John Wilson Education Society's

Wilson College (Autonomous)

Chowpatty, Mumbai-400007
RE-ACCREDITED 'A' grade by NAAC

Affiliated to the
UNIVERSITY OF MUMBAI

Syllabus for F.Y

Program: BSc

Program Code: WUSPHY (Physics)

National Education Policy 2020
Academic year 2023–2024

WILSON COLLEGE (AUTONOMOUS), SYLLABUS FOR PHYSICS
PROGRAM OUTLINE 2022-2023

YEAR	SEM	COURSE CODE	COURSE TITLE	CREDITS
FY	**I**	**WSPHYMJ111**	Basic Electronics	**2**
		WSPHYMJ112	Modern Physics	**2**
		WSPHYMJ113	Practical 1	**2**
		WSPHYSE111	Basic Measurements and Calculations	**2**
		WAPHYOE111	Electrical and Electronic gadgets for all	**2**
	II	**WSPHYMJ121**	Thermodynamics	**2**
		WSPHYMJ122	Geometrical Optics and photometry	**2**
		WSPHYMJ123	Practical 2	**2**
		WSPHYSE121	Mathematical Techniques	**2**
		WAPHYOE121	Understanding the Universe	**2**

PROGRAMME SPECIFIC OUTCOME (PSOs)

After completion of the program, the student will be able to

PSO1) Use appropriate and accurate scientific/technical terminology to **communicate** their observations and conclusions.

PSO2) **communicate** scientific concepts accurately through mathematical and graphical representations.

PSO3) **comprehend** the scientific articles and research papers.

PSO4) **analyse and question** the contents of scientific articles and arrive at logical conclusions.

PSO5) **perform** experiments and explain the results with appropriate scientific models.

PSO6) **seek clear understanding** of concepts and ideas that shape reasoning through **problem solving**.

PSO7) **Apply** mathematical constructs to model the natural laws.

PSO8) Be able to **use** various **simulators and emulators** to solve physics problems.

PSO9) Be able to **search** for relevant scientific data/information through online sources.

PSO10) **Identify** sources of error in the data.

PSO11) work effectively in teams/groups with various **interpersonal skills**.

PSO12) Appreciates the value of **diversity in teams**.

PREAMBLE:

The syllabi for various courses are designed under National Educational Policy 2020, for the first year B.Sc. programme, keeping in view the applications and modern developments in the area of physics and also to cater students who may wish to take Physics as a minor subject.
Open Elective syllabus is designed for first year B.A. students.

Discipline Specific Core Course 1

PROGRAM(s): F.YB.Sc.			SEMESTER: I		
Course: Basic Electronics			Course Code: WSPHYMJ111		
Teaching Scheme			Evaluation Scheme		
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA) (Marks- 40)	Semester End Examination (Marks- 60)
2	-	-	2	40	60

Learning Objectives:

1. To gain skills in electronics
2. To be able to understand the working and operation of electronic devices.
3. To design electronic circuits.
4. To develop applications using electronic circuits

Course Outcomes:

A student will be able to,

CO1: describe the working of simple circuits.
CO2: explain the working of basic semiconductor devices.
CO3: calculate using binary numbers.
CO4: build simple applications using semiconductor devices.
CO5: apply rules of boolean algebra.
CO6: design electronic circuits with given specifications.

DETAILED SYLLABUS

Unit	Sub - Unit	Course/ Unit Title	Lectures
I	1.1	**Introduction to Electronics**	5
		Introduction, Basic Components: Passive & Active. Types of sources: Voltage, Current, D.C. & A.C., Laws: Ohm's law, Kirchoff's laws, Voltage divider formula, Maximum Power transfer theorem.	
	1.2	**Introduction to Semiconductors**	7
		Semiconductors: Intrinsic , Extrinsic, Conduction properties. Electronic devices: P-N Junction diode, Zener diode, LED, photo-diode, thermistor, LDR. Transistor: NPN, PNP	

Unit	Sub - Unit	Course/ Unit Title	Lectures
		Modes for transistor: cut-off, saturation, active	
	1.3	**Power Supply**	**3**
		Power Supply: Halfwave, Fullwave, Bridge Rectifier with capacitor filter and zener regulator, load regulation, ripple factor.	
II			
	2.1	**AC Circuits**	**8**
		L-R, C-R & LCR circuits, impedance, Resonance circuits AC Bridges: Wien's Bridge, Maxwell's LC Bridge, Maxwell's Inductor Bridge, De-Sauty's Bridge. 1st order Passive Filters: Low, High, Bandpass.	
	2.2	**Introduction to Digital Electronics**	**7**
		Binary Number system and Binary addition & subtraction. Boolean Algebra, Basic Logic gates, and NAND and NOR as universal building blocks. Writing truth table for given digital circuits Applications - SOP, POS for realisation of truth tables	

References:

1. Boylestad and Nashelsky, Electronic devices and Circuit Theory: 7th edition, Prentice Hall of India.
2. A P Malvino, D.J. Bates , Digital Principles and Applications: 7th edition, Tata McGraw Hill
3. Roger Tokhiem, Digital electronics, 4th ed, McGraw Hill International Edition.
4. P. Horowitz, W. Hill, Art of Electronics, 3rd edition, Cambridge University Press
5. Basic Electronics - Theraja, B. L., 2005 edition, S. Chand and Company
6. Theraja and Theraja, Electrical Technology Vol I

Discipline Specific Core Course 2

PROGRAM(s): F.YB.Sc.			**SEMESTER: I**		
Course: Modern Physics			**Course Code: WSPHYMJ112**		
Teaching Scheme			**Evaluation Scheme**		
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Internal Assessment (CIA) (Marks- 40)**	**Semester End Examination (Marks- 60)**
2	**-**	**-**	**2**	**40**	**60**

Learning Objectives:
To **Communicate** concepts in modern science accurately through mathematical and graphical representations.
To comprehend the scientific articles related to Modern Physics.
To analyse and question the relevance and usefulness of radioactive material in energy and health science.
To **apply** mathematical constructs to model the natural laws in modern physics.
To be able to **search** for relevant scientific data/information through online sources.

Course Outcomes: After completing the course, learner will be able to
CO1: enlist the discoveries of various physical processes at atomic and nuclear level.
CO2: read comprehensively scientific review articles and Nobel laureate lectures who have contributed to the development of modern physics.
CO3: explain applications of radioactive isotopes in medicine and archaeology.
CO4: solve numerical problems in radioactivity and energy-matter interaction at atomic and nuclear level.
CO5: compare the working of various particle detectors.

DETAILED SYLLABUS

Unit	**Sub-Unit**	**Course/ Unit Title**	**Lectures**
I		**Understanding atomic nucleus**	**15**
	1.1	Structure of Nuclei: Basic properties of nuclei, Composition, Charge, Size, Rutherford's experiment for estimation of nuclear size, density of nucleus, Mass defect and Binding energy, Packing fraction, BE/A vs A plot, stability of nuclei (N Vs Z plot) and problems	6

Unit	Sub-Unit	Course/ Unit Title	Lectures
	1.2	Radioactivity: Radioactive disintegration concept of natural and artificial radioactivity, Properties of alpha, beta, gamma-rays, laws of radioactive decay, half-life, mean life, Successive disintegration and equilibriums, radioisotopes. Numerical Problems	6
	1.3	Carbon dating and other applications of radioactive isotopes (Agricultural, Medical, Industrial, Archaeological -information from net).	3
II		**Quantum phenomena and applications**	**15**
	2.1	Types of radiation detectors: Ionization detectors, scintillation detectors, particle detectors, TLD, thin film detectors, solid state detectors.	4
	2.2	Origin of Quantum theory, Black body (definition), Black Body spectrum, Wien's displacement law, Matter waves, wave particle duality, Heisenberg's uncertainty Principle. Davisson-Germer experiment, G. P. Thompson experiment.	4
	2.3	X-Rays production and properties. Continuous and characteristic X-Ray spectra, X-Ray Diffraction, Bragg's Law, Applications of X-Rays.	4
	2.4	Compton Effect, Pair production, Photons and Gravity, Gravitational Red Shift.	3

References:

Kaplan, Irving: Nuclear Physics, Paperback Edition, Narosa Publishing House, 2002
Beiser, A.: Concepts of Modern Physics : Tata McGraw Hill, 6th Edition, 2013
Ghosal, S.N.: Nuclear Physics, S Chand, 2019
Tayal, D.C.: Nuclear Physics, Himalaya Publishing House, 2022
Knoll, Glenn: Radiation Detection and Measurement, 4th Edition (2010), Wiley

Discipline Specific Core Course 3 (Practical)

PROGRAM(s): F.YB.Sc.			**SEMESTER: I**		
Course: Practical 1			**Course Code: WSPHYMJ113**		
Teaching Scheme			**Evaluation Scheme**		
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Internal Assessment (CIA) (Marks- 40)**	**Semester End Examination (Marks- 60)**
-	**4**	**-**	**2**	**40**	**60**

Learning Objectives:

To enable students to

1. acquire understanding of usage of basic measuring instruments.
2. plot graphs easily
3. get an understanding of the working of analogue components.
4. get an understanding of the working of digital components.

Course Outcomes:

A student will be able to,

CO1: demonstrate his/her practical skills.
CO2: practice the skills required to perform experiments in physics.
CO3: work with apparatus without fear.
CO4: correlate the ideas discussed in lectures to the experiments being carried out..
CO5: understand the concepts of errors and their estimation.
CO6: connect circuits, perform measurements and analyse observations.

Course code	**Practical**	**Credits**
	WSPHYMJ113	**2**
	Skills 1) Identifying components 2) Use of DMM 3) Graph plotting Main experiments 1. Bridge Rectifier, rectification, load regulation, ripple factor. 2. Maximum power transfer theorem 3. Zener Diode Characteristics. 4. L- R circuit 5. C-R circuit	

Course code	Practical	Credits
	6. De-Morgan's Theorem using logic gates 7. NAND and NOR as Universal Building Blocks 8. Transistor Characteristics (CE mode) 9. Thermistor Characteristics 10. Constructing Half adder, Full adder 11. Photo-diode characteristics 12. LDR characteristics 13. Reading Scientific Articles (2 experiments equivalent) Minimum 12 total experiments (skills and main) to be performed.	

Lab manual will be prepared for reference.

Skill Enhancement Course

PROGRAM(s): F.YB.Sc.			**SEMESTER:** I		
Course: Basic Measurements and Calculations			**Course Code:** WSPHYSE111		
Teaching Scheme			**Evaluation Scheme**		
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Internal Assessment (CIA) (Marks- 40)**	**Semester End Examination (Marks- 60)**
-	4	-	2	-	60

Learning Objectives:

1) expose students to basic instrumentation
2) develop measurement skills
3) develop analytical skills in laboratory measurements

Course Outcomes:

After completing this course, learner will be able to

1) enlist parameters of measuring instruments
2) use basic measuring instruments to measure physical quantities
3) record observations with correct significant digits
4) identify types of uncertainties in the measurement
5) plot graphs of given quantities
6) calculate uncertainties in derived quantities

DETAILED SYLLABUS

Practical

1. Measuring size: travelling microscope, micrometer screw, vernier callipers
2. Time measurement: using stop-watch
3. Mass measurement: single pan balance
4. Use of Digital multimeter for measurement of various electrical parameters
5. Measurement of internal resistance of voltmeter, current-meter and loading effect
6. Measurement of output impedance of signal generator
7. Constant voltage source: current capacity and internal resistance
8. Constant current source: internal resistance
9. Uncertainty analysis: sources of uncertainties, types of uncertainties

10. Propagation of uncertainties
11. Graph plotting I: linear (slope, interpolation, extrapolation)
12. Graph plotting II: Non-linear graphs (slope at given point, interpolation), converting non-linear to linear from known equation
13. Statistical analysis of data I
14. Statistical analysis of data II

Minimum 10 experiments to be completed.

Lab manual will be prepared for reference.

Open Elective / Generic Elective

PROGRAM(s): F.YB.Sc.			**SEMESTER: I**		
Course: Electrical and Electronic gadgets for all			**Course Code: WAPHYOE111**		
Teaching Scheme			**Evaluation Scheme**		
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Internal Assessment (CIA) (Marks- 60)**	**Semester End Examination**
2	**-**	**-**	**2**	**60**	**-**

Learning Objectives:

1) Inculcating the sense of curiosity about various technologies used in daily life.
2) Increasing the awareness about digital technologies.
3) Increasing scientific attitude through science behind technology around us.
4) Addressing the digital age challenges in front of a common citizen.

Course Outcomes:

After completing this course, learner will be able to

1) Calculate the energy consumption for his/her house, office, public places.
2) Compare heating technologies for their advantages and disadvantages.
3) Distinguish between ionising and non-ionising radiations.
4) Use digital camera/ mobile camera effectively.
5) Describe various network parameters.
6) Take appropriate precautions while doing online transactions.
7) Communicate with appropriate netiquettes.

DETAILED SYLLABUS

Unit	**Sub-Unit**	**Course/ Unit Title**	**Lectures**
I		**ELECTRICAL GADGETS AT HOME**	
	1.1	Concept of electricity, voltage, current, power, energy. Types of conducting materials. Electrical ratings of various appliances, electrical billing calculations. Understanding light sources and units – LED, CFL, tube lights, halogen lamps	4
	1.2	Concept of heat energy and temperature scales. Types of thermal materials. Understanding heating appliances – electric heaters, induction hotplate, microwave oven, heating pads.	5

Unit	Sub-Unit	Course/ Unit Title	Lectures
		Understanding cooling devices – dry ice storage, coolers, air-conditioning, refrigerator.	
	1.3	Understanding medical instruments: ionising and non-ionising radiations, X rays, MRI, MRA, CT scan, PET scan, ultrasonography Imaging using ECG and EEG	6
II		**ELECTRONIC AND COMMUNICATING GADGETS**	
	2.1	Digital and analog data. Electronic signals and communication media - wired and wireless communications. wifi, bluetooth, satellite communication. LAN, WAN and larger networks. Internet and world wide web. Concept of bandwidth and data compression, various file formats, 4G/5G networks.	5
	2.2	Mobile phone, PC, laptop, tablets, smart TV, Digital camera: – DSLR/Mirrorless/Mobile camera	5
	2.3	Various Social media platforms and online communication etiquette Artificial intelligence, AI tools Online transactions and safety issues	5

References:

https://www.youtube.com/c/Theengineeringmindset

Modality of Assessment

Theory Examination Pattern: (for Discipline Specific Core papers)

A. **Internal Assessment- 40%- 40 Marks per paper**

Sr. No.	Evaluation Type	Marks
1	Assignment/ Case study/ field visit report/ presentation/ project Multiple assignments may be given.	**40**
	Total	**40**

B. **External Examination- 60%- 60 Marks per paper (for Discipline Specific Core papers)**

Semester End Theory Examination:

1. Duration - These examinations shall be of **two hours** duration.
2. Theory question paper pattern:
   a) There shall be 3 questions each of 20 marks with different levels of difficulty.
   b) All questions shall be compulsory with at least 50% internal choice within the questions. (For example, 4 out of 6 sub-questions or 3 out of 6 sub-questions to be solved).
   c) All units will be given equal weightage.

Evaluation for Discipline Specific Core Practical Course:

A. **Internal Examination: 40%- 40 Marks**

Particulars	**Marks**
Regular Journal assessment	30
Viva	10
Total	**40**

B. **External Examination: 60%- 60 Marks**

Semester End Practical Examination:

Particulars	**Marks**
Long experiment	**40**
Short experiment	**20**
Total	**60**

PRACTICAL BOOK/JOURNAL

The students are required to perform a minimum number of practicals mentioned in the syllabus for certification of journal.
The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

Examination Pattern: (for Skill Enhancement course)

Skill Enhancement Course is a practical course.

There will be one single External Examination of 60 Marks

Nature of Examination

There will be 3 experiments: Each for one hour duration

Particulars	**Marks**
Experiment 1	20
Experiment 2	20
Experiment 3	20
Total	**60**

Examination Pattern: (for Open Elective/Generic Elective)

It will be assessment for total of 60 marks

Sr. No.	**Evaluation Type**	**Marks**
1	Assignment/ Case study/ field visit report/ presentation/ project	30
2	Assignment/ Case study/ field visit report/ presentation/ project	30
	Total	**60**

Discipline Specific Core Course 1

PROGRAM(s): F.Y.B.Sc.			SEMESTER: II		
Course: Thermodynamics			Course Code: WSPHYMJ121		
Teaching Scheme			Evaluation Scheme		
Lectures (hours per week)	Practical (hours per week)	Tutorials (hours per week)	Credits	Continuous Internal assessment	Semester End Examination (Marks - 60)
2	-	-	2	40	60

Learning Objectives:
1: Analyse natural phenomena
2: Model real systems
3: Understand behaviour of bulk matter
4: Predict evolution of a system

Course Outcomes:
A student will be able to,
CO1: describe macroscopic phenomena based on molecular theory of matter
CO2: correlate experimental observations to theoretical models
CO3: identify thermodynamic quantities and processes associated with different systems.
CO4: apply the first law of thermodynamics to various systems
CO5: grasp the concept of reversibility and irreversibility in systems
CO6: analyse the nature of processes using the second law of thermodynamics

DETAILED SYLLABUS

Unit	Sub-Unit	Course/ Unit Title	Lectures
I		**Molecular Structure of Matter**	15
	1.1	Dilute gas System – Equilibrium phenomena, Ideal gas Equation of state, Kinetic theory, Maxwellian velocity distribution	
	1.2	Dilute gas System – Non-equilibrium phenomena, fluctuations, mechanism of transport	
	1.3	Real gas System – Experimental observations, Theoretical Model, Van-der-Waal equation of state.	
	1.4	Phase rule and phase curves	

II		**Basic Thermodynamics**	**15**
	2.1	Basics – System, Environment, Boundaries, Interactions, Physical quantities, processes, Concept of Equilibrium	
	2.2	Zeroth Law of Thermodynamics, Concept of temperature, thermometry at different scales	
	2.3	First Law of Thermodynamics – Concept of Heat and Work, Adiabatic Processes, First Law of Thermodynamics, Relations between Thermodynamic quantities.	
	2.4	Applications of the First Law – Processes in Matter, Carnot Cycle, Joule-Thompson effect, Heat engines, Refrigerators.	

Main References:

Thermal Physics, Garg, Bansal Ghosh, Tata-McGraw Hill

Additional References:

1) Heat and Thermodynamics, M W Zemansky, McGraw Hill (5th and 7th edition)
2) Thermodynamics, Kinetic Theory, and Statistical Thermodynamics, F. W. Sears, G. L. Salinger, Addison- Wesley (3rd Edition)

Discipline Specific Core Course 2

PROGRAM: F.Y.B.Sc.			**SEMESTER:II**		
Course: Geometrical Optics and Photometry			**Course Code: WSPHYMJ122**		
Teaching Scheme			**Evaluation Scheme**		
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Internal Assessment (CIA) (Marks- 40)**	**Semester End Examination (Marks- 60)**
2	**-**	**-**	**2**	**40**	**60**

Learning Objectives:
Use appropriate and accurate scientific/technical terminology to specify optical instruments.
Comprehend the various configurations of basic optical instruments.
Apply mathematical constructs to model the optical instruments.
Be able to **search** for relevant scientific data/information through online sources.

Course Outcomes:

CO1: Understand the principles of image formation

CO2: Model thick lenses and lens systems with cardinal point calculations

CO3: Describe and analyse different types of light sources

CO4: Understand human vision perception and explore techniques to quantify it

CO5: Correlate principles of optics with camera

CO6: Compare the technical parameters of camera among different models

DETAILED SYLLABUS

Unit	**Sub-Unit**	**Course/ Unit Title**	**Lectures**
I		**Geometrical Optics and Optical Instruments**	
	1.1	Image Formation: coaxial system of two thin lenses in contact and separated by a distance, cardinal points	4
	1.2	Telescope parameters: aperture, f-number, magnification Basic telescope designs: Newtonian, Cassegrain	3

	1.3	Microscope: Compound microscope: ray diagram, resolution, numerical aperture	3
	1.4	Aberrations in optical systems: five achromatic aberrations, chromatic aberration Eyepiece parameters, achromatic combinations Corrector plates for spherical aberration: Schmidt, Maksutov	5
II		**Photometry and Camera**	
	2.1	Various camera parameters: focal length, aperture, f-stops, ASA/ISO, exposure, Lens types: standard lens, wide angle, telephoto	3
	2.2	Human vision- spectral response, primary and secondary colours, luminous intensity, luminous flux, illuminance Spectral power distribution, colour rendering	5
	2.3	Detector parameters: lateral image size, pixel size, resolution and plate scale. CMOS detectors: working principle and parameters, reading data-sheet, dark noise, hot pixels	4
	2.4	Types of lamps: incandescent lamps, discharge lamps, LED and their spectra	3

References:

Eugene Hecht, Optics 5th Edition, Pearson

Chapter 5 (5.1, 5.2, 5.3, 5.7), Chapter 6 (6.1, 6.3)

Murugeshan R and Sivaprasath Kiruthiga, Optics and Spectroscopy, S. Chand (2010)

Chapter 1 (1.1 - 1.8, 1.15 - 1.27, 1.32-1.35)

Additional Reference:

Jenkins and White: Fundamentals of Optics, (4th Edition), McGraw Hill

Discipline Specific Core Course 3 (Practical Course)

PROGRAM: F.Y.B.Sc.			**SEMESTER:II**		
Course: Practical 2			**Course Code: WSPHYMJ123**		
Teaching Scheme			**Evaluation Scheme**		
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Internal Assessment (CIA) (Marks- 40)**	**Semester End Examination (Marks- 60)**
-	**4**	**-**	**2**	**40**	**60**

Learning Objectives:
To enable students to
1. understand some fundamental ideas of Thermodynamics.
2. efficiently use mobile or other cameras.
3. make use of optical coupling of devices for real life usage.
4. understand aberration in optical systems.

Course Outcomes:
A student will be able to
- CO1) demonstrate their practical skills.
- CO2) understand and practice the skills while doing physics practical.
- CO3) understand the use of apparatus and their use without fear.
- CO4) correlate their physics theory concepts through practical.
- CO5) Understand the concepts of errors and their estimation.

Detailed syllabus

Practical (WSPHYMJ123)

Demonstration Experiments
1) Thermocouple
2) Lens aberrations
3) Mobile Camera Settings
4) Lux meter

Main Experiments
1) Radiation Correction in Specific Heat measurement
2) Constant volume Air Thermometer
3) Verification of Stefan's Law

Practical (WSPHYMJ123)
4) Latent Heat of water 5) Measurement of wavelength of LASER by grating 6) Cardinal planes for a lens system 7) Determination of focal length of convex mirror 8) Determination of focal length of concave lens 9) Total internal reflection using LASER 10) LASER beam profile 11) Reading scientific articles (2 experiments equivalent) Minimum of total 12 experiments (demonstration and main) to be completed.

Lab manual will be prepared for reference.

Skill Enhancement Course (It will be practical course)

PROGRAM: F.Y.B.Sc.			SEMESTER: 2		
Course: Mathematical Methods			**Course Code: WSPHYSE121**		
Teaching Scheme			Evaluation Scheme		
Lectures (Hours per week)	Practical (Hours per week)	Tutorials (Hours per week)	Credits	Continuous Internal Assessment CIA Marks	Semester End Examination Marks
-	4	-	2	-	60

Learning Objectives:

1) Develop mathematical skills required for theories in physics
2) Develop numerical skills
3) Appreciate Mathematical modeling of the physical world

Course Outcomes:

After completing the course, learner will be able to

1) convert physical situations into mathematical equations
2) solve mathematical equations using analytical methods when possible
3) solve mathematical equations using numerical methods
4) extract physically meaningful conclusions from numerical / algebraic expressions
5) build mathematical models for physical situations

DETAILED SYLLABUS

Unit	Subunit	Unit Title	Lectures
I		**Partial Differentiation**	**15**
	1.1	Introduction and Notation	
	1.2	Power series in two variables	
	1.3	Total Differentials	
	1.4	Approximations using differentials	
	1.5	Chain Rule or differentiating a function of a function	
	1.6	Implicit differentiation	
	1.7	More chain rule	
	1.8	Application of partial differentiation to maximum and minimum problems	
	1.9	Maximum and minimum problems with constraints: Lagrange Multipliers	

Unit	Subunit	Unit Title	Lectures
	1.10	Endpoint or boundary value problems	
	1.11	Change of variables	
	1.12	Differentiation of integrals: Leibneitz rule	
	1.13	Miscellaneous problems	
2		**Vector Analysis**	**15**
	2.1	Introduction	
	2.2	Applications of Vector multiplication	
	2.3	Triple products	
	2.4	Differentiation of vectors	
	2.5	Fields	
	2.6	Directional derivative: Gradient	
	2.7	Some other expressions involving ∇	
	2.8	Line Integrals	
	2.9	Green's theorems in the plane	
	2.10	The divergence and divergence theorem (applications only, mathematical proof not needed)	
	2.11	The curl and Stokes theorem (applications only, mathematical proof not needed)	
	2.12	Miscellaneous problems	

References:

1. Boas, Mary L., Mathematical Methods in the Physical Sciences, 3rd Edition, Wiley, 2023

Additional Reference:

1. MATHEMATICAL METHODS FOR PHYSICISTS A Comprehensive Guide SEVENTH EDITION — George B. Arfken Miami University Oxford, OH Hans J. Weber University of Virginia Charlottesville, VA Frank E. Harris University of Utah, Salt Lake City, UT
2. Vector Analysis and an introduction to Tensor Analysis—Seymour Lipschutz, Dennis Spellman, Murray R. Spiegel.

Open Elective/Generic Elective

PROGRAM: F.Y.B.Sc.			**SEMESTER:II**		
Course: Understanding the Universe			**Course Code:** WAPHYOE121		
Teaching Scheme			**Evaluation Scheme**		
Lectures (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Internal Assessment (CIA) (Marks- 40)**	**Semester End Examination (Marks- 60)**
2	-	-	2	40	60

Learning Objectives:

1) Communicate scientific concepts and scientific thought processes.
2) Inculcate curiosity towards astronomical concepts.
3) Develop skills in map-reading and graphical understanding of data.
4) Develop critical thinking

Course Outcomes:

After completing the course, the learner will be able to

1) Enlist the different types of celestial bodies
2) Match the properties of solar system objects
3) Compare the time and size scales of celestial events
4) Contrast between modern idea of cosmos and traditional cosmogony.
5) Use star maps to correlate the sky with different seasons.
6) Critically evaluate various media articles on astronomical events

DETAILED SYLLABUS

Unit	**Sub-Unit**	**Course/ Unit Title**	**Lectures**
I		**Neighbourhood in the Universe**	**15**
	1.1	Cosmic mythologies in various cultures	3
	1.2	Introduction to sky, star maps, constellations, calendars and seasons	4
	1.3	Solar system introduction	4

Unit	Sub-Unit	Course/ Unit Title	Lectures
	1.4	Space missions	4
II		**Deep sky and Cosmos**	**15**
	2.1	Birth and death of stars, nebulae, star clusters, galaxies	4
	2.2	Supernova, black hole and extreme objects in space	4
	2.3	Space-time, Space warps and Space fantasies	3
	2.4	Dark matter, dark energy, Big Bang, multiverse and beyond	4

Main References:

Astrophysics for the people in Hurry - Neil deGrasse Tyson
Exploring the Universe - Brian Clegg

Additional References:

Cosmos - Carl Sagan
Facts and Speculations in Cosmology – J. V. Narlikar and Geoffrey Burbidge
Seven Wonders of Cosmos - J. V. Narlikar
Final Frontier - Brian Clegg

Modality of Assessment

Theory Examination Pattern: (for Discipline Specific Core papers)

A. **Internal Assessment- 40%- 40 Marks per paper**

Sr. No.	Evaluation Type	Marks
1	**Assignment/ Case study/ field visit report/ presentation/ project**	**40**
	Total	**40**

B. **External Examination- 60%- 60 Marks per paper (for Discipline Specific Core papers)**

Semester End Theory Examination:

1. Duration - These examinations shall be of **two hours** duration.
2. Theory question paper pattern:
   a) There shall be 3 questions each of 20 marks with different levels of difficulty.
   b) All questions shall be compulsory with at least 50% internal choice within the questions. (For example, 4 out of 6 sub-questions or 3 out of 6 sub-questions to be solved).
   c) All units will be given equal weightage.

Evaluation for Discipline Specific Core Practical Course:

A. **Internal Examination: 40%- 40 Marks**

Particulars	**Marks**
Regular Journal assessment	30
Viva	10
Total	**40**

B. **External Examination: 60%- 60 Marks**

Semester End Practical Examination:

Particulars	**Marks**
Long experiment	40
Short experiment	20
Total	**60**

PRACTICAL BOOK/JOURNAL

The students are required to perform a minimum number of practicals mentioned in the syllabus for certification of journal.
The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

Examination Pattern: (for Skill Enhancement course)

Skill Enhancement Course is a practical course.

There will be one single External Examination of 60 Marks

Nature of Examination

Question	Problem Based on	Marks
1	Unit I	15
2	Unit I	15
3	Unit II	15
4	Unit II	15
TOTAL		**60**

Examination Pattern: (for Open Elective/Generic Elective)

It will be assessment for total of 60 marks

Sr. No.	Evaluation Type	Marks
1	Assignment/ Case study/ field visit report/ presentation/ project	30
2	Assignment/ Case study/ field visit report/ presentation/ project	30
	Total	**60**