Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B010301T/PY207	**Title of the Course**	**Electromagnetic Theory and Modern Optics**	**L**	**T**	**P**	**C**
Year	**Second**	**Semester**	Third	**4**	**0**	**0**	**4**
Pre-Requisite	10+2 with Physics	**Co-requisite**	Passed B.Sc. 1st Year				
Course Objectives	This course aims to give students the competence in the Electromagnetic Theory and Modern Optics. At the end of the course the students are expected to have hands on experience in modeling, implementation and calculation of physical quantities of relevance and also their applications in various fields.						

Course Outcomes	
CO1	To get a better understanding of electrical and magnetic phenomenon in daily life.
CO2	To troubleshoot simple problems related to electrical devices.
CO3	Comprehend the powerful applications of ballistic galvanometer.
CO4	Study the fundamental physics behind reflection and refraction of light (electromagnetic waves).
CO5	Study the working and applications of Michelson and Fabry-Perot interferometers.
CO6	Recognize the difference between Fresnel's and Fraunhofer's class of diffraction.
CO7	Comprehend the use of polarimeters.
CO8	Study the characteristics and uses of lasers.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Electrostatics**	Electric charge & charge densities, electric force between two charges. General expression for Electric field in terms of volume charge density (divergence & curl of Electric field), general expression for Electric potential in terms of volume charge density and Gauss law (applications included). Study of electric dipole. Electric fields in matter, polarization, auxiliary field **D** (Electric displacement), electric susceptibility and permittivity.	8	CO1, 2
2	**Magnetostatics**	Electric current & current densities, magnetic force between two current elements. General expression for Magnetic field in terms of volume current density (divergence and curl of Magnetic field), General expression for Magnetic potential in terms of volume current density and Ampere's circuital law (applications included). Study of magnetic dipole (Gilbert & Ampere model). Magnetic fields in matter, magnetisation, auxiliary field **H**, magnetic susceptibility and permeability.	8	CO1, 2
3	**Time Varying Electric Fields**	Faraday's laws of electromagnetic induction and Lenz's law. Displacement current, equation of continuity and Maxwell-Ampere's circuital law. Self and mutual induction (applications included). Derivation and physical significance of Maxwell's equations. Theory and working of moving coil ballistic galvanometer (applications included).	7	CO3, 4
4	**Electromagnetic Waves**	Electromagnetic energy density and Poynting vector. Plane electromagnetic waves in linear infinite dielectrics, homogeneous & inhomogeneous plane waves and dispersive & non-dispersive media. Reflection and refraction of homogeneous plane electromagnetic waves, law of reflection, Snell's law, Fresnel's formulae (only for normal incidence & optical frequencies) and Stoke's law.	7	CO3, 4
5	**Interference**	Conditions for interference and spatial & temporal coherence. Division of Wavefront - Fresnel's Biprism and Lloyd's Mirror. Division of Amplitude - Parallel thin film, wedge shaped film and Newton's Ring experiment. Interferometer - Michelson and Fabry-Perot.	8	CO5
6	**Diffraction**	Distinction between interference and diffraction. Fresnel's and Fraunhofer's class of diffraction. Fresnel's Half Period Zones and Zone plate. Fraunhofer diffraction at a single slit, n slits and Diffracting Grating. Resolving Power of Optical Instruments - Rayleigh's criterion and resolving power of telescope, microscope & grating.	8	CO6
7	**Polarization**	Polarisation by dichronic crystals, birefringence, Nicol prism, retardation plates and Babinet's compensator. Analysis of polarized light. Optical Rotation - Fresnel's explanation of optical rotation and Half Shade & Biquartz polarimeters.	7	CO7
8	**Lasers**	Characteristics and uses of Lasers. Quantitative analysis of Spatial and Temporal coherence. Conditions for Laser action and Einstein's coefficients. Three and four level laser systems. (Qualitative discussion).	7	CO8

Reference Books:

1. D.J. Griffiths, "Introduction to Electrodynamics", Prentice-Hall of India Private Limited, 2002, 3e
2. E.M. Purcell, "Electricity and Magnetism (In SI Units): Berkeley Physics Course Vol 2", McGraw Hill, 2017,2e
3. Richard P. Feynman, Robert B. Leighton, Matthew Sands, "The Feynman Lectures on Physics - Vol. 2",Pearson Education Limited, 2012
4. D.C. Tayal, "Electricity and Magnetism", Himalaya Publishing House Pvt. Ltd., 2019, 4e
5. Francis A. Jenkins, Harvey E. White, "Fundamentals of Optics", McGraw Hill, 2017, 4e
6. Samuel Tolansky, "An Introduction to Interferometry", John Wiley & Sons Inc., 1973, 2e
7. A. Ghatak, "Optics", McGraw Hill, 2017, 6e

e-Learning Source:

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx
4. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	**3**	**2**	-	-	-	-	**3**	**2**	-	**1**	**2**
CO2	**3**	**2**	-	-	-	-	**3**	**3**	-	**1**	**2**
CO3	**3**	**2**	-	-	-	-	**3**	**3**	-	**2**	**2**
CO4	**3**	**2**	-	-	-	**1**	**3**	**3**	-	**3**	**2**
CO5	**3**	**2**	-	-	-	-	**3**	**3**	-	**3**	**2**
CO6	**3**	**2**	-	-	-	-	**3**	**2**	-	**1**	**2**
CO7	**3**	**2**	-	-	-	-	**3**	**3**	-	**1**	**2**
CO8	**3**	**2**	-	-	-	-	**3**	**3**	-	**2**	**2**

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B010302P/PY208	**Title of the Course**	Demonstrative Aspects of Electricity & Magnetism	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Third	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 with Physics	**Co-requisite**	Passed B.Sc. 1st Year				
Course Objectives	The purpose of this undergraduate course is to impart practical knowledge/measurements in the field of electricity and magnetism mechanics through different experiments related to its theoretical course.						

Course Outcomes	
CO1	Students will understand the effect of distance on the intensity of magnetic field
CO2	Student will learn to find the various parameters of a ballistic galvanometer
CO3	Students will learn the methods to find the values of high and low resistances and also how to find the self inductance of a coil
CO4	Students will learn the method to compare the capacitance and also about how to find specific resistance
CO5	Students will learn the methods to find the magnetic moment and earth's magnetic field components

Experiment No.	**Title of the Experiment**	**Aim of the Experiment (*Offline)**	**Contact Hrs.**	**Mapped CO**
1	Single Coil	Variation of magnetic field along the axis of single coil	6	CO1
2	Helmholtz Coil	Variation of magnetic field along the axis of Helmholtz coil	6	CO1
3	B.G. Parameter	Ballistic Galvanometer: Ballistic constant, current sensitivity and voltage sensitivity	6	CO2
4	Leakage Method	Ballistic Galvanometer: High resistance by Leakage method	6	CO3
5	Kelvin's Double Bridge Method	Ballistic Galvanometer: Low resistance by Kelvin's double bridge method	6	CO3
6	Rayleigh's Method	Ballistic Galvanometer: Self inductance of a coil by Rayleigh's method	6	CO3
7	Capacitance Comparison	Ballistic Galvanometer: Comparison of capacitances	6	CO4
8	Carey Foster Bridge	Carey Foster Bridge: Resistance per unit length and low resistance	6	CO4
9	Magnetometer	Deflection and Vibration Magnetometer: Magnetic moment of a magnet and horizontal component of earth's magnetic field	6	CO5
10	Earth Inductor	Earth Inductor: Horizontal component of earth's magnetic field	6	CO5
Experiment No.	**Title of the Experiment**	**Aim of the Experiment (*Online Virtual Lab)**	**Contact Hrs.**	**Mapped CO**
1	Tangent galvanometer	To determine the reduction factor of the given tangent galvanometer (K). To find out the horizontal component of earth's magnetic field (Bh).	--	--
2	Magnetic field along the axis of a circular coil carrying current	To study the variation of magnetic field with distance along the axis of a circular coil carrying current.	--	--
3	Deflection magnetometer	To find the horizontal intensity of earth's magnetic field at a place and moment of the bar magnet.	--	--
4	Van de Graff generator	To Know about Van de Graff generator	--	--
5	Barkhausen effect	To experience the sound produced according to the magnetization of the rod while the magnet is getting nearer to the rod.	--	--
6	Temperature coefficient of resistance	To identify the change in resistivity of the resistor according to the change in temperature	--	--
7	Anderson's bridge	To find the inductance of a coil using Anderson's Bridge	--	--
8	Quincke's method	To determine the volume magnetic susceptibilities of paramagnetic liquids.	--	--

Reference Books:

1. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London, 1962, 9e
2. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 2015, 1e
3. R.K. Agrawal, G. Jain, R. Sharma, "Practical Physics", Krishna Prakashan Media (Pvt.) Ltd., Meerut, 2019
4. S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut, 2014, 2e

e-Learning Source:

1. Virtual Labs at Amrita Vishwa Vidyapeetham, https://vlab.amrita.edu/?sub=1&brch=74
2. Digital Platforms /Web Links of other virtual labs may be suggested / added to this lists by individual Universities.

*** A student has to perform at least 7 experiments from the Offline Experiment List and 3 from the Online Virtual Lab Experiment List / Link.**

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	**2**	**2**	--	--	--	--	**3**	**3**	--	--	**3**
CO2	**2**	**2**	--	--	--	--	**3**	**3**	--	--	**3**
CO3	**3**	**2**	--	--	--	--	**2**	**3**	--	--	**3**
CO4	**2**	**2**	--	--	--	--	**3**	**3**	--	--	**3**
CO5	**3**	**2**	--	--	--	--	**2**	**3**	--	**2**	**3**

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B010401T/PY209	**Title of the Course**	Perspectives of Modern Physics & Basic Electronics	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Fourth	**4**	**0**	**0**	**4**
Pre-Requisite	10+2 with Physics	**Co-requisite**	Passed B.Sc. 1st Year				
Course Objectives	This course aims to give students the competence in the Electromagnetic Theory and Modern Optics. At the end of the course the students are expected to have hands on experience in modeling, implementation and calculation of physical quantities of relevance and also their applications in various fields.						

Course Outcomes	
CO1	Recognize the difference between the structure of space & time in Newtonian & Relativistic mechanics.
CO2	Understand the physical significance of consequences of Lorentz transformation equations.
CO3	Comprehend the wave-particle duality.
CO4	Develop an understanding of the foundational aspects of Quantum Mechanics.
CO5	Study the comparison between various biasing techniques.
CO6	Study the classification of amplifiers.
CO7	Comprehend the use of feedback and oscillators.
CO8	Comprehend the theory and working of optical fibers along with its applications.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Relativity-Experimental Background**	Structure of space & time in Newtonian mechanics and inertial & non-inertial frames. Galilean transformations. Newtonian relativity. Galilean transformation and Electromagnetism. Attempts to locate the Absolute Frame: Michelson-Morley experiment and significance of the null result. Einstein's postulates of special theory of relativity.	7	CO1, 2
2	**Relativity-Relativistic Kinematics**	Structure of space & time in Relativistic mechanics and derivation of Lorentz transformation equations (4-vector formulation included). Consequences of Lorentz Transformation Equations (derivations & examples included): Transformation of Simultaneity (Relativity of simultaneity); Transformation of Length (Length contraction); Transformation of Time (Time dilation); Transformation of Velocity (Relativistic velocity addition); Transformation of Acceleration; Transformation of Mass (Variation of mass with velocity). Relation between Energy & Mass (Einstein's mass & energy relation) and Energy & Momentum.	8	CO1, 2
3	**Inadequacies of Classical Mechanics**	Particle Properties of Waves: Spectrum of Black Body radiation, Photoelectric effect, Compton effect and their explanations based on Max Planck's Quantum hypothesis. Wave Properties of Particles: Louis de Broglie's hypothesis of matter waves and their experimental verification by Davisson-Germer's experiment and Thomson's experiment.	8	CO3, 4
4	**Introduction to Quantum Mechanics**	Matter Waves: Mathematical representation, Wavelength, Concept of Wave group, Group (particle) velocity, Phase (wave) velocity and relation between Group & Phase velocities. Wave Function: Functional form, Normalisation of wave function, Orthogonal & Orthonormal wave functions and Probabilistic interpretation of wave function based on Born Rule.	7	CO3, 4
5	**Transistor Biasing**	Faithful amplification & need for biasing. Stability Factors and its calculation for transistor biasing circuits for CE configuration: Fixed Bias (Base Resistor Method), Emitter Bias (Fixed Bias with Emitter Resistor), Collector to Base Bias (Base Bias with Collector Feedback) &, Voltage Divider Bias. Discussion of Emitter-Follower configuration.	7	CO5
6	**Amplifiers**	Classification of amplifiers based on Mode of operation (Class A, B, AB, C & D), Stages (single & multi stage, cascade & cascode connections), Coupling methods (RC, Transformer, Direct & LC couplings), Nature of amplification (Voltage & Power amplification) and Frequency capabilities (AF, IF, RF & VF). Theory & working of RC coupled voltage amplifier (Uses of various resistors & capacitors, and Frequency response) and Transformer coupled power amplifier (calculation of Power, Effect of temperature, Use of heat sink & Power dissipation). Calculation of Amplifier Efficiency (power efficiency) for Class A Series-Fed, Class A Transformer Coupled, Class B Series-Fed and Class B Transformer Coupled amplifiers.	7	CO6
7	**Feedback and Oscillators**	**Feedback Circuits:** Effects of positive and negative feedback. Voltage Series, Voltage Shunt, Current Series and Current Shunt feedback connection types and their uses for specific amplifiers. Estimation of Input Impedance, Output Impedance, Gain, Stability, Distortion, Noise and Band Width for Voltage Series negative feedback and their comparison between different negative feedback connection types. **Oscillator Circuits:** Use of positive feedback for oscillator operation. Barkhausen criterion for self- sustained oscillations. Feedback factor and frequency of oscillation for RC Phase Shift oscillator and Wein Bridge oscillator. Qualitative discussion of Reactive Network feedback oscillators (Tuned oscillator circuits): Hartley & Colpitt oscillators.	8	CO7
8	**Introduction to Fiber Optics**	Basics of Fiber Optics, step index fiber, graded index fiber, light propagation through an optical fiber, acceptance angle & numerical aperture, qualitative discussion of fiber losses and applications of optical fibers.	8	CO8

Reference Books:

1. A. Beiser, Shobhit Mahajan, "Concepts of Modern Physics: Special Indian Edition", McGraw Hill, 2009, 6e
2. John R. Taylor, Chris D. Zafiratos, Michael A.Dubson, "Modern Physics for Scientists and Engineers",Prentice-Hall of India Private Limited, 2003, 2e
3. R.A. Serway, C.J. Moses, and C.A. Moyer, "Modern Physics", Cengage Learning India Pvt. Ltd, 2004, 3e
4. R. Resnick, "Introduction to Special Relativity", Wiley India Private Limited, 2007
5. R. Murugeshan, Kiruthiga Sivaprasath, "Modern Physics", S. Chand Publishing, 2019, 18e
6. R.L. Boylestad, L. Nashelsky, "Electronic Devices and Circuit Theory", Prentice-Hall of India Pvt. Ltd., 2015, 11e
7. J. Millman, C.C. Halkias, Satyabrata Jit, "Electronic Devices and Circuits", McGraw Hill, 2015, 4e
8. B.G. Streetman, S.K. Banerjee, "Solid State Electronic Devices", Pearson Education India, 2015, 7e
9. J.D. Ryder, "Electronic Fundamentals and Applications", Prentice-Hall of India Private Limited, 1975, 5e
10. John M. Senior, "Optical Fiber Communications: Principles and Practice", Pearson Education Limited, 2010, 3e
11. John Wilson, John Hawkes, "Optoelectronics: Principles and Practice", Pearson Education Limited, 2018, 3e
12. S.L. Gupta, V. Kumar, "Hand Book of Electronics", Pragati Prakashan, Meerut, 2016, 43e

e-Learning Source:

1. MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx
4. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	3	2	2	1	2
CO2	3	2	-	-	-	-	3	3	2	1	2
CO3	3	2	-	-	-	-	3	3	2	2	2
CO4	3	2	-	-	-	-	3	3	2	3	2
CO5	3	2	-	-	-	-	3	3	2	3	2
CO6	3	2	-	-	-	-	3	2	2	1	2
CO7	3	2	-	-	-	-	3	3	2	1	2
CO8	3	2	-	-	-	-	3	3	2	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B010402P/PY210	**Title of the Course**	Basic Electronics Instrumentation	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Fourth	**0**	**0**	**4**	**2**
Pre-Requisite	10+2 with Physics	**Co-requisite**	Passed B.Sc. 1st Year				
Course Objectives	The purpose of this undergraduate course is to impart practical knowledge/measurements in the field of electricity and magnetism mechanics through different experiments related to its theoretical course.						

Course Outcomes	
CO1	Students will learn about different transistor biasing and will also be able to do a Comparative Study of CE, CB and CC amplifier
CO2	Student will learn about Clipper, Clamper and Emitter Follower circuits
CO3	Students will learn about the Single Stage RC coupled and Transformer Coupled amplifier
CO4	Students will learn about the Schmitt Trigger circuit
CO5	Students will learn about the Hartley and Wein Bridge oscillator

Experiment No.	**Title of the Experiment**	**Aim of the Experiment (*Offline)**	**Contact Hrs.**	**Mapped CO**
1	Biasing Stability	To study the Transistor Bias Stability	6	CO1
2	CE, CB and CC amplifier	To do a Comparative Study of CE, CB and CC amplifier	6	CO1
3	Clipper Clamper	To study the Clippers and Clampers circuits	6	CO2
4	Emitter follower	To Study the Emitter Follower circuit	6	CO3
5	RC Coupled Amplifier	To study the Frequency response of single stage RC coupled amplifier	6	CO3
6	Transformer Coupled Amplifier	To study the Frequency response of single stage Transformer coupled amplifier	6	CO3
7	Negative Feedback RC Coupled Amplifier	To study the Effect of negative feedback on frequency response of RC coupled amplifier	6	CO3
8	Schmitt Trigger	To study the Schmitt Trigger Circuit	6	CO4
9	Hartley Oscillator	To study the Hartley oscillator	6	CO5
10	Wein Bridge Oscillator	To study the Wein Bridge oscillator	6	CO5
Experiment No.	**Title of the Experiment**	**Aim of the Experiment (*Online Virtual Lab)**	**Contact Hrs.**	**Mapped CO**
1	Diode as Clippers	Diode as Clippers	--	--
2	Diode as Clampers	Diode as Clampers	--	--
3	BJT as switch and Load Lines	BJT as switch and Load Lines	--	--
4	RC frequency response	RC frequency response	--	--
5	Hartley oscillator	Hartley oscillator	--	--
6	Colpitt oscillator	Colpitt oscillator	--	--
7	Fiber Optic Analog and Digital Link	Fiber Optic Analog and Digital Link	--	--
8	Fiber Optic Bi-directional Communication	Fiber Optic Bi-directional Communication	--	--
9	Wavelength Division Multiplexing	Wavelength Division Multiplexing	--	--
10	Measurement of Bending Losses in Optical Fiber	Measurement of Bending Losses in Optical Fiber	--	--
11	Measurement of Numerical Aperture	Measurement of Numerical Aperture	--	--
12	Study of LED and Detector Characteristics	Study of LED and Detector Characteristics	--	--

Reference Books:

1. R.L. Boylestad, L. Nashelsky, "Electronic Devices and Circuit Theory", Prentice-Hall of India Pvt. Ltd., 2015, 11e
2. J. Millman, C.C. Halkias, Satyabrata Jit, "Electronic Devices and Circuits", McGraw Hill, 2015, 4e
3. B.G. Streetman, S.K. Banerjee, "Solid State Electronic Devices", Pearson Education India, 2015, 7e
4. J.D. Ryder, "Electronic Fundamentals and Applications", Prentice-Hall of India Private Limited, 1975, 5e
5. John M. Senior, "Optical Fiber Communications: Principles and Practice", Pearson Education Limited, 2010, 3e
6. John Wilson, John Hawkes, "Optoelectronics: Principles and Practice", Pearson Education Limited, 2018, 3e
7. S.L. Gupta, V. Kumar, "Hand Book of Electronics", Pragati Prakashan, Meerut, 2016, 43e

e-Learning Source:

1. Virtual Labs at Amrita Vishwa Vidyapeetham, https://vlab.amrita.edu/?sub=1&brch=74
2. Virtual Labs at Amrita Vishwa Vidyapeetham https://vlab.amrita.edu/index.php?sub=1&brch=201
3. Virtual Labs an initiative of MHRD Govt. of India http://vlabs.iitkgp.ac.in/psac/#
4. Virtual Labs an initiative of MHRD Govt. of Indiahttp://vlabs.iitkgp.ac.in/be/#
5. Digital Platforms /Web Links of other virtual labs may be suggested / added to this lists by individual Universities.

*** A student has to perform at least 7 experiments from the Offline Experiment List and 3 from the Online Virtual Lab Experiment List / Link.**

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)										
PO-PSO CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	**2**	**2**	--	--	--	--	**3**	**3**	--	--	**3**
CO2	**2**	**2**	--	--	--	--	**3**	**3**	--	--	**3**
CO3	**3**	**2**	--	--	--	--	**2**	**3**	--	--	**3**
CO4	**2**	**2**	--	--	--	--	**3**	**3**	--	--	**3**
CO5	**3**	**2**	--	--	--	--	**2**	**3**	--	**2**	**3**

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**