DEPARTMENT OF PHYSICS

COURSE CURRICULUM & MARKING SCHEME

B.Sc. VII, VIII Semester

PHYSICS

(Based on Choice Based Credit System)

SESSION : 2025-26

ESTD : 1958

GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG, 491001 (C.G.)

(Former Name – Govt. Arts & Science College, Durg)

NAAC Accredited Grade A+, College with CPE - Phase III (UGC), STAR COLLEGE (DBT)

Phone : 0788-2212030

Website - www.govtsciencecollegedurg.ac.in, Email – autonomousdurg2013@gmail.com

DEPARTMENT OF PHYSICS

COURSE CURRICULUM & MARKING SCHEME

B.Sc. VII & VIII Semester

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SESSION : 2025-26

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Govt. V.Y.T. PG Autonomous College, Durg
(Chhattisgarh)
(Erstwhile: Govt. Arts & Science College, Durg)

B. Sc. WITH PHYSICS

[B.Sc. (PMC), B.Sc. (PMEl), B.Sc. (PMCs), B.Sc. (PMIt), B.Sc. (PMGl)]

VII & VIII Semester

2025-26

Govt. V.Y.T. PG Autonomous College, Durg (Chhattisgarh)

(Erstwhile: Govt. Arts & Science College, Durg)

Appendix-II (Amended)

UGCF for Multidisciplinary Courses of Study							
Sem.	**DSC**	**DSE**	**GE**	**AEC**	**SEC/ Internship/ Apprenticeship / Project/ Dissertation / Community outreach (2)**	**VAC**	**Total Credits**
I	DSC A 1-(4) DSC B 1-(4) DSC C 1-(4)		Choose one from a pool of courses GE-1 (4)	Choose one from a pool of AEC courses (2)	Choose one from a pool of courses (2)	Choose one from a pool of courses (2)	**22 Credits**
II	DSC A 2-(4) DSC B 2-(4) DSC C 2-(4)		Choose one from a pool of courses GE-2 (4)	Choose one from a pool of AEC courses (2)	Choose one from a pool of courses (2)	Choose one from a pool of courses (2)	**22 Credits**
Students exiting shall be awarded Undergraduate Certificate (in the Field of study/Discipline) after securing the minimum 40 credits in semester I and II							**Total = 44 Credits**
III	DSC A 3-(4) DSC B 3-(4) DSC C 3-(4)	Choose one from a pool of courses DSE A/B/C (4) Or Choose one from a pool of courses GE-3(4)		Choose one from a pool of AEC courses (2)	**Choose one SEC (2) OR** Internship/Apprenticeship/Project/community outreach **(2)**	Choose one from a pool of courses (2)	**22 Credits**
IV	DSC A 4-(4) DSC B 4-(4) DSC C 4-(4)	Choose one from a pool of courses DSE A/B/C (4) Or Choose one from a pool of courses GE-4(4)		Choose one from a pool of AEC courses (2)	**Choose one SEC (2)OR** Internship/Apprenticeship/Project/community outreach **(2)**	Choose one from a pool of courses (2)	**22 Credits**
Students exiting shall be awarded Undergraduate Diploma (in the Field of study/Discipline) after securing the minimum 80 credits on completion of semester IV							**Total = 88 Credits**
V	DSC A 5-(4) DSC B 5-(4) DSC C 5-(4)	Choose two from a pool of courses DSE A/B/C (4+4) OR Choose two from a pool of courses GE-5 (4) & GE-6 (4)			**Choose one SEC (2) OR** Internship/Apprenticeship/Project/community outreach **(2)**		**22 Credits**
VI	DSC A 6-(4) DSC B 6-(4) DSC C 6-(4)	Choose two from a pool of courses DSE A/B/C (4+4) Choose one from a pool of courses GE-7 (4)& GE-8 (4)			Internship/Apprenticeship/Project/community outreach **(2)**		**22 Credits**
Students exiting shall be awarded Bachelor of (in the Field of Multidisciplinary study) in relevant Discipline after securing the minimum 120 credits on completion of semester VI							**Total = 132 Credits**
VII	DSCA/B/C-(4)	Choose Four DSE (4x4) courses **OR** Choose three DSE-(3x4) and one GE-(1x4) course **OR** Choose one DSE (1 x 4) and Three GE (3 x 4) courses **OR** All Four GE 9, 10, 11 & 12 (4x4) (total=16)					**20 credits**
VIII	DSC A/B/C-(4)	Choose Four DSE(4x4) courses **OR** Choose three DSE-(3x4) and one GE-(1x4) course **OR** Choose one DSE -(1x4) and Three GE(4) (3x4) courses **OR** All Four GE 13, 14, 15 & 16 (4x4) (total=16)					**20 credits**
Students shall be awarded Bachelor of (in the Field of Multidisciplinary study) (Honours)in relevant Discipline after securing the minimum 160 credits on completion of Semester VIII OR							**Total = 172 Credits**
VII	DSCA/B/C-(4)	Choose Four DSE(4x4) courses **OR** Choose three DSE-(3x4) and one GE-(1x4) course**OR** Choose one DSE (1 x 4) and Three GE (3 x 4) courses **OR** All Four GE 9, 10, 11 & 12(4x4) (total=16)					**20 credits**
VIII	DSC A/B/C-(4)	Choose one DSE (1 x 4) courses **OR** Choose one GE(1 x 4) course **OR**			**Research Project / Dissertation (12)**		**20 credits**
Students shall be awarded Bachelor of (in the Field of Multidisciplinary study) (Honours with Research) in relevant Discipline after securing the minimum 160 credits on completion of Semester VIII							**Total = 172 Credits**

Govt. V.Y.T. PG Autonomous College, Durg (Chhattisgarh)

(Erstwhile: Govt. Arts & Science College, Durg)

Approved syllabus for Semester and CBCS curriculum of B.Sc. with PHYSICS, by the members of Board of Studies for Session 2025-26

Semester VII	No. of Credits	Semester VIII For students opting B.Sc. Honours (with Physics) CGPA (completion of VI Sem) < 7.5	No. of Credits	Semester VIII For students opting B.Sc. Honours (withResearch) CGPA (completion of VI Sem) >=7.5	No. of Credits
DSC: BPH701 Electronic Devices and Digital Electronics	3	DSC : BPH801 Atomic and Molecular Physics-II	3	DSC : BPH801 Atomic and Molecular Physics-II	3
DSC: BPHL701 Electronic Devices and Digital Electronics Lab	1	DSC : BPHL801 Atomic and Molecular Physics Lab	1	DSC : BPHL801 Atomic and Molecular Physics Lab	1
Choose four DSE from the below pool		Choose four DSE from the below pool		Research Project/Dissertation Supervised by Teacher	12
DSE: BPH702 Mathematical Physics	3	DSE : BPH802 Quantum Physics – II (3Th+1T)	4	One DSE	
DSE: BPHL702 C – Programming Lab	1	DSE : BPH803 Statistical Mechanics (3Th+1T)	4	DSE : BPH802 Quantum Physics – II (3Th+1T)	4
DSE : BPH703 Classical Mechanics (3Th+1T)	4	DSE : BPH804 Electrodynamics (3Th+1T)	4	DSE : BPH803 Statistical Mechanics (3Th+1T)	4
DSE :BPH704 Quantum Mechanics - I (3Th+1T)	4	DSE : BPH805 Introduction to Nanomaterials	3	DSE : BPH804 Electrodynamics (3Th+1T)	4
DSE :BPH705 Physics of Liquid Crystals (3Th+1T)	4	DSE : BPHL805 Introduction to Nanomaterials Lab	1	DSE : BPH805 Introduction to Nanomaterials	3
-	-	-	-	DSE : BPHL805 Introduction to Nanomaterials Lab	1

Govt. V.Y.T. PG Autonomous College, Durg (Chhattisgarh)

(Erstwhile: Govt. Arts & Science College, Durg)

Absolute Grading System (for conversion of marks into grade points)

Letter Grade	Grade point	Obtained Score
O (Outstanding) 10	10	>90 and =100
A+(Excellent) 9	9	>80 and =90
A(Very Good) 8	8	>70 and =80
B+(Good) 7	7	>60 and =70
B(Above Average) 6	6	>50 and =60
C(Average) 5	5	>40 and =50
P (Pass) 4	4	=40
F(Fail) 0	0	<40
Ab (Absent) 0	0	0

Govt. V.Y.T. PG Autonomous College, Durg (Chhattisgarh)

(Erstwhile: Govt. Arts & Science College, Durg)

Syllabus and Marking Scheme for B.Sc. with Physics
Session 2025-2026
Semester VII

Course Type	Title of the Paper	No. of Credits	Marks Allotted in Theory & Practical			
			SEM. END	INTERNAL ASS.	TOTAL MARKS	
			Max	Max	Max	Min
DSC	BPH701 Electronic Devices and Digital Electronics	3	60	15	75	30
DSC	BPHL701 Electronic Devices and Digital Electronics Lab	1	25	-	25	10
DSE	BPH702 Mathematical Physics	3	60	15	75	30
DSE	BPHL702 C – Programming Lab	1	25	-	25	10
DSE	BPH703 Classical Mechanics	4	80	20	100	40
DSE	BPH704 Quantum Mechanics - I	4	80	20	100	40
DSE	BPH705 Physics of Liquid Crystals	4	80	20	100	40

GOVT. V.Y.T.PG AUTONOMOUS COLLEGE DURG

FOUR YEAR UNDERGRADUATE PROGRAM

DEPARTMENT OF PHYSICS

COURSE CURRICULUM 2025-26

PART A: INTRODUCTION				
Program: FYUP B.Sc. with Physics		**Class: B.Sc. (with Physics)**	**Semester - VII**	**Session: 2025-2026**
1	**Course Code**	**BPH701**		
2	**Course Title**	**ELECTRONIC DEVICES AND DIGITAL ELECTRONICS**		
3	**Course Type**	**Discipline Specific Course (DSC)**		
4	**Course Learning Outcome (CLO)**	**This Course will enable the students to:** • Understand transistor and diode characteristics and apply it to design electronic circuits and microwave devices of desired configurations. • Identify and model various Photonic devices, their working principle and applications in numerous present day technologies. • Implement laws of Boolean algebra for reduction for various logic circuits and create K-Map. • Recognize microprocessor 8085 and its basic working along with familiarization of all type of memory devices.		
5	**Credit Value**	**3 Credits**	**1 Credit =15 Hours/Sem. – Learning and Observation**	
6	**Total Marks**	**Maximum Marks :100**		**Minimum Passing Marks:40**

PART B: CONTENT OF THE COURSE		
Total no. of Teaching/ Learning Periods = 45 Periods (45 Hours)		
Unit	**Topics (COURSE CONTENTS)**	**No. of Periods**
I	**Transistors:** - BJT, JFET, MOSFET and MESFET: Structure working, Derivation of the equation for I-V characteristics under different condition. **Microwave Devices:** - Gunn diode (Transferred Electron Devices), Transit time device - IMPATT diodes, TRAPATT Diode.	**10**
II	**Photonic Devices** - Radiative and non-radiative transition, optical Absorption bulk and thin flim, photo conductive device (LDR), Photo detectors, solar cell open circuit voltage and short circuit current LED (high frequency limit effect of surface and indirect recombination current, operation of LED) laser condition for population inversion in active region, light confinement factor, optical gain.	**12**
III	**Digital Electronic Devices:** Logic gates: OR, AND, NOT, NAND, NOR, Ex-OR, Ex-NOR GATES, Number system: binary numbers, binary to decimal conversion, decimal to binary conversion, binary addition, binary subtraction, 1's compliment, 2s compliments, binary multiplication and division, octal and hexadecimal numbers, BCD code and gray code. Boolean Algebra: De Morgen's theorem, laws and theorems of Boolean algebra, sum of product and product of sums simplification, Karnaugh map simplification.	**10**

IV	**Memory Devices:** RAM, ROM, PROM, EPROM, A/D and D/A converters, Static and dynamic random-access memories (SRAM and DRAM), NMOS and CMOS, charge coupled devices (CCD) Microprocessor: introduction to a microprocessor. INTEL 8085 Architecture and pin diagram, CPU, Instruction set for 8085 microprocessor and programs.	**13**

PART C - LEARNING RESOURCES

Text Books, Reference Books, Other Resources

TEXT BOOKS Recommended :

- Handbook of Electronics by Kumar & Gupta.
- Principles of Electronics by V.K. Mehta.
- Fundamental; of Digital Circuit by A. Anand Kumar.
- Digital Electronics by R.P. Jain.
- Microprocessor by Vibhute.

Reference Books

- Digital Electronics and microcomputers by R. K .Gaur
- Integrated Circuits by K. R. Botkar
- 8085 microprocessor by Ramesh Gaonkar.

Online Resources: (e- Resources/ e- Books/ e- Learning Portals)

- 8085Microprocessor: https://www.youtube.com/playlist?list=PLfzBO7vcQZ1IMDUDXph5wB9csF-yYD4GC

PART D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:	
Maximum Marks:	**75 Marks**
Continuous Comprehensive Evaluation (CCE):	**15 Marks**
Semester End Exam (SEE):	**60 Marks**
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Internal Test of 15 Marks and Assignment of 15 Marks

Semester End Exam (SEE)	**Pattern -FOUR Questions (A, B, C, D) from each Unit**	
	Question - A & B: (Compulsory) Very short answer type (02 each)	04 x 4 = 16 Marks
	Question - C: Short answer type question	04 x 4 = 16 Marks
	Question - D: Long answer type question	07 x 4 = 28 Marks
		Total = 60 Marks

Name & Signature of Members of Board of Studies

	Departmental members
V.C. Nominee	**1. H.O.D/ Dr. Jagjeet Kaur Saluja** .....
Subject Expert	**2. Dr. Anita Shukla** .....
Subject Expert	**3. Dr. Siteshwari Chandraker** .....
Alumni (member).....	**4. Dr. Abhishek Kumar Misra** .....
Prof. from other Dept. of Sc. Faculty	**5. Dr. Kusumanjali Deshmukh**.....
Specialist from Industry.....	

GOVT. V.Y.T.PG AUTONOMOUS COLLEGE DURG

FOUR YEAR UNDERGRADUATE PROGRAM

DEPARTMENT OF PHYSICS

COURSE CURRICULUM 2025-26

LAB COURSE

PART A: INTRODUCTION				
Program: FYUP B.Sc. with Physics		**Class: B.Sc. (with Physics)** **Semester - VII**		**Session: 2025-2026**
1	**Course Code**	**BPHL701**		
2	**Course Title**	**ELECTRONIC DEVICES AND DIGITAL ELECTRONICS LAB**		
3	**Course Type**	**Discipline Specific Course (DSC)**		
4	**Course Learning Outcome (CLO)**	**This Course will enable the students to:** • Design and resolve circuits for electronic applications. • Record data as required by the experimental objectives. • Analyse recorded data and formulate it to get desired results. • Implement of microprocessor 8085 programming.		
5	**Credit Value**	**1 Credit**	**1 credit =30 Hours/Sem – Learning and Observation**	
6	**Total Marks**	**Maximum Marks: 25**		**Minimum Passing Marks: 10**

PART B: CONTENT OF THE COURSE	
S. No.	**List of Experiments**
1	Study of transistor amplifier in Common Emitter (CE) mode.
2	Study of transistor amplifier in Common Base (CB) mode.
3	Design and study of Regulated Power supply.
4	Study of FET & MOSFET Characterization and Application as an Amplifier.
5	Characteristics & applications of S.C.R.
6	Study of UJT & its application.
7	Digital-I Basic logic Gates, T.T.L.NAND, NOR gates.
8	Digital-II Combinational Logic Gates.
9	Study of 4-bit adder and subtractor.
10	Experiment with microprocessor: (a) To multiply two 8 bit numbers. (b) To divide 16 bit number by 8 bit number.
11	Experiment with microprocessor: (a) To transfer a block of data in forward order. (b) To transfer a block of data in reverse order.
12	Experiment with microprocessor: (a) To arrange data in ascending order. (b) To arrange data in descending order.
13	Experiment with microprocessor: (a) To find the largest number in an array. (b) To find the smallest number in an array.

PART C - LEARNING RESOURCES

Text Books, Reference Books, Other Resources

TEXT BOOKS Recommended:

- Electronics practical by A. K. Mittal.
- Digital electronics laboratory manual by Abraham M. Michelen.
- Practical Electronics (Volume I): 8085 Microprocessor & 8051 Microcontroller Laboratory Manual by T. Veeramanikandasamy, A. Balamurugan

Online Resources: (e- Resources/ e- Books/ e- Learning Portals)

- **https://www.youtube.com/watch?v=3n61HkAP9uE**
- **https://www.youtube.com/watch?v=jBpL10FFmHk**
- **https://www.youtube.com/watch?v=x0oMKdA8Zzk**
- **https://www.youtube.com/watch?v=h4jXNsH-LvQ**
- **https://www.youtube.com/watch?v=zkJqQtTX7xc**

PART D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 25 Marks
(Will include Internal assessment, Lab records and End Semester Viva/Voce and performance)

Semester End Exam (SEE)	**Laboratory performance:** Students are required to perform one experiment, take observation and make calculations in the allotted duration of 2 hours. Viva voce will be based on the experiment performed.

Name & Signature of Members of Board of Studies

	Departmental members
V.C. Nominee	**1. H.O.D/ Dr. Jagjeet Kaur Saluja** .....
Subject Expert	**2. Dr. Anita Shukla** .....
Subject Expert	**3. Dr. Siteshwari Chandraker** .....
Alumni (member).....	**4. Dr. Abhishek Kumar Misra** .....
Prof. from other Dept. of Sc. Faculty	**5. Dr. Kusumanjali Deshmukh**.....
Specialist from Industry.....	

GOVT. V.Y.T.PG AUTONOMOUS COLLEGE DURG

FOUR YEAR UNDERGRADUATE PROGRAM

DEPARTMENT OF PHYSICS

COURSE CURRICULUM 2025-26

PART A: INTRODUCTION				
Program: FYUP B.Sc. with Physics		**Class: B.Sc. (with Physics)**	**Semester - VII**	**Session: 2025-2026**
1	**Course Code**	**BPH702**		
2	**Course Title**	**MATHEMATICAL PHYSICS**		
3	**Course Type**	**Discipline Specific Elective (DSE)**		
4	**Course Learning Outcome (CLO)**	**This Course will enable the students to:** • Analyze - Basic idea of Group, finite and infinite decimal Vector space and Subspace. Basic idea about matrix Compute eigen Values and eigen vectors, characteristic polynomials and apply to basic digonalization of matrix • Determine the continuity, differentiability of functions, find the complementary function of PI and LDE. • Distinguish the integral of infinite order into general and singular integrals. Solve and apply linear equation of order two and higher LDE using Laplace's Transformation. Perform Transforms like Laplace's Transformation, Fourier series, Fourier Transformations. Get familiar with the modelling assumption and derive the idea to PDE. • Learn to derive solution by series expansion and Legendre, Bessel's, Hermite and Lagurre equation and physical applications of Legendre, Hermite and Lagurres polinomials.		
5	**Credit Value**	**3 Credits**	**1 Credit =15 Hours/Sem. – Learning and Observation**	
6	**Total Marks**	**Maximum Marks :100**		**Minimum Passing Marks:40**

PART B: CONTENT OF THE COURSE		
Total no. of Teaching/ Learning Periods = 45 Periods (45 Hours)		
Unit	**Topics (COURSE CONTENTS)**	**No. of Periods**
I	**GROUP -** Basic idea of Group, Finite and infinite group, Identity element, Groups of Vector, Ordered set of numbers, Linear dependence and independence of Vector, Properties of linearly independent and dependent System, subspace Subspace of n- Vector s, Vector field, orthonormal vectors, ortho-normalzation by Scmidts orthogonalization method linear transformation of the space, Vector space of n-tuplets, Inner product space, linear transformation, homogeneous and non homogeneous transformation. Full linear transformation of a quadratic form.	**12**

II	**MATRICES** – Real, symmetric and Hermitian matrices. matrices with polynomial elements the inverse matrix, orthogonal matrix, independent element of an orthogonal matrix, unitary matrix, independent element of a unitary matrix, Eigen Values and Eigen vectors, Digonalization of matrix. Linear equation, Solution of linear equation by Cramer's rule.	**10**
III	**SPECIAL FUNCTIONS-** Solution of second order linear differential equation with constant coefficients, Second orders linear ODEs with variable coefficient, Series integration method of the solution of linear differential equation (Frobenius method), Solution by series expansion and Legendre, Bessel's, Hermite and Lagurre equation, Physical applications, Generating Functions, recurrence formulae, orthogonality, Rodrigueues formula of Legendre, Hermite and Laguerre polynomials.	**13**
IV	**INTEGRAL TRANSFORM** – Laplace's Transformation - Definition of Laplace's transform sectional or piecewise continuity, functions of exponential order, sufficient condition for existence of Laplace transform, first and second shifting theorem, change of scale property, LT of derivatives and LT of integrals, Inverse LT definition and properties, Inverse LT by Partial fraction, Fourier series, Fourier Transform definition properties linearity theorem similarity theorem and Conjugate theorem, Fourier Transform of derivatives.	**10**

PART C - LEARNING RESOURCES

Text Books, Reference Books, Other Resources

TEXT BOOKS Recommended :

- Text book of Matrices by Shanti Narayana.
- Higher Engineering Mathematics by H.K. Das.

Reference Books:

- Laplaces Transfrom by Murray R.S.Spiegel
- Special function by J.N.Sharma
- Matrix & Tensors in Physics by R.K.Gupta , A.W.Joshi
- Mathematical method for engineering and physicist. By A.K.Mukhopadhyay.
- Introduction to mathematical physics by Charlie Harper.
- Advanced Engineering Mathematics by Jain and Iyenger.

Online Resources: (e- Resources/ e- Books/ e- Learning Portals)

- https://youtu.be/KaLA1cWhQlA?si=tJOtk9r65eJok-Jz
- https://youtu.be/QrvMdqdjbvw?si=CafcWFAKXow-maZO
- https://youtu.be/d7NF-_8vVv4?si=-dflsL9Al0KBGiha

PART D: ASSESSMENT AND EVALUATION		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **75 Marks** **Continuous Comprehensive Evaluation (CCE):** **15 Marks** **Semester End Exam (SEE):** **60 Marks**		
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Internal Test of 15 Marks and Assignment of 15 Marks	
Semester End Exam (SEE)	**Pattern -FOUR Questions (A, B, C, D) from each Unit** Question - A & B: (Compulsory) Very short answer type (02 each) Question - C: Short answer type question Question - D: Long answer type question	04 x 4 = 16 Marks 04 x 4 = 16 Marks 07 x 4 = 28 Marks **Total = 60 Marks**

Name & Signature of Members of Board of Studies

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GOVT. V.Y.T.PG AUTONOMOUS COLLEGE DURG

FOUR YEAR UNDERGRADUATE PROGRAM

DEPARTMENT OF PHYSICS

COURSE CURRICULUM 2025-26

LAB COURSE

PART A: INTRODUCTION				
Program: FYUP B.Sc. with Physics		**Class: B.Sc. (with Physics)** **Semester - VII**		**Session: 2025-2026**
1	**Course Code**	**BPHL702**		
2	**Course Title**	**C PROGRAMMING LAB**		
3	**Course Type**	**Discipline Specific Elective (DSE)**		
4	**Course Learning Outcome (CLO)**	**This Course will enable the students to:** • Write Program in C- Language for a given problem. • Execute and run the program successfully. • Debug the errors notified during the run. • Compare and appreciate the software programming.		
5	**Credit Value**	**1 Credit**	**1 credit =30 Hours/Sem – Learning and Observation**	
6	**Total Marks**	**Maximum Marks: 25**		**Minimum Passing Marks: 10**

PART B: CONTENT OF THE COURSE	
S. No.	**List of Experiments**
1	Write a program to convert the temperature from Celsius to Fahrenheit.
2	Write a program to convert the temperature from Fahrenheit to Celsius.
3	Write a program that prints the even numbers from 1 to 100.
4	Write a program that computes and prints a table of factorials for any given number n.
5	Write a program to calculate and print the first n Fibonacci numbers.
6	Write a program to calculate simple interest.
7	Write a program for simple interest of three sets of principal amount, rate and number of years.
8	Write a program to sort numbers in ascending order.
9	Write a program to sort numbers in descending order.
10	Write a program to accept three numerical values and print the biggest number out of this.
11	Write a program to input an integer through key board and then to find out whether it is odd or even number.
12	Write a program to print two numbers.
13	Write a program for solving two simultaneous equations.

PART C - LEARNING RESOURCES
Text Books, Reference Books, Other Resources
TEXT BOOKS Recommended: • Programming in Ansi C by E- Balagurusamy • Let us C by Jayant Kanetkar **Online Resources: (e- Resources/ e- Books/ e- Learning Portals)**

PART D: ASSESSMENT AND EVALUATION	
Suggested Continuous Evaluation Methods: **Maximum Marks: 25 Marks** **(Will include Internal assessment, Lab records and End Semester Viva/Voce and performance)**	
Semester End Exam (SEE)	**Laboratory performance:** Students are required to perform one experiment, take observation and make calculations in the allotted duration of 2 hours. Viva voce will be based on the experiment performed.

Name & Signature of Members of Board of Studies

V.C. Nominee	**Departmental members** **1. H.O.D/ Dr. Jagjeet Kaur Saluja**.....
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Subject Expert	**3. Dr. Siteshwari Chandraker** .....
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Prof. from other Dept. of Sc. Faculty	**5. Dr. Kusumanjali Deshmukh**.....
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GOVT. V.Y.T.PG AUTONOMOUS COLLEGE DURG

FOUR YEAR UNDERGRADUATE PROGRAM

DEPARTMENT OF PHYSICS

COURSE CURRICULUM 2025-26

PART A: INTRODUCTION			
Program: FYUP B.Sc. with Physics		**Class: B.Sc. (with Physics) Semester - VII**	**Session: 2025-2026**
1	**Course Code**	**BPH703**	
2	**Course Title**	**CLASSICAL MECHANICS**	
3	**Course Type**	**Discipline Specific Elective (DSE)**	
4	**Course Learning Outcome (CLO)**	**This Course will enable the students to:** • Understand planar and spatial motion of a rigid body, • Utilize appropriate mathematical tools to analyse and solve a system's equations. • Demonstrate a basic knowledge of Lagrangian and Hamiltonian dynamics. • Apply Lagrangian & Hamiltonian methods to complex motion problems. • Demonstrate an understanding of the central-force motion.	
5	**Credit Value**	**3 Credits + 1 Tutorial**	**1 credit =15 Hours – Learning and Observation**
6	**Total Marks**	**Maximum Marks :100**	**Minimum Passing Marks:40**

PART B: CONTENT OF THE COURSE

Total no. of Teaching/ Learning Periods = 45 Periods (45 Hours)

Unit	Topics (COURSE CONTENTS)	No. of Periods
I	Preliminaries, Newtonian mechanics of one and many particle system; conservation laws. Working theorem, Constraints, their classification principle of virtual work, The basic problem with constraint forces. D'Alemberts principle, degree of freedom,generalized coordinates.	**9**
II	Lagrange's equations, Jacobi integral Generalized moment and energy. Gauge function for Lagrangian integrals of motion, concept of symmetry, symmetries of space and time with conservation laws, invariance under Galilean transformation, Special theory of relativity- Lorentz transformations, relativistic kinematics and mass–energy equivalence.	**12**
III	Rotating frames, inertial forces, Electromagnetic analogy of the inertial forces terrestrial and astronomical applications of carioles force. Central force. Two body problem, stability of orbit, conditions for closure, Kepler's equation, orbits of artificial satellites.	**11**

IV	Principle of least action, Hamilton's Principle and characteristic function H-J (Hamilton Jacobi) equation canonical Transformation, Generating Function, Poisson bracket, Poisson theorem, Study of small oscillations using generalized coordinates.	13
	Tutorial	**15**
	Formulation of Problem: Use Classical method to solve mechanical problem as follows **Problem-Solving** • Discussion of Generalized coordinates, D' Alembert's Principle and its applications. • Problems solving of degree of freedom and generalized coordinates. **Mathematical Formulation and obtaining equation of motion** • Lagrange equation of motion for different systems • Numerical calculation related with Special theory of relativity **Discussion of Rotating frames and central forces** • Reduction of two body problem in single body • Discussion of central force related problems **Canonical Transformation and their applications** • Transformation equation from one set to other set • Numerical problems related with Poisson Bracket and Canonical Transformation	

PART C - LEARNING RESOURCES

Text Books, Reference Books, Other Resources

TEXT BOOKS Recommended :

- Classical Mechanics by H.Goldestein
- Classical Mechanics by N. C.Rana & P.S. Joag
- Classical Mechanics by J. C. Upadhyaya
- Classical Mechanics by Gupta Kumar
- Classical Mechanics by Pouranic
- Feynman, Richard P. (2005). The Feynman Lectures on Physics. Vol. 1 (2nd ed.). Addison-Wesley. ISBN 978-0-8053-9065-0.

Reference Books :

- Halliday, David; Resnick, Robert (1970). Fundamentals of Physics. John Wiley & Sons. Chapters 1–21. Numerous subsequent editions.
- Hamill, Patrick (2014). A Student's Guide to Lagrangians and Hamiltonians. Cambridge University Press. ISBN 978-1107617520.
- Hand, Louis; Finch, Janet (1998). Analytical Mechanics. Cambridge University Press. ISBN 0521573270.
- Kibble, T. W.; Berkshire, F. H. (2004). Classical Mechanics. Imperial College Press. ISBN 1860944248.

- Kleppner, Daniel; Kolenkow, Robert (1973). An Introduction to Mechanics. McGraw-Hill. ISBN 0-07-035048-5.
- Morin, David (2005). Introduction to Classical Mechanics: With Problems and Solutions. Cambridge University Press. ISBN 9780521876223.
- Müller-Kirsten, Harald J.W. (2024). Classical Mechanics and Relativity (2nd ed.). World Scientific. ISBN 9789811287114.
- Taylor, John (2005). Classical Mechanics. University Science Books. ISBN 978-981-12-8711-4.
- Young, Hugh D.; Freedman, Roger A. (2019). University Physics with Modern Physics (15th ed.). Pearson. ISBN 978-0135159552.

Online Resources: (e- Resources/ e- Books/ e- Learning Portals)

1. https://ocw.mit.edu/courses/8-01sc-classical-mechanics-fall-2016/
2. https://m.youtube.com/watch?v=83QCm3LkuEg&t=0s
3. https://homepages.iitb.ac.in/~shukla/class_mech.html

PART D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Comprehensive Evaluation (CCE):	**20 Marks**
Semester End Exam (SEE):	**80 Marks**

Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Internal Test of 20 Marks and Assignment of 20 Marks

Semester End Exam (SEE)	**Pattern -FOUR Questions (A, B, C, D) from each Unit**	
	Question - A & B: (Compulsory) Very short answer type (02 each)	04 x 4 = 16 Marks
	Question - C: Short answer type question	06 x 4 = 24 Marks
	Question - D: Long answer type question	10 x 4 = 40 Marks
		Total = 80 Marks

Name & Signature of Members of Board of Studies

	Departmental members
V.C. Nominee	**1. H.O.D/ Dr. Jagjeet Kaur Saluja**.....
Subject Expert	**2. Dr. Anita Shukla** .....
Subject Expert	**3. Dr. Siteshwari Chandraker** .....
Alumni (member).....	**4. Dr. Abhishek Kumar Misra** .....
Prof. from other Dept. of Sc. Faculty	**5. Dr. Kusumanjali Deshmukh**.....
Specialist from Industry.....	

GOVT. V.Y.T.PG AUTONOMOUS COLLEGE DURG

FOUR YEAR UNDERGRADUATE PROGRAM

DEPARTMENT OF PHYSICS

COURSE CURRICULUM 2025-26

PART A: INTRODUCTION			
Program: FYUP B.Sc. with Physics		**Class: B.Sc. (with Physics)** **Semester - VII**	**Session: 2025-2026**
1	**Course Code**	**BPH704**	
2	**Course Title**	**Quantum Mechanics-I**	
3	**Course Type**	**Discipline Specific Elective (DSE)**	
4	**Course Learning Outcome (CLO)**	**This Course will enable the students to:** • Get familiarize with basic non-relativistic quantum mechanics, old quantum theory, interpretation of wave function, uncertainty principle in quantum mechanics and commutation relations. • Solve and analyze Dirac delta function, box normalization, Hilbert space, matrix mechanics, Schrodinger, Heisenberg and interaction pictures, particle in a box, tunneling through a potential barrier, linear harmonic oscillator. • Develop the idea of symmetry in space and time, spherical harmonics, angular momentum, addition of angular momenta and Clebsch-Gordon coefficients. • Understand the basic concepts of hydrogen atom in quantum mechanics, time independent perturbation theory and its applications to harmonic oscillator, Zeeman effect without spin and Stark effect.	
5	**Credit Value**	**3 Credits + 1 Tutorial**	**1 credit =15 Hours – Learning and Observation**
6	**Total Marks**	**Maximum Marks :100**	**Minimum Passing Marks:40**

PART B: CONTENT OF THE COURSE

Total no. of Teaching/ Learning Periods = 45 Periods (45 Hours)

Unit	Topics (COURSE CONTENTS)	No. of Periods
I	**Origin of Quantum Mechanics** : Born's statistical and Bohr-Heisenberg (Copenhagen) interpretations of wave function, Superposition of states and collapse of wave function, Schrodinger cat experiment, EPR paradox. **Mathematical Formulation** : Linear vector space, Wave function as a vector in Hilbert space, Dirac's bra and ket notations, orthogonality and completeness conditions, Observables and operators, Properties of Hermitian operators, Expectation values, Unitary transformations, Position and momentum representation, Ehrenfest's theorem, Dirac delta function.	10
II	**Uncertainty Principle:** Heisenberg uncertainty principle, its theoretical proof an application. **Quantum Dynamics:** Rectangular potential barrier and tunneling, Linear Harmonic oscillator solution using creation and annihilation operators, Schrodinger, Heisenberg & Interaction pictures.	11

III	**Angular Momentum:** Definition of angular momentum, eigenvalues and Eigen functions of orbital and total angular momenta, Spherical harmonics, Angular momentum matrices, Spin and parity operators, symmetry and conservation principle, Pauli spin matrices, Addition of two angular momenta, Clebsch- Gordon coefficients for j1= j2 = 1/2.	**12**
IV	**Hydrogen Atom**: Radial equation, asymptotic solution, eigen values and eigen functions, degeneracy; Laguerre polynomials. **Perturbation Theory**: Time independent perturbation theory – non-degenerate and degenerate cases, removal of degeneracy, applications to (i) harmonic oscillator, (ii) first order Stark effect in hydrogen and (iii) Zeeman effect without electron spin.	**12**
	Tutorial	**15**
	Formulation of Problem: Use QM method to formulate a problem/ given system or situation **Problem-Solving** **1. Foundations of Quantum Mechanics** • Probability interpretation: Given a wave function, calculate the probability of finding a particle in a certain region. • Superposition principle: Compute expectation values for a superposed state. **2. Mathematical Formulation** • Vector space: Represent wave functions as vectors and verify orthogonality. • Dirac notation: Express a given wave function in bra-ket form and compute expectation values. • Hermitian operators: Prove a given operator is Hermitian and compute eigenvalues. • Unitary transformations: Apply a unitary operator to a given state and check probability conservation. **3. Uncertainty Principle** • Application: Find uncertainty in momentum for a Gaussian wave packet. **4. Quantum Dynamics** • Rectangular barrier: Compute transmission and reflection coefficients. • Tunneling: Estimate decay probability for an alpha particle. • Harmonic oscillator: Find energy eigenvalues using creation and annihilation operators. **5. Angular Momentum** • Compute eigenvalues of L2L^2L2 and LzL_zLz for a given state. • Normalize and compute spherical harmonics for l=1,m=0l=1, m=0l=1,m=0. • Compute Pauli matrices and verify their algebra. • Solve an addition of angular momentum problem using Clebsch-Gordon coefficients. **7. Perturbation Theory** Compute first-order energy correction for a perturbed harmonic oscillator.	

PART C - LEARNING RESOURCES

Text Books, Reference Books, Other Resources

TEXT BOOKS Recommended :

- Quantum Mechanics: Satyaprakash.
- Quantum Mechanics : Gupta Kumar

Reference Books :

- Introduction to Quantum Mechanics by David J. Griffiths
- Quantum Mechanics by B. H. Bransden and C. J. Joachain
- Quantum Mechanics by L. I. Schiff
- Quantum Mechanics : Concepts & Applications by Nouredine Zettili
- Quantum Mechanics : Non-relativistic Theory by L. D. Landau & E.M. Lifshitz
- Quantum Mechanics by Mathews and Venkatesan.

Online Resources: (e- Resources/ e- Books/ e- Learning Portals)

PART D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Comprehensive Evaluation (CCE):	**20 Marks**
Semester End Exam (SEE):	**80 Marks**

Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Internal Test of 20 Marks and Assignment of 20 Marks

Semester End Exam (SEE)	**Pattern -FOUR Questions (A, B, C, D) from each Unit**	
	Question - A & B: (Compulsory) Very short answer type (02 each)	04 x 4 = 16 Marks
	Question - C: Short answer type question	06 x 4 = 24 Marks
	Question - D: Long answer type question	10 x 4 = 40 Marks
		Total = 80 Marks

Name & Signature of Members of Board of Studies

	Departmental members
V.C. Nominee	**1. H.O.D/ Dr. Jagjeet Kaur Saluja** .....
Subject Expert	**2. Dr. Anita Shukla** .....
Subject Expert	**3. Dr. Siteshwari Chandraker** .....
Alumni (member).....	**4. Dr. Abhishek Kumar Misra** .....
Prof. from other Dept. of Sc. Faculty	**5. Dr. Kusumanjali Deshmukh**.....
Specialist from Industry.....	

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FOUR YEAR UNDERGRADUATE PROGRAM

DEPARTMENT OF PHYSICS

COURSE CURRICULUM 2025-26

PART A: INTRODUCTION				
Program: FYUP B.Sc. with Physics		**Class: B.Sc. (with Physics)**	**Semester - VII**	**Session: 2025-2026**
1	**Course Code**	**BPH705**		
2	**Course Title**	**PHYSICS OF LIQUID CRYSTALS**		
3	**Course Type**	**Discipline Specific Elective (DSE)**		
4	**Course Learning Outcome (CLO)**	**This Course will enable the students to:** • To learn basics of liquid crystals, their special optical properties • To learn synthesis of liquid crystals, identification of liquid crystal phases and textures. • Applications of liquid crystals in everyday life.		
5	**Credit Value**	**3 Credits + 1 Tutorial**	**1 credit =15 Hours – Learning and Observation**	
6	**Total Marks**	**Maximum Marks :100**	**Minimum Passing Marks:40**	

PART B: CONTENT OF THE COURSE

Total no. of Teaching/ Learning Periods = 45 Periods (45 Hours)

Unit	Topics (COURSE CONTENTS)	No. of Periods
I	Introduction : History of liquid crystals, Mesophase, Types of liquid crystals Thermotropic, Lyotropic, Classification of Liquid Crystals on the basis of Symmetry and structure. Applications: Liquid Crystals in Devices like Liquid crystal displays – (watches, calculators, televisions, clocks, navigation systems, visors, thermometers)- Working principle, Influence of electric field	**10**
II	Optical Properties of Liquid Crystals: Optical Anisotropy, Double Refraction, Birefringence, Polarization of Light, Molecular polarizability, Order Parameter, Phase Transition, I order, II order and monotropic transitions, Theories of Liquid Crystalline Phase Transitions Nature of phase transitions and critical phenomena in liquid crystals, Maier-Saupe and Van der Waals theories for nematic - isotropic and nematic-smectic A transitions; Landau theory: Essential ingradients.	**11**
III	Dielectric and Electro-optical Properties of Liquid Crystals: Dielectric properties like Relative permittivity loss factor Cole- Cole Plot, Calculation of important physical parameters from dielectric data. Electro-optical Properties of Liquid Crystals: Electro-optical Properties of Liquid Crystals like response time, V-I Characteristics, Measurements of Spontaneous polarization, Viscosity and Anchoring Energy Parameters	**12**
IV	Characterization Techniques: Polarizing Optical Microscopy (POM), Differential Scanning Calorimetry, X-ray Diffraction, Electro-optical measurements, UV-VIS Spectroscopy, FTIR Spectroscopy, Dielectric Measurements Measurement of order parameters, magnetic resonance, electron spin resonance, Raman Scattering and X- ray diffraction.	**12**

Tutorial		15
	Fundamentals & Basic Concepts • Understanding definition and introduction of liquid crystal • Discussion of application of liquid crystal in different fields :Liquid Crystal Displays (LCDs), Sensors, Materials Science **Optical Properties of Liquid Crystals** • Discussion of optical properties of liquid crystals • Discussion of Theoretical Model related with liquid crystal **Dielectric and Electro-optical Properties of Liquid Crystals** • Calculation of different parameters from dielectric study • Calculation of different parameters from electro-optical study **Different Characterization Techniques** • Demonstration of FTIR Spectroscopy • Demonstration of UV-Vis Spectroscopy • Analysis of Spectroscopic Techniques by using different software's	

PART C - LEARNING RESOURCES

Text Books, Reference Books, Other Resources

TEXT BOOKS Recommended :

- Quantum Mechanics: Satyaprakash.
- Quantum Mechanics : Gupta Kumar

Reference Books :

- Introduction to Quantum Mechanics by David J. Griffiths
- Quantum Mechanics by B. H. Bransden and C. J. Joachain
- Quantum Mechanics by L. I. Schiff
- Quantum Mechanics : Concepts & Applications by Nouredine Zettili
- Quantum Mechanics : Non-relativistic Theory by L. D. Landau & E.M. Lifshitz
- Quantum Mechanics by Mathews and Venkatesan.

Online Resources: (e- Resources/ e- Books/ e- Learning Portals)

- https://www.nisenet.org/catalog/exploring-products-liquid-crystal-displays
- https://spectrum.ieee.org/video-friday-3d-printed-liquid-crystal-elastomer
- https://dev.ti.com/tirex/explore/node?node=A__AFQSr-4o0s.emuCNylk-Zw__MSPM0-ACADEMY__2f1Egw1__LATEST
- https://ocw.tau.edu.ng/courses/electrical-engineering-and-computer-science/6-007-electromagnetic-energy-from-motors-to-lasers-spring-2011/lab-videos/lab-3-liquid-crystal-displays/

PART D: ASSESSMENT AND EVALUATION		
Suggested Continuous Evaluation Methods:		
Maximum Marks:	**100 Marks**	
Continuous Comprehensive Evaluation (CCE):	**20 Marks**	
Semester End Exam (SEE):	**80 Marks**	
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Internal Test of 20 Marks and Assignment of 20 Marks	
Semester End Exam (SEE)	**Pattern -FOUR Questions (A, B, C, D) from each Unit**	
	Question - A & B: (Compulsory) Very short answer type (02 each)	04 x 4 = 16 Marks
	Question - C: Short answer type question	06 x 4 = 24 Marks
	Question - D: Long answer type question	10 x 4 = 40 Marks
		Total = 80 Marks

Name & Signature of Members of Board of Studies

	Departmental members
V.C. Nominee	**1. H.O.D/ Dr. Jagjeet Kaur Saluja** .....
Subject Expert	**2. Dr. Anita Shukla** .....
Subject Expert	**3. Dr. Siteshwari Chandraker** .....
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Prof. from other Dept. of Sc. Faculty	**5. Dr. Kusumanjali Deshmukh**.....
Specialist from Industry.....	

Govt. V.Y.T. PG Autonomous College, Durg (Chhattisgarh)

(Erstwhile: Govt. Arts & Science College, Durg)

Syllabus and Marking Scheme for B.Sc. with Physics
Session 2025-2026
Semester VIII

Course Type	Title of the Paper	No. of Credits	Marks Allotted in Theory & Practical			
			SEM. END	INTERNAL ASS.	TOTAL MARKS	
			Max	Max	Max	Min
DSC	BPH801 Atomic and Molecular Physics-II	3	60	15	75	30
DSC	BPHL801 Atomic and Molecular Physics Lab	1	25	-	25	10
DSE	BPH802 Quantum Physics - II	4	80	20	100	40
DSE	BPH803 Statistical Mechanics (3Th + 1T)	4	80	20	100	40
DSE	BPH804 Electrodynamics (3Th + 1T)	4	80	20	100	40
DSE	BPH805 Introduction to Nanomaterials	3	60	15	75	30
DSE	BPHL805 Introduction to Nanomaterials Lab	1	25	-	25	10
Research Project/Dissertation		12	-	-	300	120

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FOUR YEAR UNDERGRADUATE PROGRAM

DEPARTMENT OF PHYSICS

COURSE CURRICULUM 2025-26

PART A: INTRODUCTION				
Program: FYUP B.Sc. with Physics		**Class: B.Sc. (with Physics)** **Semester - VIII**		**Session: 2025-2026**
1	**Course Code**	**BPH801**		
2	**Course Title**	**ATOMIC & MOLECULAR PHYSICS-II**		
3	**Course Type**	**Discipline Specific Course (DSC)**		
4	**Course Learning Outcome (CLO)**	**This Course will enable the students to:** • Describe the atomic spectra of one and two valance electron atoms. • Explain the change in behavior of atoms in external applied electric and magnetic field. • Explain rotational, vibrational, electronic and Raman spectra of molecules. • Describe electron spin and IR spectroscopy and their applications.		
5	**Credit Value**	**3 Credits**	**1 Credit =15 Hours/Sem. – Learning and Observation**	
6	**Total Marks**	**Maximum Marks :100**		**Minimum Passing Marks:40**

PART B: CONTENT OF THE COURSE

Total no. of Teaching/ Learning Periods = 45 Periods (45 Hours)

Unit	**Topics (COURSE CONTENTS)**	**No. of Periods**
I	Stationary energy states, radiation terms, continuous spectra, quantum numbers of the individual electrons the Pauli's Principle, quantum theoretical addition of angular momentum vectors, quantum numbers and angular momentum of the whole atom, term Symbols, influence of a magnetic or electric field, selection rules, nuclear spin..	**10**
II	Atomic Orbital, Hydrogen Spectrum (Bohr theory, Sommerfeld theory and Sommerfeld Relativistic Correction) , Spectrum of alkali elements Different Series of Alkali atoms , spin orbit interaction & fine Structure in alkali spectra , Normal and anomalous Zeeman effect, Paschen Back effect, Stark effect, Two electron system, Interaction energy in LS and JJ coupling.	**11**
III	The rigid rotator – The molecules as a rigid rotator, energy eigen values, Eigen function, spectrum. The non-rigid rotator energy levels, The diatomic molecules symmetric top, asymmetric top and spherical top molecule, angular momenta, energy levels, Eigen functions, infrared spectrum.	**12**
IV	The diatomic molecule as an harmonic oscillator, energy levels, Eigen functions, spectrums. Molecules as Vibrating rotator, Vibration spectrum of diatomic molecule, P, Q and R branches, Applications of vibrational spectroscopy, Infra-red spectrum, general experimental arrangement for studying infrared spectra, FTIR.	**12**

PART C - LEARNING RESOURCES

Text Books, Reference Books, Other Resources

TEXT BOOKS Recommended :

- Introduction to atomic spectra- H.E.White
- Fundamental of spectroscopy – C.B.Banwell.
- Spectra of diatomic molecules – Herzbeng
- Molecular structure & Spectroscopy – G.Aruldhas.
- Atomic and Molecular Spectra - Rajkumar

Reference Books

- The classic "Atomic physics" by *Max born*.
- Atomic Physics by *J Foot*.
- The Feynman's lectures volumes.
- Introductory Nuclear Physics by *K S Krane*.

Online Resources: (e- Resources/ e- Books/ e- Learning Portals)

- https://www.youtube.com/watch?v=RWcrL3sRt08
- http://sites.iiserpune.ac.in/~bhasbapat/phy420.html
- https://www.worldscientific.com/worldscibooks/10.1142/3239?srsltid=AfmBOorYNHmUlrm4emEKoDTF6toWQ30Qkjehf0NOEBhAt8A5VDEkKVD6

PART D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:	
Maximum Marks:	**75 Marks**
Continuous Comprehensive Evaluation (CCE):	**15 Marks**
Semester End Exam (SEE):	**60 Marks**

Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Internal Test of 15 Marks and Assignment of 15 Marks

Semester End Exam (SEE)	**Pattern -FOUR Questions (A, B, C, D) from each Unit**	
	Question - A & B: (Compulsory) Very short answer type (02 each)	04 x 4 = 16 Marks
	Question - C: Short answer type question	04 x 4 = 16 Marks
	Question - D: Long answer type question	07 x 4 = 28 Marks
		Total = 60 Marks

Name & Signature of Members of Board of Studies

	Departmental members
V.C. Nominee	**1. H.O.D/ Dr. Jagjeet Kaur Saluja** .....
Subject Expert	**2. Dr. Anita Shukla** .....
Subject Expert	**3. Dr. Siteshwari Chandraker** .....
Alumni (member).....	**4. Dr. Abhishek Kumar Misra** .....
Prof. from other Dept. of Sc. Faculty	**5. Dr. Kusumanjali Deshmukh**.....
Specialist from Industry.....	

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FOUR YEAR UNDERGRADUATE PROGRAM

DEPARTMENT OF PHYSICS

COURSE CURRICULUM 2025-26

LAB COURSE

PART A: INTRODUCTION				
Program: FYUP B.Sc. with Physics		**Class: B.Sc. (with Physics)** **Semester - VIII**		**Session: 2025-2026**
1	**Course Code**	**BPHL801**		
2	**Course Title**	**ATOMIC & MOLECULAR PHYSICS LAB**		
3	**Course Type**	**Discipline Specific Course (DSC)**		
4	**Course Learning Outcome (CLO)**	**This Course will enable the students to:** • Describe the atomic spectra of one and two valance electron atoms. • Explain the change in behavior of atoms in external applied electric and magnetic field. • Explain rotational, vibrational, electronic and Raman spectra of molecules. • Describe electron spin and IR spectroscopy and their applications.		
5	**Credit Value**	**1 Credit**	**1 credit =30 Hours/Sem – Learning and Observation**	
6	**Total Marks**	**Maximum Marks: 25**		**Minimum Passing Marks: 10**

PART B: CONTENT OF THE COURSE

S. No.	List of Experiments
1	Study of temperature dependence of resistivity of a semiconductor by four probe method.
2	Determination of Lande's factor of DPPH using Electron Spin Resonance (ESR) Spectrometer.
3	Measurement of Hall Co-efficient to identify p or n type semiconductors.
4	Determination of Young's modulus "Y" by Newton's Rings.
5	Determination of Young's modulus "Y" by Carno's method.
6	Determination of "e/m" by Millikan's oil drop method.
7	Calibration of drum of a Constant Deviation Spectrometer.
8	Verification of Fresnel's formula.
9	Study of characteristics of negative temperature coefficient Thermister.
10	Analysis of elliptically polarized light by Babinet's Compensator.
11	Determination of refractive index of a liquid Abbe's refractometer.
12	Determination of numerical aperture and bending loss of an Optical fiber.
13	Photoconductivity rise and decay studies and determination of photoconductivity gain.
14	Photo diode characteristics.
15	Photo Transistor characteristics.

16	Determination of Planck Constant with the help of a photo cell.
17	To determine the dielectric constant and permittivity of a solid by resonance method.

PART C - LEARNING RESOURCES

Text Books, Reference Books, Other Resources

TEXT BOOKS Recommended:

- Introduction to atomic spectra- H.E.White
- Fundamental of spectroscopy – C.B.Banwell.
- Spectra of diatomic molecules – Herzbeng
- Molecular structure & Spectroscopy – G.Aruldhas.
- Atomic and Molecular Spectra – Rajkumar
- The classic "Atomic physics" by *Max born*.
- Atomic Physics by *J Foot*.
- The Feynman's lectures volumes.
- Introductory Nuclear Physics by *K S Krane*.

Online Resources: (e- Resources/ e- Books/ e- Learning Portals)

- https://www.youtube.com/watch?v=RWcrL3sRt08
- http://sites.iiserpune.ac.in/~bhasbapat/phy420.html
- https://www.worldscientific.com/worldscibooks/10.1142/3239?srsltid=AfmBOorYNHmUlrm4emEKoDTF6toWQ30Qkjehf0NOEBhAt8A5VDEkKVD6

PART D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 25 Marks
(Will include Internal assessment, Lab records and End Semester Viva/Voce and performance)

Semester End Exam (SEE)	**Laboratory performance:** Students are required to perform one experiment, take observation and make calculations in the allotted duration of 2 hours. Viva voce will be based on the experiment performed.

Name & Signature of Members of Board of Studies

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FOUR YEAR UNDERGRADUATE PROGRAM

DEPARTMENT OF PHYSICS

COURSE CURRICULUM 2025-26

PART A: INTRODUCTION				
Program: FYUP B.Sc. with Physics		**Class: B.Sc. (with Physics)**	**Semester - VIII**	**Session: 2025-2026**
1	**Course Code**	**BPH802**		
2	**Course Title**	**Quantum Mechanics-II**		
3	**Course Type**	**Discipline Specific Elective (DSE)**		
4	**Course Learning Outcome (CLO)**	**This Course will enable the students to:** • Familiarize with time independent perturbation theory and Fermi-Golden rule, variation method, WKB approximation as well as adiabatic and sudden approximations. • Introduce laboratory and center of mass frames, scattering cross-sections, partial wave analysis, Born approximation. • Develop the idea of identical particles in quantum mechanics and their collision, spin angular momentum, Pauli pin matrices, effect of identity and spin. • Understand the basic concepts of semi classical theory of radiation and electric dipole transition, line width, quantization of electromagnetic field, creation and annihilation operators, spontaneous and stimulated emissions.		
5	**Credit Value**	**3 Credits + 1 Tutorial**	**1 credit =15 Hours – Learning and Observation**	
6	**Total Marks**	**Maximum Marks :100**		**Minimum Passing Marks:40**

PART B: CONTENT OF THE COURSE

Total no. of Teaching/ Learning Periods = 45 Periods (45 Hours)

Unit	**Topics (COURSE CONTENTS)**	**No. of Periods**
I	**Time dependent perturbation theory,** Harmonic perturbation, Fermi's golden rule, Variational method and its application to calculate expectation value of the energy, WKB approximation theory and its applications, adiabatic and sudden approximations.	**12**
II	**Hamiltonian and interaction term in the semi-classical theory of radiation:** transition probability for absorption and induced emission, Dipole approximation – transition rates with dipole approximation, Spontaneous and stimulated emission, Plank's distribution formula, line breadth, selection rules, selection rules, forbidden transitions	**10**

III	**Scattering in laboratory and center of mass reference frames**, scattering amplitude, differential scattering cross section and total scattering cross section, Spherically symmetric potentials, partial wave analysis and phase shifts, scattering by perfectly rigid sphere and by square well potential, Greens function, Born approximation, validity of Born approximation.	**12**
IV	**Relativistic Quantum Mechanics:** Klein-Gordon (KG) equation and its plane wave solution and equation of continuity, Dirac equation for free particle, Plane wave solutions of Dirac equation, charge and current densities, Covariant form of Dirac equation, Dirac interpretation of negative energy states and concept of antiparticles, Dirac γ- matrices and their properties.	**11**
	Tutorial	**15**
	Formulation of Problem: Use QM method to formulate a problem/ given system or situation **Problem-Solving :** **1. Time-Dependent Perturbation Theory** • Transition probability for a two-level system under periodic perturbation • Application of Fermi's Golden Rule to atomic transitions • WKB Approximation: Tunneling probability through a potential barrier **2. Interaction of Radiation with Matter** • Calculating transition probabilities for dipole transitions • Finding the selection rules for atomic transitions • Estimating line broadening in atomic spectra **3. Scattering Theory** • Computing the differential cross-section for a given potential (e.g., Yukawa potential) • Scattering by a hard sphere: Calculating the total cross-section • Born Approximation: Validity check for a given weak potential **4. Relativistic Quantum Mechanics** • Computing expectation values of Dirac matrices in given spinor states • Application of the Dirac equation to predict antiparticle properties	

PART C - LEARNING RESOURCES

Text Books, Reference Books, Other Resources

TEXT BOOKS Recommended :

- Quantum Mechanics: Satyaprakash.
- Quantum Mechanics : Gupta Kumar

Reference Books :

- Introduction to Quantum Mechanics by David J. Griffiths
- Quantum Mechanics by B. H. Bransden and C. J. Joachain
- Quantum Mechanics by L. I. Schiff
- Quantum Mechanics : Concepts & Applications by Nouredine Zettili
- Quantum Mechanics : Non-relativistic Theory by L. D. Landau & E.M. Lifshitz
- Quantum Mechanics by Mathews and Venkatesan.

Online Resources: (e- Resources/ e- Books/ e- Learning Portals)

PART D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Comprehensive Evaluation (CCE):	**20 Marks**
Semester End Exam (SEE):	**80 Marks**

Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Internal Test of 20 Marks and Assignment of 20 Marks

Semester End Exam (SEE)	**Pattern -FOUR Questions (A, B, C, D) from each Unit**	
	Question - A & B: (Compulsory) Very short answer type (02 each)	04 x 4 = 16 Marks
	Question - C: Short answer type question	06 x 4 = 24 Marks
	Question - D: Long answer type question	10 x 4 = 40 Marks
		Total = 80 Marks

Name & Signature of Members of Board of Studies

V.C. Nominee	**Departmental members**
Subject Expert	**1. H.O.D/ Dr. Jagjeet Kaur Saluja** .....
Subject Expert	**2. Dr. Anita Shukla** .....
Alumni (member).....	**3. Dr. Siteshwari Chandraker** .....
Prof. from other Dept. of Sc. Faculty	**4. Dr. Abhishek Kumar Misra** .....
Specialist from Industry.....	**5. Dr. Kusumanjali Deshmukh**.....

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FOUR YEAR UNDERGRADUATE PROGRAM

DEPARTMENT OF PHYSICS

COURSE CURRICULUM 2025-26

PART A: INTRODUCTION				
Program: FYUP B.Sc. with Physics		**Class: B.Sc. (with Physics)**	**Semester - VIII**	**Session: 2025-2026**
1	**Course Code**	**BPH803**		
2	**Course Title**	**STATISTICAL MECHANICS**		
3	**Course Type**	**Discipline Specific Elective (DSE)**		
4	**Course Learning Outcome (CLO)**	**This Course will enable the students to:** • Apply statistical ensembles to relate microscopic states with thermodynamic quantities • Study classical and quantum statistics to analyze the behavior of ideal gases and their distributions. • Analyze imperfect gases and phase transitions using statistical models. • Understand and apply concepts of fluctuations and Brownian motion in statistical physics.		
5	**Credit Value**	**3 Credits + 1 Tutorial**	**1 credit =15 Hours – Learning and Observation**	
6	**Total Marks**	**Maximum Marks :100**	**Minimum Passing Marks:40**	

PART B: CONTENT OF THE COURSE		
Total no. of Teaching/ Learning Periods = 45 Periods (45 Hours)		
Unit	**Topics (COURSE CONTENTS)**	**No. of Periods**
I	**Foundation of statistical mechanics** – Specification of the state of a system statistical ensemble, contact between statistical and thermo dynamical quantities, Micro canonical ensemble, perfect gas in micro canonical ensemble, partition function and its correlation with thermodynamic quantities nature of probability function partition function for canonical ensemble thermodynamic functions for canonical ensemble. Perfect mono atomic gas in canonical ensemble, Grand canonical ensemble: Partition function and thermo dynamic function for grand canonical ensemble, Perfect gas in grand canonical ensemble.	**12**
II	Classical ideal gas entropy of mixing, Gibbs's paradox, Phase space Liouvelle's theorem, Maxwellian distribution from canonical distribution, Transition from classical statistical mechanics to quantum statistical mechanics, indistinguishability and quantum statistics. The density matrix, condition for statistical equilibrium, B.E., F.D. & M.B. statistics evaluation of constant α and β , Result of three statistics, Properties of ideal Bose gas, gas degeneracy, B.E. condensation, ideal fermi dirac gas – energy & pressure of gas & light and strong degeneracy.	**13**

III	**Theory of imperfect gases** – Virial equation of state Virial coefficients, cluster expansion for a classical gas. The Ising model in one dimension, exact solution of Ising model in one dimensions Phase transition, Phase transition of first and second kind, Landau's Phenomenological theory of phase transition.	**11**
IV	**Fluctuations** – Thermo dynamic fluctuations spatial correlation in a fluid, The Langevin's theory of the Brownian motion, Einstein Relation and Expression for mobility (Nernst relation) Fokker – Planck equation, Fluctuation dissipation theorem.	**9**
	Tutorial	**15**
	• Calculate the number of microstates for a system with given energy and particles for given ensembles • Derive expressions for average particle number and pressure for a perfect gas in given ensemble • Compute phase space volume for a classical system using Liouville's theorem. • Compare α and β constants in B.E., F.D., and M.B. statistics and evaluate them numerically for simple system • Apply cluster expansion to estimate thermodynamic functions of a real gas. • Identify the nature of phase transitions using given data (e.g., entropy or specific heat jumps). • Derivation of Einstein's relation connecting diffusion coefficient • Solution of the Fokker-Planck equation for simple probability distributions.	

PART C - LEARNING RESOURCES

Text Books, Reference Books, Other Resources

TEXT BOOKS Recommended :

- Statistical Mechanics by R.K.Patharia.
- Statistical Mechanics by Landau & Lifshiz.
- Statistical Mechanics by Bhattacharya.

Reference Books :

- Statistical Mechanics by Satyapraksh
- Statistical and thermal Physics by F.Reif
- Statistical Mechanics by K.Huang.

Online Resources: (e- Resources/ e- Books/ e- Learning Portals)

e-Books (Free & Open Access)

1. Statistical Mechanics by R.K. Pathria and Paul D. Beale https://books.google.com/
2. Thermal Physics by Charles Kittel and Herbert Kroemer
3. Fundamentals of Statistical and Thermal Physics by F. Reif Available at Archive.org
4. Lectures on Statistical Mechanics by David Tong (Cambridge University) Download PDF

e-Learning Portals / MOOCs

1. NPTEL (National Programme on Technology Enhanced Learning)
   Statistical Mechanics by Prof. V. Balakrishnan (IIT Madras) https://nptel.ac.in/

PART D: ASSESSMENT AND EVALUATION		
Suggested Continuous Evaluation Methods:		
Maximum Marks:	**100 Marks**	
Continuous Comprehensive Evaluation (CCE):	**20 Marks**	
Semester End Exam (SEE):	**80 Marks**	
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Internal Test of 20 Marks and Assignment of 20 Marks	
Semester End Exam (SEE)	**Pattern -FOUR Questions (A, B, C, D) from each Unit**	
	Question - A & B: (Compulsory) Very short answer type (02 each)	04 x 4 = 16 Marks
	Question - C: Short answer type question	06 x 4 = 24 Marks
	Question - D: Long answer type question	10 x 4 = 40 Marks
		Total = 80 Marks

Name & Signature of Members of Board of Studies

	Departmental members
V.C. Nominee	**1. H.O.D/ Dr. Jagjeet Kaur Saluja** .....
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Subject Expert	**3. Dr. Siteshwari Chandraker** .....
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FOUR YEAR UNDERGRADUATE PROGRAM

DEPARTMENT OF PHYSICS

COURSE CURRICULUM 2025-26

PART A: INTRODUCTION				
Program: FYUP B.Sc. with Physics		**Class: B.Sc. (with Physics)**	**Semester - VIII**	**Session: 2025-2026**
1	**Course Code**	**BPH804**		
2	**Course Title**	**ELECTRODYNAMICS**		
3	**Course Type**	**Discipline Specific Elective (DSE)**		
4	**Course Learning Outcome (CLO)**	**This Course will enable the students to:** • Review and illustrate Lorentz transformation of space and time and Maxwell's field equations in terms of four vectors, electromagnetic field tensor, Lienard -Wiechert Potential. • Explain Motion of charged particles in E-M field and theories related to Larmour's formula, relativistic generalization of Larmour's formula, Bremrstrahlung radiation, Synchrotron Radiation, Cerenkov radiation, Abraham- Lorentz formula. • Explain propagation of EMW in free space and extend the idea for conducting and dielectric media. • Apply Boundary conditions to derive expression for transmission and reflection of EMWs and implement it for waveguides and cavity resonators.		
5	**Credit Value**	**3 Credits + 1 Tutorial**	**1 credit =15 Hours – Learning and Observation**	
6	**Total Marks**	**Maximum Marks :100**		**Minimum Passing Marks:40**

PART B: CONTENT OF THE COURSE

Total no. of Teaching/ Learning Periods = 45 Periods (45 Hours)

Unit	Topics (COURSE CONTENTS)	No. of Periods
I	**Review of four vectors**, Lorentz transformation of space and time in four-vector form. Maxwell's field equations in terms of four vectors, vector potential and scalar potential, electromagnetic field tensor, Maxwell's equations in covariance four tensor form, Lorentz Transformation of electric and magnetic Fields, The invariants of the electromagnetic field, Retarded potential, Lienard Wiechert potentials.	**10**
II	**Electric and Magnetic fields due to a uniformly moving charge,** radiation of accelerated charge at low velocity - Larmour's formula, relativistic generalization of Larmour's formula, Bremrstrahlung radiation, Synchrotron Radiation, Cerenkov radiation, Angular distribution of radiation emitted by an accelerated charge, radiation damping- Abraham- Lorentz formula.	**11**
III	**Electromagnetic waves and its interaction with matter on macroscopic scale :** Electromagnetic waves (EMW) in free space, propagation of EMW in isotropic, anisotropic dielectrics, in conducting media,	**12**

IV	**Reflection, Transmission and /total Reflection of EMWs:** Boundary conditions, Fresnel formulae, Propagation of EMW between conducting planes, Wave guides : TE and TM mode, Rectangular and cylindrical wave guides, cavity resonator.	**12**
	Tutorial	**15**
	Numerical /Tutorial Topics **1. Four-Vectors and Lorentz Transformations** • Numerical problems on **Lorentz transformations** of time and space coordinates. • **Invariant spacetime interval** calculation under Lorentz transformation. • Numerical problems on **four-momentum** and **four-velocity** transformations. • **Four-current** and **field tensors** transformations in the context of special relativity. **2.. Radiation from Accelerated Charges** • Numerical derivations and applications of **Larmor's formula** for power radiated by an accelerating charge. • **Relativistic generalization of Larmor's formula** and its application in different scenarios. • **Bremsstrahlung radiation**: Calculation of energy radiated by a particle under acceleration. • **Synchrotron radiation** calculations for high-energy charged particles in magnetic fields. • **Cerenkov radiation** and angular distribution of radiation emitted by an accelerated charge. **3. Electromagnetic Wave Propagation in Different Media** • Numerical problems on **wave propagation** in free space and through isotropic and anisotropic dielectrics. • **Transmission and reflection coefficients** at dielectric and conducting boundaries using **Fresnel equations**. • Numerical calculations on **waveguides** for both **TE (Transverse Electric)** and **TM (Transverse Magnetic)** modes. • **Waveguide cutoff frequency** for different modes and calculations of **phase velocity** and **group velocity**. **4. Waveguides and Cavity Resonators** • **Calculation of cutoff frequencies** for different modes in **rectangular** and **cylindrical waveguides**. • Numerical examples on the **field distribution** in waveguide modes. • **Resonance frequency** of a **cavity resonator** and related numerical problems.	

PART C - LEARNING RESOURCES

Text Books, Reference Books, Other Resources

TEXT BOOKS Recommended :

- Introduction to Electrodynamics by David J. Griffith
- Classical Electrodynamics by J.D. Jackson.

Reference Books :

- Classical Electricity & Magnetism by Panofsky & Phillips.
- Principles of Electrodynamics by Melvin Schwartz,
- Classical Electrodynamics by J. Schwinger, L.L. Derrad, K.L. Milton, W.Y. Tsai, J. Norton.
- Modern Problems in Classical Electrodynamics by Charles A. Brau,
- Electrodynamics of Continuous Media by L. D. Landau and E. M. Lifshitz and L.P. Pitaevskii,
- Electrodynamics : An introduction including quantum effects by H.J.W. Mueller-Kirsten.

Online Resources: (e- Resources/ e- Books/ e- Learning Portals)

PART D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Comprehensive Evaluation (CCE):	**20 Marks**
Semester End Exam (SEE):	**80 Marks**

Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Internal Test of 20 Marks and Assignment of 20 Marks

Semester End Exam (SEE)	**Pattern -FOUR Questions (A, B, C, D) from each Unit**	
	Question - A & B: (Compulsory) Very short answer type (02 each)	04 x 4 = 16 Marks
	Question - C: Short answer type question	06 x 4 = 24 Marks
	Question - D: Long answer type question	10 x 4 = 40 Marks
		Total = 80 Marks

Name & Signature of Members of Board of Studies

	Departmental members
V.C. Nominee	**1. H.O.D/ Dr. Jagjeet Kaur Saluja** .....
Subject Expert	**2. Dr. Anita Shukla** .....
Subject Expert	**3. Dr. Siteshwari Chandraker** .....
Alumni (member).....	**4. Dr. Abhishek Kumar Misra** .....
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FOUR YEAR UNDERGRADUATE PROGRAM

DEPARTMENT OF PHYSICS

COURSE CURRICULUM 2025-26

PART A: INTRODUCTION				
Program: FYUP B.Sc. with Physics		**Class: B.Sc. (with Physics)**	**Semester - VIII**	**Session: 2025-2026**
1	**Course Code**	**BPH805**		
2	**Course Title**	**INTRODUCTION TO NANOMATERIALS**		
3	**Course Type**	**Discipline Specific Elective (DSE)**		
4	**Course Learning Outcome (CLO)**	**This Course will enable the students to:** • Understand size-dependent phenomena at the nanoscale and Describe the basic concepts and types of nanomaterials • Critically discuss hazards related to usage of nanomaterials • Compare different synthesis routes , • Interpret results obtained from characterization of nanomaterials to discover the associated properties • Evaluate and discuss optical, electrical and magnetic properties materials at nanoscale		
5	**Credit Value**	**3 Credits**	**1 Credit =15 Hours/Sem. – Learning and Observation**	
6	**Total Marks**	**Maximum Marks :100**		**Minimum Passing Marks:40**

PART B: CONTENT OF THE COURSE		
Total no. of Teaching/ Learning Periods = 45 Periods (45 Hours)		
Unit	**Topics (COURSE CONTENTS)**	**No. of Periods**
I	**Fundamentals of Nanoscience:** **Introduction to nanoscale systems** Classification of nanomaterials: 0D, 1D, 2D, and 3D; Surface to volume ratio and quantum confinement; Differences between nanomaterials and bulk materials **Nanotechnology Ethics and Safety** Environmental and health impacts of nanomaterials;Toxicity concerns and risk assessment; Regulatory frameworks and ethical considerations	**10**
II	**Synthesis of Nanomaterials** Top-down approaches: ball milling, lithography; Bottom-up approaches: Sol Gel, hydrothermal, CVD, green synthesis; Advantages and limitations of different synthesis methods	**13**
III	**Characterization Techniques** Structural: XRD, SEM, TEM; Surface: AFM, BET; Spectroscopic: UV-Vis, FTIR, Raman , Particle size analysis, zeta potential, and DLS	**12**

IV	**Properties and Applications** Optical, magnetic, electrical, thermal, and mechanical properties; Applications in electronics, medicine, energy, and environment	**10**

PART C - LEARNING RESOURCES

Text Books, Reference Books, Other Resources

TEXT BOOKS Recommended :

- Introduction to Nanoscience and Nanotechnology – K.K. Chattopadhyay & A.N. Banerjee
- Nanotechnology: Principles and Practices – Sulabha K. Kulkarni

Reference Books

- Nanostructures and Nanomaterials – Guozhong Cao

Online Resources: (e- Resources/ e- Books/ e- Learning Portals)

e-Books (Free & Open Access)

- **https://web.pdx.edu/~pmoeck/phy381/intro-nanotech.pdf**
- **https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000831ME/P001852/M030097/ET/1525781634Module-6_Unit-1_NSNT.pdf**
- http://cdn.intechopen.com/pdfs-wm/37900.pdf
- http://myukk.xsrv.jp/free_journal/download.php?fn=NDFCT511_full.pdf
- http://www.researchgate.net/profile/Yoshinori_Ando/publication/42804843_Chemical_Vapor_Deposition_of_Carbon_Nanotubes_A_Review_on_Growth_Mechanism_and_Mass_Production/links/0fcfd50809726e590a000000.pdf
- http://www.understandingnano.com/electrical-properties-carbon-nanotubes.html
- http://education.mrsec.wisc.edu/documents/usingVectors-_answers.pdf
- http://www.understandingnano.com/nanotubes-carbon-properties.html

e-Learning Portals / MOOCs

- NPTEL: Introduction to Nanotechnology and Applications – https://nptel.ac.in/courses/118104008
- MIT OCW: Nanomaterials course – https://ocw.mit.edu

PART D: ASSESSMENT AND EVALUATION		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **75 Marks** **Continuous Comprehensive Evaluation (CCE):** **15 Marks** **Semester End Exam (SEE):** **60 Marks**		
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	Internal Test of 15 Marks and Assignment of 15 Marks	
Semester End Exam (SEE)	**Pattern -FOUR Questions (A, B, C, D) from each Unit** Question - A & B: (Compulsory) Very short answer type (02 each) Question - C: Short answer type question Question - D: Long answer type question	04 x 4 = 16 Marks 04 x 4 = 16 Marks 07 x 4 = 28 Marks **Total = 60 Marks**

Name & Signature of Members of Board of Studies

	Departmental members
V.C. Nominee	**1. H.O.D/ Dr. Jagjeet Kaur Saluja** .....
Subject Expert	**2. Dr. Anita Shukla** .....
Subject Expert	**3. Dr. Siteshwari Chandraker** .....
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FOUR YEAR UNDERGRADUATE PROGRAM

DEPARTMENT OF PHYSICS

COURSE CURRICULUM 2025-26

LAB COURSE

PART A: INTRODUCTION				
Program: FYUP B.Sc. with Physics		**Class: B.Sc. (with Physics)**	**Semester - VIII**	**Session: 2025-2026**
1	**Course Code**	**BPHL805**		
2	**Course Title**	**INTRODUCTION TO NANOMATERIALS**		
3	**Course Type**	**Discipline Specific Elective (DSE)**		
4	**Course Learning Outcome (CLO)**	**This Course will enable the students to:** • Gain hands-on experience with basic nanomaterials synthesis and analysis. • Analyze size-dependent properties and their implications. • Apply methods for synthesizing nanomaterials using physical and chemical routes. • Interpret data from common characterization techniques. • Apply Simulation techniques for designing and evaluation of nanostructure.		
5	**Credit Value**	**1 Credit**	**1 credit =30 Hours/Sem – Learning and Observation**	
6	**Total Marks**	**Maximum Marks: 25**		**Minimum Passing Marks: 10**

PART B: CONTENT OF THE COURSE	
S. No.	**List of Experiments**
1	UV-Vis analysis of nanoparticles (demo/data interpretation)
2	XRD analysis of nanoparticle crystal structure (demo/data interpretation)
3	Analysis of SEM images (data from external lab or image sets)
4	Analysis and interpretation of TEM Images (data from external lab or image sets)
5	Particle size estimation using DLS (demo/data interpretation)
6	SEM image analysis of nanoparticle morphology (data from external lab or image sets)
7	Preparation of nanocomposite film (e.g., PVA + nanoparticles)
8	Project: Design a synthesis method for a chosen nanomaterial (presentation/report)
9	Data analysis and simulation tools like NanoHUB , SIESTA, or virtual labs (Amrita/PHET) will be used

PART C - LEARNING RESOURCES

Text Books, Reference Books, Other Resources

TEXT BOOKS Recommended:

1. UV-Vis Analysis of Nanoparticles (Demo/Data Interpretation)

Textbooks:

- *Nanostructures and Nanomaterials: Synthesis, Properties and Applications* – Guozhong Cao & Ying Wang
- *Instrumental Methods of Analysis* – Willard, Merritt, Dean & Settle

E-resources:

- NanoHUB UV-Vis Tools: https://nanohub.org/resources/uvvis
- Amrita Virtual Lab (UV-Vis): https://vlab.amrita.edu/?sub=2&brch=190&sim=338&cnt=1

2. XRD Analysis of Nanoparticle Crystal Structure (Demo/Data Interpretation)

Textbooks:

- *Elements of X-ray Diffraction* – B.D. Cullity and S.R. Stock
- *Characterization of Materials* – Elton N. Kaufmann

E-resources:

- NanoHUB XRD Tools: https://nanohub.org/resources/xrdpatterns
- Materials Project Database: https://materialsproject.org/
- Amrita Virtual Lab (XRD): https://vlab.amrita.edu/?sub=1&brch=201&sim=808&cnt=1

3. Analysis of SEM Images (Data from External Lab or Image Sets)

Textbooks:

- *Scanning Electron Microscopy and X-Ray Microanalysis* – Joseph Goldstein et al.
- *Introduction to Scanning Electron Microscopy* – Ray Egerton

E-resources:

- ImageJ Software: https://imagej.nih.gov/ij/
- NanoHUB SEM Tools: https://nanohub.org/resources/sem
- Amrita SEM Lab: https://vlab.amrita.edu/?sub=1&brch=282&sim=1510&cnt=1

4. Analysis and Interpretation of TEM Images (Data from External Lab or Image Sets)

Textbooks:

- *Transmission Electron Microscopy* – David B. Williams & C. Barry Carter
- *Fundamentals of Microstructural Analysis* – Braithwaite and West

E-resources:

- NanoHUB TEM Simulators: https://nanohub.org/resources/tem
- ImageJ Plugins: https://imagej.nih.gov/ij/plugins/
- Amrita TEM Lab: https://vlab.amrita.edu/?sub=1&brch=282&sim=1520&cnt=1

5. Particle Size Estimation Using DLS (Demo/Data Interpretation)

Textbooks:

- *Colloidal Science of Flotation* – Anh V. Nguyen & Hans Joachim Schulze
- *Dynamic Light Scattering: Applications of Photon Correlation Spectroscopy* – R. Pecora

E-resources:

- Malvern Panalytical Knowledge Hub: https://www.malvernpanalytical.com/en/learn/knowledge-center
- NanoHUB DLS Tools: https://nanohub.org/resources/22196
- Malvern Instruments YouTube Channel: https://www.youtube.com/user/MalvernInstruments

PART D: ASSESSMENT AND EVALUATION	
Suggested Continuous Evaluation Methods: **Maximum Marks: 25 Marks** **(Will include Internal assessment, Lab records and End Semester Viva/Voce and performance)**	
Semester End Exam (SEE)	**Laboratory performance:** Students are required to perform one experiment, take observation and make calculations in the allotted duration of 2 hours. Viva voce will be based on the experiment performed.

Name & Signature of Members of Board of Studies

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