UNIVERSITY OF JAMMU

(NAAC ACCREDITED 'A' GRADE' UNIVERSITY)
(Baba Sahib Ambedkar Road, Jammu-180006 (J&K)

Academic Section
Email: academicsectionju14@gmail.com

NOTIFICATION
(24/January/Adp./98)

It is hereby notified for the information of all concerned that the Vice-Chancellor, in anticipation of the approval of the Academic Council, is pleased to authorize the adoption of the Syllabi and Courses of Studies in the subject of **Physics** of Semester **Vth, VIth,VIIth and VIIIth for Four Year Under Graduate Programme (FYUGP)** under the **Choice Based Credit System** as per **NEP-2020 (as given in the annexure)** for the examinations to be held in the years as per the details given below:

Subject	Semester	For the examinations to be held in the year
Physics	Semester-V	December 2024, 2025 and 2026
	Semester-VI	May 2025, 2026 and 2027
	Semester-VII	December 2025, 2026 and 2027
	Semester-VIII	May 2026, 2027 and 2028

The Syllabi of the courses are also available on the University website: www.jammuuniversity.ac.in.

Sd/-
DEAN ACADEMIC AFFAIRS

No. F. Acd/II/24/13141-13185
Dated: 12-1-2024

Copy for information and necessary action to:

1. Dean Faculty of Science
2. HOD/Convener, Board of Studies **Physics**
3. Sr. P.A.to the Controller of Examinations
4. All members of the Board of Studies
5. Confidential Assistant to the Controller of Examinations
6. Director, Computer Centre, University of Jammu
7. Deputy Registrar/Asstt. Registrar (Conf. /Exams. UG)
8. Incharge University Website for necessary action please

Sumita Sharma 10/01/2024
Deputy Registrar (Academic)

10/01/24
Today 10/01/24

UNIVERSITY OF JAMMU
SYLLABII OF PHYSICS FOR FOUR YEAR UNDERGRADUATE PROGRAMME (FYUGP) UNDER CBCS AS PER NEP-2020
W.E.F.ACADEMIC SESSION 2024

List of Major, Minor and Skill Enhancement Courses in Physics for 5th, 6th, 7th and 8th Semesters of FYUGP (Four Year Undergraduate Program) as per NEP-2020

SEMESTER-V

S. No	Course Type	Course No.	Course Title	Credits	Marks				Total Marks
					Theory		Practical / Tutorial		
					Mid Semester	End Semester	Assessment	Exam	
1.	Major	UMJPYT501	Relativity	2	10	40	------	-----	50
2.	Major	UMJPYT502	Mathematical Physics-II	3Th+1P	15	60	10	15	100
3.	Major	UMJPYT503	Quantum Mechanics-I	3Th+1T	15	60	10	15	100
4.	Major	UMJPYT504	Molecular Physics	3Th+1P	15	60	10	15	100
5.	Minor	UMIPYT505	Atomic and Molecular Physics	3Th+1P	15	60	10	15	100
6.	Skill Enhancement	USEPYI506	Summer Internship	2		50	-------	-------	50

SEMESTER-VI

S. No	Course Type	Course No.	Course Title	Credits	Marks				Total Marks
					Theory		Practical / Tutorial		
					Mid Semester	End Semester	Assessment	Exam	
1.	Major	UMJPYT601	Statistical Physics	3Th+1P	15	60	10	15	100
2.	Major	UMJPYT602	Laser Physics and Fibre Optics	3Th+1P	15	60	10	15	100
3.	Major	UMJPYT603	Basics of Condensed Matter Physics	3Th+1P	15	60	10	15	100
4.	Major	UMJPYT604	Fundamentals of Nuclear Physics	3Th+1T	15	60	10	15	100
5.	Minor	UMIPYT605	Laser Physics	3Th+1P	15	60	10	15	100

SEMESTER-VII

S. No	Course Type	Course No.	Course Title	Credits	Marks				Total Marks
					Theory		Practical / Tutorial		
					Mid Semester	End Semester	Assessment	Exam	
1.	Major	UMJPYT701	Classical Mechanics	3Th+1T	15	60	10	15	100
2.	Major	UMJPYT702	Astrophysics	3Th+1T	15	60	10	15	100
3.	Major	UMJPYT703	Electronics-III	3Th+1P	15	60	10	15	100
4.	Major	UMJPYT704	Research Methodology and Research Ethics	3Th+1T	15	60	10	15	100
5.	Minor	UMIPYT705	Electronics	3Th+1P	15	60	10	15	100

SEMESTER-VIII

S. No	Course Type	Course No.	Course Title	Credits	Marks				Total Marks
					Theory		Practical / Tutorial		
					Mid Semester	End Semester	Assessment	Exam	
1.	Major (Honours)	UMJPYT801	Computational Techniques and Programming	3Th+1P	15	60	10	15	100
2.	Major (Honours)	UMJPYT802	Quantum Mechanics-II	3Th+1T	15	60	10	15	100
3.	Major (Honours)	UMJPYT803	Electrodynamics and Plasma Physics	3Th+1T	15	60	10	15	100
4.	Major (Honours)	UMJPYT804	Mathematical Physics-III	3Th+1T	15	60	10	15	100
5.	Minor (Honours)	UMIPYT805	Quantum Mechanics	3Th+1T	15	60	10	15	100
6.	Major (Honours with Research	UMJPYT806	Scientific editing and Programming	3Th+1P	15	60	10	15	100
7.	Minor (Honours with Research)	UMIPYT807	Quantum Mechanics	3Th+1T	15	60	10	15	100
8.	Skill Enhancement (Honours with Research)	USEPYP808	Research Project	12	---	300	---	---	300

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Syllabus of Physics for 5th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2024, 2025, 2026

Semester	V	Type	Major
Course Name	Relativity	Course Code	UMJPYT501
Credits	2(Theory)	LTP	2-0-0
Contact Hrs	30 (Theory)		
Duration of Exam	2½ hours		
For Theory: End Semester Exam: 40 Marks Mid Semester Exam: 10 Marks			

Note: The Mid Term Examination Shall be conducted after completing 50% of Syllabus.

Course learning outcomes:

After completing this course content, student will be able to understand

- General features of relativity
- Setup and significance of Michelson-Morley experiment
- Fundamental concepts and applications of special theory of relativity

Unit-I

Introduction to relativity:

Galilean relativity, Newtonian mechanics, Electrodynamics and inconsistency with Galilean relativity, ether and experiments for its detection, failure to detect ether. Measurement of velocity of light in moving frames. Lorentz, Poincare and developments towards relativity.

Unit-II

Special Theory of relativity:

Michelson-Morley Experiment and its out- come, Postulates of Special Theory of Relativity, Lorentz Transformations, Simultaneity and order of events, Lorentz contraction, Time dilation, Relativistic transformation of velocity, Frequency and wave number, Relativistic addition of velocities, Variation of mass with velocity, Massless Particles, Mass energy Equivalence, Relativistic Doppler effect, Relativistic Kinematics, Transformation of Energy and Momentum.

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Syllabus of Physics for 5th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2024, 2025, 2026

Semester	V	Type	Major
Course Name	Relativity	Course Code	UMJPYT501
Credits	2(Theory)	LTP	2-0-0
Contact Hrs	30 (Theory)		
Duration of Exam	2½ hours		
For Theory: End Semester Exam: 40 Marks Mid Semester Exam: 10 Marks			

Unit-III

Beyond special relativity:

Inertial and gravitational mass, Equivalence principle, Introducing gravitational field as general coordinate transformation, Principle of general covariance, Metric tensor and affine connection, Gravitational potential as metric tensor, Laws of physics in presence of gravitation, gravitational time dilation and red shift, Experimental observation of gravitational red shift.

Note for paper setters for End Semester Examination:

The question paper will be of 40 marks. There shall be 2 sections in the question paper with pattern as follows:

Section-A shall consist Four (4) short answer questions having one question from each unit. The students are required to attempt all questions. Each question shall be of 2½ Marks.
Section-B shall consist of six (6) long answer questions having two questions from each unit. The students are required to attempt one question from each unit. Each question shall be of 10 Marks.

The numerical problems should not exceed more than 20% of the maximum marks.

Note for paper setters for Mid Semester Examination:

The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.

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Syllabus of Physics for 5th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2024, 2025, 2026

Semester	V	Type	Major
Course Name	Relativity	Course Code	UMJPYT501
Credits	2(Theory)	LTP	2-0-0
Contact Hrs	30 (Theory)		
Duration of Exam	2½ hours		
For Theory: End Semester Exam: 40 Marks Mid Semester Exam: 10 Marks			

The question paper will be of 10 marks. There shall be 2 sections in the question paper with pattern as follows :

Section-A shall comprise of 3 questions (of 2½ marks each) and the students are required to attempt any two questions.

Section-B shall comprise of 2 questions (of 5 marks each) and the students are required to attempt any one question.

Text and Reference Books

1. Introduction to Special Theory of Relativity by Resnick
2. Relativity by A. Einstein
3. Classical Electrodynamics by J.D. Jackson
4. Electrodynamics by W. K. H. Panofsky & M. Phillips
5. Classical Mechanics by H. Goldstein

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Syllabus of Physics for 5th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2024, 2025, 2026

Semester	V	Type	Major
Course Name	Mathematical Physics-II	Course Code	UMJPYT502
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Theory (3 Credits)

Note: The Mid Term Examination Shall be conducted after completing 50% of Syllabus.

Course learning outcomes:

The students shall be able to grasp the basic concepts of complex variables, linear algebra, Fourier series, Fourier transforms and differential equations. After the completion of this course the students shall be able to solve the mathematical problems in physics.

Unit-I: Complex function:
Functions of a complex variable, Limit, continuity and differentiability, analytic functions, Cauchy Riemann equations, Cauchy Riemann equations in polar form, Laplace's equation, Harmonic functions, Line integral of a complex function, Multivalued functions and branch cuts, Analyticity and Singularities of complex functions, Power series in a complex variable.

Unit-II: Linear Algebra:
Special type of matrices: Hermitian and anti-Hermitian, Orthogonal and unitary matrices and their properties. Similar matrices, Orthogonal, Unitary and Similarity transformations, Determination of eigen values and eigen vectors of matrices, Cayley-Hamilton theorem, Important theorems on eigen values and eigen vectors. Diagonalization of matrices.

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Syllabus of Physics for 5th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2024, 2025, 2026

Semester	V	Type	Major
Course Name	Mathematical Physics-II	Course Code	UMJPYT502
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Unit-III: Fourier Series:
Fourier series, Dirichlet conditions, determination of Fourier coefficients, F.S. for arbitrary period, discontinuous functions, odd and even functions, half-wave expansions (sine and cosine series), applications of Fourier series (square, rectangular, triangular, saw tooth waves and half wave and full wave rectifiers), Parseval's theorem, Complex form of Fourier series, simple problems on above topics.

Unit-IV: Differential equations:
Singular points of differential equations, regular and irregular singular points; Legendre differential and Legendre functions, Generating Function, Rodrigues' formula , Orthogonal properties, Recurrence formulae, Hermite differential equation and polynomials, Generating Function, Recurrence formulae, Rodrigues' formula, Orthogonality of Hermite polynomials.

Note for paper setters for End Semester Examination:

The question paper will be of 60 marks. There shall be 2 sections in the question paper with pattern as follows:
Section-A shall comprise of 4 short answer type questions (of 3 marks each) with one question from each unit. The students have to attempt all the questions from Section A.
Section-B shall comprise of a total of 8 questions with two questions selected from each unit. Each question shall be of 12 marks. The students have to attempt 4 questions by selecting only one question from each unit.
The numerical problems should not exceed more than 20% of the maximum marks.

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Syllabus of Physics for 5th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2024, 2025, 2026

Semester	V	Type	Major
Course Name	Mathematical Physics-II	Course Code	UMJPYT502
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Note for paper setters for Mid Semester Examination:

The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.

The question paper will be of 15 marks. There shall be 2 sections in the question paper with pattern asfollows :

Section-A shall comprise of 3 questions (of 4 marks each) and the students are required to attempt any two questions.

Section-B shall comprise of 2 questions (of 7 marks each) and the students are required to attempt any one question.

Text and Reference Books :

1. Mathematical Methods for Physicists by G.B. Arfken and H.J. Weber
2. Matrices and Tensors for Physicists by A.W. Joshi
3. Schaum's Outlines Complex variables by Murray. R. Spiegel
4. Schaum's Outline of Theory and problems of Fourier Analysis by Murray. R. Spiegel
5. Mathematical Physics by Satya Prakash

Syllabus for Practicals:

Note: Do any five

Use C/C++/Scilab/Matlab/Mathematica or any other numerical simulations for solving following problems:

1. To solve simultaneous linear equations by using matrix method.
2. To find eigen values and eigen vector of a matrix.
3. To evaluate fourier coefficients and plot fourier series of square wave or rectangular wave
4. To plot the fourier series representation of triangular/ sawtooth wave and show graphically that that fourier series representation converges with original function.
5. To plot the fourier series of half wave or full wave rectifier for different number of terms.
6. To plot first five Legendre polynomials.
7. To plot first five Hermite polynomials.

Pattern of Exam For Practicals:

Continuous Assessment : 10 marks

Final Examination (To be conducted by the course coordinator internally) : 15 marks

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Syllabus of Physics for 5th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2024, 2025, 2026

Semester	V	Type	Major
Course Name	Quantum Mechanics-I	Course Code	UMJPYT503
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory)	1 Hour (Tutorials)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Theory (3 Credits)

Note: The Mid Term Examination Shall be conducted after completing 50% of Syllabus.

Course learning outcomes:
After completing this course content, student will be able to understand

- the wave mechanics
- the role of uncertainty in quantum physics
- apply operators to it to obtain information about a particle's physical properties

Unit-I: Wave Mechanical Concepts:

Limitations of Classical Physics, Wave nature of particles, Davisson and Germer expertiment, the Uncertainty Principle and its applications, Interpretation of wave function, Admissibility conditions on the wave function, Time independent Schrodinger equation, Time dependent Schrodinger equation, principle of superposition, wave packet, Stationary States, Eherenfest's Theorem.

Unit-II: General Formalism of Quantum Mechanics:

Hilbert space, Operators (linear momentum, angular momentum, energy, Hamiltonian) , Eigen values and Eigen vectors of operators, Postulates of Quantum Mechanics, Quantum Dynamics-Schrodinger Picture, Heisenberg Picture and Interaction Picture. Dirac's Notation, Hermitian Adjoint and its properties. orthogonality of states, Expectation value of operator. Hermitian and unitary operators and their properties. Commutators and properties.

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Syllabus of Physics for 5th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2024, 2025, 2026

Semester	V	Type	Major
Course Name	Quantum Mechanics-I	Course Code	UMJPYT503
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory)	1 Hour (Tutorials)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Unit-III: One Dimensional Problems:
Time independent Schrödinger equation formulation and its solution: the infinite square well potential- asymmetric and symmetric well , Potential Step, The Potential Barrier and tunneling effect, the finite square well potential-scattering solutions and bound state solutions, Linear Harmonic Oscillator : Eigen values and eigen functions.

Unit-IV: Theory of Angular Momentum:
Angular Momentum Operator: Orbital Angular Momentum, Spin Angular Momentum, and Total Angular momentum- commutation relations, eigen values and eigen states.
Matrix representation of angular momentum operators, Pauli spin matrices and their properties.
Addition of two Angular Momenta: General formalism.

***Note for paper setters for End Semester Examination*:**

The question paper will be of 60 marks. There shall be 2 sections in the question paper with pattern as follows:
Section-A shall comprise of 4 short answer type questions (of 3 marks each) with one question from each unit. The students have to attempt all the questions from Section A.
Section- B shall comprise of a total of 8 questions with two questions selected from each unit. Each question shall be of 12 marks. The students have to attempt 4 questions by selecting only one question from each unit.
The numerical problems should not exceed more than 20% of the maximum marks.

***Note for paper setters for Mid Semester Examination*:**
The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.
The question paper will be of 15 marks. There shall be 2 sections in the question paper with pattern as follows :
Section-A shall comprise of 3 questions (of 4 marks each) and the students are required to attempt any two questions.
Section-B shall comprise of 2 questions (of 7 marks each) and the students are required to attempt any one question.

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Syllabus of Physics for 5th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2024, 2025, 2026

Semester	V	Type	Major
Course Name	Quantum Mechanics-I	Course Code	UMJPYT503
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory)	1 Hour (Tutorials)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Text and Reference Books

1. Quantum Physics by Robert Eisberg and Robert Resnick (John Wiley and sons).
1. Quantum Mechanics: Theory and Applications by A. K. Ghatak and S. Lokanathan.
2. Quantum Mechanics by L. I. Schiff (McGraw-Hill Book, New York).
3. Quantum Mechanics by Cohen and Tanandji.
4. Quantum Mechanics: Concepts and Applications by NouredineZettili.

Syllabus for Tutorials

1. Consider a one-dimensional simple Harmonic oscillator of frequency ω and mass m. Using the uncertainty principle, show that the energy of its ground state will be $\frac{1}{2}\hbar\omega$. Note that this ground state energy is also called "zero-point" energy.

2. Let K be an operator defined by $K = |\phi\rangle\langle\Psi|$,
   (a) Under what conditions is K Hermitian.
   (b) Calculate K^2. Under what conditions is K a projection.
   (c) Show that K can always be written in the form $K = \lambda P_1 P_2$, where λ is a constant to be calculated and P_1 and P_2 are projectors.

3. Consider the free-particle as a central force problem. Set up the time independent Schrödinger equation

$$-\frac{\hbar^2}{2m}\nabla^2\Psi = E\,\Psi$$

in spherical polar coordinate system, and examine the nature of the solutions. What will happen if we introduce a constant potential V_0 everywhere?

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Syllabus of Physics for 5th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2024, 2025, 2026

Semester	V	Type	Major
Course Name	Quantum Mechanics-I	Course Code	UMJPYT503
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory)	1 Hour (Tutorials)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

4. Consider a three-dimensional isotropic simple harmonic oscillator of mass m and potential $V(r) = \frac{1}{2}m\omega^2(x^2+y^2+z^2) = \frac{1}{2}m\omega^2 r^2$. Note that this system is also spherically symmetric. Set up the Schrödinger equation for the isotropic 3D oscillator in the spherical polar coordinates, and obtain the eigen values.

5. Compute the energy levels for a hydrogen atom by assuming that the electron moves in circular orbits around the nucleus such that the circumference of an orbit is an integral number of de-Broglie wavelengths. Show that this condition also amounts to quantization of the angular momentum of the electron.

6. Find the Clebsch–Gordan coefficients and transformation matrix associated with the coupling of the spins of the electron and the proton of a hydrogen atom in its ground state.

7. Coupling of the spin and orbital angular momentum of a particle with s = 1/2 and l = 1 and calculation of C-G coefficients.

Pattern of Exam For Tutorials:

Continuous Assessment : 10 marks

Final Examination (To be conducted by the course coordinator internally) : 15 marks

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Syllabus of Physics for 5th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2024, 2025, 2026

Semester	V	Type	Major
Course Name	Molecular Physics	Course Code	UMJPYT504
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Theory (3 Credits)

Note: The Mid Term Examination Shall be conducted after completing 50% of Syllabus.

Course learning outcomes:

The course introduces students to the basic physics of molecules and their spectra. After successful completion of the course, students will be able to

- acquire specialised understanding of how light interacts with molecules and materials
- It helps to investigate the structure of the molecule, the bond length of the bond, rotation of bonds, the rigidity of bonds, electronic configuration of atom in the ground state, and excited states.

Unit I: Molecular Binding:

Properties of Chemical bonds, Molecular orbitals (bonding and anti bonding orbital) Quantum mechanical treatment of H_2^+: Molecular orbital Theory, Homonuclear diatomic molecules, Heitler-London valance bond theory for diatomic molecules, Heteronuclear diatomic molecules, Hybridization (sp, sp^2,sp^3),Term symbols for molecular states.

Unit II : Electric and magnetc Properties of molecules

Dielectric and dielectric constant, polarization, dipole moment, dipole moment from dielctric constant measurement, dipole moment and molecular structure.
The magnetic properties of the molecules, dimagnetic, para magnetic, ferromagentic and anti-ferromagnetic materials, magnetic susceptibility and its measurement, diamagnetism and paramagnetism.

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Syllabus of Physics at FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2024, 2025, 2026

Semester	V	Type	Major
Course Name	Molecular Physics	Course Code	UMJPYT504
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Unit III: Molecular Spectra: Rotational, Vibrational

Introduction to molecular spectra, types of molecular spectra, Born-Oppenheimer approximation
Pure rotational spectra: Salient features of rotational spectra, rotational spectra of a diatomic molecule as rigid rotator, diatomic molecule as non-rigid rotator, Bond length from rotational spectra (CO and HCl molecule). Polyatomic molecules: Moment of inertia, Linear, spherical top, symmeteric top molecules. Relative intensity of lines in rotational spectra.
Salient features of vibrational spectra, vibrational spectra of a diatomic molecule as a harmonic oscillator, as anharmonic oscillator.

Unit IV: Rotational-vibrational and Raman spectra

Salient features of vibrational-rotational spectra, spectra of diatomic molecule as rigid rotator and harmonic oscillator, Spectra of diatomic molecule as a non-rigid rotator and anharmonic oscillator, fine structure of rotational-vibrational bands.
Raman effect and salient features of Raman Spectra, classical theory of Raman effect, Quantum theory of Raman spectra, rotational Raman Spectra, Vibrational Raman spectra.

Note for paper setters for End Semester Examination:

The question paper will be of 60 marks. There shall be 2 sections in the question paper with pattern as follows:
Section-A shall comprise of 4 short answer type questions (of 3 marks each) with one question from each unit. The students have to attempt all the questions from Section A.
Section-B shall comprise of a total of 8 questions with two questions selected from each unit. Each question shall be of 12 marks. The students have to attempt 4 questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

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Syllabus of Physics for 5th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2024, 2025, 2026

Semester	V	Type	Major
Course Name	Molecular Physics	Course Code	UMJPYT504
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Note for paper setters for Mid Semester Examination:
The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.
The question paper will be of 15 marks. There shall be 2 sections in the question paper with pattern asfollows :
Section-A shall comprise of 3 questions (of 4 marks each) and the students are required to attempt anytwo questions.
Section-B shall comprise of 2 questions (of 7 marks each) and the students are required to attempt anyone question.
Text and Reference Books :

1. Elements of Spectroscopy by Gupta, Kumar, Sharma (A Pragati Edition).
2. Atomic and Molecular Spectroscopy by Mool Chand Gupta, New Age International publishers.
3. Fundamentals of molecular spectroscopy by C. N. Banwell, and E.M. McCash, (McGraw Hill Education)
4. Physics of Atoms and Molecules by B. H. Bransden and C. J. Jochain (Pearson Education) 2nd Ed., 2003
5. Atomic Spectra and Atomic Structure by G. Herzberg (Dover Publications), 2003.
6. Molecular Spectra and Molecular Structure by G. Herzberg (Van Nostrand), 1950.
7. Atoms, Molecules and Photons by W. Demtroder (Springer), 2006.
8. Basic atomic & Molecular Spectroscopy by J. M. Hollas (Royal Society of Chemistry), 2002.

Syllabus for Practicals:

Note : Perform any five of the following experiments as per the availability of equipments/ apparatus

1. To determine charge to mass ratio (e/m) of an electron.
2. To determine the Ionization Potential of mercury using Thyratron valve.
3. To determine the value of Planck's constant.
4. To determine the value of Rydberg's constant using hydrogen emission spectrum.
5. To determine Lande's g-factor from ESR spectra.

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Syllabus of Physics for 5th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2024, 2025, 2026

Semester	V	Type	Major
Course Name	Molecular Physics	Course Code	UMJPYT504
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

6. To observe spectral band formation in Franck-Hertz Experiment and record the characteristic curve.
7. To study the absorption spectrum of iodine vapours and calculate electronic energy gap and vibrational energies.
8. To observe Zeeman's effect using Fabry-Perot etalon in transverse and longitudinal components and determine their polarization states.

Note: The concerned department may add some more practicals on the availability of some new equipments related to the course.

Pattern of Exam For Practicals:

Continuous Assessment : 10 marks

Final Examination (To be conducted by the course coordinator internally) : 15 marks

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Syllabus of Physics for 5th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2024, 2025, 2026

Semester	V	Type	Minor
Course Name	Atomic & Molecular Physics	Course Code	UMIPYT505
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Theory (3 Credits)

Note: The Mid Term Examination Shall be conducted after completing 50% of Syllabus.

Course learning outcomes:

The course introduces students to the basic physics of molecules and their spectra. After successful completion of the course, students will be able to understand theories explaining the structure of atoms and the origin of the observed atomic and molecular spectra.

Unit I Bohr's theory and Hydrogen atom spectra: Prodcution of spectra, types of spectra, wave number, spectrum of hydrogen atom and spectral series, failure of electromagnetic theory of radiations, Bohr''s theory and spectrum of hydrogen atom, Franck-hertz experiment. The quantum conditions and application of quantization, Sommerfeld elliptical orbits. Space quantization, quantum numbers and their Physical significance

Unit II Fine structure spectra and Alkali atom spectra

Magnetic moment of an atom and Lande's g-factor, Larmor's theorem, Stern-Gerlach experiment, fine structure of hydrogen lines, spectral terms and their notation.

Alkali atoms and their properties, Different series in alikali atoms, Ritz combination principle, term values in alkali spectra and quantum defect, spin-orbit interaction, doublet structure of alkali spectra, transition lines and intensity rules.

Unit III Molecular Binding, Electric and magnetic Properties of molecules

Molecular orbitals (bonding and anti bonding orbital):Molecular orbital Theory, Homonuclear diatomic molecules, Heteronuclear diatomic molecules, Hybridization (sp, sp^2,sp^3),Term symbols for molecular states.

Dielectric and dielectric constant, polarization, dipole moment, dipole moment from dielctric constant measurement, dipole moment and molecular structure, The magnetic properties of the molecules, dimagnetic, para magnetic, ferromagentic and anti-ferromagnetic materials.

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Syllabus of Physics for 5th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2024, 2025, 2026

Semester	V	Type	Minor
Course Name	Atomic & Molecular Physics	Course Code	UMIPYT505
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Unit IV Molecular Spectra

Introduction to molecular spectra, types of molecular spectra, Pure rotational spectra: Salient features of rotational spectra, rotational spectra of a diatomic molecule as rigid rotator, Salient features of vibrational spectra, vibrational spectra of a diatomic molecule as a harmonic oscillator.

Salient features of vibrational-rotational spectra, spectra of diatomic molecule as rigid rotator and harmonic oscillator, Raman effect and salient features of Raman spectra.

Note for paper setters for End Semester Examination:

The question paper will be of 60 marks. There shall be 2 sections in the question paper with pattern as follows:

Section-A shall comprise of 4 short answer type questions (of 3 marks each) with one question from each unit. The students have to attempt all the questions from Section A.

Section-B shall comprise of a total of 8 questions with two questions selected from each unit. Each question shall be of 12 marks. The students have to attempt 4 questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

Note for paper setters for Mid Semester Examination:

The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.

The question paper will be of 15 marks. There shall be 2 sections in the question paper with pattern as follows:

Section-A shall comprise of 3 questions (of 4 marks each) and the students are required to attempt any two questions.

Section-B shall comprise of 2 questions (of 7 marks each) and the students are required to attempt any one question.

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Syllabus of Physics for 5th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2024, 2025, 2026

Semester	V	Type	Minor
Course Name	Atomic & Molecular Physics	Course Code	UMIPYT505
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Text and Reference Books :

1. Elements of Spectroscopy by Gupta, Kumar, Sharma (A Pragati Edition).
2. Atomic and Molecular Spectroscopy by Mool Chand Gupta, New Age International publishers
3. Fundamentals of molecular spectroscopy by C. N. Banwell, and E.M. McCash, (McGraw Hill Education)
4. Physics of Atoms and Molecules by B. H. Bransden and C. J. Jochain (Pearson Education) 2nd Ed., 2003
5. Atomic Spectra and Atomic Structure by G. Herzberg (Dover Publications),2003.
6. Molecular Spectra and Molecular Structure by G. Herzberg (Van Nostrand),1950.
7. Atoms, Molecules and Photons by W. Demtroder (Springer), 2006.

Syllabus for Practicals:

Note : Perform any five of the following experiments as per the availability of equipments/ apparatus

1. To determine charge to mass ratio (e/m) of an electron.
2. To determine the Ionization Potential of mercury using Thyratron valve.
3. To determine the value of Planck's constant.
4. To determine the value of Rydberg's constant using hydrogen emission spectrum.
5. To determine Lande's g-factor from ESR spectra.
6. To observe spectral band formation in Franck-Hertz Experiment and record the characteristic curve.
7. To study the absorption spectrum of iodine vapours and calculate electronic energy gap and vibrational energies.
8. To observe Zeeman's effect using Fabry-Perot etalon in transverse and longitudinal components and determine their polarization states.

Note: *The concerned department may add some more practicals on the availability of some new equipments related to the course.*

Pattern of Exam For Practicals:

Continuous Assessment : 10 marks

Final Examination (To be conducted by the course coordinator internally) : 15 marks

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Syllabus of Physics for 5th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2024, 2025, 2026

Semester	V	Type	Skill Enhancement
Course Name	Summer Internship	Course Code	USEPYI506
Credits	2	LTP	0-0-2
Contact Hrs	15 days		
Max. Marks	50		

All students will undergo internships / Apprenticeships in a firm, industry, or organization or Training in labs with faculty and researchers in their own or other HEIs/research institutions during the summer term. Students will be provided with opportunities for internships with local industry, business organizations, health and allied areas, local governments (such as panchayats, municipalities), Parliament or elected representatives, media organizations, artists, crafts persons, and a wide variety of organizations so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability.

The internship shall be under a college teacher who will be designated as Internship Supervisor. After completion of summer internship, students will have to produce a report related to the work carried out by the student and duly signed by Internship Supervisor and College Principal. The Internship Report will be Evaluated Internally by a Board of Examiners set up by the Principal of the College.

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Syllabus of Physics for 6th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2025, 2026, 2027

Semester	VI	Type	Major
Course Name	Statistical Physics	Course Code	UMJPYT601
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Theory (3 Credits)

Note: The Mid Term Examination Shall be conducted after completing 50% of Syllabus.

Course learning outcomes:

After completing this course content, student will be able to understand

- probabilistic description of nature at the microscopic level
- concepts of entropy and temperature as defined in statistical mechanics
- interactions between particles.

Unit 1: Review of probability theory:

Probability, Law of equal priori probability, Probability of consideration of tossing of coins, throwing of dice, distribution of n molecules in two halves of a box. Phase space, macro and micro states, thermodynamics probability, effects of constraints on a system.

Distribution of n distinguishable particles in k compartments of unequal sizes, Most probable distribution- equilibrium state of dynamic system, deviation from the state of maximum probability- Fluctuations and their dependence on N, Division of phase space into cells. Types of statistics. Basic approach in three statistics.

Unit-II: Classical ensemble theory:

Postulates of statistical mechanics, Liouville's equation. concept of ensemble and types.
Microcanonical ensemble: Partition Function, Thermodynamic Functions of an Ideal Gas, Boltzmann's definition of entropy, Gibbs Paradox, Sackur Tetrode equation.
Canonical ensemble: partition function and thermodynamic functions of perfect gas.
Grand-canonical ensemble: Partition function and thermodynamic functions. Application to perfect gas, Equivalence of the various ensembles

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Syllabus of Physics for 6th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2025, 2026, 2027

Semester	VI	Type	Major
Course Name	Statistical Physics	Course Code	UMJPYT601
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Unit-III Maxwell Boltzmann Statistics:

No. of microstates in the energy range, Stirling formula, Boltzmann's distribution law, evaluation of α and β parameters, Maxwell's distribution of speeds and momentum. Graphical representation of distribution of speeds, Experimental verification of Maxwell-Boltzmann law. Average speed, root mean square speed and most probable speed of gas molecules, Applications of Maxwell Boltzmann statistics. Degrees of freedom and law of equipartition of energy.

Unit-IV: Quantum statistical mechanics:

Indistinguishable particles in quantum mechanics. Bosons and Fermions. Bose-Einstein distribution law, Application of B.E statistics to black body radiation and derivation of Planck's radiation law, Bose Einstein gas and Bose-Einstein condensation.
Fermi Dirac (F.D) statistics and its distribution law, Fermi distribution function and chemical potential. Application of F-D statistics to electron gas in metals, Zero point energy and Fermi energy.

Note for paper setters for End Semester Examination:

The question paper will be of 60 marks. There shall be 2 sections in the question paper with pattern as follows:
Section-A shall comprise of 4 short answer type questions (of 3 marks each) with one question from each unit. The students have to attempt all the questions from Section A.
Section-B shall comprise of a total of 8 questions with two questions selected from each unit. Each question shall be of 12 marks. The students have to attempt 4 questions by selecting only one question from each unit.
The numerical problems should not exceed more than 20% of the maximum marks.

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Syllabus of Physics for 6th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2025, 2026, 2027

Semester	VI	Type	Major
Course Name	Statistical Physics	Course Code	UMJPYT601
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Note for paper setters for Mid Semester Examination:
The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.
The question paper will be of 15 marks. There shall be 2 sections in the question paper with pattern asfollows :
Section-A shall comprise of 3 questions (of 4 marks each) and the students are required to attempt anytwo questions.
Section-B shall comprise of 2 questions (of 7 marks each) and the students are required to attempt anyone question.

Text and Reference Books :

1. Statistical Physics of Particles, Meiran Kardar (Cambridge University Press, 2007).
2. Statistical Mechanics, Kerson Huang (2ndEdition, Wiley-India, 2008).
3. Statistical Mechanics, R.K. Pathria (Butterworth-Heinemann, 1996).
4. Statistical Mechanics:An Advanced course with problems and solutions, Ryogo Kubo (North- Holland, 1965).

Syllabus for Practicals:
Note : Do any five
Use C/C++/Scilab/Matlab/Mathematica or any other numerical simulations for solving following problems:

1. To plot Planck's law for black body radiations at different temperatures.
2. To compute and plot the probability of various macrostates in tossing of n-coins simultaneously versus no. of heads for n= 4, 6, 8, 10, 12, 16.
3. To compute macrostates and microstates for distribution of n-particles using Maxwell-Boltzmann for n= 5, 8, 10 in k-compartments.

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Syllabus of Physics for 6th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2025, 2026, 2027

Semester	VI	Type	Major
Course Name	Statistical Physics	Course Code	UMJPYT601
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

4. To plot Maxwell-Boltzmann distribution curve for energies at different temperatures
5. To plot Bose-Einstein distribution curve for energies at different temperatures
6. To plot Fermi-Dirac distribution curve for energies at different temperatures
7. Computation of Maxwell velocity distribution function for a gas, and plot it
8. To plot Debye's Specific Heat Curve of solid and study compare with Dulong-Petit Law.
9. To compute macrostates and microstates for distribution of n-particles using Bose-Einstein/ Fermi-Dirac for n= 5, 10, 15 in k-compartments.

Pattern of Exam For Practicals:

Continuous Assessment : 10 marks

Final Examination (To be conducted by the course coordinator internally) : 15 marks

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Syllabus of Physics for 6th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2025, 2026, 2027

Semester	VI	Type	Major
Course Name	Laser Physics and Fibre Optics	Course Code	UMJPYT602
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Theory (3 Credits)

Note: The Mid Term Examination Shall be conducted after completing 50% of Syllabus.

Course learning outcomes:

The course aims to present the fundamentals of radiation-matter interaction and the principle of laser including population inversion, resonator cavity and generation of pulsed laser. It includes adequate knowledge to students regarding the principle, design, and working of different laser systems(solid-state, gas, liquid, semiconductor). This course provides the students knowledge behind light propagation in optical fibre waveguide, modes of propagation and mechanisms of pulse dispersion and signal attenuations. The course will provide the students with practical applicability of lasers in the laboratory setting.

On the completion of the course students should be able to understand

- Interaction of radiation with matter in the form of absorption, spontaneous and stimulated emission of radiations.
- Principle of laser action, including population inversion, pumping schemes, and threshold condition for laser beam generation.
- And comprehend the importance of optical resonators and modes of lasers
- Techniques of generation of pulsed lasers: Q-switching and Mode locking
- Design, working and applications of common laser types- He-Ne Laser, Ruby laser, CO_2 Laser, organic dye lasers, semiconductor lasers.
- The basic structure of an optical fibre and the pulse propagation in optical fibres.
- And explain the various types of dispersions and mechanisms of signal attenuation in optical fibre communication system.

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Syllabus of Physics for 6th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2025, 2026, 2027

Semester	VI	Type	Major
Course Name	Laser Physics and Fibre Optics	Course Code	UMJPYT602
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Unit-1: Basics of Lasers

Interaction of Light with matter- Absorption, Spontaneous Emission and Stimulated Emission, Einstein's Coefficients, Light Amplification, Population Inversion, Conditions for Lasing Action. Pumping, Direct and Indirect Pumping Methods, Metastable states, Active Medium, Laser Rate Equations for Two-Level, Three-Level and Four-Level Systems.

Properties of Laser Beams- Directionality, Intensity, Monochromaticity, Spatial and Temporal Coherence.

Unit-II: Optical Resonators

Action of Optical resonator, Types of resonators, Longitudinal and Transverse modes. Modes of Rectangular cavity and Open Planar Resonator. Quality Factor. Critical Population Inversion and Schawlow-Townes condition for laser oscillations.

Generation of Pulsed Laser: Q-switching principle and techniques- Electro-optical Shutter (Pockel's Effect) and Acoustic-optical Shutter. Principle of Mode Locking.

Unit-III: Laser Systems

General Description, construction, working and applications of different laser systems-

Solid State Lasers: Ruby Laser, Nd-YAG Laser.

Gas Lasers: Helium-Neon Laser, Argon- ion Laser, Carbon Dioxide Laser.

Liquid Laser: Tunable Dye Laser.

Semiconductor Laser: Principle of Semi-conductor Laser, Homojunction and Heterojunction laser structure, Applications.

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Syllabus of Physics for 6th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2025, 2026, 2027

Semester	VI	Type	Major
Course Name	Laser Physics and Fibre Optics	Course Code	UMJPYT602
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Unit-IV: Basics of Optical Fiber Waveguides

Basic structure of optical fibre and propagation of signal, Acceptance angle. Numerical Aperture. Optical fibre communication system- its components, applications, advantages and disadvantages

Classification of optical fibres: monomode and multimode, step-index fibre and graded index, and their comparison, Number of modes, cut-off wavelength.

Attenuation in Optical Fibres: Material losses- Intrinsic and Extrinsic, Linear and non-linear scattering losses, leaky modes, bending losses.

Dispersion in Optical Fibre- intermodal dispersion, material (chromatic) dispersion, waveguide dispersion.

Note for paper setters for End Semester Examination:

The question paper will be of 60 marks. There shall be 2 sections in the question paper with pattern as follows:

Section-A shall comprise of 4 short answer type questions (of 3 marks each) with one question from each unit. The students have to attempt all the questions from Section A.

Section- B shall comprise of a total of 8 questions with two questions selected from each unit. Each question shall be of 12 marks. The students have to attempt 4 questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

Note for paper setters for Mid Semester Examination:

The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.

The question paper will be of 15 marks. There shall be 2 sections in the question paper with pattern as follows :

Section-A shall comprise of 3 questions (of 4 marks each) and the students are required to attempt any two questions.

Section-B shall comprise of 2 questions (of 7 marks each) and the students are required to attempt any one question.

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Syllabus of Physics for 6th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2025, 2026, 2027

Semester	VI	Type	Major
Course Name	Laser Physics and Fibre Optics	Course Code	UMJPYT602
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Text and Reference Books :

1. Principles of Lasers by O. Svelto
2. Lasers by A.E. Siegman
3. Laser Fundamentals by W.T. Silfvast
4. Lasers: Fundamentals and Applications by K. Thyagarajan and A. Ghatak
5. Lasers and Non –linear optics by B.B. Laud
6. An Introduction to Lasers: theory and Applications- M.N. Avadhanulu
7. Optical Fibre Communications- Principles and practice by J.M. Senior
8. Introduction to Fibre Optics by A. Ghatak and K. Thyagarajan

Syllabus for Practicals:

Note : Perform any 05 of the following experiments as per availability of the apparatus

List of Experiments

1. Determination of laser beam characteristics-power distribution, spot size, divergence of beam and spatial coherence.
2. Measurement of thread angle, pitch and diameter of screw using laser.
3. To determine the data track spacing of a CD by using laser light.
4. To determine the width of wire or narrow slit using laser.
5. To measure the absorption coefficient of a material by using laser light.
6. Measurement of wavelength of Laser light using diffraction grating.
7. Determination of refractive index of liquid by using laser light.
8. Verification of Malus' Law using laser beam
9. To determine Brewster's angle of a glass plate by using laser light.
10. To measure the Numerical Aperture of an optical fibre.

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Syllabus of Physics for 6th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2025, 2026, 2027

Semester	VI	Type	Major
Course Name	Laser Physics and Fibre Optics	Course Code	UMJPYT602
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

11. To study the near field intensity profile of an optical fibre and study its refractive index profile.
12. To study the transmission of laser beam through an optical fibre and figure out the loss due to bending of the fibre and length of the fibre.

Note: The concerned department may add some more practicals on the availability of some new equipments related to the course.

Pattern of Exam For Practicals:

Continuous Assessment : 10 marks

Final Examination (To be conducted by the course coordinator internally) : 15 marks

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Syllabus of Physics for 6th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2026, 2028

Semester	VI	Type	Major
Course Name	Basics of Condensed Matter Physics	Course Code	UMJPYT603
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Theory (3 Credits)

Note: The Mid Term Examination Shall be conducted after completing 50% of Syllabus.

Course learning outcomes:

After completing this course content, student will be able to understand:

- The correlation between bonding and the properties of solids
- Basic principles of structure of materials, crystallography and crystal defects.
- Space efficient arrangement of constituent particles in a crystal lattice

Unit I: Atomic Bonding:

Interatomic forces, types of bonding, ionic bonding, bond dissociation energy of NaCl molecule, cohesive energy of ionic crystals, evaluation of Madelung constant for NaCl structure, Madelung potential, The Born-Haber cycle, covalent bonding, directional nature of the covalent bond, Metallic bonding, Hydrogen bonding, van der Waals' bonding.

Unit II: Crystallography

Introduction, The crystalline state, polycrystalline solids and amorphous solids, crystal lattice, basis, unit cell, primitive and non-primitive unit cells, Wigner-Seitz unit cell, number of lattice points per unit cell, Symmetry operations.
Bravais lattices and Crystal systems, lattice planes and Miller Indices. Interplanar spacing, Reciprocal lattice: properties and Reciprocal lattice to SC, BCC, FCC lattices.

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Syllabus of Physics for 6th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2026, 2028

Semester	VI	Type	Major
Course Name	Basics of Condensed Matter Physics	Course Code	UMJPYT603
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Unit III: Atomic packing

Packing of equal spheres in 2- and 3- dimensions, close-packing of equal spheres in 3-dimensions, Classification of close packing on the basis of identity period, axial ratio and lattice constants, voids in close packing, size and coordination of voids, significance of voids, examples of some close packed structures (NaCl, ZnS, Diamond).

Unit IV: Defects in crystals

Classification of impurities, Crystallographic imperfection, Point defects : Schottky and Frankel, Line defects, Dislocations : Edge and screw, Burger's vector, Dislocation motion, stress fields of dislocation : dislocation Energy, Shear strength of a single crystal, Plane defects : introductory ideas of Stacking fault and Grain boundaries.

Note for paper setters for End Semester Examination:

The question paper will be of 60 marks. There shall be 2 sections in the question paper with pattern as follows:

Section-A shall comprise of 4 short answer type questions (of 3 marks each) with one question from each unit. The students have to attempt all the questions from Section A.

Section- B shall comprise of a total of 8 questions with two questions selected from each unit. Each question shall be of 12 marks. The students have to attempt 4 questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

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Syllabus of Physics for 6th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VI	Type	Major
Course Name	Basics of Condensed Matter Physics	Course Code	UMJPYT603
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Note for paper setters for Mid Semester Examination:
The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.
The question paper will be of 15 marks. There shall be 2 sections in the question paper with pattern as follows :
Section-A shall comprise of 3 questions (of 4 marks each) and the students are required to attempt anytwo questions.
Section-B shall comprise of 2 questions (of 7 marks each) and the students are required to attempt anyone question.

Text and Reference Books :

1. Crystallography Applied to Solid State Physics by A.R.Verma and O.N.Srivastava
2. Solid State Physics by Kittle
3. Solid State Physics by M.A.Wahab
4. Elementary Solid State Physics by M. Ali Omar
5. Applied Solid State Physics by Rajnikant

Syllabus for Practicals:

Note : Perform any five of the following experiments as per the availability of apparatus

1. To determine the Hall coefficient and the carrier concentration of the sample material.
2. To determine the dielectric constant of given sample.
3. To determine band gap of given semiconducting material by using Four Probe method.
4. To trace B-H curve for ferromagnetic specimen and determine coerecivity, retentivity and magnetic induction field
5. To determine the magnetic susceptibility of paramagnetic sample by using Quinck's Tube method.
6. To measure the transition temperature of high temperature superconductor.
7. To study the variation of resistance of thermistor with temperature.

Note: The concerned department may add some more practicals on the availability of some new equipments related to the course.

Pattern of Exam For Practicals:

Continuous Assessment : 10 marks

Final Examination (To be conducted by the course coordinator internally) : 15 marks

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Syllabus of Physics for 6th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2025, 2026, 2027

Semester	VI	Type	Major
Course Name	Fundamentals of Nuclear Physics	Course Code	UMJPYT604
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory)	1 Hour (Tutorials)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Theory (3 Credits)

Note: The Mid Term Examination Shall be conducted after completing 50% of Syllabus.

Course learning outcomes:

After completing this course content, student will be able to understand

- Basic properties of nucleus.
- Various nuclear models which described the nucleus.
- Radioactivity and elementary idea of particle physics.

Unit 1: Introduction to Nuclear Physics

General Properties of nuclei: Atomic number(Z), mass number(A), Size of the nucleus and radius, nuclear mass - amu, density of nuclear matter -a simple estimate, binding energy curve, angular momentum, parity and statistics, magnetic dipole moments - Schmidt limits, electric quadrupole moment, magnetic dipole moment of nuclei

Unit-II: Nuclear Models

Liquid drop model, Bethe-Weizsacker's semi-empirical mass formula, Mass parabolas - Prediction of stability against beta decay for members of an isobaric family, Stability limits against spontaneous fission. Nuclear shell model: - single particle shell model, Magic numbers in the nucleus, collective model, vibrational and rotational spectra.

Unit-III : Radioactivity:

Radioactive disintegration and displacement law,growth and decay of radioactivity, Half-life and mean life of radioactive substances. Alpha particles, alpha disintegration energy,range of alpha particles and Gieger-Nuttall law, beta particles, energetics of β-decay, Fermi theory of allowed β-decay, selection rules in β-decay. Nature of gamma rays, photoelectric absorption of γ-rays, Compton scattering of γ-rays, Electron–positron pair production and annihilation.

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Syllabus of Physics for 6th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2025, 2026, 2027

Semester	VI	Type	Major
Course Name	Fundamentals of Nuclear Physics	Course Code	UMJPYT604
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory)	1 Hour (Tutorials)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Unit-IV : Particle Physics

Elementary particles: Introduction, Classification of elementary particles, Particle interactions, Conservation laws (linear &angular momentum, energy, charge, baryon number & lepton number), particles and antiparticles (Electrons and positrons, Protons and anti-protons, Neutrons and antineutrons, Neutrinos and anti-neutrinos), Photons, Mesons, Quark model (Qualitative).

Note for paper setters for End Semester Examination:

The question paper will be of 60 marks. There shall be 2 sections in the question paper with pattern as follows:

Section-A shall comprise of 4 short answer type questions (of 3 marks each) with one question from each unit. The students have to attempt all the questions from Section A.

Section- B shall comprise of a total of 8 questions with two questions selected from each unit. Each question shall be of 12 marks. The students have to attempt 4 questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

Note for paper setters for Mid Semester Examination:

The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.

The question paper will be of 15 marks. There shall be 2 sections in the question paper with pattern as follows :

Section-A shall comprise of 3 questions (of 4 marks each) and the students are required to attempt any two questions.

Section-B shall comprise of 2 questions (of 7 marks each) and the students are required to attempt any one question.

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Syllabus of Physics for 6th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2025, 2026, 2027

Semester	VI	Type	Major
Course Name	Fundamentals of Nuclear Physics	Course Code	UMJPYT604
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory)	1 Hour (Tutorials)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Text and Reference Books :

1. Nuclear Physics, S. N. Ghoshal (S. Chand & Co.)
2. Introduction to Elementary Particles: David Griffith, Second Revised Edition, Wiley-VCH.
3. Nuclear Physics, S.B. Patel (Wiley Eastern Ltd.)
4. Concepts of Modern Physics: Arthur Beiser, Shobhit Mahajan, S Rai Choudhury (6th Ed.) (TMH).

Syllabus for Tutorials:

1. Study the Applications of Nuclear Physics in
   (a) Fission reactors
   (b) Fusion reactors
   (c) Muon catalyzed fusion
   (d) Medical Physics
   (e) Radiation dosimetry
2. Compute the values of the magnetic dipole moments expected from the shell model, and compare with the experimental values:

Nuclide	I^{π}	μ(exp.) (μ_N)
^{75}Ge	$\frac{1}{2}^-$	+0.510
^{87}Sr	$\frac{9}{2}^+$	-1.093
^{91}Zr	$\frac{5}{2}^+$	-1.304
^{47}Sc	$\frac{3}{2}^-$	+5.34
^{147}Eu	$\frac{11}{2}^-$	+6.06

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Syllabus of Physics for 6th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2025, 2026, 2027

Semester	VI	Type	Major
Course Name	Fundamentals of Nuclear Physics	Course Code	UMJPYT604
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory)	1 Hour (Tutorials)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

3. Detailed study about the discrepancies found in shell model and the possible causes for them.

4. In the decay of ^{242}Cm to ^{238Pu}, the maximum α energy is 6112.9 $\pm$ 0.1 keV. Given the mass of ^{238}Pu, find the mass of ^{242}Cm.

5. What is the kinetic energy given to the proton in the decay of the neutron when (a) the electron has negligibly small kinetic energy; (b) the neutrino has negligibly small energy?

6. A nucleus has the following sequence of states beginning with the ground state: $\frac{3^+}{2}$, $\frac{7^+}{2}$, $\frac{5^+}{2}$, $\frac{1^-}{2}$ and $\frac{3^-}{2}$. Draw a level scheme showing the intense γ transitions likely to be emitted and indicate their multipole assignment.

Pattern of Exam For Tutorials:

Continuous Assessment : 10 marks

Final Examination (To be conducted by the course coordinator internally) : 15 marks

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Syllabus of Physics for 6th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2025, 2026, 2027

Semester	VI	Type	Minor
Course Name	Laser Physics	Course Code	UMIPYT605
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Theory (3 Credits)

Note: The Mid Term Examination Shall be conducted after completing 50% of Syllabus.

Course learning outcomes:

The course aims to present the fundamentals of radiation-matter interaction and the principle of laser including resonator cavity and generation of pulsed laser. It includes adequate knowledge to students regarding the principle, design, and working of different laser systems (solid-state, gas, liquid, semiconductor). This course provides a brief overview of applications of lasers in fields of science, holography, industry, medical science, military, ranging, etc. The course will provide the students with practical applicable information in the laboratory setting.

On the completion of the course students should be able to understand

- Interaction of radiation with matter in the form of absorption, spontaneous and stimulated emission of radiations.
- Principle of laser action, including population inversion, pumping schemes, and threshold condition for laser beam generation.
- And comprehend the importance of optical resonators and modes of lasers
- Techniques of generation of pulsed lasers: Q-switching and Mode locking
- Design, working and applications of common laser types- He-Ne Laser, Ruby laser, CO_2 Laser, organic dye lasers, semiconductor lasers.
- the applications of lasers in the fields of science, and real world applications including holography, fibre communication, industrial applications for material processing, medical applications, etc

Unit-1: Basics of Lasers

Interaction of Light with matter- Absorption, Spontaneous Emission and Stimulated Emission, Einstein's Coefficients, Light Amplification, Population Inversion, Conditions for Lasing Action. Pumping, Direct and Indirect Pumping Methods, Metastable states, Active Medium, Laser Rate Equations for Two-Level, Three-Level and Four-Level Systems.

Properties of Laser Beams- Directionality, Intensity, Monochromaticity, Spatial and Temporal Coherence.

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Syllabus of Physics for 6th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2025, 2026, 2027

Semester	VI	Type	Minor
Course Name	Laser Physics	Course Code	UMIPYT605
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Unit-II: Optical Resonators

Action of Optical resonator, Types of resonators, Longitudinal and Transverse modes. Modes of Rectangular cavity and Open Planar Resonator. Quality Factor. Critical Population Inversion and Schawlow-Townes condition for laser oscillations.
Generation of Pulsed Laser: Q-switching principle and techniques- Electro-optical Shutter (Pockel's Effect) and Acoustic-optical Shutter. Principle of Mode Locking.

Unit-III: Laser Systems

General Description, construction, working and applications of different laser systems-
Solid State Lasers: Ruby Laser, Nd-YAG Laser.
Gas Lasers: Helium-Neon Laser, Argon- ion Laser, Carbon Dioxide Laser.
Liquid Laser: Tunable Dye Laser.
Semiconductor Laser: Principle of Semi-conductor Laser, Homojunction and Heterojunction laser structure, Applications.

Unit-IV: Applications of Lasers

Laser induced nuclear fusion, Cooling and trapping of neutral atoms.
Holography: Basic Principle, Recording of Hologram and Reconstruction of image.
Laser Application in Optical communication system, Tracking of moving objects, precise measurements of length, speed and acceleration.
Industrial applications in material processing. Medical Applications, Military Applications.

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Syllabus of Physics for 6th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2025, 2026, 2027

Semester	VI	Type	Minor
Course Name	Laser Physics	Course Code	UMIPYT605
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Note for paper setters for End Semester Examination:

The question paper will be of 60 marks. There shall be 2 sections in the question paper with pattern as follows:

Section-A shall comprise of 4 short answer type questions (of 3 marks each) with one question from each unit. The students have to attempt all the questions from Section A.

Section- B shall comprise of a total of 8 questions with two questions selected from each unit. Each question shall be of 12 marks. The students have to attempt 4 questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

Note for paper setters for Mid Semester Examination:

The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.

The question paper will be of 15 marks. There shall be 2 sections in the question paper with pattern as follows :

Section-A shall comprise of 3 questions (of 4 marks each) and the students are required to attempt any two questions.

Section-B shall comprise of 2 questions (of 7 marks each) and the students are required to attempt any one question.

Text and Reference Books :

1. Principles of Lasers by O. Svelto
2. Lasers by A.E. Siegman
3. Laser Fundamentals by W.T. Silfvast
4. Lasers: Fundamentals and Applications by K. Thyagarajan and A. Ghatak
5. Lasers and Non –linear optics by B.B. Laud
6. An Introduction to Lasers: theory and Applications- M.N. Avadhanulu

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Syllabus of Physics for 6th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2025, 2026, 2027

Semester	VI	Type	Minor
Course Name	Laser Physics	Course Code	UMIPYT605
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Practicals:

Note : Perform any 05 of the following experiments as per availability of the apparatus

List of Experiments

1. Determination of laser beam characteristics-power distribution, spot size, divergence of beam and spatial coherence.
2. To study and characterize the intensity profile of a laser beam
3. Measurement of thread angle, pitch and diameter of screw using laser.
4. To determine the data track spacing of a CD by using laser light.
5. To determine the width of wire or narrow slit using laser.
6. To measure the absorption coefficient of a material by using laser light.
7. Measurement of wavelength and angular spread of Laser light using diffraction grating.
8. To determine the grating pitch of diffraction grating using laser light of known wavelength.
9. Determination of refractive index of liquid by using laser light.
10. Verification of Malus's Law using laser beam
11. To determine Brewster's angle of a glass plate by using laser light.
12. To measure the Numerical Aperture of an optical fiber.

Note: The concerned department may add some more practicals on the availability of some new equipments related to the course.

Pattern of Exam For Practicals:

Continuous Assessment : 10 marks

Final Examination (To be conducted by the course coordinator internally) : 15 marks

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Syllabus of Physics for 7th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2025, 2026, 2027

Semester	VII	Type	Major
Course Name	Classical Mechanics	Course Code	UMJPYT701
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory)	1 Hour (Tutorials)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Theory (3 Credits)

Note: The Mid Term Examination Shall be conducted after completing 50% of Syllabus.

Course learning outcomes:
After completing this course content, student will be able to understand

- the Newtonian mechanics
- different formalisms of classical physics
- four dimensional formulation and continuum mechanics

Unit-I : Newtonian mechanics:

Single and many particle systems-Conservation laws of linear momentum, angular momentum and energy. Application of Newtonian mechanics: Two-body central force field motion. Kepler's laws of planetary motion. Scattering in a central force field, scattering cross section, The Rutherford scattering problem.

Unit-II: Lagrangian formalism:

Constrains in motion, generalised co-ordinates, virtual work and D'Alembert's principle. Lagrangian equation of motion. Symmetry and cyclic co-ordinates. Hamilton variational principle; Lagrangian equation of motion from variationalpriniciple. Simple applications.

Unit-III: Hamiltonian formalism:

Hamilton's equations of motion- from Legendre transformations and the variational Principle. Simple applications. Canonical transformations. Poisson brackets-Canonical equations of motion in Poisson bracket notation. Hamilton-Jocobi equations.

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Syllabus of Physics for 7th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2025, 2026, 2027

Semester	VII	Type	Major
Course Name	Classical Mechanics	Course Code	UMJPYT701
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory)	1 Hour (Tutorials)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Unit-IV: Relativistic mechanics

Relativistic mechanics: Four-dimensional formulation- four-vectors, four-velocity and four-acceleration. Lorentz co-variant form of equation of motion. Continuum mechanics Basic concepts, equations of continuity and motion; Simple applications.

Note for paper setters for End Semester Examination:

The question paper will be of 60 marks. There shall be 2 sections in the question paper with pattern as follows:
Section-A shall comprise of 4 short answer type questions (of 3 marks each) with one question from each unit. The students have to attempt all the questions from Section A.
Section- B shall comprise of a total of 8 questions with two questions selected from each unit. Each question shall be of 12 marks. The students have to attempt 4 questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

Note for paper setters for Mid Semester Examination:

The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.
The question paper will be of 15 marks. There shall be 2 sections in the question paper with pattern as follows :
Section-A shall comprise of 3 questions (of 4 marks each) and the students are required to attempt any two questions.
Section-B shall comprise of 2 questions (of 7 marks each) and the students are required to attempt any one question.

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Syllabus of Physics for 7th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2025, 2026, 2027

Semester	VII	Type	Major
Course Name	Classical Mechanics	Course Code	UMJPYT701
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory)	1 Hour (Tutorials)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Text and Reference Books :

1. Classical Mechanics: H Goldstein, (Addision-Wesley, 1950)
2. Introduction to Classical Mechanics: R G Takwale and P S Puranik (TMH, 1979)
3. Classical Mechanics: N C Rana and P S Joag (Tata McGraw, 1991)
4. Mechanics: Landau L D and Lifshitz E M (Addition-Wesley, 1960)

Syllabus for Tutorials:

1. Consider the motion of a particle of mass m moving in a plane. Use plane polar co-ordinates as generalized co-ordinates and deduce the expression for the component of generalized force. Find the radial and tangential components of force.
2. Discuss the superiority of Lagrangian Mechanics over Newtonian approach. Consider few examples and solve it using both these approaches.
3. Two mass points of mass m_1 and m_2 are connected by a string passing through ahole in a smooth table so that m_1 rests on the table surface and m_2 hangs suspended.Assuming $m_2$moves only in a vertical line, what are the generalized coordinates for the system? Write the Lagrange equations for the system and, discuss the physical significance any of them might have. Reduce the problem to a single second-order differential equation and obtain a first integral of the equation. What is its physical significance?
4. Consider two-dimensional harmonic oscillator. Set up the action variables and obtain its fundamental frequencies.
5. Obtain the solution of problem of projectile of mass m in the earth's gravitational field along y-axis by Hamilton-Jacobi method.
6. Consider a mass m on the end of a massless rigid rod of length l, the other end of which is free to rotate about a fixed point. This is a spherical pendulum.Find the Lagrangian and the equations of motion.

Pattern of Exam For Tutorials:

Continuous Assessment : 10 marks

Final Examination (To be conducted by the course coordinator internally) : 15 marks

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Syllabus of Physics for 7th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2025, 2026, 2027

Semester	VII	Type	Major
Course Name	Astrophysics	Course Code	UMJPYT702
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Theory (3 Credits)

Note: The Mid Term Examination Shall be conducted after completing 50% of Syllabus.

Course learning outcomes:

After completing this course content, student will be able to understand

- Physical universe and its evolution.
- Define and use fundamental principles and techniques of astronomy and astrophysics.
- Attain the knowledge of evolution, classification, formation of, stars, planets and galaxies.

Unit-I : Introduction to Astrophysics:

Sky coordinates and motions: Earth Rotation, Sky coordinates, seasons, phases of the Moon - the Moon's orbit and eclipses, timekeeping (sidereal Vs synodic period); Planetary motions - Kepler's Laws, Gravity;Planets: Formation of Solar System, planet types, planet atmospheres - extrasolar planets; Stars: Measuring stellar characteristics (temperature, distance, luminosity, mass, size) - HR diagram - stellar structure (equilibrium, nuclear reactions, energy transport) - stellar evolution.

Unit-II : Astronomical Techniques:

Telescopes and Detectors – optical, infrared, radio, x-rays, gamma-rays, neutrinos and cosmic rays; Gravitational radiation; Imaging – focal plane imagers, PSF and deconvolution, interferometry Photometry, Spectroscopy; Solar telescopes; Surveys, Astronomical databases, Virtual Observatory.

Unit-III : Planetary Sciences:

Overview of Solar system: Structure and Composition; Meteorites, Asteroids, Comets, Minor planets, Trans-Neptunian Objects, Centaurs - Planetary rings - Planet formation: Evolution of protoplanetary disks, Growth of solid bodies, Formation of Terrestrial and Giant planets - Planetary Migration: - Extrasolar Planets: Detection techniques - Estimating planetary masses, sizes, orbital parameters --Habitable zones: factors influencing habitable zone.

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Syllabus of Physics for 7th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2024, 2025, 2026

Semester	VII	Type	Major
Course Name	Astrophysics	Course Code	UMJPYT702
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Unit-IV : Galaxies:

Classification of galaxies: contents and dimensions; collisionless stellar dynamics: relaxation time, dynamical friction, violent relaxation: galactic potential and orbits, rotation curves, Star formation history and chemical evolution, active galaxies and activity duty cycle, galaxies at high redshift - clusters and groups, evidence of dark matter.

Note for paper setters for End Semester Examination:

The question paper will be of 60 marks. There shall be 2 sections in the question paper with pattern as follows:

Section-A shall comprise of 4 short answer type questions (of 3 marks each) with one question from each unit. The students have to attempt all the questions from Section A.

Section-B shall comprise of a total of 8 questions with two questions selected from each unit. Each question shall be of 12 marks. The students have to attempt 4 questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

Note for paper setters for Mid Semester Examination:

The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.

The question paper will be of 15 marks. There shall be 2 sections in the question paper with pattern as follows :

Section-A shall comprise of 3 questions (of 4 marks each) and the students are required to attempt any two questions.

Section-B shall comprise of 2 questions (of 7 marks each) and the students are required to attempt any one question.

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Syllabus of Physics for 7th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2024, 2025, 2026

Semester	VII	Type	Major
Course Name	Astrophysics	Course Code	UMJPYT702
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Text and Reference Books :

1. BW Carroll & DA Ostlie, An Introduction to Modern Astrophysics, Latest Edition, Addison-Wesley.
2. C.R. Kitchin, Astrophysical Techniques, CRC press
3. The Solar System: Therese Encrenaz and Jean-Pierre Bibring (Latest Edition) - Astronomy and Astrophysics Library, Springer.
4. The Origin and Evolution of the Solar System: Michael M. Woolfson - IoP CRC Press
5. L.S. Sparke and J.S. Gallagher, Galaxies in the Universe, Cambridge University Press.
6. J. Binney and S. Tremaine, Galactic Dynamics, Princeton University Press.

Syllabus for Tutorials:

Tutorials on Fitting techniques (linear and non-linear, fits to data with experimental errors, evaluating goodness of fit, etc) and error analysis, Handling of data and getting familiar with data analysis packages like IRAF, AIPS, Classification of stars based on their spectra and the use of spectral classification in deriving distances to stars, etc), imaging star clusters with various filters and plotting on H-R diagram.

Pattern of Exam For Tutorials:

Continuous Assessment : 10 marks

Final Examination (To be conducted by the course coordinator internally) : 15 marks

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Syllabus of Physics for 7th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2025, 2026, 2027

Semester	VII	Type	Major
Course Name	Electronics-III	Course Code	UMJPYT703
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Theory (3 Credits)

Note: The Mid Term Examination Shall be conducted after completing 50% of Syllabus.

Course learning outcomes:

After completing this course content, student will be able to understand:

- Some of the advanced transistors, their working and characteristics
- Comprehend the design and operations of SCRs and UJTs
- Comprehend the use of feedback
- Operational Amplifier, their advantages, characteristics, different modes of operations and a few main applications.
- Working of CRO and its applications, Basic rectifiers and Filter, IC-555 and its basic application
- Logic families and the working of various logic circuits and their simplification
- Combinational and sequential digital circuits, Converters

Unit- I : Transistors

UJT and SCR: Construction, working, equivalent circuit and I-V characteristics
JFET: types, p-channel and n-channel, working and I-V characteristics, parameters and their relationships, comparison of BJT and JFET
MOSFET: E-MOSFET, D-MOSFET—n channel and p-channel, Construction, working, symbols, biasing, drain and transfer characteristics. CMOS logic: CMOS-inverter, circuit and working, CMOS characteristics.

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Syllabus of Physics for 7th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2025, 2026, 2027

Semester	VII	Type	Major
Course Name	Electronics-III	Course Code	UMJPYT703
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Unit-II :Op-amp and its applications

Op-Amp: Differential amplifier, block diagram of op-amp, characteristics of an ideal and Practical Op-Amp, open and closed loop configuration, Frequency response, CMRR, Slew Rate and concept of virtual ground.

Applications of op-amps: Concept of feedback: positive and negative, advantages of negative feedback (qualitative study), Inverting and non-inverting amplifiers, summing and difference amplifier, differentiator , Integrator, Clipper, comparator and zero-crossing detector.

Unit-III Instrumentation

CRO: Introduction, block diagram, Applications of CRO- Study of waveform, measurement of voltage, current, frequency and phase diagram

Power Supplies: Half-wave rectifiers, centre-tapped and bridge full-wave rectifies, calculation of ripple factors, rectification efficiency,

Filters: basic idea about capacitor filter, First and second order active Low pass, High pass and Band pass filters

IC 555-times: Introduction , block diagram, astable and monostable multivibrator circuits

Unit-IV Logic families and Digital Circuits

Logic families: Pulse characteristics, Logic families-classification of digital ICs, characteristics of logic families, circuit description of TTL NAND gate with totem pole and open collector,

Simplification of Logic Circuit using Boolean algebra, Conversion of a truth table into an equivalent Logic Circuit, Minimization techniques using K-maps (upto 4 variables): Minterms, maxterms, SOP, POS

Combinational and sequental Logic circuits: Half-Adder, Full Adders, half subtractor and full subtractor, Multiplexer and Demultiplexer

SR, JK and D-Flip Flop, synchronous mod-8 counter

Converters: DAC with binary weighted resistor and R-2R resistor ladder network, ADC: Successive approximation method.

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Syllabus of Physics for 7th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2025, 2026, 2027

Semester	VII	Type	Major
Course Name	Electronics-III	Course Code	UMJPYT703
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Note for paper setters for End Semester Examination:

The question paper will be of 60 marks. There shall be 2 sections in the question paper with pattern as follows:

Section-A shall comprise of 4 short answer type questions (of 3 marks each) with one question from each unit. The students have to attempt all the questions from Section A.

Section- B shall comprise of a total of 8 questions with two questions selected from each unit. Each question shall be of 12 marks. The students have to attempt 4 questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

Note for paper setters for Mid Semester Examination:

The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.

The question paper will be of 15 marks. There shall be 2 sections in the question paper with pattern as follows :

Section-A shall comprise of 3 questions (of 4 marks each) and the students are required to attempt any two questions.

Section-B shall comprise of 2 questions (of 7 marks each) and the students are required to attempt any one question.

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Syllabus of Physics for 7th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2025, 2026, 2027

Semester	VII	Type	Major
Course Name	Electronics-III	Course Code	UMJPYT703
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Text and Reference Books

1 "Semiconductor devices: Physics and technology," by S.M Sze, 2nd edition , Wiley India edition (2002)

2 "Basic Electronics" by Albert Malvino David Bates and A.B Patil

3 "Electronic Fundamentals and Applications", J.D. Ryder, Prentice-Hall of India Pvt. Ltd, 1975, 5e

4 "Electronic Devices and Circuit Theory" by R.L. Boylesad, L. Nashelsky, Prentice-Hall of India Pvt. Ltd.

5 "Modern Digital Electronics" by R.P. Jain, McGraw Hill

6 "Digital Principles and Applications", by D. Leach and A. Malvino, McGraw Hill 2010.

Syllabus for Practicals

Perform any 05 of the following experiments as per availability of the apparatus

List of experiments

1. Energy band gap of semiconductor by four probe method
2. Characteristics of FET, MOSFET, SCR,
3. UJT: Characteristics and relaxation oscillator
4. Study and verification of the truth tables of LOGIC Gates using IC's
5. Study of clocked SR and JK Flip flop
6. Design of inverting and non-inverting amplifier using op-amp and determination of gain.
7. Design and study of inverting adder and subtractor.
8. A-stable MV using IC-555 timer
9. Mono stable multivibrator using IC-555 timer.
10. Design and study of first order high-pass and Low-pass filters
11. Half Adder and Full adder using (I) Logic gates and using (ii) NAND gates.

Note: The concerned department may add some more practicals on the availability of some new equipments related to the course.

Pattern of Exam For Practicals:

Continuous Assessment : 10 marks

Final Examination (To be conducted by the course coordinator internally) : 15 marks

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Syllabus of Physics for 7th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2025, 2026, 2027

Semester	VII	Type	Major
Course Name	Research Methodology & Research Ethics	Course Code	UMJPYT704
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory)	1 Hour (Tutorials)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Theory (3 Credits)

Note: The Mid Term Examination Shall be conducted after completing 50% of Syllabus.

Course learning outcomes:
After completing this course content, student will be able to:

- define research and know about the feature of a good research,
- know about the objectives, need and scope of research,
- explain different types of research,
- know about the various approaches to research, and
- clarify various stages involved in research process
- identifying and define the research problem,
- explain the sources and criteria of a good research problem,
- understand the concepts of research design, and
- understand the different types of research design used for conducting different types of researches
- define primary and secondary data,
- know about the various methods of primary data collection,
- explore the different sources of secondary data, and
- apply the appropriate method for data collection.

Unit- I: Research Methodology -I

Foundations of Research: Definition and characteristics of Research, Meaning, Objectives and Nature of Research, Importance of research, Relevance of research and Restrictions in Research, Research process, Difference between Research Method and Research Process.
Scientific Method: Steps in Scientific Method, Distinction between scientific method and Non-scientific method.

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Syllabus of Physics for 7th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2025, 2026, 2027

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Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory)	1 Hour (Tutorials)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Research Problem: Importance of formulating a Research Problem, Sources of research Problems, Consideration in selecting Research Problem, Steps in formulation of research problem

Research design: Meaning and Definition of Research Design, and Importance of Research design, Types of research Designs, Characteristics of scientific method, Concept and Importance in Research – Features of a good research design

Unit-II : Research Methodology -II

Literature review, Importance of review and main components of Literature review

Hypothesis: Meaning, Nature & Characteristics, significance of Hypothesis, Types of Hypothesis, Sources of Hypothesis, caracteristics of Good Hypothesis,

Sampling: Aims of sampling, characteristics of good sample, Basis of sampling, advantages of sampling, limitations of sampling, Sampling technique or methods, probability sampling methods

sample design and choice of sampling, Sampling Frame, Sampling Error, Sample Size,

Unit-III : Research Methodology -III

Distiction between Primary data and secondary data, Data collection procedure for primary data methods of data collection

Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of Interpretation of Data

Report Writing: Discussions, Conclusion, referencing and various formats for reference writing, Bibliography, Thesis Writing, Thesis writing, Formats of publications in research journals including subject classification, Impact factor, Citation index

Paper Writing – Layout of a Research Paper, Impact factor of Journals, When and where to publish ?

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Semester	VII	Type	Major
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Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory)	1 Hour (Tutorials)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Unit-IV Philosophy, Ethics ad scientific conduct

Introduction to Philosophy: definition, nature and scope, concept, branches
Ethics: definition, moral philosophy, nature of moral judgements and reactions, Ethical issues related to publishing, Plagiarism and Self-Plagiarism.
Ethics with respect to science and research. Intellectual and research integrity, Scientific misconducts: Falsification, Fabrication and Plagiarism, Redundant Publications: duplicate and overlapping publications, Selective reporting and misrepresentation of data..

Note for paper setters for End Semester Examination:

The question paper will be of 60 marks. There shall be 2 sections in the question paper with pattern as follows:
Section A shall comprise of 4 short answer type questions (of 3 marks each) with one question from each unit. The students have to attempt all the questions from Section A.
Section B shall comprise of a total of 8 questions with two questions selected from each unit. Each question shall be of 12 marks. The students have to attempt 4 questions by selecting only one question from each unit.
The numerical problems should not exceed more than 20% of the maximum marks.

Note for paper setters for Mid Semester Examination:

The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.
The question paper will be of 15 marks. There shall be 2 sections in the question paper with pattern as follows :
Section-A shall comprise of 3 questions (of 4 marks each) and the students are required to attempt any two questions.
Section-B shall comprise of 2 questions (of 7 marks each) and the students are required to attempt any one question.

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Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory)	1 Hour (Tutorials)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Text and Reference Books :

1) Research Methodology, C.R. Kothari, Newage Publication
2) Management Research Methodology, Krishnaswamy, Sirakumar, Pearson
3) Research Methodology, Zeikmund, Cengage
4) Research Methodology, Paneer Selvam, PHI
5) Research Methodology, Prasanta Sarangi, Taxmann A Text Book of Research Methodology,
6) Donald Cooper & Pamela Schindler, TMGH, 9th edition. Business Research Methods – Alan
7) Bryman & Emma Bell, Oxford University Press. Research Methodology – C.R.Kothar
8) Panneerselvam, R. X. and Stephens, J. Theory and Problems of Statistics, Tata Mc-Graw Hill Publishing Company, New Delhi.
9) Bhandarkar, P.L. and Wilkinson, T.S. Methodology and Techniques of Social Research.
10) Dubin, Robert, Theory Building New York; MacMillan Publishing Co., Quoted in W Emory,
11) Business Research Methods., Gupta, S.P. Statistical Method, Sultan Chand and Sons, New Delhi.
12) Kothari, C.R. Research Methodology-Methods and Techniques, Whishwa Prakashan, New Delhi

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Semester	VII	Type	Major
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Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory)	1 Hour (Tutorials)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Tutorials:

- Open access publications and initiatives
- online resource to check publisher copyright and self archiving policies,
- Software tools to identify predatory publications
- Journal finder
- Journals in the field of Physics,
- When and where to publish ? Ethical issues related to publishing,
- Use of plagiarism software like Turnitin, Urkund and other open source software tools
- Data bases:
  - Indexing databases
  - Citation databases: Web of Science, Scopus, etc
- Impact factor of journals as per Journal Citation Report, SNIP,SJR,IPP,Cite Score
- Metrics:h-index, g index, i10 index, altmetrics
- Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases
- Use of tools / techniques for Research: methods to search required information effectively,
- Reference Management Software like Zotero/Mendeley,
- Software for paper formatting like LaTeX/MS Office
- Review of some literature

Pattern of Exam For Tutorials:

Continuous Assessment : 10 marks

Final Examination (To be conducted by the course coordinator internally) : 15 marks

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Syllabus of Physics for 7th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2025, 2026, 2027

Semester	VII	Type	Minor
Course Name	Electronics	Course Code	UMIPYT705
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Theory (3 Credits)

Note: The Mid Term Examination Shall be conducted after completing 50% of Syllabus.

Course learning outcomes:

After completing this course content, student will be able to understand:

- Some of the advanced transistors, their working and characteristics
- Comprehend the design and operations of SCRs and UJTs
- Comprehend the use of feedback
- Operational Amplifier, their advantages, characteristics, different modes of operations and a few main applications.
- Working of CRO and its applications, Basic rectifiers and Filter, IC-555 and its basic application
- Logic families and the working of various logic circuits and their simplification
- Combinational and sequential digital circuits, Converters

Unit- I Transistors

UJT and SCR: Construction, working, equivalent circuit and I-V characteristics

JFET: types, p-channel and n-channel, working and I-V characteristics, parameters and their relationships, comparison of BJT and JFET

MOSFET: E-MOSFET, D-MOSFET—n channel and p-channel, Construction, working, symbols, biasing, drain and transfer characteristics,

Unit-II Op-amp and its applications

Op-Amp: Differential amplifier, block diagram of op-amp, characteristics of an ideal and Practical Op-Amp, open and closed loop configuration, Frequency response, CMRR, Slew Rate and concept of virtual ground.

Applications of op-amps: Concept of feedback: positive and negative, advantages of negative feedback (qualitative study), Inverting and non-inverting amplifiers, summing and difference amplifier, differentiator , Integrator.

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Syllabus of Physics for 7th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2025, 2026, 2027

Semester	VII	Type	Minor
Course Name	Electronics	Course Code	UMIPYT705
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Unit-III Instrumentation

CRO: Introduction, block diagram, Applications of CRO-- Study of waveform, measurement of voltage, current, frequency and phase diagram

Power Supplies: Half-wave rectifiers, centre-tapped, calculation of ripple factors, rectification efficiency,

Filters: basic idea about capacitor filter, First and second order active Low pass, High pass filters

IC 555-times: Introduction , block diagram, astable and monostable multivibrator circuits

Unit-IV Logic families and Digital Circuits

Logic families: Pulse characteristics, Logic families-classification of digital ICs, characteristics of logic families, circuit description of TTL NAND gate with totem pole and open collector, Simplification of Logic Circuit using Boolean algebra, Conversion of a truth table into an equivalent Logic Circuit, Minimization techniques using K-maps (upto 4 variables):

Combinational and sequential Logic circuits: Half-Adder, Full Adders, Multiplexer and De-multiplexer, SR, JK Flip Flop,

Converters: DAC with binary weighted resistor and R-2R resistor ladder network, ADC: Successive approximation method.

Note for paper setters for End Semester Examination:

The question paper will be of 60 marks. There shall be 2 sections in the question paper with pattern as follows:

Section-A shall comprise of 4 short answer type questions (of 3 marks each) with one question from each unit. The students have to attempt all the questions from Section A.

Section- B shall comprise of a total of 8 questions with two questions selected from each unit. Each question shall be of 12 marks. The students have to attempt 4 questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

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Syllabus of Physics for 7th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2025, 2026, 2027

Semester	VII	Type	Minor
Course Name	Electronics	Course Code	UMIPYT705
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Note for paper setters for Mid Semester Examination:

The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.

The question paper will be of 15 marks. There shall be 2 sections in the question paper with pattern as follows :

Section-A shall comprise of 3 questions (of 4 marks each) and the students are required to attempt anytwo questions.

Section-B shall comprise of 2 questions (of 7 marks each) and the students are required to attempt anyone question.

Text and Reference Books :

- "Semiconductor devices: Physics and technology," by S.M Sze, 2nd edition , Wiley India edition (2002)
- "Basic Electronics" by Albert Malvino David Bates and A.B Patil
- "Electronic Fundamentals and Applications", J.D. Ryder, Prentice-Hall 0f India Pvt. Ltd, 1975, 5e
- "Electronic Devices and Circuit Theory" by R.L. Boylesad, L. Nashelsky, Prentice-Hall of India Pvt. Ltd.
- "Electronic Fundamentals and Applications by J.D. Ryder, Prentice-Hall of India Pvt. Ltd.
- "Modern Digital Electronics" by R.P. Jain, McGraw Hill
- "Digital Principles and Applications", by D. Leach and A. Malvino, McGraw Hill 2010.

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Syllabus of Physics for 7th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in Dec 2025, 2026, 2027

Semester	VII	Type	Minor
Course Name	Electronics	Course Code	UMIPYT705
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Practicals

Perform any 05 of the following experiments as per availability of the apparatus
List of experiments

1. Energy band gap of semiconductor by four probe method
2. Characteristics of FET, MOSFET, SCR,
3. UJT: Characteristics and relaxation oscillator
4. Study and verification of the truth tables of LOGIC Gates using IC's
5. Study of clocked SR and JK Flip flop
6. Design of inverting and non-inverting amplifier using op-amp and determination of gain.
7. Design and study of inverting adder and subtractor.
8. A-stable MV using IC-555 timer
9. Mono stable multivibrator using IC-555 timer.
10. Design and study of first order high-pass and Low-pass filters
11. Half Adder and Full adder using (I) Logic gates and using (ii) NAND gates

Note: The concerned department may add some more practicals on the availability of some new equipments related to the course.

Pattern of Exam For Practicals:

Continuous Assessment : 10 marks

Final Examination (To be conducted by the course coordinator internally) : 15 marks

Suggested Books

1 B.Sc. Practical physics by C.L Arora
2 Practical Physics by R.K. Shukla
3 B.Sc. Practical physics by Harnam Singh

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours)	Type	Major
Course Name	Computational techniques and programming	Course Code	UMJPYT801
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Theory (3 Credits)

Note: The Mid Term Examination Shall be conducted after completing 50% of Syllabus.

Course learning outcomes:

The aim of this course is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics. After completing this course content, student will be able

- familiarized to the basic concepts of computers, programming language.
- Learn the fundamental concepts of python programming syntax and semantics
- Use of computer language to learn about data types, data structures and handling files using Python as a tool in solving physics problems.
- learn the use of python modules and functions
- Use of computational methods to solve physical problems.

Unit I : Fundamentals

Importance of computers in Physics, paradigm for solving physics problems for solution. Algorithms and Flowcharts: Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types.

Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin (x) as a series, algorithm for plotting (1) Lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal.

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours)	Type	Major
Course Name	Computational techniques and programming	Course Code	UMJPYT801
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Unit II : Python -I

Data types, operators, expressions, types conversion in python, operators, expressions
Loops: selection, indentation, repetition, break and Continue statement, Nested loops, Scope of a variable.
Strings: Introduction to strings, string operations, Transversal of strings
Methods and inbuilt functions, lists, nested lists, Copying Lists

Unit III : Python II

Functions: Introduction, function definition, user defined functions, Python standard Libraries.
File Handling: Introduction, types of files, opening and closing files, writing to a file, Reading from a file, Creating offset in a file, Creating and traversing a file.
Stacks: Introduction, Operations, Queue: Introduction, Operations,
Sorting: Bubble sort, selection sort, insertion sort

Unit IV : Scientific word processing

Application of Python programming in solving problems using bisection method, trapezoidal methods Runge –Kutta methods.
MS WORD: Test formatting, Math Type, MS Equation editor, MS excel and its application in physics.

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Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Note for paper setters for End Semester Examination:

The question paper will be of 60 marks. There shall be 2 sections in the question paper with pattern as follows:

Section-A shall comprise of 4 short answer type questions (of 3 marks each) with one question from each unit. The students have to attempt all the questions from Section A.

Section- B shall comprise of a total of 8 questions with two questions selected from each unit. Each question shall be of 12 marks. The students have to attempt 4 questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

Note for paper setters for Mid Semester Examination:

The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.

The question paper will be of 15 marks. There shall be 2 sections in the question paper with pattern as follows :

Section-A shall comprise of 3 questions (of 4 marks each) and the students are required to attempt any two questions.

Section-B shall comprise of 2 questions (of 7 marks each) and the students are required to attempt any one question.

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

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Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Text and Reference Books :

1. Computational Physics: An Introduction, R. C. Verma, et al. New Age International Publishers, New Delhi(1999).
2. Computational Physics, V.K. Mittal, R.C. Verma & S.C. Gupta- Published by Ane Books.

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For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Practicals:

- Exercises on Linux Commands, familiarity with DOS commands
- working with Latex to prepare some scientific reports including figures, tables, including citations etc.

Using Python write/execute programs

- To print out all natural even/ odd numbers be given set of numbers.
- Calculating Euler number using exp(x) series evaluated at x=1 To compile a frequency distribution and evaluate mean, standard deviation etc.
- To evaluate the sum of a finite series and the area under a curve.
- To find the product of two matrices
- To find a set of prime numbers and Fibonacci series.
- Plotting trajectory of a projectile projected horizontally.
- Plotting trajectory of a projectile projected making an angle with the horizontal.
- To find the roots of a quadratic equation.
- Motion of a projectile using simulation and plot the output for visualization.
- Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization.
- Motion of a particle in a central force field and plot the output for visualization

Pattern of Exam For Practicals:

Continuous Assessment : 10 marks

Final Examination (To be conducted by the course coordinator internally) : 15 marks

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours)	Type	Major
Course Name	Quantum Mechanics-II	Course Code	UMJPYT802
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Theory (3 Credits)

Note: The Mid Term Examination Shall be conducted after completing 50% of Syllabus.

Course learning outcomes:

After completing this course content, student will be able to understand

- the concept of identical particles
- the concept of perturbation.
- Scattering

Unit-I : Identical Particles:

Principle of Indistinguishability, Symmetrization and Permutation Operators, Statistics of Identical Particles, Pauli exclusion principle,scattering of identical particles,excited states of helium atom, Hartee-Fock field,Thomson-Fermi statistical method, Molecular orbital theory(hydrogen molecule ion H_2^+), heitler- London theory of hydrogen molecule.

Unit-II : Approximation methods for stationary states:

Time-Independent Perturbation Theory:- Non-degenerate Perturbation Theory, Degenerate Perturbation Theory, Fine Structure of Hydrogen Lines, Hyperfine Splitting, Effect of magnetic field in hydrogen atom. Variational Method, Wentzel-Kramers-Brillouin General Formalism:- Bound States for Potential Wells with No Rigid Walls, Bound States for Potential Wells with One Rigid Wall, Bound States for Potential Wells with Two Rigid Walls, Tunneling through a Potential Barrier.

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours)	Type	Major
Course Name	Quantum Mechanics-II	Course Code	UMJPYT802
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Unit-III: Time-dependent perturbation theory:

Time-Dependent Perturbation Theory: - Transition Probability, Transition Probability for a Constant Perturbation, Transition Probability for a Harmonic Perturbation. Adiabatic and Sudden Approximations: - Adiabatic Approximation, Sudden Approximation. Interaction of Atoms with Radiation: - Semi - Classical Theory of Interaction of Atoms with Radiation, Einstein's Transition Probabilities (Coefficients A and B), Quantization of the Electromagnetic Field, Electric Dipole Selection Rules, Spontaneous Emission.

Unit-IV: Scattering theory:

Scattering and Cross Section:- Connecting the Angles in the Lab and CM Frames, Connecting the Lab and CM Cross Sections. Scattering Amplitude of Spinless Particles:- Scattering Amplitude and Differential Cross Section. The Born Approximation:- First Born Approximation, Validity of the First Born Approximation. Partial Wave Analysis for elastic and inelastic scattering, scattering from hard sphere, scattering of identical particles.

Note for paper setters for End Semester Examination:

The question paper will be of 60 marks. There shall be 2 sections in the question paper with pattern as follows:

Section-A shall comprise of 4 short answer type questions (of 3 marks each) with one question from each unit. The students have to attempt all the questions from Section A.

Section- B shall comprise of a total of 8 questions with two questions selected from each unit. Each question shall be of 12 marks. The students have to attempt 4 questions by selecting only one question from each unit.
The numerical problems should not exceed more than 20% of the maximum marks.

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours)	Type	Major
Course Name	Quantum Mechanics-II	Course Code	UMJPYT802
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Note for paper setters for Mid Semester Examination:

The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.

The question paper will be of 15 marks. There shall be 2 sections in the question paper with pattern as follows :

Section-A shall comprise of 3 questions (of 4 marks each) and the students are required to attempt anytwo questions.

Section-B shall comprise of 2 questions (of 7 marks each) and the students are required to attempt anyone question.

Text and Reference Books

1. Quantum Physics by Robert Eisberg and Robert Resnick (John Wiley and sons).
2. Quantum Mechanics: Theory and Applications by A. K. Ghatak and S. Lokanathan.
3. Quantum Mechanics by L. I. Schiff (McGraw-Hill Book, New York).
4. Quantum Mechanics by Cohen and Tanandji.
5. Quantum Mechanics: Concepts and Applications by Nouredine Zettili.
6. Advanced quantum mechanics by B. S. Rajput

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours)	Type	Major
Course Name	Quantum Mechanics-II	Course Code	UMJPYT802
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus forTutorials

1. Consider a one-dimensional harmonic oscillator. Use the vibrational method to estimate the energies of (a) the ground state, (b) the first excited state, and (c) the second excited state.
2. Consider a hydrogen atom, subjected to a perturbation potential of the form, $V(r) = a\,\mathrm{Cos}(2r/a_0)$, where a_0 is the Bohr radius and $a << 1$ is a positive constant. Calculate the first order change in the ground state energy using perturbation theory.
3. For a particle of mass m moving in a one-dimensional box with walls at x = 0 and x = L, use the variational method to estimate
   (a) Its ground state energy and
   (b) Its first excited state energy.
4. (i) Calculate to first-order perturbation theory the contribution due to the spin-orbit interaction for the nth excited state for a positronium atom.
   (ii) Use the result of part (i) to obtain numerical values for the spin-orbit correction terms for the 2p level and compare them to the energy of n = 2.
5. Optimize the trial function $e^{-\alpha r}$ and evaluate the ground state energy of the hydrogen atom.

Pattern of Exam For Tutorials:

Continuous Assessment : 10 marks

Final Examination (To be conducted by the course coordinator internally) : 15 marks

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours)	Type	Major
Course Name	Electrodynamics & Plasma Physics	Course Code	UMJPYT803
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Theory (3 Credits)

Note: The Mid Term Examination Shall be conducted after completing 50% of Syllabus.

Course learning outcomes:

After completing this course content, student will be able to understand

- the fundamentals of electrodynamics
- basic concept of plasma physics
- electromagnetism using the tools of magnetohydrodynamics and plasma physics.

Unit-I : Electrostatics and Method of Images:

Electric Field, Gauss's Law, Poisson's and Laplace's equations, Solution of Laplace's equation in various coordinates, Green's Theorem, Dirichlet and Neumann boundary conditions, Method of Images, Point charge near an infinite Grounded Conducting Plane, Point charge in the presence of Grounded Conducting Sphere, Point charge in the presence of Charged, Insulated Conducting sphere, Point charge near a Conducting Sphere held at Fixed Potential, Conducting sphere in a Uniform Electric Field.

Unit-II: Magnetostatics and Maxwell Equations:

Biot-Savart Law, The magnetic field of a Steady Current, Ampere's Law, Comparison of Magnetostatics and Electrostatics, Maxwell's Displacement Current; Maxwell's Equations, Scalar and Vector potentials, Maxwell's equations in terms of scalar and vector potentials, Non uniqueness of Electromagnetic potentials, Gauge Transformation, Lorentz gauge and Coulomb gauge. Minkowski Space and Four vectors, Covariance of Maxwell's equations.

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours)	Type	Major
Course Name	Electrodynamics & Plasma Physics	Course Code	UMJPYT803
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Unit-III : Electromagnetic Waves and Radiation by Moving Charges:
Electromagnetic Waves in Vacuum: The Wave Equation for E and B, Monochromatic Plane Waves, Energy and Momentum in Electromagnetic Waves. Electromagnetic Waves in Matter: Propagation in Linear Media, Reflection and Transmission at Normal Incidence, Reflection and Transmission at Oblique Incidence. Electromagnetic Waves in Conductors, Reflection at a Conducting Surface. Wave Guides, TE and TM Waves in a Rectangular Wave Guide, Retarded Time, Lienard-Wiechert Potentials for a point charge, Total power radiated by a point charge: Larmor's formula and its relativistic generalization.

Unit-IV: Basics in Plasma Physics:
Occurrence of Plasmas in Nature, Quasineutrality of plasma, Debye Shielding, The Plasma Parameter, Criteria for Plasmas, Representation of Waves in Plasma, Group Velocity, Plasma Oscillations, Electron Plasma Waves, Sound Waves, Ion Waves, Validity of the Plasma Approximation, Comparison of Ion and Electron Waves, Elementary Concepts: Plasma Oscillations, Debye Shielding, Plasma Parameters, Magnetoplasma, Plasma Confinement, First, Second, and Third Adiabatic Invariants (Pinch Effect, Magnetic Mirrors), Formation of Van Allen radiation belt.

Note for paper setters for End Semester Examination:

The question paper will be of 60 marks. There shall be 2 sections in the question paper with pattern as follows:

Section-A shall comprise of 4 short answer type questions (of 3 marks each) with one question from each unit. The students have to attempt all the questions from Section A.
Section- B shall comprise of a total of 8 questions with two questions selected from each unit. Each question shall be of 12 marks. The students have to attempt 4 questions by selecting only one question from each unit.
The numerical problems should not exceed more than 20% of the maximum marks.

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours)	Type	Major
Course Name	Electrodynamics & Plasma Physics	Course Code	UMJPYT803
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Note for paper setters for Mid Semester Examination:

The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.

The question paper will be of 15 marks. There shall be 2 sections in the question paper with pattern asfollows :

Section-A shall comprise of 3 questions (of 4 marks each) and the students are required to attempt anytwo questions.

Section-B shall comprise of 2 questions (of 7 marks each) and the students are required to attempt anyone question.

Text and Reference Books

1. Panofsky & Phillips: Classical electricity and magnetism.
2. Classical Electrodynamics: J.D. Jackson
3. Fundamentals of Plasma Physics: J. A. Bittencourt.
4. Principles of plasma physics: N. A. Krall, A. W. Trivelpiece

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Semester	VIII (Honours)	Type	Major
Course Name	Electrodynamics & Plasma Physics	Course Code	UMJPYT803
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Tutorials

1. A point charge is placed a distance d > R from the centre of an equally charged, isolated conducting sphere of radius R.
   (a) Inside of what distance from the surface of the sphere is the point charge attracted rather than repelled by the charged sphere?
   (b) What is the limiting value of the force of attraction when the point charge is located a distance a (=d – R) from the surface of the sphere, if a << R?
   (c) What are the results for parts a and b if the charge on the sphere is twice (half) as large as the point charge, but still the same sign?
2. A hollow right circular cylinder of radius b has its axis coincident with the z-axis and its ends at Z = 0 and Z = L. The potential on the end faces is zero, while the potential on the cylindrical surface is given as V(ϕ, z). Using the appropriate separation of variables in cylindrical; coordinates, find a series solution for the potential anywhere inside the cylinder.

3. A sphere of radius a carries a uniform surface-charge distribution σ. The sphere is rotated about a diameter with constant angular velocity ω. Obtain the vector potential and magnetic flux density both inside and outside the sphere.
4. Consider Debye's potential created by a punctual test charge q_T that is placed inside an homogeneous plasma. (a) Show that the charge in the shielding cloud exactly cancels q_T. Calculate the total charge inside spheres of radii $\lambda_D/2$, λ_D and $5\lambda_D$. (b) Determine the electrostatic interaction energy between the test charge and the particles in the plasma and the total mean energy of the plasma particles (assume $T_e = T_i = T$).

Pattern of Exam For Tutorials:

Continuous Assessment : 10 marks

Final Examination (To be conducted by the course coordinator internally) : 15 marks

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours)	Type	Major
Course Name	Mathematical Physics-III	Course Code	UMJPYT804
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Theory (3 Credits)

Note: The Mid Term Examination shall be conducted after completing 50% of Syllabus.

Course learning outcomes:

The student should be able to understand the basic theory of special functions, complex variables, tensor analysis, differential equations and Laplace transforms. Upon completion of the course, the students will be able to apply the mathematical tools to solve the problems of physics.

Unit I

Special functions and Complex Variables:
Beta, Gamma and error functions and their properties and inter relationships, Graph of gamma function, evaluation of error function. Evaluation of Miscellaneous integrals,
Taylor and Laurent series of complex function. Cauchy's Residue theorem, Methods of finding residues, Evaluation of definite integrals by use of residue theorem. Contour integration, Jordan lemma. Simple problems on the above topics

Unit II

Tensor Analysis:
Introduction, N-dimensional space, coordinate transformation, summation convention, contravariant and covariant vectors, Contravariant, covariant and mixed tensors, Kronecker delta, The fully antisymmetric tensor, Tensors of higher rank, scalars or invariants, symmetric and skew-symmetric tensors, fundamental operations with tensors (Addition, Subtraction, Outer multiplication, Contraction, Inner multiplication). Quotient law, metric tensor, Conjugate or reciprocal tensor, Associated tensors, Covariant differentiation of vectors and tensors, Simple problems on the above topics

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours)	Type	Major
Course Name	Mathematical Physics-III	Course Code	UMJPYT804
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Unit III

Differential Equations:

Bessel's differential equation and its solutions, Recurrence formulae, Generating function, Jacobi series, Bessel's integrals, Orthonormality of Bessel functions, Bessel's functions of first and second kind, Spherical Bessel and Neumann functions, Recurrence relations and orthogonality of spherical Bessel's functions, Laguerre's differential equation and polynomials, Generating Function, Rodrigue's formula, Orthogonal properties of Laguerre's polynomials

Unit IV

Laplace Transforms:

Laplace transform: Conditions for L.T., Properties of L.T., First and Second shifting theorems, L.T. of derivatives, L.T. of integrals, L.T. of periodic functions, Initial and final value theorems, Laplace transform of Dirac delta function, Relationship between Fourier and Laplace transforms, Inverse L.T. of derivatives, Inverse L.T. of Integrals, Inverse L.T. by Partial fraction's method, Solution of Differential equations with constant coefficients by Laplace transforms

Note for paper setters for End Semester Examination:

The question paper will be of 60 marks. There shall be 2 sections in the question paper with pattern as follows:

Section-A shall comprise of 4 short answer type questions (of 3 marks each) with one question from each unit. The students have to attempt all the questions from Section A.

Section- B shall comprise of a total of 8 questions with two questions selected from each unit. Each question shall be of 12 marks. The students have to attempt 4 questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours)	Type	Major
Course Name	Mathematical Physics-III	Course Code	UMJPYT804
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Note for paper setters for Mid Semester Examination:

The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.
The question paper will be of 15 marks. There shall be 2 sections in the question paper with pattern asfollows :
Section-A shall comprise of 3 questions (of 4 marks each) and the students are required to attempt anytwo questions.
Section-B shall comprise of 2 questions (of 7 marks each) and the students are required to attempt anyone question.

Text and Reference Books :

1. Mathematical Methods for Physicists by G.B. Arfken and H.J. Weber
2. Matrices and Tensors for Physicists by A.W. Joshi
3. Schaum's Outlines Complex variables by Murray. R. Spiegel
4. Schaum's Outline of Theory and problems of Laplace Transforms by Murray. R. Spiegel
5. Schaum's Outline of Theory and problems of Tensor Analysis by Murray. R.Spiegel
6. Mathematical Methods for Physics and Engineering, by K.F. Riley, M.P. Hobson and S.J. Bence.
7. Mathematical Physics by H.K. Dass
8. Mathematical Physics by Satya Prakash

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours)	Type	Major
Course Name	Mathematical Physics-III	Course Code	UMJPYT804
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Tutorials:

1. Evaluate gamma function and draw a graph for it.
2. Evaluate error function and draw a graph for it.
3. Evaluate definite integrals by contour integration.
4. Applications of tensors to Non-Relativistic Physics.
5. Graph of Bessel's function of first kind.
6. Graph first five Laguerre polynomials.
7. Properties of Dirac Delta function.
8. Derivative of Dirac Delta function.
9. Three-dimensional Dirac Delta function.
10. Applications of Laplace transforms.

Pattern of Exam For Tutorials:

Continuous Assessment : 10 marks

Final Examination (To be conducted by the course coordinator internally) : 15 marks

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours)	Type	Minor
Course Name	Quantum Mechanics	Course Code	UMIPYT805
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Theory (3 Credits)

Note: The Mid Term Examination Shall be conducted after completing 50% of Syllabus.

Course learning outcomes:

After completing this course content, student will be able to understand

- the wave mechanics
- the role of uncertainty in quantum physics
- apply operators to it to obtain information about a particle's physical properties

Unit-I : Wave Mechanical Concepts:

Limitations of Classical Physics, Planck's Quantum Hypothesis, Stern Gerlach Experiment, Wave nature of particles, the Uncertainty Principle and its Probabilistic interpretation, principle of superposition, wave packet, Interpretation of wave function, Time independent Schrodinger equation, Time dependent Schrodinger equation, Eherenfest's Theorem, Stationary States.

Unit-II: General Formalism of Quantum Mechanics:

Linear Vector Space, Operations in Linear Space, Eigen values and Eigen vectors of operators, Hermitian operator, Postulates of Quantum Mechanics, Simultaneous Measurability of Observables, Dimensionality of Quantum Space, Dirac's Notation, Equation of motion, Momentum Representation.

Unit-III: One Dimensional Problems:

Properties of one dimensional motion, Free Particle in one dimension, Potential Step, The Potential Barrier and well, the tunneling effect, the infinite square well potential- asymmetric and symmetric well, the finite square well potential-scattering solutions and bound state solutions, Harmonic Oscillator, the Hydrogen atom.

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours)	Type	Minor
Course Name	Quantum Mechanics	Course Code	UMIPYT805
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Unit-IV: Theory of Angular Momentum:
Angular Momentum Operator, Angular Momentum Commutation Relations, Orbital Angular Momentum, Spin Angular Momentum, Spin dependent interaction in Atoms, Addition of two Angular Momenta: Properties of C. G. Coefficients, Orthogonality Properties, Angular Momentum and Rotations.

Note for paper setters for End Semester Examination:

The question paper will be of 60 marks. There shall be 2 sections in the question paper with pattern as follows:
Section-A shall comprise of 4 short answer type questions (of 3 marks each) with one question from each unit. The students have to attempt all the questions from Section A.
Section- B shall comprise of a total of 8 questions with two questions selected from each unit. Each question shall be of 12 marks. The students have to attempt 4 questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

Note for paper setters for Mid Semester Examination:

The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.
The question paper will be of 15 marks. There shall be 2 sections in the question paper with pattern as follows :
Section-A shall comprise of 3 questions (of 4 marks each) and the students are required to attempt any two questions.
Section-B shall comprise of 2 questions (of 7 marks each) and the students are required to attempt any one question.

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours)	Type	Minor
Course Name	Quantum Mechanics	Course Code	UMIPYT805
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Text and Reference Books:

1. Quantum Physics by Robert Eisberg and Robert Resnick (John Wiley and sons).
2. Quantum Mechanics: Theory and Applications by A. K. Ghatak and S. Lokanathan.
3. Quantum Mechanics by L. I. Schiff (McGraw-Hill Book, New York).
4. Quantum Mechanics by Cohen and Tanandji.
5. Quantum Mechanics: Concepts and Applications by Nouredine Zettili.

Syllabus forTutorials

1. Consider a one-dimensional simple Harmonic oscillator of frequency ω and mass m. Using the uncertainty principle, show that the energy of its ground state will be $\frac{1}{2}\hbar\omega$. Note that this ground state energy is also called "zero-point" energy.

2. Let K be an operator defined by $K = |\phi\rangle\langle\Psi|$,
   (a) Under what conditions is K Hermitian.
   (b) Calculate K^2. Under what conditions is K a projection.
   (c) Show that K can always be written in the form $K = \lambda P_1 P_2$, where λ is a constant to be calculated and P_1 and P_2 are projectors.

3. Consider the free-particle as a central force problem. Set up the time independent Schrödinger equation

$$-\frac{\hbar^2}{2m}\nabla^2\Psi = E\,\Psi$$

in spherical polar coordinate system, and examine the nature of the solutions. What will happen if we introduce a constant potential V_0 everywhere?

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours/[illegible])	Type	Minor
Course Name	Quantum Mechanics	Course Code	UMIPYT805
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

4. Consider a three-dimensional isotropic simple harmonic oscillator of mass m and potential $V(r) = \frac{1}{2}m\omega^2(x^2+y^2+z^2) = \frac{1}{2}m\omega^2 r^2$. Note that this system is also spherically symmetric. Set up the Schrödinger equation for the isotropic 3D oscillator in the spherical polar coordinates, and obtain the eigen values.

5. Compute the energy levels for a hydrogen atom by assuming that the electron moves in circular orbits around the nucleus such that the circumference of an orbit is an integral number of de Broglie wavelengths. Show that this condition also amounts to quantization of the angular momentum of the electron.

Pattern of Exam For Tutorials:

Continuous Assessment : 10 marks

Final Examination (To be conducted by the course coordinator internally) : 15 marks

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours with Research)	Type	Major
Course Name	Scientific editing and programming	Course Code	UMJPYT806
Credits	3(Theory) + 1 (Practicals)	LTP	3-0-1
Contact Hrs	45 (Theory) + 30 (Practicals)		
Duration of Exam	3 Hours (Theory)	2½ hours (Practicals)	
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Note: The Mid Term Examination Shall be conducted after completing 50% of Syllabus.

Course Outcomes: The aim of this course is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics. After completing this course content, student will be able

- familiarized to the basic concepts of computers, programming language.
- Learn the fundamental concepts of Python programming syntax and semantics
- Use of computer language to learn about data types, data structures and handling files using Python as a tool in solving physics problems.
- learn the use of Python modules and functions
- Will be able to use computational methods to solve physical problems.
- Will learn and use scientific editor Latex for preparation of documents and presentations

Unit I : Fundamentals

Importance of computers in Physics, paradigm for solving physics problems for solution. Algorithms and Flowcharts: Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types.

Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin (x) as a series, algorithm for plotting (1) Lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal.

Unit II : Python -I

Python: Data types, operators, expressions, types conversion in python, operators, expressions

Loops: selection, indentation, repetition, break and Continue statement, Nested loops, Scope of a variable.

Strings: Introduction to strings, string operations, Transversal of strings

Methods and inbuilt functions, lists, nested lists, Copying Lists

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Unit III: Python II

Functions: Introduction, function definition, user defined functions, Python standard Libraries.
File Handling: Introduction, types of files, opening and closing files, writing to a file, Reading from a file, Creating offset in a file, Creating and traversing a file.
Stacks: Introduction, Operations, Queue: Introduction, Operations,
Sorting: Bubble sort, selection sort, insertion sort

Unit IV: Scientific word processing

Introduction to LaTeX /TeX word processor, preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages.
Formulae and equations, Figures and other floating bodies, Lining in columns- Tabbing and tabular environment, Generating table of contents, bibliography and citation, Making an index and glossary, List making environments, Fonts, Picture environment and colors, errors.

Text and Reference Books :

1. Computational Physics: An Introduction, R. C. Verma, et al. New Age International Publishers, New Delhi(1999).
2. Computational Physics, V.K. Mittal, R.C. Verma & S.C. Gupta- Published by Ane Books.

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For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Practicals: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Practicals:

- Exercises on Linux Commands, familiarity with DOS commands
- working with Latex to prepare some scientific reports including figures, tables, including citations etc.

  Using Python write/execute programs
- To print out all natural even/ odd numbers be given set of numbers.
- Calculating Euler number using exp(x) series evaluated at x=1 To compile a frequency distribution and evaluate mean, standard deviation etc.
- To evaluate the sum of a finite series and the area under a curve.
- To find the product of two matrices
- To find a set of prime numbers and Fibonacci series.
- Plotting trajectory of a projectile projected horizontally.
- Plotting trajectory of a projectile projected making an angle with the horizontal.
- To find the roots of a quadratic equation.
- Motion of a projectile using simulation and plot the output for visualization.
- Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization.
- Motion of a particle in a central force field and plot the output for visualization

Pattern of Exam For Practicals:

Continuous Assessment : 10 marks

Final Examination (To be conducted by the course coordinator internally) : 15 marks

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours with Research)	Type	Minor
Course Name	Quantum Mechanics	Course Code	UMIPYT807
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Syllabus for Theory (3 Credits)

Note: The Mid Term Examination Shall be conducted after completing 50% of Syllabus.

Course learning outcomes:

After completing this course content, student will be able to understand

- the wave mechanics
- the role of uncertainty in quantum physics
- apply operators to it to obtain information about a particle's physical properties

Unit-I : Wave Mechanical Concepts:

Limitations of Classical Physics, Planck's Quantum Hypothesis, Stern Gerlach Experiment, Wave nature of particles, the Uncertainty Principle and its Probabilistic interpretation, principle of superposition, wave packet, Interpretation of wave function, Time independent Schrodinger equation, Time dependent Schrodinger equation, Eherenfest's Theorem, Stationary States.

Unit-II: General Formalism of Quantum Mechanics:

Linear Vector Space, Operations in Linear Space, Eigen values and Eigen vectors of operators, Hermitian operator, Postulates of Quantum Mechanics, Simultaneous Measurability of Observables, Dimensionality of Quantum Space, Dirac's Notation, Equation of motion, Momentum Representation.

Unit-III: One Dimensional Problems:

Properties of one dimensional motion, Free Particle in one dimension, Potential Step, The Potential Barrier and well, the tunneling effect, the infinite square well potential- asymmetric and symmetric well, the finite square well potential-scattering solutions and bound state solutions, Harmonic Oscillator, the Hydrogen atom.

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours with Research)	Type	Minor
Course Name	Quantum Mechanics	Course Code	UMIPYT807
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Unit-IV: Theory of Angular Momentum:
Angular Momentum Operator, Angular Momentum Commutation Relations, Orbital Angular Momentum, Spin Angular Momentum, Spin dependent interaction in Atoms, Addition of two Angular Momenta: Properties of C. G. Coefficients, Orthogonality Properties, Angular Momentum and Rotations.

Note for paper setters for End Semester Examination:

The question paper will be of 60 marks. There shall be 2 sections in the question paper with pattern as follows:
Section-A shall comprise of 4 short answer type questions (of 3 marks each) with one question from each unit. The students have to attempt all the questions from Section A.
Section- B shall comprise of a total of 8 questions with two questions selected from each unit. Each question shall be of 12 marks. The students have to attempt 4 questions by selecting only one question from each unit.

The numerical problems should not exceed more than 20% of the maximum marks.

Note for paper setters for Mid Semester Examination:

The Mid Semester Examination shall be conducted by the course coordinator after completion of 50% of the syllabus.
The question paper will be of 15 marks. There shall be 2 sections in the question paper with pattern as follows :
Section-A shall comprise of 3 questions (of 4 marks each) and the students are required to attempt any two questions.
Section-B shall comprise of 2 questions (of 7 marks each) and the students are required to attempt any one question.

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours with Research)	Type	Minor
Course Name	Quantum Mechanics	Course Code	UMIPYT807
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

Text and Reference Books:

1. Quantum Physics by Robert Eisberg and Robert Resnick (John Wiley and sons).
2. Quantum Mechanics: Theory and Applications by A. K. Ghatak and S. Lokanathan.
6. Quantum Mechanics by L. I. Schiff (McGraw-Hill Book, New York).
7. Quantum Mechanics by Cohen and Tanandji.
8. Quantum Mechanics: Concepts and Applications by Nouredine Zettili.

Syllabus forTutorials

1. Consider a one-dimensional simple Harmonic oscillator of frequency ω and mass m. Using the uncertainty principle, show that the energy of its ground state will be $\frac{1}{2}\hbar\omega$. Note that this ground state energy is also called "zero-point" energy.

2. Let K be an operator defined by $K = |\phi\rangle\langle\Psi|$,
   (a) Under what conditions is K Hermitian.
   (b) Calculate K^2. Under what conditions is K a projection.
   (c) Show that K can always be written in the form $K = \lambda P_1 P_2$, where λ is a constant to be calculated and P_1 and P_2 are projectors.

3. Consider the free-particle as a central force problem. Set up the time independent Schrödinger equation

$$-\frac{\hbar^2}{2m}\nabla^2\Psi = E\,\Psi$$

in spherical polar coordinate system, and examine the nature of the solutions. What will happen if we introduce a constant potential V_0 everywhere?

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours with Research)	Type	Minor
Course Name	Quantum Mechanics	Course Code	UMIPYT807
Credits	3(Theory) + 1 (Tutorials)	LTP	3-1-0
Contact Hrs	45 (Theory) + 15 (Tutorial)		
Duration of Exam	3 Hours (Theory) 1 Hour (Tutorials)		
For Theory: End Semester Exam: 60 Marks Mid Semester Exam: 15 Marks		For Tutorials: Final Exam: 15 Marks Continuous Assessment: 10 Marks	

4. Consider a three-dimensional isotropic simple harmonic oscillator of mass m and potential $V(r) = \frac{1}{2}m\omega^2(x^2+y^2+z^2) = \frac{1}{2}m\omega^2 r^2$. Note that this system is also spherically symmetric. Set up the Schrödinger equation for the isotropic 3D oscillator in the spherical polar coordinates, and obtain the eigen values.

5. Compute the energy levels for a hydrogen atom by assuming that the electron moves in circular orbits around the nucleus such that the circumference of an orbit is an integral number of de Broglie wavelengths. Show that this condition also amounts to quantization of the angular momentum of the electron.

Pattern of Exam For Tutorials:

Continuous Assessment : 10 marks

Final Examination (To be conducted by the course coordinator internally) : 15 marks

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Syllabus of Physics for 8th Semester of FYUGP under CBCS as per NEP-2020 for the examination to be held in May 2026, 2027, 2028

Semester	VIII (Honours with Research)	Type	Skill Enhancement
Course Name	Research Project	Course Code	USEPYP808
Credits	12	LTP	0-0-12
Contact Hrs	360		
Duration of Exam			
Dissertation = 08 credits (200 marks) Viva/presentation = 04 credits (100 marks)			

1. Research Project work (12 credits) shall be started at the beginning of 7th Semester.
2. There shall be a Project Synopsis in the programme based on the major area/subject. The permanent faculty with Ph.D. and research experience (as per UGC guidelines) shall be the research project supervisor after being recognized by the Departmental Research Committee (DRC) of the concerned Department of the college.
3. The college offering FYUGP with Research should have its own College Research Committee (CRC) for each discipline with at least one member from any University of the region.
4. The project report/dissertation shall be evaluated by the external expert from other University/Colleges to be nominated by the Principal out of the panel supplied by the CRC.
5. Project proposal to be scrutinized by the College Research Committee for the concerned subject.
6. In the 8th Semester, Evaluation of Dissertation shall be offline and Viva-Voce shall be either offline or online as per the convenience of the examiner. The Dissertation evaluation shall be carried out by an external expert.

Dissertation = 08 credits (200 marks)
Viva/presentation = 04 credits (100 marks)