Integral University, Lucknow
Department of Mathematics & Statistics
Study and Evaluation Scheme (w.e.f 2020-21)

B. Sc. (Physics, Mathematics, Computer Science) **III[rd] year / V[th] Semester**

(Computer Science, Mathematics)

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Total	Credit	Total Credits	Attributes							SDG
				L	T	P	CT	TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
THEORIES																					
1	CS321	Object Oriented Programming Using Java	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
2	CS323	Fundamentals of Software Engineering	Core	3	1	0	40	20	60	40	100	3:1:0	4			√					
3	CS324	Computer Graphics & Multimedia	Core	2	1	0	40	20	60	40	100	2:1:0	3			√					
4	MT301	Advanced Calculus	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
5	MT302	Mathematical Statistics	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
6	MT303	Number Theory	Core	2	1	0	40	20	60	40	100	2:1:0	3	√		√					
PRACTICAL																					
7	MT304	Statistical Techniques Lab	Practical	0	0	2	40	20	60	40	100	0:0:1	1	√		√					
8	CS322	Object Oriented Programming using Java Lab	Practical	0	0	2	40	20	60	40	100	0:0:1	1	√		√					
TOTAL				16	6	4	320	160	480	320	800	24	24								

CT = Class Test; **TA** = Teacher's Assessment,; **ESE** = End Semester Examination; **Sessional** = CT + TA; **Subject Total** = Sessional + ESE

Integral University, Lucknow
Department of Mathematics & Statistics
Study and Evaluation Scheme (w.e.f 2020-21)

B. Sc. (Physics, Mathematics, Computer Science) **III[rd] year / V[th] Semester**

(Physics, Computer Science)

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Total	Credit	Total Credits	Attributes							SDG
				L	T	P	CT	TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
THEORIES																					
1	PY301	Elements Of Quantum Mechanics, Atomic & Molecular Spectra	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
2	PY302	Classical Mechanics, Relativity & Statistical Physics	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
3	PY303	Solid State, Nuclear & Particle Physics	Core	2	1	0	40	20	60	40	100	2:1:0	3	√		√					
4	CS321	Object Oriented programming using Java	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
5	CS323	Fundamentals of Software Engineering	Core	3	1	0	40	20	60	40	100	3:1:0	4			√					
6	CS324	Computer Graphics & Multimedia	Core	2	1	0	40	20	60	40	100	2:1:0	3			√					
PRACTICAL																					
7	PY304	Advance Electricity & Magnetism Lab	Practical	0	0	2	40	20	60	40	100	0:0:1	1	√		√					
8	CS322	Object Oriented programming using Java Lab	Practical	0	0	2	40	20	60	40	100	0:0:1	1	√		√					
TOTAL				16	6	4	320	160	480	320	800	24	24								

CT = Class Test; **TA** = Teacher's Assessment,; **ESE** = End Semester Examination; **Sessional** = CT + TA; **Subject Total** = Sessional + ESE

Integral University, Lucknow
Department of Mathematics & Statistics
Study and Evaluation Scheme (w.e.f 2020-21)

B. Sc. (Physics, Mathematics, Computer Science) **III[rd] year / V[th] Semester**

(Physics, Mathematics)

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Total	Credit	Total Credits	Attributes							SDG
				L	T	P	CT	TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
THEORIES																					
1	PY301	Elements of Quantum Mechanics, Atomic & Molecular Spectra	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
2	PY302	Classical Mechanics, Relativity & Statistical Physics	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
3	PY303	Solid State, Nuclear & Particle Physics	Core	2	1	0	40	20	60	40	100	2:1:0	3	√		√					
4	MT301	Advanced Calculus	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
5	MT302	Mathematical Statistics	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
6	MT303	Number Theory	Core	2	1	0	40	20	60	40	100	2:1:0	3	√		√					
PRACTICAL																					
7	MT304	Statistical Techniques Lab	Practical	0	0	2	40	20	60	40	100	0:0:1	1	√		√					
8	PY304	Advance Electricity & Magnetism Lab	Practical	0	0	2	40	20	60	40	100	0:0:1	1	√		√					
TOTAL				16	6	4	320	160	480	320	800	24	24								

CT = Class Test; **TA** = Teacher's Assessment,; **ESE** = End Semester Examination; **Sessional** = CT + TA; **Subject Total** = Sessional + ESE

Integral University, Lucknow

Effective from Session: 2018-19							
Course Code	**MT301**	**Title of the Course**	**Advanced Calculus**	**L**	**T**	**P**	**C**
Year	Third	**Semester**	Fifth	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 with Mathematics	**Co-requisite**					
Course Objectives	The purpose of this undergraduate course is to impart basic and key knowledge of differential & integral calculus. Students will be able to evaluate derivative of several functions using different techniques. They will also learn to evaluate different types of integrals. After successful completion of course, the student will be able to explore subject into their respective dimensions.						

Course Outcomes	
CO1	Students will gain an understanding of Function of several variables, Domains and Range, Functional notation, Limits and continuity and differentiability. They will also learn to find Partial derivatives, Differential of functions of n variables, Differentials of composite functions by using the chain rule.
CO2	Students will be able to understand Implicit functions, Inverse functions, They will also study directional derivatives and will be able to find Partial derivatives of higher order, Higher derivatives of composite functions. They will learn to find Maxima and minima of functions of several variables.
CO3	Students will gain an understanding of Line integrals in the plane, Basic properties of Line integrals, Line integrals as integrals of vectors and will be able to solve line integral by Green's theorem , and get knowledge of independence of path, simply connected domains , Extension of result of multiply connected domains.
CO4	Students will create the own understanding and find Double integral over a rectangular region, Double integral as volume, Area of a region in a plane., Transformation of double integral from Cartesian to polar co - ordinate and vice versa. They will study triple integral and learnto solve them in Cartesian , cylindrical and spherical co – ordinate.
CO5	Students will gain an understanding of solution of Improper integrals, convergence of Camparison test, convergence of Abel's test, Dirichlet's test, convergence of. They will also study convergence of beta and gamma functions.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		Function of several variables, Domains and Range, Functional notation, Limits and continuity and differentiability, Partial derivatives, Differential of functions of n variables, Differentials of composite functions, chain rule.	8	1
2		Implicit functions, Inverse functions, The directional derivatives, Partial derivatives of higher order, Higher derivatives of composite functions, Maxima and minima of functions of several variables.	8	2
3		Line integrals in the plane, Basic properties of Line integrals, Line integrals as integrals of vectors, Green's theorem , independence of path, simply connected domains , Extension of result of multiply connected domains.	8	3
4		Double integral over a rectangle region, Double integral as volume, Area of a region in a plane , Transformation of double integral from Cartesian to polar co - ordinate and vice versa, Triple integral in Cartesian , cylindrical and spherical co - ordinate .	8	4
5		Improper integrals, convergence of $\int_a^\infty f(x)dx$, Camparison test , convergence of $\int_a^\infty \frac{dx}{x^n}dx, a>0$,Abel's test, Dirichlet's test, convergence of $\int_a^\infty \frac{dx}{(x-a)^n}dx, a>0$,convergence of beta and gamma functions.	8	5

Reference Books:

1. G. B. Thomas, M.D. Wier, J. Hass: Calculus, Pearsons Education
2. S. C . Malik and S. Arora : Mathematical analysis, Wiley Eastern Ltd
3. D. V. Widder: Advanced Calculus, Prentice Hall of India Pvt. Ltd.

e-Learning Source:

1. https://nptel.ac.in/courses/111107108/
2. file:///C:/Users/Admin/Downloads/Vector%20Calculus%20by%20Krishna%20Series.pdf
3. https://www.academia.edu/8509213/Advanced_Calculus._Fifth_Edition-Wifred_Kaplan

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	1	1	1	2	2	2	3	2	3
CO2	3	2	2	1	1	1	2	1	1	2	2	2
CO3	3	2	2	1	1	1	2	2	2	2	2	2
CO4	3	1	2	1	1	1	2	2	2	3	3	2
CO5	3	1	2	1	1	1	2	3	2	2	3	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: 2018-19							
Course Code	**MT302**	**Title of the Course**	**Mathematical Statistics**	**L**	**T**	**P**	**C**
Year	Third	**Semester**	Fifth	**3**	**1**	**0**	**4**
Pre-Requisite		**Co-requisite**					
Course Objectives	The course explores the basic concepts of modern statistics and its applications for decision-making in economics, business, and other fields of sciences. Our everyday lives, as well as economic and business activities, are full of data analysis and distribution theory offer useful techniques for quantifying these uncertainties. The course is heavily oriented towards the formulation of mathematical statistics and practical applications.						

Course Outcomes	
CO1	To understand the definition and scope of Statistics, concepts of statistical population and sample. Quantitative and qualitative data, primary and secondary sources of data collection, scales of measurement- nominal, ordinal, interval and ratio. Presentation of data: tabular and graphical form including bar diagram, histogram, pie chart, frequency curve and frequency polygon
CO2	Able to solve Measures of Central Tendency: Arithmetic mean, median, mode, geometric mean and harmonic mean, quartiles and percentiles. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation and variance, coefficient of variation and coefficient of skewness
CO3	To understand Bivariate data: Definition, scatter diagram, Karl Pearson's coefficient of correlation Spearman coefficient rank correlation and tied ranks. Simple linear regression, principle of least squares
CO4	To understand Definitions of Probability – classical, statistical, and axiomatic, random experiments, sample space and events, laws of addition and multiplication, independent events, conditional Probability and Bayes' theorem
CO5	To understand Mathematical expectation, Probability mass function (pmf) and Probability density function (pdf). Binomial Probability distributions, Poisson Probability distributions, and Normal Probability distributions.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		The definition and scope of Statistics, concepts of statistical population and sample. Quantitative and qualitative data, primary and secondary sources of data collection, scales of measurement- nominal, ordinal, interval and ratio. Presentation of data: tabular and graphical form including bar diagram, histogram, pie chart	8	1
2		Measures of Central Tendency: Arithmetic mean, median, mode, geometric mean and harmonic mean, quartiles and percentiles. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation and variance, coefficient of variation and coefficient of skewness	8	2
3		Bivariate data: Definition, scatter diagram, Karl Pearson's coefficient of correlation Spearman coefficient rank correlation and tied ranks. Simple linear regression, principle of least squares	8	3
4		Definitions of Probability – classical, statistical, and axiomatic, random experiments, sample space and events, laws of addition and multiplication, independent events, conditional Probability and Bayes' theorem	8	4
5		Mathematical expectation, Probability mass function (pmf) and Probability density function (pdf). Binomial Probability distributions, Poisson Probability distributions, and Normal Probability distributions	8	5

Reference Books:

1. Sampling techniques: W.G. Cochran, Wiley
2. Sampling methodologies and applications: P.S.R.S. Rao, Chapman and Hall/CRC 2000
3. Elements of sampling theory and methods: Z. Govindrajalu, Prentice Hall, 1999
4. Sampling: P. Mukhopadhyaya, Prentice Hall of India, 1998
5. Theory of sample surveys with applications: P.V.Sukhatme, B.V.Sukhatme, S. Sukhatme and C. Asok, IASRI, Delhi, 1984.
6. Sampling Techniques: Daroga Singh & Chaudhry, F.S New age International

e-Learning Source:

1. https://www.youtube.com/watch?v=be9e-Q-jC-0
2. https://www.youtube.com/watch?v=bQ5_PPRPjG4
3. https://www.youtube.com/watch?v=jauhoR7w1YM

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	2	2	2	1	1	2	2	2
CO2	3	3	2	2	2	3	2	2	2	2	3	3
CO3	2	2	3	3	2	2	2	2	2	2	3	3
CO4	2	2	2	3	2	2	1	1	2	2	2	3
CO5	2	3	2	3	2	2	3	2	2	2	3	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: 2018-19							
Course Code	**MT303**	**Title of the Course**	**Number Theory**	**L**	**T**	**P**	**C**
Year	Third	**Semester**	Fifth	**2**	**1**	**0**	**3**
Pre-Requisite	10+2 with PCM	**Co-requisite**					
Course Objectives	The course is intended to allow students to be exposed to some foundational ideas in number theory without the technical baggage often associated with a more advanced courses. The course provides students an opportunity to develop an appreciation of pure mathematics while engaged in the study of number theoretic results. The course is also designed to provide students an opportunity to work with conjectures, proofs, and analysing mathematics.						

Course Outcomes	
CO1	Can be able to demonstrate Cartesian product of sets, Equivalence relation and partition, Fundamental theorem of equivalence of relation, Equivalence sets.
CO2	Demonstrate knowledge and understanding of topics including, but not limited to divisibility, cardinal numbers, congruence's, quadratic reciprocity, Diophantine equations and cantor's theorem.
CO3	Can analyse hypotheses and conclusions of mathematical statements of divisibility, congruence, greatest common divisor, prime, and prime factorization.
CO4	Can apply different techniques of congruence to verify mathematical assertions, including proof by induction, by contrapositive and by contradiction tie and by contradiction.
CO5	Can solve systems of Diophantine equations using the Chinese Remainder Theorem & the Euclidean algorithm and Lagrange's theorem

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		Cartesian product of sets, Equivalence relation and partition, Fundamental theorem of equivalence of relation, Equivalence sets.	6	1
2		Cardinal numbers, power of continuum, cardinal arithmetic, Inequalities in cardinals, Cantor's theorem, Schrodar Berntien Theorem	6	2
3		Division Algorithm, greatest common divisor, least common multiplier, prime number, unique factorisation theorem.	6	3
4		Congruence, Complete residue theorem, Euler's theorem	6	4
5		Linear congruence, Chinese remainder theorem, problem based on Chinese remainder theorem, Lagrange's theorem	6	5

Reference Books:

1. J Hunter: Number Theory
2. David M. Burton: Elementary Number Theory
3. Seymour Lipschutz: Set theory and related topics

e-Learning Source:

1. https://www.youtube.com/watch?v=SCvtxjpVQms
2. https://www.youtube.com/watch?v=-Qtl4nn7R4A

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	1	1	2	3	3	2	2	3	2	3
CO2	3	2	1	1	2	1	3	1	1	3	2	2
CO3	2	2	1	1	2	1	3	2	2	2	1	2
CO4	3	2	2	1	1	1	1	2	2	2	3	3
CO5	3	2	1	1	2	1	3	3	2	2	3	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: 2018-19							
Course Code	**MT304**	**Title of the Course**	**Statistical Techniques Lab**	**L**	**T**	**P**	**C**
Year	Third	**Semester**	Fifth	**0**	**0**	**2**	**1**
Pre-Requisite		**Co-requisite**					
Course Objectives	To make students capable of describing data in practical situations simultaneously to teach students to make proper and efficient use of the tools which are used to describe data. To make students able to fit real time data on various pre-defined probability distributions.						

Course Outcomes	
CO1	After completing Practical 1, students will be able to create visual representation of various types of data.
CO2	After the completion of Practical 2, 3 and 4, students will be able to well describe the central value and variability of data. Students will also learn the method of comparison of variability between to or more data sets and to figure out the shape of the given data in terms of skewness and Kurtosis.
CO3	After the completion of Practical 5, 6 & 7 students will be able to obtain the degree of relationship between two or more variables for qualitative and quantitative data both. Students will also be able to find out functional relationship between two or more variables.
CO4	After the successful completion of Practical 8, students will be able to fit real data on a given Binomial distribution.
CO5	After the successful completion of Practical 9 & 10, students will be able to fit real data on a given Poisson & Normal distribution.

			Contact Hrs.	**Mapped CO**
Practical 1		Graphical representation (bar, histogram and pie chart) of data.	4	1
Practical 2		Problems based on measures of central tendency (Mean, median and mode).	4	2
Practical 3		Problems based on measures of dispersion (MD, SD and CV)	4	2
Practical 4		Problems based coefficient of skewness.	4	2
Practical 5		Karl Pearson correlation coefficient.	4	3
Practical 6		Lines of regression, angle between lines and estimated values of variables.	4	3
Practical 7		Problems based on Spearman rank correlation with and without ties.	4	3
Practical 8		Fitting of binomial distributions for n and p given	4	4
Practical 9		Fitting of Poisson distributions for given value of lambda	4	5
Practical 10		Fitting of Normal distribution for given value of mean and variance	4	5

Reference Books:

1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

e-Learning Source:

1. https://youtu.be/KIBZUk39ncI
2. https://www.youtube.com/watch?v=m9a6rg0tNSM
3. https://www.youtube.com/watch?v=nqPS29IvnHk
4. https://www.youtube.com/watch?v=JPK0LFsu18g
5. https://www.youtube.com/watch?v=vvv9DhUrzlY
6. https://www.youtube.com/watch?v=uq5w2aFwNhE&list=PLLgJVrtHe9RoB9LIZPuwv_zZNmGniGrai
7. https://www.youtube.com/watch?v=5lh1Wr5_1Q0&list=PLGihLBEp_66K6zl4QGMXIf-d1hcoXIQ0a

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	1	1	1	3	2	2	1	2	3
CO2	3	1	2	1	2	1	3	3	3	2	2	1
CO3	3	2	1	1	2	1	2	2	2	2	3	3
CO4	2	1	1	1	2	1	3	2	2	3	3	2
CO5	2	2	1	2	2	1	3	2	2	2	3	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: 2020-21							
Course Code	PY301	**Title of the Course**	**Elements of Quantum Mechanics, Atomic and Molecular Spectra**	**L**	**T**	**P**	**C**
Year	**Third**	**Semester**	Fifth	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 with Physics	**Co-requisite**					
Course Objectives	To provide working knowledge of the Quantum Mechanics postulates on the physical systems and to introduce some of the basic systems in atomic physics. To gain greater familiarity with quantum mechanics by studying its application to atomic systems.						

Course Outcomes	
CO1	Would be able to analyze the inadequacies of classical mechanics in atomic domain and provide the understanding of quantum theory of light in order to analyze Blackbody Radiation.
CO2	Provided with the wavefunction of a system, students would be able to normalize it and determine the expectation values.
CO3	To solve the Schrodinger‟s equation for time independent problems like free particle, particle in an infinite potential well, square potential well, the step potential and potential barrier.
CO4	It includes an understanding of LS and JJ coupling in order to be able to use appropriate quantum numbers for labelling of energy levels.
CO5	To analyze the origin of electronic, vibrational and rotational energy levels and undertake simple calculations of energy levels.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Matter Waves	Inadequacies of classical mechanics, black body radiation, theoretical laws of black body radiation, photoelectric phenomenon, Compton effect, Planck‟s quantum hypothesis, development of quantum mechanics, Bohr‟s quantization condition, wave particle duality, de- Broglie hypothesis, velocity of de-Broglie waves, phase and group velocities and their relationship for a non-relativistic particle.	08	CO1
2	Schrodinger Equation I	Heisenberg‟s uncertainty principle with derivation and its applications, ground state energy of Hydrogen atom & linear harmonic oscillator Basic postulates of quantum mechanics, Schrodinger Equation: time dependent and time independent form, Physical interpretation of the wave function, orthogonality and normalization of wave functions, basic problem related to wave function, probability current density, Ehrenfest theorem.	08	CO2
3	Schrodinger Equation II	Applications of Schrodinger wave equation: (free particle, a particle in 1-D infinitely deep potential well, a particle in 3-D infinitely deep potential well, 1-D linear harmonic oscillator, one dimensional motion in step potential, rectangular potential barrier, square well potential), expectation values of dynamical quantities, momentum space wave function.	08	CO3
4	Atomic spectra	Spectra of hydrogen, deuteron and alkali atoms, spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d, and f states, selection rules, Singlet and triplet fine structure in alkaline earth spectra, L-S and J-J couplings. Weak spectra: continuous X-ray spectrum and its dependence on voltage, Duane and Haunt‟s law. Characteristics X-rays, Moseley‟s law, doublet structure and screening parameters in X-ray spectra, X-ray absorption spectra.	08	CO4
5	Molecular spectra	Discrete set of electronic energies of molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotation and rotation- vibration spectra, Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra.	08	CO5

Reference Books:

1. A. Beiser, “Perspectives of Modern Physics (McGraw Hill).
2. H. E. White; “Introduction to Atomic Physics (D. Van Nostrand Company)
3. R. P. Feymann, R. B. Leighton and M. Sands; “The Feynman Lectures on Physics, Vol. III (B I Publications. Bombay. Delhi, Calcutta, Madras).
4. Eisenberg and Resnick; “Quantum Physics of Atoms, „Molecules, Solids, Nuclei and Particles” (John Wiley).

e-Learning Source:

1. https://nptel.ac.in/courses/115/104/115104096/
2. https://nptel.ac.in/courses/115/102/115102023/
3. https://nptel.ac.in/courses/115/105/115105100/

	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**			**1**		**1**	**3**	**1**		
CO2	**3**	**1**			**2**		**3**	**3**	**1**		
CO3	**3**	**1**			**2**		**3**	**3**	**1**		
CO4	**3**	**1**			**2**		**3**	**3**	**3**	**2**	
CO5	**3**	**1**			**2**		**3**	**3**	**3**	**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: 2020-21							
Course Code	PY302	**Title of the Course**	**Classical Mechanics, Relativity and Statistical Physics**	**L**	**T**	**P**	**C**
Year	**Third**	**Semester**	Fifth	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 with Physics	**Co-requisite**					
Course Objectives	To provide the dynamics of system of particles, motion of rigid body, Lagrangian and Hamiltonian formulation of mechanics and to give the students a thorough understanding of the theory and methods of statistical physics.						

Course Outcomes	
CO1	Students will gain an understanding of the Classical Mechanics and basic theories of Physics like Lagrangian and Hamiltonian Dynamics.
CO2	Students will be able to develop a deep understanding of various phenomena of Special Theory of Relativity and concept of mass-energy equivalence.
CO3	Students will be able to master basic statistical methods and concepts like probability, random variables, expected value, variance, estimators and common probability distributions.
CO4	Students will be able to write the distribution function of various systems and further calculate various thermodynamic potentials.
CO5	Interpretation of Maxwellian distribution. Analysis of statistical mechanical description of Fermi- and Bose- statistics for electron and photon.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Lagrangian and Hamiltonian Dynamics	Constraints: holonomic and non-holonomic, time independent and time dependent, Generalized coordinates, Lagrange equations from D"Alembert"s principle, velocity dependent potentials, Variational principle: Technique of the calculus of variation, Hamilton"s variational principle, Lagrange equations using Hamilton"s principle, Generalized momenta, cyclic coordinates. Definition of Hamiltonian and its physical significance, Hamilton"s equations of motion from variational principle.	08	CO1
2	Special Theory of Relativity	Reference systems, inertial frames, Galilean invariance and conservation laws, propagation of light, Michelson-Morley experiment; search for ether, Postulates for the special theory of relativity, Lorentz transformations, length contraction, time dilation, velocity addition theorem, variation of mass with velocity, mass-energy equivalence, particle with a zero rest mass.	08	CO2
3	The Statistical Basis of Thermodynamics	Probability and thermodynamic probability, principle of equal a priori probabilities, probability distribution and its narrowing with increase in number of particles.	08	CO3
4	Some Universal Laws	The μ (mu)- space representation, division of μ (mu)- space into energy sheets and into phase cells of arbitrary size, applications to one-dimensional harmonic oscillator and free particles, Equilibrium before two systems in thermal contact, Probability and entropy, Boltzmann entropy relation, Statistical interpretation of second law of thermodynamics.	08	CO4
5	Quantum Statistical Mechanics	**Maxwellian distribution of speeds in an ideal gas:** Distribution of speeds and of velocities, experimental verification, distinction between mean, r.m.s. and most probable speed values. **Transition to quantum statistics:** „h" as a natural constant and" its implications, cases of particle in a one-dimensional box and one-dimensional harmonic oscillator, Indistinguishability of particles and its consequences, Bose-Einstein, and Fermi-Dirac distributions, photons in black body chamber, free electrons in a metal, Fermi level and Fermi energy.	08	CO5

Reference Books:

1. A. Beiser, "Concepts of Modern Physics" (McGraw-Hill).
2. B. B. Laud, "Introduction to Statistical Mechanics" (Macmillan 1981).
3. F. Reif, "Statistical Physics" (McGraw-Hill 1988).
4. K. Haung, "Statistical Physics" (Wiley Eastern, 1988).

e-Learning Source:

1. https://nptel.ac.in/courses/115/106/115106123/
2. https://nptel.ac.in/courses/115/105/115105098/
3. https://nptel.ac.in/courses/115/101/115101011/
4. https://nptel.ac.in/courses/104/101/104101125/

	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	1	1		1	2	3	1		
CO2	3	2	1	1		1	2	3	1		
CO3	3	1	1				1	3	1		
CO4	3	1				2	1	3	3	2	
CO5	3						2	3	3	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: 2020-21							
Course Code	PY303	**Title of the Course**	**Solid State, Nuclear and Particle Physics**	**L**	**T**	**P**	**C**
Year	**Third**	**Semester**	Fifth	**2**	**1**	**0**	**3**
Pre-Requisite	10+2 with Physics	**Co-requisite**					
Course Objectives	The purpose of this undergraduate course is to impart basic and key knowledge of solid state, nuclear and particle physics. By using the principal of physics and mathematics to obtain quantitative relations which are very important for higher studies. After successfully completion of course, the students will be able to explore subject into their respective dimensions						

Course Outcomes	
CO1	Students will gain an understanding of crystal structure, diffraction and reciprocal lattice which help in determine the crystal structure of any material.
CO2	Students will gain an understanding of crystal bonding and the vibrations involved in crystal Lattice which help them to understand the concept of vibrational dynamics.
CO3	Students will gain an understanding of materials (metals and semiconductors) and able to find the band gap based on which they define the material type.
CO4	Students will understand the basic properties of nucleus, know about Nuclear Forces and Nuclear Reactions which helps in defining the type of nuclear reaction.
CO5	Students will gain basic knowledge of particle physics and ability to outline the physical origins of particle physics.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Crystal Structure	Lattice translation vectors and lattice, Symmetry operations, Basis and Crystal structure, Primitive Lattice cell, Two-dimensional lattice types, systems, Number of lattices, Number of Lattices, Index system for crystal planes, Miller indices, Simple crystal structures, NaCl, hcp, diamond. Bragg's law, experimental diffraction method, Laue method, rotating crystal method, powder method.	08	CO1
2	Crystal Bonding and Lattice Structure	Crystal of inert gases, Van der Walls-London interaction, repulsive interaction, Equilibrium lattice constants, Cohesive energy, compressibility and bulk modulus, ionic crystal, Madelung energy, evaluation of Madelung constant, Covalent crystals, Hydrogen-bonded crystals, Atomic radii. Lattice Heat capacity, Einstein model. Vibrations of monatomic lattice, derivation of dispersion relation, Force constants, Lattice with two atoms per primitive cell.	08	CO2
3	Band Theory	Hall effect (metals and semiconductors), Origin of band theory, Kronig-Penney model, Number of orbitals in a band, conductor, Semi- conductor and insulators, Effective mass, Concept of holes.	08	CO3
4	Nuclear Physics	**General Properties of Nucleus:** Brief survey of general Properties of the Nucleus, Mass defect and binding energy, charges, Size, Spin and Magnetic moment. **Nuclear Forces:** Saturation phenomena and Exchange forces, Deuteron ground state properties. **Nuclear Reactions:** Nuclear reactions and their conservation laws, Cross section of nuclear reactions, Theory of fission (Qualitative), Nuclear reactors and Nuclear fusion.	08	CO4
5	Particle Physics	Basic particle interactions (gravitational, Electromagnetic, week and strong interactions), Basic classification based on rest mass, Spin and half-life, particles and antiparticles, idea of resonances, conservation rules in fundamental interactions, determination of spin and parity of pions, strange particles.	08	CO5

Reference Books:

1. Puri and Babbar, "Solid State Physics" (S. Chand).
2. C. Kittel, "Introduction to Solid State Physics"- Vth Edition (John Wiley &Sons).
3. H. S. Mani and G. K. Mehta, "Introduction to Modern Physics" (Affiliated East-West Press—1989).
4. A. Beiser, "Perspectives of Modern Physics" (McGraw-Hill).
5. Martin, B.R. and Shaw, Particle Physics (John Wiley).

e-Learning Source:

1. https://nptel.ac.in/courses/115/104/115104109/
2. https://nptel.ac.in/courses/115/105/115105099/
3. https://nptel.ac.in/courses/115/103/115103101/

	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	1	1		2	1	1	3	1	2	2
CO2	3	1	2		3	1	1	3	1	2	
CO3	3	1	2		3	1	1	3	1	1	
CO4	3	1			2	1		3	3		2
CO5	3	1			2	1		3	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: 2020-21							
Course Code	PY304	**Title of the Course**	**Advance Electricity and Magnetism Lab**	**L**	**T**	**P**	**C**
Year	**Third**	**Semester**	Fifth	**0**	**0**	**2**	**1**
Pre-Requisite	10+2 with Physics	**Co-requisite**					
Course Objectives	The purpose of this undergraduate course is to impart practical knowledge/measurements in electricity and magnetism through different experiments.						

Course Outcomes	
CO1	To understand the concept of the charging and discharging of RC and LCR circuits and concept of Lissajous figures using a CRO
CO2	To understand the working and response of PV and Solar cell and determining the fill factor
CO3	To use ballistics galvanometer for various applications.
CO4	To understand the concept of decay of currents in LR and RC circuits and hence estimate the resonancefrequency and quality factor
CO5	Implement bridges for various applications.

Experiment No.	**Title of the Experiment**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Charging and discharging of RC and LCR circuits	To study the charging and discharging of RC and LCR circuits.	2	CO1
2	Lissajous figures using a CRO	To study of Lissajous figures using a CRO.	2	CO1
3	Solar Cell	To study the spectral response of a solar cell.	2	CO2
4	Calibration of B.G.	To calibrate a ballistic galvanometer with a standard solenoid and then to find out ballistic constant.	2	CO3
5	Hall Probe Method	Hall Probe Method for measurement of magnetic Field.	2	CO3
6	Study of LR and RC circuits	Study of decay of currents in LR and RC circuits.	2	CO4
7	Frequency Response of LCR circuit	To study the response curve for LCR circuit and hence estimate the resonance frequency and quality factor.	2	CO4
8	Wien's Bridge	To determine the capacitance of a condenser by Wien's bridge.	2	CO5
9	Photo Cell	To draw the characteristic of a photoelectric cell.	2	CO2
10	Time Constant	To study Time constant in a LR circuit.	2	CO4

Reference Books:

1. Practical Physics. by R. K. Shukla, New Age International Private Limited; Third edition.
2. B.Sc. Practical Physics by Harnam Singh and Hemme, S. Chand.
3. B. Sc. Practical Physics by CL Arora, S Chand & Company.
4. Practical Physics by Kumar P.R.S., Prentice Hall India Learning Private Limited

e-Learning Source:

1. https://www.exploratorium.edu/snacks/subject/electricity-and-magnetism
2. https://ocw.mit.edu/courses/physics/8-02-physics-ii-electricity-and-magnetism-spring-2007/experiments/
3. http://www.rossnazirullah.com/BSc/BSc.htm

	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	1		3	1	2	1		1	3
CO2	2	1	3		2	2	3	2		1	3
CO3	3	2	2		3	3	2	3		2	3
CO4	2	3	3		1	2	3	3		3	3
CO5	3	2	1		3	1	2	2		1	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: 2016-17							
Course Code	CS321	**Title of the Course**	**Object Oriented Programming Using java**	**L**	**T**	**P**	**C**
Year	**3RD**	**Semester**	5TH	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 with Physics	**Co-requisite**					
Course Objectives	Its main objective is to teach the basic concepts and techniques which form the object oriented programming paradigm Using java.						

Course Outcomes	
CO1	Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs
CO2	Read and make elementary modifications to Java programs that solve real-world problems.
CO3	Validate input in a Java program
CO4	Identify and fix defects and common security issues in code.
CO5	Document a Java program using Javadoc.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Introduction**	Flavors of Java, Java Designing Goal, Role of Java Programmer in Industry, Features of Java Language, JVM –The heart of Java , Java's Magic Byte code, Installing Java, Java Program Development, Java Source File Structure ,Compilation, Executions. **Basic Language Elements:** Lexical Tokens, Identifiers, Keywords, Literals, Comments, Primitive Data types, Operators Assignments	8	1
2	**Object Oriented Programming**	Class Fundamentals , Object & Object reference , Object Life time & Garbage Collection, Creating and Operating Objects , Constructor & initialization code block, Access Control, Modifiers, methods Nested , Inner Class &Anonymous Classes ,Abstract Class & Interfaces Defining Methods, Argument Passing Mechanism , Method Overloading, Recursion, Dealing with Static Members, Finalize() Method, Native Method. Use of "this " reference, Use of Modifiers with Classes & Methods , shallow and deep cloning, Generic Class Types.	8	2
3	**Extending Classes and Inheritance**	Use and Benefits of Inheritance in OOP, Types of Inheritance in Java, Inheriting Data members and Methods , Role of Constructors in inheritance , Overriding Super Class Methods ,Use of "super" , Polymorphism in inheritance ,Type Compatibility and Conversion Implementing interfaces.**Package:** Organizing Classes and Interfaces in Packages , Package as Access Protection , Defining Package ,CLASSPATH Setting for Packages	8	3
4	**Exception Handling**	The Idea behind Exception ,Exceptions & Errors ,Types of Exception ,Control Flow In Exceptions, JVM reaction to Exceptions ,Use of try, catch, finally, throw, throws in Exception Handling ,In-built and User Defined Exceptions, Checked and Un-Checked Exceptions. **Array & String :** Defining an Array, Initializing & Accessing Array, Multi –Dimensional Array, Operation on String, Mutable & Immutable String, Creating Strings using StringBuffer.	8	4
5	**I/O classes**	Understanding Threads , Needs of Multi-Threaded Programming ,Thread Life-Cycle, Thread Priorities ,Synchronizing Threads . **I/O Classes :**Input/Output Operation in Java(java.io Package),Streams and the new I/O Capabilities ,Understanding Streams, The Classes for Input and Output, The Standard Streams, Working with File Object, File I/O Basics, Reading and Writing to Files, Buffer and Buffer Management, Read/Write Operations with File Channel, Serializing Objects.	8	5

Reference Books:

1. Naughton, Schildt, "The Complete Reference JAVA2", TMH
2. Balagurusamy E, "Programming in JAVA", TMH
3. "Head First Java" by Kathe Sierra.
4. "A Beginner's Guide (Sixth Edition)" by Herbert Schildt

e-Learning Source:

www.java2s.com

www.edx.org

www.udemy.com

www.learnjavaonline.org

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	3	2	2	1		3	1	2		3		3		3		1	3	1
CO2	2	2	2		3	1	1	3		2	1	3	2	1	3			
CO3	3	1	3	2	2	2			3		2	2	3		1	2	1	2
CO4	2	2	2	2	1	1	3		2	3	3	1	1	2	3			3
CO5	2	3	2	2	3	3	3			2	2	3		1		3	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: 2018-2019							
Course Code	CS322	**Title of the Course**	Object Oriented Programming using Java Lab	**L**	**T**	**P**	**C**
Year	Third	**Semester**	Fifth	**0**	**0**	**4**	**2**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	Basic concepts and techniques which form the object oriented programming paradigm Using java.						

Course Outcomes	
CO1	To implement concepts data type and arrays
CO2	To understand the use of classes and interfaces
CO3	To Use of packages, strings and dynamic input of values
CO4	To Understand the concepts of modularity using methods and I/O package
CO5	To use threads and exceptions

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Arrays	Write programs to use primitive data type. Write programs to use Arrays.		
2	Classes and Interfaces	Write programs to use classes. Write programs to use interfaces.		
3	Packages	Write programs for using and creating packages. Write programs to use String, String Buffer class and String Builder.		
4	Methods	Implements the concepts of functions, function overloading, function overriding. Describe I/O package & develop its applications.		
5	Threads and exceptions	Write programs based on Threads, Runnable Interface & use all its methods. Create program for Exceptions.		

Reference Books:

1.Naughton, Schildt, "The Complete Reference JAVA2", TMH

2.Balagurusamy E, "Programming in JAVA", TMH

3. "Head First Java" by Kathe Sierra

4. "A Beginner's Guide (Sixth Edition)" by Herbert Schildt

e-Learning Source:

www.java2s.com

www.udemy.com

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	-	-	-	-	-	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	3	2	2	1		3	1						3				1	
CO2	2	2	2		3	1	1						2			2		
CO3	3	1	3	2	2	2							1				2	
CO4	2	2	2	2	1	1	3							2	2			
CO5	2	3	2	2	3	3	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: 2018-2019							
Course Code	CS323	**Title of the Course**	Fundamentals of Software Engineering	**L**	**T**	**P**	**C**
Year	III	**Semester**	V	3	1	0	4
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	1. Explain the basic understanding of software, its characteristics, and importance of following engineering principles to develop software. 2. Study of software design principles and project scheduling 3. To understand the phase of requirement analysis and make the students capable to prepare quality documentation for software development. 4. To understand the testing strategies and follow good programming practices. 5. To develop effort estimation and risk management skills for developing software.						

Course Outcomes	
CO1	Identify the best suitable SDLC model for a given set of user requirements.
CO2	Design highly cohesive and low coupled software.
CO3	Create a good quality SRS and the standard coding guidelines and practices.
CO4	Prepare best possible test cases to uncover errors.
CO5	Estimate the total effort, to assess and manage the potential risks involved while developing the software.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Software Engineering	Introduction to Software Engineering: Types of Software, Quality of Good Software. Phases of Software Development Life Cycle, Software Life Cycles Models: Waterfall Model, Prototype Model, Iterative Model, Spiral Model, Software Requirements Analysis and Specification: SRS, Characteristics of SRS.	8	1
2	Software Design Principles	Software Design Principles: Software Design, Design Process, Design Principles: Abstraction, Refinement, Modularity, Information Hiding. Project Scheduling & Staffing: Overall Scheduling, Detailed Scheduling, Team Structure.	8	2
3	Software Requirements Analysis and Specification	Software Requirements Analysis and Specification: Software Requirements: Need for SRS, Requirement Process, Problem Analysis, Time Estimation, Resource Allocation, Software Maintenance: Categories of Maintenance, Coding: Coding Standard and Guidelines.	8	3
4	Testing Fundamentals	Testing Fundamentals: Error Fault and Failure, Test Cases and Test Criteria, Testing: Black Box Testing and White Box Testing, Unit Testing, Integration Testing. Coding: Programming Principles and Guidelines: Common Coding Errors, Structured Programming, Programming Practices.	8	4
5	Risk Management	Risk Management: Reactive and Proactive Risk Strategies, Software Risks, Risk Analysis, Identification, Projection, Assessment, Monitoring and Managing the Risk. Effort Estimation Models, A Bottom-Up Estimation Approach, COCOMO Model.	8	5

Reference Books:

1. R. Pressman, “Software Engineering”, TMH.
2. Pankaj Jalote, “An Integrated Approach to Software Engineering”, Narosa.
3. Rajib Mall, “Fundamental of Software Engineering”, PHI

e-Learning Source:

https://onlinecourses.nptel.ac.in/noc20_cs68/preview

https://nptel.ac.in/courses/106105087

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	1	3	2					1			3
CO2		2		1		2			2		
CO3	3		2				1	2			
CO4		1			2		2			1	
CO5		1		1							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:							
Course Code	**CS-324**	**Title of the Course**	**Computer Graphics & Multimedia**	**L**	**T**	**P**	**C**
Year	**3**	**Semester**	5	**2**	**1**	**0**	**3**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To learn the basic concepts and components of a graphics system. To learn various algorithms for line drawing, circle drawing, scan conversion and filling of polygons. To learn the basic principles of 2- dimensional computer graphics. To learn and understand technical aspect of Multimedia Systems. To learn various file formats for audio, video and text media used in multimedia systems. To comprehend and analyze the fundamentals of animation						

Course Outcomes	
CO1	Understand the basic concepts of computer graphics, graphics systems & their components, its applications and their relevance to classical and modern problems.
CO2	Discuss various algorithms for line drawing, circle drawing, scan conversion and filling of polygons.
CO3	Use of two-dimensional geometric transformations on graphics objects and their application in composite form (Translation, Scaling, Rotation, Reflection, Shearing, and Reflection problems based on these) and make aware of the illumination models and color systems.
CO4	Developed understanding of technical aspect of Multimedia System, its components, hardware and Multimedia I/O technologies.
CO5	Understand various file formats for audio, video and text media and elaborate on the fundamentals of animation.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Computer Graphics	Introduction to Computer Graphics: Introduction, Operations, Applications of Computer Graphics; Overview of Interactive Graphics, Pixels, Resolution, Aspect Ratio; Graphics standards, Graphical Input Output devices: CRT, LCD, Plasma Display System, Raster-Scan Display System, Random-Scan Display System, Printers, etc.	8	1
2	Scan Conversion	Scan Conversion: DDA and Bressenham's Line, midpoint circle drawing algorithm; DDA and Bressenham's Circle drawing algorithm, Polygon: Polygon Representation, Entering Polygons, Filling Polygons: Flood Fill Algorithm, Boundary-Fill Algorithm and Scan-line Polygon Filling Algorithm.	8	2
3	Geometrical Transformation	Geometrical Transformation: Basic Transformation: Translation, Scaling, Rotation, Homogeneous coordinate systems, Composite transformations. Illumination and Color Systems: Illumination, Shading, Shadow, Concept of colors, CIE color standards.	8	3
4	Introduction to multimedia	Introduction to multimedia, multimedia components, multimedia hardware, SCSI, IDE, MCI multimedia data and file format standards - Multimedia I/O technologies -Digital voice and audio -Video image and animation - Full motion video - Storage and retrieval technologies.	6	4
5	File formats	File formats: RTF, TIFF, MIDI, video compression, Image file formats: JPEG, PNG, BMP, GIF; Hypertext and Hypermedia, multimedia tools, CD-ROM, Computer Animation Design, Types of Animation, Creating Animation, Flash, Publishing Flash Movies	8	5

Reference Books:

Malay K. Pakhira, "Computer Graphics Multimedia and Application" PHI.

Chemmakesava R. Alavala, "Computer Graphics" PHI.

D.Hearn and Baker, "Computer Graphics" Prantice Hall of India.

e-Learning Source:

https://onlinecourses.nptel.ac.in/noc20_cs90/preview

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO4	PSO5
CO1	1	3	2			2		2			3
CO2	1		2				2		3		
CO3	1	3	3				2	3		2	
CO4	1			3		3	2		1		
CO5	1	3		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
Department of Mathematics & Statistics
Study and Evaluation Scheme (w.e.f 2020-21)

B. Sc. (Physics, Mathematics, Computer Science) **III[rd] year / VI[th] Semester**

(Computer Science, Mathematics)

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Total	Credit	Total Credits	Attributes							SDG
				L	T	P	CT	TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
THEORIES																					
1	CS325	Introduction to Open Source Technology	Core	3	1	0	40	20	60	40	100	3:1:0	4	√	√						
2	CS326	ERP(Elective)	Core	3	1	0	40	20	60	40	100	3:1:0	4			√					
	CS327	HCI(Elective)	Core													√					
	CS328	E-Commerce (Elective)	Core													√					
3	MT305	Statics & Dynamics	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
4	MT306	Analysis	Core	3	1	0	40	20	60	40	100	3:1:0	4								
5	MT307	Basic Mathematical Modelling (Elective)	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
	MT308	Linear Programming (Elective)	Core											√	√	√					
6	CS330	UG CS Project	Core	0	0	8	0	0	0	200	200	0:0:4	4	√	√	√					
Total				15	5	8	200	100	300	400	700	24	24								

CT = Class Test; **TA** = Teacher's Assessment,; **ESE** = End Semester Examination; **Sessional** = CT + TA; **Subject Total** = Sessional + ESE

Integral University, Lucknow
Department of Mathematics & Statistics
Study and Evaluation Scheme (w.e.f 2020-21)

B. Sc. (Physics, Mathematics, Computer Science) **III[rd] year / VI[th] Semester**

(Physics, Computer Science)

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Total	Credit	Total Credits	Attributes							SDG
				L	T	P	CT	TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
THEORIES																					
1	PY305	Applied Electronics	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
2	CS325	Introduction to Open Source Technology	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
3	CS326	ERP(Elective)	Core	3	1	0	40	20	60	40	100	3:1:0	4			√					
	CS327	HCI(Elective)	Core													√					
	CS328	E-Commerce(Elective)	Core													√					
5	PY307	Mathematical Methods in Physics (Elective)	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
	PY308	Advanced Solid State Physics(Elective)												√		√					
6	PY309	UG Physics Project	Core	0	0	8	0	0	0	200	200	0:0:4	4	√		√		√		√	
	CS330	UG CS Project	Core											√	√	√					
7	CS329	Web Technologies and Applications	Core	3	1	0	40	20	60	40	100	3:1:0	4	√	√	√					
	PY306	Physics of Materials	Core											√		√					
Total				15	5	8	200	100	300	400	700	24	24								

CT = Class Test; **TA** = Teacher's Assessment,; **ESE** = End Semester Examination; **Sessional** = CT + TA; **Subject Total** = Sessional + ESE

Integral University, Lucknow
Department of Mathematics & Statistics
Study and Evaluation Scheme (w.e.f 2020-21)

B. Sc. (Physics, Mathematics, Computer Science) **III[rd] year / VI[th] Semester**

(Physics, Mathematics)

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Total	Credit	Total Credits	Attributes							SDG
				L	T	P	CT	TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics	
THEORIES																					
1	PY305	Applied Electronics	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
2	PY307	Mathematical Methods in Physics (Elective)	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
	PY308	Advanced Solid State Physics(Elective)	Core											√		√					
3	MT305	Statics & Dynamics	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
4	MT306	Analysis	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
5	MT307	Basic Mathematical Modelling (Elective)	Core	3	1	0	40	20	60	40	100	3:1:0	4	√		√					
	MT308	Linear Programming (Elective)	Core											√	√	√					
6	PY309	UG Physics Project	Core	0	0	8	0	0	0	200	200	0:0:4	4	√		√		√		√	
			Total	15	5	8	200	100	300	400	700	24	24								

CT = Class Test; **TA** = Teacher's Assessment,; **ESE** = End Semester Examination; **Sessional** = CT + TA; **Subject Total** = Sessional + ESE

Integral University, Lucknow

Effective from Session: 2018-19							
Course Code	**MT305**	**Title of the Course**	**Statics & Dynamics**	**L**	**T**	**P**	**C**
Year	Third	**Semester**	Sixth	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 with Mathematics	**Co-requisite**					
Course Objectives	The purpose of this undergraduate course is to impart basic and key knowledge of motion of body on various type of surfaces. Students will be able to learn about equilibrium and bodies acted upon by forces under different conditions. After successful completion of course, the student will be able to explore subject into their respective dimensions.						

Course Outcomes	
CO1	Students will be able to understand Velocity and acceleration along radial and transverse directions and along Tangential and normal directions. They will also study Simple harmonic motion in various situations and about Motion under other laws of forces, Earth attraction, Elastic strings.
CO2	Students will gain an understanding of Motion of bodies in resisting medium, Constrained motion (circular and cycloidal only).
CO3	Students will gain an understanding of motion of particle on smooth and rough plane curves, Rocket motion and also study about Central orbits and Kepler's law, Motion of a particle in three dimensions.
CO4	Students will create the own understanding of Common catenary, Centre of gravity and get knowledge of Stable and unstable equilibrium, Virtual work.
CO5	Students will learn about Forces in three dimensions, Poinsot's central axis, Wrenches, Null line and null plane.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		Velocity and acceleration along radial and transverse directions, and along Tangential and normal directions, Simple harmonic motion, Motion under other laws of forces, Earth attraction, Elastic strings	8	1
2		Motion in resisting medium, Constrained motion (circular and cycloidal only).	8	2
3		Motion on smooth and rough plane curves, Rocket motion, Central orbits and Kepler's law, Motion of a particle in three dimensions.	8	3
4		Common catenary, Centre of gravity, Stable and unstable equilibrium, Virtual work.	8	4
5		Forces in three dimensions, Poinsot's central axis, Wrenches, Null line and null plane.	8	5

Reference Books:

1 R.S. Verma - A Text Book on Statics., Pothishala Pvt. Ltd., Allahabad

2. S.L. Loney - An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies, Kalyani Publishers, New Delhi.

3. J.L. Synge & B.A. Griffith - Principles of Mechanics, Tata McGraw-Hill, 1959.

4. M.A. Pathan: Statics

5. Jhonson and Beer: Vector Mechanics for Engineers

6. Zafar Ahsan: Lectures Notes on Mechanics

e-Learning Source:

1. https://nptel.ac.in/courses/112/106/112106180/
2. https://www.mathcity.org/bsc/notes_of_mechanics/tariq_mahmood_qadri
3. https://www.fisica.net/mecanicaclassica/introduction_to_statics_and_dynamics_by_rudra_pratap.pdf
4. https://www.msuniv.ac.in/Download/Pdf/2c2167ab44cf4fc

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	1	1	1	2	2	2	1	2	2
CO2	3	2	2	1	1	1	2	3	3	2	2	1
CO3	3	2	2	1	1	1	2	2	2	2	3	3
CO4	3	2	2	1	1	1	2	2	2	3	3	2
CO5	3	2	2	1	1	1	2	2	2	3	3	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: 2018-19							
Course Code	**MT306**	**Title of the Course**	**Analysis**	**L**	**T**	**P**	**C**
Year	Third	**Semester**	Sixth	**3**	**1**	**0**	**4**
Pre-Requisite	B.Sc Second year	**Co-requisite**					
Course Objectives	1. This is an introductory course on analysis for mathematics students. The aim of this course is to introduce and develop basic analytic concepts of limit, convergence, integration and differentiation. 2. This course is aimed to provide an introduction to the theories for functions of a complex variable. The concepts of analyticity, Cauchy-Riemann relations and harmonic functions are then introduced.						

Course Outcomes

CO1	Describe fundamental properties of the real numbers that lead to the formal development of real analysis.
CO2	Demonstrate an understanding of limits and how they are used in sequences, series, differentiation and integration;
CO3	Understand and be able to use notions of convergence involving sequences of functions, including the difference between pointwise and uniform convergence. Apply the Weierstrass M-test and the uniform convergence theorem for integrals to examples.
CO4	Demonstrate understanding of the basic concepts underlying complex analysis.
CO5	Find Laurent series about isolated singularities, and determine residues and use the residue theorem to compute several kinds of real integrals.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		Find Laurent series about isolated singularities, and determine residues and use the residue theorem to compute several kinds of real integrals.	8	1
2		Sequence of real numbers, Subsequence, Bounded and monotonic sequences, Convergent sequences, Cauchy's theorems on limit, Cauchy sequence, Cauchy general principle of convergence.	8	2
3		Uniform convergence of sequences and series of functions, Weierstrass - M test, Abel's and Dirichlet's test, Boundedness and intermediate value properties of continous functions, Uniform continuity, Meaning of sign of derivative, Darboux theorem	8	3
4		Functions of Complex variables, Limit, Continuity and differentiability, CR – equations , Analytic functions, Harmonic functions, Construction of analytic function.	8	4
5		Cauchy fundamental theorem, Cauchy integral formula, Derivatives of analytic functions, Morera's and Lioville's theorem, Zeros of analytic function, Singularities, Residues and theorem of Residue.	8	5

Reference Books:

1. Robert G. Bartle and Donald R. Sherbert : Introduction to Real Analysis,Wiley Student Edition.

2. S. C . Malik and S. Arora : Mathematical analysis, Wiley Eastern Ltd.

3. R . V. Churchill and J.W. Brown: Complex Variable & Applications, McGrow Hill, International Book Company, London
Goyal and Gupta : Function of a Complex Variable, Pragati Prakashan.

e-Learning Source:

1. https://swayam.gov.in/nd1_noc20_ma03/preview
2. https://www.youtube.com/watch?v=gJ1pYz1k0qM
3. https://www.youtube.com/watch?v=t9xW7UaZwZ0

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	1	1	2	1	1	1	1	2	2	2
CO2	3	1	2	1	3	1	1	2	2	1	2	3
CO3	3	1	2	1	3	1	1	1	2	1	2	3
CO4	3	1	1	1	2	1	1	2	2	2	3	3
CO5	3	1	1	1	2	1	1	2	2	3	3	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: 2018-19							
Course Code	**MT307**	**Title of the Course**	**BASIC MATHEMATICAL MODELING**	**L**	**T**	**P**	**C**
Year	Third	**Semester**	Sixth	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 with Mathematics	**Co-requisite**					
Course Objectives	The course is aimed to develop the skills in mathematics specially in calculus which is necessary for grooming them into successful science graduate. The topics introduced will serve as basic tools for specialized studies in science field.						

Course Outcomes

CO1	Assess and articulate what type of modeling techniques are appropriate for a given physical system.
CO2	Construct a Mathematical model of a given physical system and analyze it.
CO3	Make predictions of the behavior of a given physical system based on the analysis of its Mathematical Model.
CO4	Demonstrate understanding of powerful mathematical tools such as calculus of several variables, differential equations and elementary dynamical systems theory
CO5	Recognize the power of mathematical modeling and analysis and be able to apply their understanding to their further studies.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		Simple situations requiring mathematical modeling, techniques of mathematical modeling, classifications of mathematical modeling, characteristics of mathematical models. Mathematical modeling through geometry, algebra, trigonometry and calculus. Limitations of methodical modeling.	8	1
2		Mathematical modeling through ordinary differential equations first order linear growth and decay models, compartment models, mathematical modeling in dynamics through first order ODE. Mathematics modeling through Systems of ODE of first order	8	2
3		Mathematical modeling in population dynamics, mathematical modeling of epidemic, Compartment model through system of ODE. Mathematical Modeling of circular motion, Planetary motions and motions of satellite.	8	3
4		Mathematics modeling in economics, in medicine, Arms race, Battles, international trade in terms of system of ODE and dynamic through ordinary differential equations. Mathematical Modeling through ODE of second order.	8	4
5		Mathematical modeling through difference equations: The need, basic theory, modeling in Economics and finance, modeling in population dynamics and Genetics, Modeling in probability theory. Examples of Mathematical modeling through difference equations	8	5

Reference Books:

1. Robert G. Bartle and Donald R. Sherbert : Introduction to Real Analysis,Wiley Student Edition.
2. S. C . Malik and S. Arora : Mathematical analysis, Wiley Eastern Ltd.
3. R . V. Churchill and J.W. Brown: Complex Variable & Applications, McGrow Hill, International Book Company, London
Goyal and Gupta : Function of a Complex Variable, Pragati Prakashan.

e-Learning Source:

1. https://www.youtube.com/watch?v=-uCwgZUz51o
2. https://nptel.ac.in/courses/111107113/
3. https://study.com/academy/lesson/types-of-mathematical-models.html
4. https://www.frontiersin.org/articles/10.3389/fgene.2015.00354/fullpdf
5. https://www.youtube.com/watch?v=jV4Hlh8gHLs

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	2	1	1	3	1	1	1	2	2	1
CO2	2	2	2	1	1	2	2	2	1	1	2	3
CO3	3	2	3	1	1	2	1	2	2	1	2	3
CO4	3	2	3	1	1	3	2	2	2	1	2	3
CO5	3	2	1	1	1	2	1	2	2	3	3	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: 2018-19							
Course Code	**MT308**	**Title of the Course**	**Linear Programming**	**L**	**T**	**P**	**C**
Year	Third	**Semester**	Sixth	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 with Mathematics	**Co-requisite**					
Course Objectives	To teach the basic concepts of Linear Programming, Integer Linear Programming, Multi-objective and Stochastic linear programming. To make students able for Post optimal analysis and optimal decision making problem. This is a great beginner course for those interested in Mathematical Programming Optimization.						

Course Outcomes	
CO1	Formulation of real life problems in the form of linear programming problem and various method to solve the formulated LPP.
CO2	Can obtain the problem when changing the parameters of the problem in later stages.
CO3	Understanding pure and mixed integer programming problems with different methods of solving those problems.
CO4	Understand Multi-objective and Stochastic programming problem and various methods to make them deterministic in order to solve efficiently.
CO5	Learn decision making problems under various environment explicitly the theory of games.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1		Formulation of linear programming problem, simplex algorithm, Primal Dual relationship, Economical interpretation of the dual, Dual Simplex method. Revised simplex method. Bounded variable simplex method	8	1
2		Sensitivity Analysis: Change in values of objective function coefficient, Change in right hand side values, Change in coefficient of coefficient, Adding a new product and adding a constraint.	8	2
3		Integer programming formulation, all integers and mixed integer programming problems, Gomory's cutting plane algorithm, Branch and bound algorithm. Knapsack problem.	8	3
4		tochastic programming models, Chance constraints optimization, two stage problems. Goal Programming methods and applications.	8	4
5		Decision Theory: Introduction, Elements of decision problem, Types of decision making environment, Decision tree. Game Theory: Basic definitions, Two-person Zero-sum games, Pure and mixed strategy, Principle of Dominance, Graphical method, Solution of games by linear programming method.	8	5

Reference Books:

1. Mokhtar S. Bazara, John J. Jarvis "Linear Programming and Network Flows" Fourth Edition. WILEY A John Wiley & Sons, Inc., Publication.
2. H.A. TAHA "Operations Research- An Introduction" Pearson.
3. K.Swarup, P.K.Gupta and A. Manmohan, "Operations Research", S. Chand.
4. Hiller And Liebarman, "Introduction to Operations Research", McGraw Hill Company.
5. David K. J. Mtetwa, "Linear Programming" Paradise publishers, US.

e-Learning Source:

1. https://www.youtube.com/watch?v=TwAvQJAM9Hk
2. https://www.youtube.com/watch?v=M8POtpPtQZc
3. https://www.youtube.com/watch?v=KLHWtBpPbEc
4. https://www.youtube.com/watch?v=o-N0jFUpdWo
5. https://www.youtube.com/watch?v=56-iiZEjqnU
6. https://www.youtube.com/watch?v=LAC212ZwBB4
7. https://www.youtube.com/watch?v=gkm6WljmbOk
8. https://www.youtube.com/watch?v=EyVYAngxkPA

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	2	2	1	3	1	1	1	2	2
CO2	3	1	1	1	2	1	3	2	2	3	2	3
CO3	3	1	1	2	2	1	3	2	2	2	2	3
CO4	3	2	3	1	1	1	3	2	1	1	2	3
CO5	3	2	1	2	2	1	3	2	3	3	3	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: 2020-21							
Course Code	PY305	**Title of the Course**	**Applied Electronics**	**L**	**T**	**P**	**C**
Year	**Third**	**Semester**	Sixth	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 with Physics	**Co-requisite**					
Course Objectives	The purpose of this undergraduate course is to impart basic and key knowledge of electronics and its applications. By using the principles of modern physics and mathematics to obtain quantitative relations which are very important for higher studies. After successfully completion of course, the students will be able to explore subject into their respective dimensions.						

Course Outcomes	
CO1	Students will gain an understanding of modern physics and characterization of semiconductor based electronic devices.
CO2	Students will be able to realize the important concepts of advance electronics related to bipolar junction transistors.
CO3	Students will gain an understanding of advanced concepts of transistors and related to biasing circuits for small- and large-scale signal conditioning, power amplifications and effect of external factors in transistor operations.
CO4	Students will learn about the high switching semiconducting devices like FETs and MOSFETs for designing power supplies for industrial and commercial applications.
CO5	Students will learn about the Power electronic devices like the UJT, TRIAC, etc. and designing Integrated Circuits for fabrication of high yield monolithic ICs.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Semiconductor and p-n junction diode	Diffusion of minority carriers in semiconductor, work function in metals and semiconductors Junctions between metal and semiconductors, Semiconductor and p.n. Junction, Depletion layer, Junction Potential Width of depletion layer, Field and Capacitance of depletion layer, Forward A.C. and D.C. resistance of junction, Reverse Breakdown, Zener and Avalanche diodes, Tunnel diodes, Point contact diode, their importance at High frequencies, LED photodiodes, Effect of temperature on Junction diode Thermistors.	08	CO1
2	Transistor-I	Transistor parameters, base width modulation, transit time and life-time of minority carriers, Base-Emitter resistance Collector conductance, Base spreading resistance, Diffusion capacitance, Reverse feedback ratio, Equivalent circuit for transistors, Basic model, hybrid model and Y parameter equivalent circuit, Input and output impedances.	08	CO2
3	Transistor-II	Current and Voltage gain, Biasing formulae for transistors, Base bias, emitter bias and mixed type bias and mixed type biasing for small and large signal operation, Transistor circuit application at law frequencies, their AC and DC equivalent for three different modes of operation, Large signal operation of transistors, Transistor Power amplifiers, Class A and B operation, Maximum power output Effect of temperature, heat sinks, thermal resistance Distortion in amplifiers, cascading of stages, Frequency response, Negative and positive feedback in transistor amplifiers.	08	CO3
4	Field effect transistors and Power Supplies	Field effect transistors and their characteristics, biasing of FET, use in preamplifiers, MOSFET and their simple uses. Electronically regulated low and high voltage power supplies, Inverters for battery operated equipments. Phototransistors, Silicon Controlled rectifiers.	08	CO4
5	Power Electronics and Integrated Circuits	Triac Construction, Operation and Characteristics, Unijunction Transistors (UJT), its characteristics, IC-classification, Making monolithic ICs, IC-fabrication of components on monolithic IC, IC packings, IC symbols.	08	CO5

Reference Books:

1. B. G. Streetman; "Solid State Electronic Devices", UK Edition (Prentice-Hall of India. New Delhi, 1986).
2. W. D. Stanley; "Electronic Devices, Circuits and Applications" (Prentice-Hall, New Jersey, USA. 1988).
3. J. D. Ryder; "Electronics Fundamentals and Applications" IInd Edition (Prentice-Hall of India. New Delhi, 1986).
4. I. Millman and A. Grabel; "Microelectronics", International. Edition (McGraw-Hill Book Company, New York, 1988).

e-Learning Source:

1. https://nptel.ac.in/courses/117/107/117107095/
2. https://nptel.ac.in/courses/108/101/108101091/
3. https://nptel.ac.in/courses/117/103/117103063/

	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	1	2	1	2	3	2	1	2	2
CO2	1	3	2		3	1	2	1	2	3	3
CO3	3	2	1	1	2	2	3	3	3	2	2
CO4	2	2	3		1	1	2	1	2	2	3
CO5	1	3	1	2	3	2	1	2	1	2	1

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	PY306	**Title of the Course**	**Physics of Materials**	**L**	**T**	**P**	**C**
Year	**Third**	**Semester**	Fifth	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 with Physics	**Co-requisite**					
Course Objectives	The purpose of this undergraduate course is to impart basic and key knowledge of materials. By using the basic knowledge of materials to obtain quantitative relations which are very important for further research. After successfully completion of course, the student will be able to explore subject into their respective dimensions.						

Course Outcomes	
CO1	To learn about crystal structure and its fractures
CO2	To introduce crystal imperfection and elastic properties of crystals.
CO3	To introduce the structure of metals, alloys, ceramics and glasses and their processing.
CO4	To Introduce the Nanomaterials and nanotechnology
CO5	To learn various characterization techniques of nanoparticles or nanomaterials

Experiment No.	**Title of the Experiment**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	**Introduction:** Atomic basis of structure – ionic bonding, Covalent bonding, Metallic bonding, Secondary bonding, Crystalline and non-crystalline states, crystal symmetry, silica and silicates, polymers, fullerenes. **Fracture:** Ductile fracture, Brittle fracture, Fracture toughness, Ductile-brittle transition, Protection against fracture, Fatigue fracture.	08	CO1
2	Crystal Imperfections and Elastic Properties	**Crystal Imperfections:** Point, line, surface and volume imperfections, dislocations and their geometry, Disorder in polymers and non-crystalline materials. **Elastic Properties:** Elastic behavior and its atomic model, Rubber like elasticity, anelastic behavior, relaxation processes, viscoelastic behavior, plastic deformation	08	CO2
3	Structure and Processing of Materials	Structure of metals and alloys, structure of ceramics and glasses, structure of polymers, structure of composites (qualitative). Brief introduction of processing of metals, alloys, ceramic and glasses.	08	CO3
4	Introduction to Nanomaterials	Brief introduction of nanomaterials, properties of Nanomaterials. Methods to produce nanomaterials: Sol-Gel synthesis method. Applications of nanomaterials. Carbon Nanomaterials: classification and properties, Nanowires: classification, properties and applications. Nanocomputers.	08	CO4
5	Tools and Techniques	Crystallography: Particle size determination, Electron Microscopy: Scanning Electron Microscopy (SEM), Tunneling Electron Microscopy (TEM) (qualitative), sample preparation for an electron microscope, Difference between TEM and SEM, Disadvantages of electron microscope, atomic force microscope (AFM) (qualitative).	08	CO5

Reference Books:

1. Introduction to Solid State Physics: C. Kittel (Wiley, VII ed.)
2. Introduction to Solids: L.V. Azaroff (Tata McGraw Hill).
3. Solid State Physics: A.J. Dekker (Prentice-Hall).
4. Essentials of Materials Science: A.G. Guy (McGraw Hill).

e-Learning Source:

1. https://nptel.ac.in/courses/115/104/115104109/
2. https://nptel.ac.in/courses/115/105/115105099/
3. https://nptel.ac.in/courses/113/107/113107075/
4. https://nptel.ac.in/courses/115/101/115101007/

	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	1	2	1	2	3	2	1	2	2
CO2	1	3	2		3	1	2	1	2	3	3
CO3	3	2	1	1	2	2	3	3	3	2	2
CO4	2	2	3		1	1	2	1	2	2	3
CO5	1	3	1	2	3	2	1	2	1	2	1

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	PY307	**Title of the Course**	**Mathematical Methods in Physics (Elective 1)**	**L**	**T**	**P**	**C**
Year	**Third**	**Semester**	Sixth	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 with Physics	**Co-requisite**					
Course Objectives	The main objective of this course is to familiarize students with a range of mathematical methods that are essential for solving advanced problems in theoretical physics.						

Course Outcomes	
CO1	Students will be able to apply the methods of vector analysis. These methods provide a natural aid to the understanding of geometry and some physical concepts. They are also a fundamental tool in many theories of Applied Physics.
CO2	Students will be able to use computational techniques and algebraic skills essential for the study of systems of linear equations, matrix algebra, vector spaces, eigenvalues and eigenvectors, orthogonality, and diagonalization. (Computational and Algebraic Skills).
CO3	Students will understand the convergence and divergence of infinite series and to evaluate successive differentiation and determine the area and volume by applying the techniques of double and triple integrals.
CO4	Students will express the concept of probability and its features, explain the concept of a random variable and the probability distributions.
CO5	Students will use the gamma function, beta function and special functions to: evaluate different types of integral calculus problems and Fourier series to solve differential equations.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Vector Calculus and Curvilinear Coordinates	Vector Calculus and Curvilinear Coordinates Differential vector operators: Gradient, divergence and curl. Gauss's theorem, Green's theorem, Stoke's theorem, Some simple examples based on these theorems, orthogonal curvilinear coordinates, cylindrical and spherical polar coordinates, divergence, gradient, curl and Laplacian in these coordinates.	08	CO1
2	Vector Spaces and Linear Algebra	Determinants for linear algebraic equations, Laplace development, Cramer's rule, antisymmetry, Gauss elimination. Matrices–basic definition, classification and operations, orthogonal matrices, Hermitian matrices, unitary matrices, Rank of matrices, eigenvalues and eigenvectors.	08	CO2
3	Infinite Series and Multiple Integrals	Infinite Series: Fundamental concepts, convergence tests, alternating series, algebra of series, power series, Taylor series. Multiple Integrals: Double and triple integrals, application of multiple integrals, change of variables in integrals, general properties of Jacobians, surface and volume integrals.	08	CO3
4	Statistics and Probability	Statistics and Probability: Statistical distributions, second moments and standard deviations, definition of probability, fundamental laws of probability, discrete probability distributions, combinations and permutations, continuous distributions: expectation, moments and standard deviation, Binomial, Poisson and Gaussian distributions.	08	CO4
5	Special Functions	Beta and gamma functions: problems, relation between beta and gamma functions, Bessel's differential equations, Legendre's differential equations, Hermite's differential equations, Laguerre's differential equations (Qualitative), series solutions, Dirac delta functions and its properties.	08	CO5

Reference Books:

1. Mathematical Methods for Physicists: G. Arfken and H. J. Weber (Academic Press, San Diego) 7th edition, 2012.
2. Mathematical Methods in the Physical Sciences, M.L. Boas (Wiley) 2002.
3. Applied Mathematics for Engineers and Physicists, L. A. Pipes & L. R. Harvill (McGraw- Hill), 1971.
4. Mathematical Methods for Physics and Engineering, K. F. Riley, M.P. Hobson and S.J. Bence (Cambridge University Press), 1998.

e-Learning Source:

1. https://www.freebookcentre.net/Physics/Mathematical-Physics-Books.html
2. https://nptel.ac.in/courses/115106086/

	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	1	1		2	1	2	3	2	1	1
CO2	3	1	2	1	3		3	2	3	3	1
CO3	2	3	2		3	2	2	3	1	2	2
CO4	3		1	1	2		1	2	2	3	1
CO5	1	2	1	2	2	1		3	2	2	1

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

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

Integral University, Lucknow

Effective from Session: 2020-21							
Course Code	PY308	**Title of the Course**	**Advanced Solid-State Physics (Elective 2)**	**L**	**T**	**P**	**C**
Year	**Third**	**Semester**	Sixth	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 with Physics	**Co-requisite**					
Course Objectives	This course aims to extend the material covered in the basic courses in Solid State Physics, Electronic Materials and Device Physics and provide a broader and deeper understanding of the physics of today's semiconductor devices. This includes discussions on the materials properties and optical properties underlying fundamental devices.						

Course Outcomes	
CO1	Students will gain an understanding of the vibrations involved in Lattice which help them to understand the concept of phonon and vibrational dynamics.
CO2	Students will gain knowledge of semiconductor and their benefits over conductors and trying to improve upon these qualities.
CO3	Students will gain an understanding of dielectric material, their properties and use of dielectric material in capacitor. It will help in understanding about Capacitors, as it is one of the most basic electrical components in any electronic circuit.
CO4	Students will gain an understanding of different kinds of magnetic material and it uses.
CO5	Students will be able to evaluate the optical properties of the material and will create own understanding approaches to the finding them.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Elementary Lattice Dynamics	Elementary Lattice Dynamics: Lattice vibrations and phonons. Linear monoatomic and diatomic chains, Acoustical and optical phonons, Qualitative description of the phonon spectrum in solids, Dulong and Petit's law, Einstein and Debye theories of specific heat of solids, T^3 law.	08	CO1
2	Semiconductor Physics	Classifying materials as semiconductors, Chemical bonds in semiconductors, Mechanism of current flow, Forbidden, valence and conduction bands, Intrinsic and extrinsic semiconductors, Carrier concentration and Fermi level for intrinsic semiconductor, Carrier concentration, Fermi level and conductivity of extrinsic semiconductor.	08	CO2
3	Dielectric Properties of Materials	Polarization, Depolarization field, Electric susceptibility, Polarizability, Sources of polarizability (electronic, ionic, dipolar and orientational), Classical theory of electric polarizability, Frequency dependence of ionic polarizability, Local electric field at an atom, Clausius-Mosotti equation, Langevin-Debye equation, Complex dielectric constant and loss.	08	CO3
4	Magnetic Properties of Materials	Magnetic properties of matter: dia, para, ferri and ferromagnetic materials, Classical Langevin theory of dia and paramagnetic materials, Quantum mechanical treatment of paramagnetism, Curie law, Weiss's theory of ferromagnetic domains, Discussion of B-H Curve, hysteresis and energy loss.	08	CO4
5	Optical Properties of Materials	Classical Model-Drude model, ionic conduction, Optical refractive index and relative dielectric constant, Optical absorption in metals, semiconductors and insulators, Colour centres, Excitons, Luminescence, LED, Photo detector, Photomultiplier.	08	CO5

Reference Books:

1. Introduction to Solid State Physics by Charles Kittel (Willey Publication).
2. Elements of Solid-State Physics by Puri and Babbar (S. Chand).
3. Solid State Physics by S. O. Pillai (New Age International).

e-Learning Source:

1. https://nptel.ac.in/courses/115/104/115104109/
2. https://nptel.ac.in/courses/115/105/115105099/
3. https://nptel.ac.in/courses/113/107/113107075/
4. https://nptel.ac.in/courses/115/101/115101007/

	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		1		1	2		3	3	2	1
CO2	3		2		3	2	2	3	3	2	1
CO3	3		2		3	2	2	3	3	2	1
CO4	3		1		2	2	2	3	3	2	1
CO5	3		2		3	2	2	3	3	2	1

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

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

Integral University, Lucknow

Effective from Session: 2018-19							
Course Code	CS325	**Title of the Course**	Introduction to Open Source Technology	**L**	**T**	**P**	**C**
Year	**Third**	**Semester**	Sixth	**3**	**1**	**0**	**4**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To expose students to free open source software environment and introduce them to use open source packages. To make student able to understand the basic directory, file structure of Linux, basic database structure and design Concepts. This course describes the fundamental principles and terms of web application development using Linux, Apache, MySQL and PHP (LAMP).						

Course Outcomes	
CO1	To expose students to free open source software environment and introduce them to use of open source packages for web application development using Linux, Apache, MySQL and PHP (LAMP).
CO2	To understand the basic directory, file structure of Linux, basic database structure and design concepts.
CO3	Install and configure database server (MySQL) for use with PHP and Apache to provide interactive dynamical content for the web.
CO4	Implement server side programming language (PHP), with dynamic content
CO5	Install and configure a Web platform (LAMP) used in web-site development.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Open Source**	Open-Source Definition, The distribution terms of open source software, open source Vs. Closed Source Software, Shareware, Freeware Free and Open Source Software (FOSS), LAMP (Linux, Apache, MySQL, PHP).	8	CO1
2	**Linux**	Introduction of Linux, Linux Vs. Windows, benefits of Linux, Architecture of Linux, Linux Kernel, Basic Linux commands, Administrative Commands.	8	CO2
3	**Apache**	Introduction to Web server. Types of Web Servers: Apache, Tomcat, XAMP. Installing and Testing of Apache on Linux. Introduction to Open Source Programming Languages: PhP, Python, Perl.	8	CO3
4	**PHP**	Testing and Installation of PHP on Linux. Basics of PHP scripts, Variables, Data types, Operators and Expressions, Constants, Flow control functions, If statement, Loops, Arrays, Strings, Dates and Times, Forms.	8	CO4
5	**MySQL Server and Application**	MySQL: Configuring MySQL Server, working with MySQL Databases, MySQL Tables, SQL Commands – INSERT, SELECT, UPDATE, REPLACE, DELETE. Date and Time functions in MySQL. Connecting to MySQL with PHP. Developing PHP scripts for dynamic web page like Feedback form, registration form.	8	CO5

Reference Books:

1. James Lee, Brent Ware.” Open Source Web Development with LAMP: Using Linux, Apache, MySQL, Perl, and PHP”, Addison Wesley
2. Jason Gerner, Morgan Owens, Elizabeth Naramore, Matt Warden, “Professional LAMP: Linux, Apache, MySQL and PHP5 Web Development”, Wrox Publication.
3. Christopher Negus “Red Hat Linux Bible” Wiley Publishing ISBN : 0-7645-4333-4
4. Julie C Meloni , “PHP, MySQL and Apache” Pearson Education ISBN : 81-297-0443-9
5. The Complete Reference Linux Peterson Tata McGraw HILL ISBN : 0-07-044489-7

e-Learning Source:

https://onlinecourses.swayam2.ac.in/aic20_sp32/preview

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1		3	2		1	2							2	3	1	2	2	
CO2	2	1			2		2							3	2	1	3	
CO3	2	1		3		1							3	3	2	1	1	
CO4	3	3	1	1	2	1							3	2	3	2		
CO5	3	2			1		2						3	2	3		1	

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

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

Integral University, Lucknow

Effective from Session: 2018-19							
Course Code	CS326	**Title of the Course**	Enterprise Resource Planning (ERP)	**L**	**T**	**P**	**C**
Year	**Third**	**Semester**	Sixth	**3**	**1**	**0**	**4**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	1. To provide a contemporary and forward-looking on the theory and practice of Enterprise Resource Planning Technology. 2. To focus on a strong emphasis upon practice of theory in Applications and Practical oriented approach. 3. To train the students to develop the basic understanding of how ERP enriches the business organizations in achieving a multidimensional growth. 4. To aim at preparing the students technological competitive and make them ready to self-upgrade with the higher technical skills.						

Course Outcomes	
CO1	Basic understanding of Enterprise Resource Planning Technology.
CO2	Make basic use of Enterprise software, and its role in integrating business functions
CO3	Analyze the strategic options for ERP identification and adoption.
CO4	Design the ERP implementation strategies.
CO5	Create reengineered business processes for successful ERP implementation.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**An Overview to ERP**	Definition ERP, Common Myths related to ERP, Origin and Need for an ERP System, Risks and Benefits of an ERP. ERP and Related Technologies: Business Process Reengineering (BPR), Data Warehousing, Data Mining, Online Analytical Processing (OLAP), Product Life Cycle Management (PLM), Supply Chain Management (SCM), Customer Relationship Management (CRM) and Geographical Information System (GIS).	10	CO1
2	**Market place and its growth**	Market Overview, Reasons for the Growth of ERP Market, Reasons for the Failure of ERP, Functional Modules of ERP. ERP Implementation Basics: Technological, Operational, and Impact of ERP Implementation on Current Market, Implementation Challenges and possible solutions.	8	CO2
3	**Related Technologies and Implementation Process of ERP**	Business Process Re-engineering, Management Information systems, Decision Support Systems, Executive Information Systems. ERP Implementation Process: Implementation Life Cycle, Package Selection Implementation Methodologies, Implementation Plan, Risk Assessment, ERP Project Teams, Implementation Vendors Evaluation Criterion.	10	CO3
4	**Success and Failure Factors of an ERP Implementation**	Success Factors, Failure Factors. ERP Operation and Maintenance: After Going Live, Ongoing Implementation Efforts, Upgrading Vs. New Software, Operation and Maintenance of the ERP System, ERP Maintenance Phase, Maximizing the ERP System.	8	CO4
5	**ERP and E-Business**	Supply Chain Integration, The E-Business Process Model, Components of E-Business Supply Chain. Emerging Trends in ERP: Future of ERP, Faster Implementation Methodologies, Customization Tools, Business Models, Challenges of E-Commerce.	8	CO5

Reference Books:

1. Lexis Leon, "Enterprise Resource Planning", TMH.
2. Brady, Manu, Wegner, "Enterprise Resource Planning", TMH.
3. V.K Garg, N.K. Venkitakrishnan, "ERP Ware: ERP Implementation Framework", Prentice Hall of India.
4. ERP – Ravi Shankar and S. Jaiswal (Galgotia)

e-Learning Source:

https://nptel.ac.in/courses/110105148

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	1		3	2								2	3		1	
CO2	3	2		2	2		1						1	2		3		
CO3	2	3		1		2	3						1		3	2	2	
CO4	2	3	3		1	1							3	3	2		1	
CO5	1	2		2			2						2	2	3	1		

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

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

Integral University, Lucknow

Effective from Session: 2018-19							
Course Code	CS327	**Title of the Course**	Human Computer Interaction (HCI)	**L**	**T**	**P**	**C**
Year	**Third**	**Semester**	Sixth	**3**	**1**	**0**	**4**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• **Learn the foundations of Human Computer Interaction** • **Be familiar with the design technologies for individuals and persons with disabilities** • **Be aware of mobile Human Computer interaction.** • **Learn the guidelines for user interface**						

Course Outcomes	
CO1	Understand a definition of interaction design and human-computer interaction..
CO2	Illustrates the concepts of usability, user experience and user-centered design, the lifecycle model of interaction design.
CO3	Understand the structure of models and theories of human computer interaction and vision.
CO4	Discuss mobile HCI ,designs and tools
CO5	Design an interactive web interface on the basis of models studied.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Human Interaction**	History and Introduction to Human Computer Interaction (HCI Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.	8	CO1
2	**Interactive Design**	Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.	8	CO2
3	**Cognitive Models**	Cognitive models –Socio-Organizational issues and stake holder requirements – Communication and collaboration models-Hypertext, Multimedia and WWW.	8	CO3
4	**Mobile Ecosystem**	Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.	8	CO4
5	**Web Interface Designing**	Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies.	8	CO5

Reference Books:

1. Human – Computer Interaction. Alan Dix, Janet Fincay, Gre Goryd, Abowd, Russell Bealg, Pearson. (Unit 1,2,3)
2. Brian Fling, "Mobile Design and Development", First Edition , OReilly Media Inc., 2009 (UNIT –4)
3. Designing the user interface. 3rd Edition Ben Shneidermann , Pearson Education Asia.
4. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, OReilly, 2009. (UNIT-V).
5. User Interface Design, Soren Lauesen , Pearson Education.

e-Learning Source:

https://nptel.ac.in/courses/106103115

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	3	1	2	1		1							3	2		1	
CO2	3	1		2		2	1						3	3		1	2	
CO3		3	1	3		2							2	2	3	2		
CO4	2	3		3	1		2							3	2		1	
CO5	2	3	2			1	1						2	3	3	1	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: 2016-17							
Course Code	CS328	**Title of the Course**	**E-Commerce**	**L**	**T**	**P**	**C**
Year	**3RD**	**Semester**	6TH	**3**	**1**	**0**	**4**
Pre-Requisite	10+2 with Maths	**Co-requisite**					
Course Objectives	This course provides an introduction to E-Commerce for business and management. It is designed to familiarize students with organizational and managerial foundations of systems, the technical foundation for understanding E-commerce.						

Course Outcomes	
CO1	Understand the basic concepts and technologies used in the field of E-commerce
CO2	Have the knowledge of the different types E-commerce.
CO3	Understand the processes of developing and implementing information systems.
CO4	Be aware of the ethical, social, and security issues of E-commerce.
CO5	Have the knowledge of the different types of technical issues in e commerce and protocols.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	E-Business and E-Commerce	Definition of Electronic Commerce, E-Commerce: Technology and Prospects, Incentives for Engaging in Electronic Commerce, Needs of E-Commerce, Advantages and Disadvantages, Framework. E-Commerce Applications: E-Advertising, Entertainment, E-Marketing, Search Engines, E-Banking, Mobile Commerce, Online Trading, E-Shopping.	8	1
2	Architecture Framework of E-Commerce	Application Services, Brokerage and Data Management, Middleware Services and Network Infrastructure. Network Infrastructure for E- Commerce: Internet and Intranet based E-commerce- Issues, Problems and Prospects, Network Infrastructure, Network Access Equipment's, Broadband Telecommunication (ATM, ISDN, and FRAME RELAY)	8	2
3	Electronic Payments	Overview, The SET Protocol, Payment Gateway, Certificate, Digital Tokens ,Consumer Oriented E-Commerce Applications, Advantages and Risks, Types of Payment System (Credit Cards, E-Cash, Smart-Cards), etc.,Electronic Data Interchange: Non EDI System, Partial EDI System, Fully Integrated EDI System, Prerequisites for EDI. Issues of EDI: Legal Issues, Security Issues, Privacy Issues	8	3
4	Security Protocols	Open Systems Interconnection (OSI), TCP/IP, FTP, HTTP, SMTP, S-HTTP, SSL. Messaging Protocols: Basic Mail Protocol, Security Enhanced mail protocol. Web Security: Security Issues on Web, Importance of Firewall, Components of Firewall, Transaction Security, Emerging Client Server, Security Threats	8	4
5	E-Marketing Techniques	Search Engines, Directories, Registrations, Solicited Targeted E-mails, Interactive Sites, Spam Mails. Applications of 5P's (Product, Price, Place, Promotion, People).E-Advertising Techniques: Banners, Sponsorships, Portals, Online Coupons. Mobile Commerce: Introduction, Wireless Application Protocol, WAP Technology.	8	5

Reference Books:

David Whiteley, "E-Commerce", Tata McGraw Hill, 2000.

Greenstein and Feinman, "Electronic Commerce – Security: Risk Management & Control", McGraw-Hill, 1999

Ravi Kalakota and A.B. Whinston, "Frontiers of Electronic Commerce", Pearson Education, 2005.

"A Beginner's Guide (Sixth Edition)" by Herbert Schildt. Eframi Turban, Jae Lee, David King, K. Michale Chung, "Electronic Commerce", Pearson Education, 2000.

e-Learning Source:

www.wix.com

www.prestashop.com

www.coursera.org

www.teachee.com

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO4	PSO5	PSO6	PSO7
CO1	**3**	**2**	**2**	**1**		**3**	**1**	**2**		**3**		**3**		**3**		**1**	**3**	**1**
CO2	**2**	**2**	**2**		**3**	**1**	**1**	**3**		**2**	**1**	**3**	**2**	**1**	**3**			
CO3	**3**	**1**	**3**	**2**	**2**	**2**			**3**		**2**	**2**	**3**		**1**	**2**	**1**	**2**
CO4	**2**	**2**	**2**	**2**	**1**	**1**	**3**		**2**	**3**	**3**	**1**	**1**	**2**	**3**			**3**
CO5	**2**	**3**	**2**	**2**	**3**	**3**	**3**			**2**	**2**	**3**		**1**		**3**	**2**	

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

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