

K.S. Rangasamy College of Arts and Science
(Autonomous)
Tiruchengode- 637 215

Department of Physics (PG)

Details of Elective Course offered by the Department

ELECTIVE I

S.No	Subject code	Subject
1	18PPHEL201	Modern Optics
2	18PPHEL202	Nonlinear Dynamics
3	18PPHEL203	Biomaterials

ELECTIVE II


S.No	Subject code	Subject
1	18PPHEL301	Physics of Nanoscale
2	18PPHEL302	Crystal Growth and Thin Film Physics
3	18PPHEL303	Instrumental Methods of Analysis

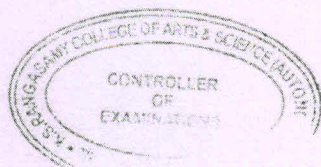
List of Encl.:


- Syllabus copy of the courses


HOD

Dr. G. SURESH KUMAR, M.Sc., M.Phil., Ph.D.
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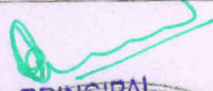


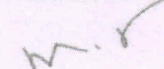

COE

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SCHEME OF EXAMINATION

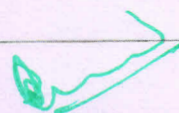
Subject Code	Subject	Hrs of Instruction	Exam Duration (Hrs)	Max Marks			Credit Points
				CA	CE	Total	
First Semester							
Part A							
18PPHM101	Core I: Mathematical Physics	6	3	25	75	100	5
18PPHM102	Core II: Classical Mechanics	6	3	25	75	100	5
18PPHM103	Core III: Statistical Mechanics	6	3	25	75	100	5
18PPHM104	Core IV: Condensed Matter Physics	6	3	25	75	100	5
18PPHMP101	Core Practical I: Advanced Physics Practical I	5	4	40	60	100	3
Non-credit							
18PLS101	Career Competency Skills I	1	-	-	-	-	-
Total		30				500	23
Second Semester							
Part A							
18PPHM201	Core V: Quantum Mechanics I	6	3	25	75	100	5
18PPHM202	Core VI: Electromagnetic Theory	6	3	25	75	100	5
	Elective I	5	3	25	75	100	4
18PPHMP201	Core Practical II: Advanced Physics Practical II	5	4	40	60	100	3
18PCSPHI201	IDC I: Computer Graphics and Multimedia	3	3	25	75	100	2
18PCSPHIP201	IDC Practical I: Multimedia Tools	2	3	40	60	100	2
Part B							
18PVE201	Value Education: Human Rights	2	3	25	75	100	2
Non-credit							
18PLS201	Career Competency Skills II	1	-	-	-	-	-
Total		30				700	23

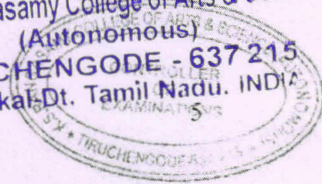

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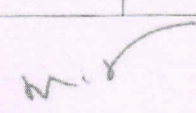

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M.Sc., Physics (Students admitted from 2018-2019 onwards)

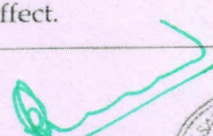
Subject code	Subject	Hrs of Instruction	Exam Duration (Hrs)	Max Marks			Credit Points
				CA	CE	Total	
Third Semester							
Part A							
18PPHM301	Core VII: Quantum Mechanics II	6	3	25	75	100	5
18PPHM302	Core VIII: Advanced Electronics	6	3	25	75	100	4
18PPHM303	Core IX: Microprocessor and Microcontroller	5	3	25	75	100	4
	Elective II	5	3	25	75	100	4
18PPHMP301	Core Practical III: Advanced Electronics Practical	4	3	40	60	100	3
Optional Papers							
18PECPHI301	IDC II: Modern Biomedical Instrumentation	4	3	25	75	100	4
18PBCPHI301	IDC II: Molecular Biophysics						
Total		30				600	24
Fourth Semester							
Part A							
18PPHM401	Core X: Spectroscopy	6	3	25	75	100	4
18PPHM402	Core XI: Nuclear and Particle Physics	6	3	25	75	100	4
18PPHM403	Core XII: Computational Physics	6	3	25	75	100	4
18PPHMP401	Core practical IV: Computation using MATLAB	3	3	40	60	100	2
18PPHPR401	Project & Viva-Voce	5	-	50	150	200	6
Total		26				600	20
Grand total						2400	90

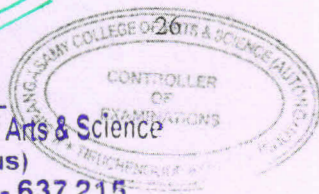

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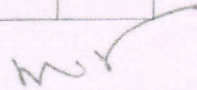



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18PPHEL201	ELECTIVE I: MODERN OPTICS	SEMESTER - II	
COURSE OBJECTIVES The course aims <ul style="list-style-type: none"> To impart knowledge on polarization, double refraction and lasers To provide knowledge on fibre optics, non-linear optics, electro-optical and magneto-optical effects. 			
Credits: 4		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	Polarization and double refraction: Linearly and circularly polarized waves-Transverse character of light waves - Polarizer and analyser - Production of polarized light - The wire grid polarizer and the polaroid- Polarization by reflection - Polarization by scattering - Malu's law - The phenomenon of double refraction - Normal and oblique incidence - Interference of polarized light - Quarter and half-wave plates - Analysis of polarized light - Optical activity.	10	CO1
II	Laser Physics: Basic principles - Spontaneous and stimulated emissions, components of a laser, optical amplification - Resonator and lasing action - Types of lasers - Solid state lasers - Ruby laser - Nd:YAG laser - Gas lasers - He-Ne laser - CO ₂ laser - Semiconductor lasers - Liquid laser - Dye laser and Chemical lasers - Applications of various laser.	10	CO2
III	Fiber optics: Total internal reflection - Optical Fiber - Glass fibers - Coherent bundle - Numerical aperture - Attenuation in optical fibers - Attenuation limit - Single mode and multi-mode fibers - Pulse dispersion in multimode optical fibers - Ray dispersion in multimode step index fibers - Parabolic-index fibers - Material dispersion - Dispersion and maximum bit rates - Fiber-optic sensors.	10	CO3
IV	Non-linear optics: Basic principles - Harmonic generation - Second harmonic generation - Phase matching - Third harmonic generation - Optical mixing - Parametric amplification - Self focusing of light.	10	CO4
V	Magneto-optics and electro-optics: Magneto-optical effects - Zeeman effect - Faraday effect - Voigt effect or magnetic double refraction - Cotton-Mouton effect - Kerr magneto optic effect - Electro-optical effects - Stark effect - Electric double refraction - Kerr electro-optic effect - Pockels electro-optic effect.	10	CO5


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TEXT BOOKS:	
1	<i>Ajoy Ghatak</i> , 2005. Optics , [Third Edition], Tata McGraw-Hill Publishing, New Delhi [Unit-I, III, V].
2	<i>Laud, B.B.</i> 2011. Laser and Non-Linear Optics . [Third Edition]. New Age International Publishers, New Delhi. [Unit: II, IV]
REFERENCE BOOKS:	
1	<i>Silfvast.T, W.</i> 2004. Laser Fundamentals , [Second Edition]. Cambridge University Press, New York.
2	<i>Jenkins. F.A and White. H.E.</i> , Fundamentals of Optics , [Fourth Edition]. McGraw-Hill International Edition, London, 2001.
3	<i>Lipson, S.G., Lipson. H., and Tannhauser. D.S.</i> , 1996. Optical Physics [Third Edition]. Cambridge University Press, London.
WEB REFERENCES:	
1	https://ocw.mit.edu/courses/physics/
2	http://nptel.ac.in/syllabus/115104041/
3	https://www.khanacademy.org/
4	http://nptel.ac.in/downloads/115101008/

COURSE OUTCOMES (CO)

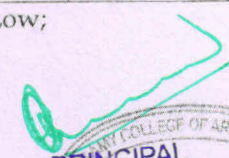
After completion of the course, the students will be able to

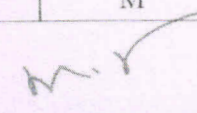
CO 1	Describe the phenomena of polarization and double refraction.
CO 2	Explain the principle, construction and working of various lasers.
CO 3	Explain the fundamentals of optical fibers and related concepts.
CO 4	Analyze the various optical non-linear phenomena.
CO 5	Analyze the various electro-optical and magneto-optical effects.

MAPPING

PSO CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	H	H	H	H	L
CO 2	H	M	M	M	H
CO 3	H	M	M	M	M
CO 4	H	H	H	H	M
CO 5	H	H	H	H	M

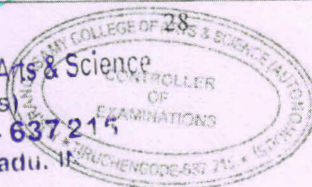
H-High; M-Medium; L-Low;


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18PPHEL202	ELECTIVE I: NONLINEAR DYNAMICS	SEMESTER - II	
COURSE OBJECTIVES The course aims <ul style="list-style-type: none"> To impart knowledge on nonlinear dynamical systems. To provide the concept of solitons, chaos and its related phenomena To impart knowledge on applications of nonlinear dynamical systems. 			
Credits: 4		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	Introduction to nonlinear dynamical systems - The notion of nonlinearity- Superposition principle and its validity - Linear and nonlinear oscillators- Autonomous and nonautonomous systems - Equilibrium points - Phase space - Classification of equilibrium points - Stability of fixed points.	10	CO1
II	Chaos- simple bifurcations - Saddle node, pitchfork, transcritical bifurcation- The logistic map - Onset of chaos- Other routes to chaos- Period doubling phenomenon - Quasi periodic route to chaos- Intermittency route to chaos- Bifurcation scenario in Duffing oscillator - Chaos in conservative systems.	10	CO2
III	Solitons - Birth of soliton - Nonlinear dispersive systems- Cnoidal and solitary waves- Scott Russel phenomenon and KdV equation- Fermi-Pasta-Ulam (FPU) lattice problem - FPU recurrence phenomenon- Asymptotic analysis- Numerical experiment of Zabusky and Kruskal.	10	CO3
IV	Integrability and methods to soliton equations- The notion of integrability - Painleve analysis and its application to KdV equation, nonlinear Schrödinger equation- Lax pair for KdV equations- Inverse Scattering Method and its application to KdV equation- Hirota's bilinearization method- Examples: KdV and nonlinear Schrödinger equation.	10	CO4
V	Applications- Chaos and secure communications - Nonlinear optics and biological systems - Role of soliton in condensed matter systems.	10	CO5
TEXT BOOKS:			
1	Lakshmanan, M and Rajasekar, S. 2003. Nonlinear Dynamics, Integrability, Chaos and Patterns. Springer-Verlag, Berlin.		

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REFERENCE BOOKS:	
1	<i>Drazin, P.G.</i> 1992. Nonlinear systems , Cambridge University Press, Cambridge.
2	<i>Leon, G and Kaplan, D.</i> 1995. Understanding Nonlinear Dynamics . Springer, New York.
3	<i>Ablowitz, M.J. and Clarkson, P.A.</i> 1991. Solitons, Nonlinear Evolution Equations and Inverse Scattering , Cambridge University Press, Cambridge.
4	<i>Dodd, R. Eilbeck, J. Gibbson J. and Morris, H.</i> 1982. Solitons and Nonlinear Wave Equations , Academic, New York.
WEB REFERENCES:	
1	http://nptel.ac.in/courses/108101002/
2	https://ocw.mit.edu/courses/physics/

COURSE OUTCOMES (CO)

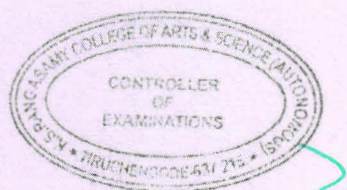
After completion of the course, the students will be able to

CO 1	Explain the fundamentals of nonlinear dynamical systems.
CO 2	Apply the concept of chaos and related theories.
CO 3	Analyze the solitons and related phenomena.
CO 4	Create the different equations to describe non-linear systems.
CO 5	Apply solitons and chaos for various real time applications.

MAPPING

PSO CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	H	H	H	H	L
CO 2	H	H	H	H	M
CO 3	H	H	H	H	M
CO 4	M	H	H	H	H
CO 5	L	H	H	M	H

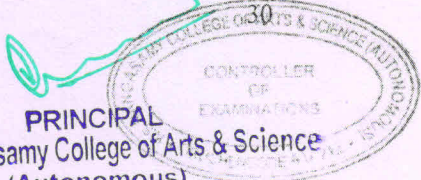
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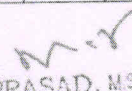
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18PPHEL203	ELECTIVE I: BIOMATERIALS	SEMESTER - II	
COURSE OBJECTIVES			
The course aims			
<ul style="list-style-type: none"> To impart knowledge on materials used for clinical applications. To provide knowledge on various biomedical implants. 			
Credits: 4		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	Introduction to biomaterials - Classification- Impact of biomaterials- Tissue response to various biomaterials - Mechanical properties of biomaterials and its importance - Surface properties: Surface energy, Contact angles and critical surface tension - Surface improvements - Thermal treatments - Sterilization - Safety and efficacy testing of biomaterials.	10	CO1
II	Metals and alloys - Stainless steel - Cobalt-chromium alloys - Titanium based alloys- Nitinol - Metallic corrosion - Biological tolerance of metal implants - Polymers - Polyurethanes - Hydrogels - Polyamides - Silicone - Collagens - Cellulose - Chitin - Alginates - Polymers in biomedical use.	10	CO2
III	Ceramics - Bioinert ceramics - Carbon - Alumina- Ytria stabilized zirconia - Surface reactive ceramics - Bioglass - Resorbable ceramics - Hydroxyapatite: Properties and applications - Tricalcium phosphate: Properties and applications - Composites.	10	CO3
IV	Tissue graft - Tissue engineering -Bulk space fillers - Maxillofacial implants - biomaterials in urological practice - Vascular implants - Synthetic blood vessel - Cardiac valve replacement - Blood substitutes - Artificial kidney - Biomaterials in ophthalmology - Contact lenses - Optical implants - Eye shields - Artificial tears -Biosensors - Drug delivery systems.	10	CO4
V	Biomaterials in orthopedics - Bone: Composition, Structure and Mechanical properties - Osteoblasts - Osteoclasts - Bioelectric effect - Bone healing - Osteoporosis - Bone regeneration with resorbable materials - Teeth: Structure, Composition and Mechanical properties - Biomaterials in dentistry.	10	CO5



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TEXT BOOKS:	
1	<i>Sujata V. Bhat.</i> 2010. Biomaterials [Second Edition]. Narosa Publishing House, New Delhi.
REFERENCE BOOKS:	
1	<i>Park. J, Lakes. R. S.</i> 2007. Biomaterials: An Introduction [Third Edition]. Springer Publication.
2	<i>Reema Shukla,</i> 2014. Biomaterials [First Edition]. Nandu Printers & Publishers Pvt. Ltd. Chennai.
WEB REFERENCES:	
1	http://nptel.ac.in/courses/113104009/
2	https://ocw.mit.edu/index.htm

COURSE OUTCOMES (CO)

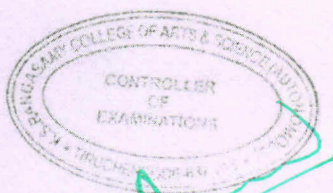
After completion of the course, the students will be able to

CO 1	Explain the basics of biomaterials, their classification, properties and efficacy testing.
CO 2	Know about properties and applications of metallic and polymeric materials.
CO 3	Describe the properties and applications of various ceramics biomaterials
CO 4	Create various implants for biomedical applications.
CO 5	Analyze the structure of bone and teeth and apply the various materials for orthopedics and dentistry.

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	H	M	M	M	H
CO 2	M	H	H	M	H
CO 3	M	H	H	L	H
CO 4	M	H	H	L	H
CO 5	M	M	M	L	H

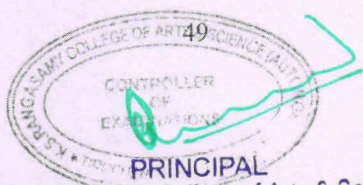
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18PPHEL301	ELECTIVE II: PHYSICS OF NANOSCALE	SEMESTER - III	
<p>COURESE OBJECTIVES: The course aims</p> <ul style="list-style-type: none"> To impart knowledge on basics of nanoscience, preparation and properties, of nanomaterials To inculcate knowledge on various characterization methods and applications of nanomaterials. 			
Credits: 4		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	<p>Introduction to the nanoworld: History of nanoscience - Nano and nature - Classification of Nanomaterials - Nanorods, nanoparticles, nanotubes - Size and dimensionality effects.</p> <p>Quantum mechanics of nanosystems: Density of states and quantum confinement - Quantum wells - Quantum wires - Quantum dots - Superlattices.</p>	10	CO1
II	<p>Basic aspects of synthesis of nanomaterials: Bottom-Up approach: Sol-gel synthesis - Hydrothermal growth - Thin film growth: Physical vapor deposition - Chemical vapor deposition - Top-Down approach: Ball milling - Microfabrication - Lithography - Ion-beam lithography.</p>	10	CO2
III	<p>Properties of nanostructured materials: Nanoscale magnetism - Optoelectronic property of bulk and nanostructures - Electronic structure of nanomaterials and Fermi surface - Luminescence properties of nanomaterials - Specific heat of nanocrystalline materials - Melting points of nanomaterials - Mechanical properties of nanostructured materials.</p>	10	CO3
IV	<p>Nanoscale characterization techniques: X-ray diffraction and Scherrer method - Scanning electron microscopy - Transmission electron microscopy - Energy Dispersive X-ray analysis - Scanning probe microscopy - Atomic Force microscopy - X-ray photoelectron spectroscopy - Diffuse reflectance spectra - Photoluminescence spectroscopy - IR and Raman spectroscopy - DC magnetization measurements: SQUID - VSM.</p>	10	CO4



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V	<p>Prime materials in nanoworld: Carbon nanotubes - Graphene - Metal nanoparticles - Semiconducting nanoparticles.</p> <p>Application of nanomaterials: Impact of nanoscience in materials science - Nanoelectronics - Nanophotonics - Nanocatalyst - Applications of nanomaterials in textiles - Applications of nanomaterials in biology and medicine - Nanocosmetics - Nanosensors - Drug delivery - Cancer therapy - Tissue engineering - Impact of nanomaterials in energy and environment.</p>	10	CO5
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TEXT BOOKS:

- 1 M.S. Ramachandra Rao and Shubra Singh. 2013. **Nanoscience and Nanotechnology: Fundamentals to Frontiers.** [First Edition]. John-Wiley & Sons, USA.
- 2 C.N.R. Rao. 2013. **Nanoworld: Introduction to Nanotechnology and Nanotechnology.** [Third Edition]. Navakarnataka Publications Private Limited, Bangalore.

REFERENCE BOOKS:

- 1 Charles P.Poole and Frank J. Owens. 2009. **Introduction to Nanotechnology.** John-Wiley & Sons, USA.
- 2 Guozhong Gao. 2010. **Nanostructures and Nanomaterials Synthesis, Properties and Applications.** [Second Edition]. Cambridge University Press India Pvt Ltd.
- 3 De Jongh, J. 1994. **Physics and Chemistry of Metal Cluster Compounds.** Kluwer Academic Publishers, Dordrecht.
- 4 Kenneth J. Klabunde. 2001. **Nanoscale Materials in Chemistry.** John-Wiley & Sons, USA.

WEB REFERENCES:

- 1 <https://epgp.inflibnet.ac.in/ahl.php?csrno=831>
- 2 <https://nptel.ac.in/courses/118102003/>
- 3 <https://nptel.ac.in/courses/118104008/>
- 4 https://www.sciencedaily.com/news/matter_energy/nanotechnology/
- 5 <http://www.understandingnano.com/index.htm>

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Explain the fundamentals of nanoscience.
CO 2	Describe the various methods for synthesis of nanoparticles.
CO 3	Analyze the various properties of nanomaterials.
CO 4	Apply the different analytical method for the characterization of nanoparticles
CO 5	Utilize the nanostructured materials for various applications

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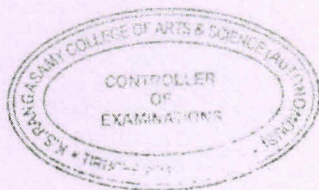
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MAPPING

PSO CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	H	M	M	M	H
CO 2	H	L	M	M	H
CO 3	H	M	H	H	H
CO 4	H	H	H	H	H
CO 5	L	L	M	H	H

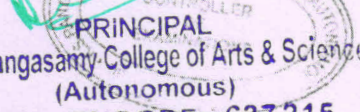
H-High; M-Medium; L-Low;



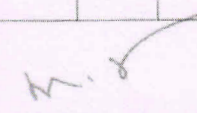
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18PPHEL302	ELECTIVE II: CRYSTAL GROWTH AND THIN FILM PHYSICS	SEMESTER - III	
COURSE OBJECTIVES:			
The course aims			
<ul style="list-style-type: none"> To impart knowledge on crystal growth theory and techniques To provide knowledge on thin films deposition and characterization methods. 			
Credits: 4		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	Nucleation theory: Nucleation - Homogenous and heterogeneous nucleation - Concept of formation of critical nucleus - Theory of nucleation. Solution Growth Technique: Low temperature solution growth: Solution - Solubility and super solubility - Expression of super saturation - Miers T-C diagram - Crystallizer - Seed preparation and mounting - Slow cooling and solvent evaporation methods.	10	CO1
II	Gel Growth Technique: Principle - Various types - Structure of gel - Importance of gel - Experimental procedure - Chemical reaction method - Single and double diffusion method - Chemical reduction method - Complex and decomplexion method - Solubility reduction method - Advantages of gel method.	10	CO2
III	Melt technique: Bridgman technique - Basic process - Various crucibles design - Thermal consideration - Vertical Bridgman technique - Czochralski technique - Experimental arrangement - Growth process. Vapour technique: Physical vapour deposition - Chemical vapour deposition (CVD) - Chemical Vapour Transport.	10	CO3
IV	Thin Film Deposition Techniques : Thin Films - Deposition Techniques - Physical Methods - Resistive Heating, Electron Beam Gun, Laser Gun Evaporation and Flash Evaporations, Sputtering - Reactive Sputtering, Radio-Frequency Sputtering - Chemical Methods - Spray Pyrolysis - Spin coating method.	10	CO4
V	Characterization Technique: Powder and single crystal X-ray diffraction - Fourier transform infrared analysis - EDX analysis - Scanning electron microscopy (SEM) - Atomic force microscopy (AFM) - UV-Vis NIR spectrometer - Photoluminescence (PL) spectrometer - Microhardness.	10	CO5



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TEXT BOOKS:

1. *Santhana Ragavan, P. Ramasamy, P.* 2001. **Crystal Growth Processes and Methods**, KRU Publications, Kumbakonam. [Unit- I to III]
2. *A. Goswami, A.* 1996. **Thin Film Fundamentals**, [First Edition]. New Age International (P) Limited, New Delhi [Unit-I, IV, V].

REFERENCE BOOKS:

- 1 *Brice, J.C.* 1986. **Crystal Growth Processes**, John Wiley and Sons, New York.
- 2 *Sangawal, K.*1994. **Elementary crystal growth**, Shan Publisher, UK.
- 3 *Maissel. L.I. and clang, R.* 1970. **Hand Book of Thin Films Technology**, McGraw-Hill, New York.
- 4 *William, M. and Steve, D.* 1986. **Instrumental Methods of analysis**, CBS Publishers, New Delhi.

WEB REFERENCES:

- 1 <https://epgp.inflibnet.ac.in/ahl.php?csrno=831>
- 2 <https://nptel.ac.in/courses/113104004/>

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Explain the fundamentals of crystal and thin film growth.
CO 2	Describe the various solution growth and gel growth techniques for grow single crystals.
CO 3	Demonstrate the various melt and vapour growth techniques for grow single crystals.
CO 4	Apply the different deposition techniques to prepare thin films.
CO 5	Utilize the various analytical methods for characterizing the crystalline materials.

MAPPING

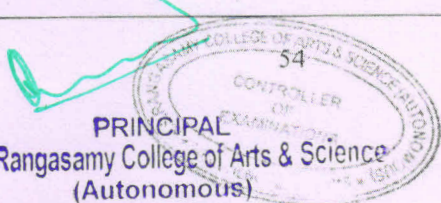
PSO CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	H	H	M	M	M
CO 2	H	M	H	H	M
CO 3	H	M	H	H	M
CO 4	H	M	H	H	H
CO 5	H	M	H	H	H


H-High; M-Medium; L-Low;

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18PPHEL303	ELECTIVE II: INSTRUMENTAL METHODS OF ANALYSIS	SEMESTER - III	
COURSE OBJECTIVES:			
The course aims			
<ul style="list-style-type: none"> To impart knowledge on different errors, analysis of experimental data and concept of stress analysis. To impart knowledge on the basic theories, construction and working of various analytical instruments for analyze the materials. 			
Credits: 4		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	Errors and analysis of experimental data: Types of errors - Mean, variance and standard deviation - Sampling techniques - Chi square test. Experimental stress analysis: Stress analysis by strain gauging - high temperature strain gauge techniques - Photoelasticity and holography.	10	CO1
II	Thermal analysis: Thermogravimetric analysis - Instrumentation and applications - Differential scanning calorimetric - Instrumentation - Specific heat capacity measurements - Determination of thermochemical parameters - Differential thermal analysis - Basic principles - Melting point determination and analysis.	10	CO2
III	X-ray analysis: Single crystal and powder X-ray diffraction - Interpretation of diffraction patterns - Indexing - Unknown and phase identification - Thin film characterization - Energy dispersive X-ray analysis - X-ray fluorescence method and its applications.	10	CO3
IV	Optical methods and electron microscopy: IR and Raman spectroscopy - X-ray photoelectron spectroscopy - Diffuse reflectance spectra - Photoluminescence spectroscopy - Near field scanning optical microscopy - Transmission electron microscopy - Scanning probe microscopy - Atomic force microscopy.	10	CO4
V	Electrical methods : Hall Effect - Carrier density - Resistivity - Two probe and four probe methods - CV characteristics - Schottky barrier capacitance - Impurity concentration - Electrochemical CV profiling - Limitations. Magnetic methods: SQUID - VSM.	10	CO5


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TEXT BOOKS:	
1	Sivasankar, B. 2012. Instrumental Methods of Analysis, Oxford University Press, Oxford.
2	Belk, J.A. 1979. Electron microscopy and Microanalysis of Crystalline Materials, Applied Science Publishers, London.
REFERENCE BOOKS:	
1	Willard, Merritt, Dean and Settle. 2012. Instrumental Methods of Analysis, CBS Publishers, New Delhi.
2	Philips, V.A. 1971. Modern Metallographic Techniques and their Applications, Wiley Interscience, USA.
WEB REFERENCES:	
1	https://nptel.ac.in/syllabus/103108100/
2	https://epgp.inflibnet.ac.in/ahl.php?csrno=831
3	https://nptel.ac.in/courses/113104004/

COURSE OUTCOMES (CO)

After completion of the course, the students will be able to

CO 1	Explain the different errors, analysis of experimental data and concept of stress analysis.
CO 2	Describe the principle and working of different analytical methods for thermal analysis.
CO 3	Utilize the X-ray diffraction technique for characterizing the crystals and thin films.
CO 4	Explain the fundamentals of various optical and electron microscopic techniques.
CO 5	Apply the various analytical methods for measuring the electrical properties of materials.

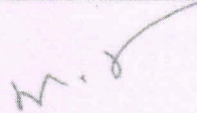
MAPPING

PSO CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	M	H	H	H	M
CO 2	H	H	H	H	L
CO 3	H	H	H	H	M
CO 4	H	H	H	H	H
CO 5	H	M	H	H	M

H-High; M-Medium; L-Low;



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