Scientists, Louis Theodore, Wiley Interscience								