ANNEXURE C
Faculty of Sciences
Syllabus for

Master of Science (Physics) (FYIP)

(Semester I -VI)
(Under Credit Based Continuous Evaluation Grading System)
(12+3+2 System of Education)
Session: 2026-27

Kanya Maha Vidyalaya, Jalandhar
(Autonomous)
The Heritage Institution

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF FIVE YEAR INTEGRATED PROGRAMME

Master of Science (Physics) (FYIP)

Session-2026-27

Semester-I									
Sr. No.	**Course Code**	**Course Type**	**Course Title**	**Credits**	**Max Marks**				**Exam time in Hours)**
					Total	**Ext**		**CA**	
				L-T-P		**L**	**P**		
1.	**FPHL-1421** **FPHL-1031** **FPHL-1431**	C	Punjabi(Compulsory) [1]Basic Punjabi [2]Punjab History and Culture	2-0-0	50	35		15	3
2.	**FPHL-1102**	AEC	Communicative English-I	2-0-0	50	35		15	3
3.	**FPHL-1393**	DSC	Mechanics	4-0-0	100	70	-	30	3
4.	**FPHL-1394**	DSC	Thermal Physics	4-0-0	100	70	-	30	3
5.	**FPHL-1335**	C	Mathematical Physics-I	4 -0-0	100	70	-	30	3
6.	**FPHM-1086** **OR**	E**	Organic Chemistry OR	3-0-1	100	40	30	30	3+3
	FPHM-1126		Computer Fundamentals and PC Software	3-0-1	100	40	30	30	3+3
7.	**FPHP-1397**	DSC	Physics Lab-I	0-0-3	100	-	70	30	3
8.	**VACF-1491**	VAAC	*Foundation Course	2-0-0	50	35		15	1
Total credits				**25**					

[1] Special paper in lieu of Punjabi (Compulsory) for those who have not studied Punjabi upto 8th/ 10th Class. .

[2] Special paper in lieu of Punjabi (Compulsory) for those students who are not domicile of Punjab.

***credits/ grade points of these courses will not be added in SGPA/ CGPAof the semester/ Programme and only grades will be provided.**

****** Students will opt for any one course.**

C- Compulsory

E-Elective

AEC-Ability Enhancement Course

DSC-Discipline Specific Course

VAAC-Value Added Audit Courses

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF FIVE YEAR INTEGRATED PROGRAMME

Master of Science (Physics) (FYIP)

Session-2026-27

Semester II

Sr. No.	Course Code	Course Type	Course Title	Credits	Max Marks				Examination time in Hours)
					Total	Ext		CA	
				L-T-P		L	P		
1	FPHL-2421 FPHL-2031 FPHL-2431	C	Punjabi(Compulsory) [1]Basic Punjabi [2]Punjab History and Culture	2-0-0	50	35	-	15	3
2	FPHL-2102	AEC	Communicative English-II	2-0-0	50	35	-	15	3
3	FPHL-2393	DSC	Electricity and Magnetism	4-0-0	100	70	-	30	3
4	FPHL-2394	DSC	Waves and Oscillations	4-0-0	100	70	-	30	3
5.	FPHL- 2335	C	Mathematical Physics-II	4-0-0	100	70	-	30	3
6	FPHM-2086	E**	Inorganic Chemistry (Atomic Structure and Periodic Table)	3-0-1	100	40	30	30	3+3
	OR		OR						
	FPHM-2126		Introduction to Programming in C	3-0-1	100	40	30	30	3+3
7	FPHP-2397	DSC	Physics Lab-II	0-0-3	100	-	70	30	3
8	VACD-2161	VAC	Drug Abuse and Ethical education	4-0-0	100	70	-	30	3
Total Credits				27					

[1] Special paper in lieu of Punjabi (Compulsory) for those who have not studied Punjabi upto 8th/ 10th Class.

[2] Special paper in lieu of Punjabi (Compulsory) for those students who are not domicile of Punjab.

** Students will opt any one course.

C- Compulsory
E-Elective
AEC-Ability Enhancement Course
DSC-Discipline Specific Course
VAC-Value Added Courses

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF FIVE YEAR INTEGRATED PROGRAMME

Master of Science (Physics) (FYIP)

Session-2026-27

Semester-III									
Sr. No.	**Course Code**	**Course Type**	**Course Title**	**Credits**	**Max Marks**				**Exam time in Hours)**
					Total	**Ext**		**CA**	
						L	**P**		
1.	FPHL-3391	C	Electromagnetic Theory	4-0-0	100	70	-	30	3
2.	FPHL-3392	C	Optics	4-0-0	100	70	-	30	3
3.	FPHL-3173	C	Mathematical Physics-III	4-0-0	100	70	-	30	3
4.	FPHM-3394	MDC	Introduction to Glass Science and Glass Ceramics	3-0-1	100	40	30	30	3+3
5.	FPHM-3125 or FPHM-3085	E**	Python Programming or Physical Chemistry	3-0-2	100	40	30	30	3+3
6.	FPHP-3396	C	Physics Lab-III	0-0-3	100	-	70	30	3
7.	VACE-3221	VAC	Environmental studies	2-0-0	50	35	-	15	3
Total Credits				28					

[1] Special paper in lieu of Punjabi (Compulsory) for those who have not studied Punjabi upto 8th/ 10th Class. .

[2] Special paper in lieu of Punjabi (Compulsory) for those students who are not domicile of Punjab.

**** Students will opt any one course.**

C- Compulsory
E-Elective
MDC-Multi Disciplinary Course
VAC-Value Added Courses

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF FIVE YEAR INTEGRATED PROGRAMME

Master of Science (Physics) (FYIP)

Session-2026-27

Semester IV

Sr. No.	Course Code	Course Type	Course Title	Credits	Max Marks				Examination time in Hours)
					Total	Ext		CA	
						L	P		
1.	FPHL-4391	C	Analog Systems and Applications	4-0-0	100	70	-	30	3
2.	FPHL-4392	C	Elements of Modern Physics	4-0-0	100	70	-	30	3
3.	FPHL- 4393	DSC	Special Theory of Relativity	4-0-0	100	70	-	30	3
4.	FPHM-4084	E**	Introduction to Molecular Spectroscopy and Quantitative estimation methods	3-0-1	100	40	30	30	3+3
.	OR		OR						
	FPHM-4125		R Programming	3-0-1	100	40	30	30	3+3
5.	FPHP-4396	C	Physics Lab-IV	0-0-3	100	-	70	30	3
6.	FPHL-4390	SEC	Medical Physics	3-0-0	100	70		30	3
7..	VACP-4511	*VAAC	Personality Development and Gender Sensitization	2-0-0	50	35	-	15	3
Total Credits				24					

[1] Special paper in lieu of Punjabi (Compulsory) for those who have not studied Punjabi upto 8th/ 10th Class. .

[2] Special paper in lieu of Punjabi (Compulsory) for those students who are not domicile of Punjab.

***credits/ grade points of these courses will not be added in SGPA/ CGPA of the semester/ Programme and only grades will be provided.**

****** Students will opt any one course.**

C- Compulsory
E-Elective
DSC-DSC-Discipline Specific Course
VAAC-Value Added Audit Course
SEC- Skill Enhancement Course

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF FIVE YEAR INTEGRATED PROGRAMME

MASTER OF SCIENCE (PHYSICS) (FYIP)

Session-2026-27

Semester-V									
Sr. No.	**Course Code**	**Course Type**	**Course Title**	**Credits**	**Max Marks**				**Examination time in Hours)**
					Total	**Ext**		**CA**	
				L-T-P		**L**	**P**		
1.	FPHL-5391	C	Quantum Mechanics and Applications	4-0-0	100	70	-	30	3
2.	FPHL-5392	C	Digital Systems and Applications	4-0-0	100	70	-	30	3
3.	FPHL-5393	C	Mathematical Physics-III	4-0-0	100	70	-	30	3
4.	FPHM-5394	MDC	Applied Glass Science	3-0-1	100	40	30	30	3+3
5.	FPHP-5395	C	Digital Electronics Lab	0-0-3	100	70	-	30	3
6.	FPHP-5396	C	Quantum Lab	0-0-3	75	60	-	15	3
7.	FPHI-5397/	C	Internship and Report Writing	0-0-3	75	-	75	-	3
			Total Credits	25					

***Marks of these papers will not be added in total marks**

C- Compulsory
CCFR-Co-curricular Field Work and Report Writing
MDC-Multi Disciplinary Course

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF FIVE YEAR INTEGRATED PROGRAMME

MASTER OF SCIENCE (PHYSICS) (FYIP)

Session-2026-27

Semester VI

Sr. No.	Course Code	Course Type	Course Title	Credits	Max Marks				Examination time in Hours)
					Total	Ext		CA	
				L-T-P		L	P		
1	FPHL-6391	C	Solid State Physics	4-0-0	100	70	-	30	3
2	FPHL-6392	C	Statistical Mechanics	4-0-0	100	70	-	30	3
3	FPHL-6393	C	Nuclear and Particle Physics	4-0-0	100	70	-	30	3
4	FPHL-6394 (OPT-I)	DSC	Fabrication of Electronic Devices	4-0-0	100	70	-	30	3
	FPHL-6394 (OPT-II)		Biological Physics						
	FPHL-6394 (OPT-III)		MOOC (12 weeks)						
5	FPHL-6395	C	Basics of Artificial Intelligence	3-0-1	100	40	30	30	3+3
6	FPHP-6396	C	Solid State Physics Lab	3-0-0	100	70	-	30	3
7	FPHP-6397	C	Lab on Statistical Mechanics	0-0-3	100	70	-	30	3
8	VACJ-5551	VAAC	Job Readiness	2-0-0	50	35		15	
	Total Credits			28					

****Marks of these papers will not be added in total marks**

Student can opt any of the options-I, II, III from serial number 4

C- Compulsory
DSC-DSC-Discipline Specific Course
VAAC-Value Added Audit Course

PROGRAM SPECIFIC OUTCOMES (PSOs)

Programme Specific Outcomes of Master of Science (Five Year Integrated Programme) Physics (M.Sc. (Physics) (FYIP))

PSO1: Scientific Knowledge and Conceptual Clarity

Acquire a systematic and conceptual understanding of fundamental and advanced principles of sciences.

Demonstrate familiarity with key domains such as electromagnetism, quantum mechanics, modern physics, classical mechanics, optics, and medical physics.

Apply foundational concepts to explain scientific phenomena.

Apply fundamental understanding of glass structure, phase behavior, and physical properties to analyze, design, and optimize glass materials for advanced scientific and industrial applications.

PSO2: Problem-Solving and Analytical Skills

Develop the ability to analyze physical systems quantitatively and qualitatively using scientific reasoning and mathematical modeling.

Solve numerical problems using techniques from differential equations, linear algebra, calculus, and vector analysis.

Formulate and analyze physical problems in nuclear, atomic, and medical physics using logical and computational approaches.

PSO3: Practical and Laboratory Skills

Gain hands-on experience in performing physics experiments related to electronics, optics, atomic physics, and electromagnetic theory.

Use modern instrumentation and data analysis techniques such as spectrometers, oscilloscopes, detectors, dosimeters, and computer-based simulations.

Interpret experimental data, evaluate uncertainties, and validate theoretical predictions through empirical methods.

PSO4: Programming and Computational Thinking

Learn programming languages like Python and R for data analysis, simulations, and automation of experimental procedures.

Use computational tools for solving physical problems involving large datasets, simulations (e.g., Monte Carlo), and graphical visualizations.

Apply code-based solutions in modern research areas such as quantum computation, medical imaging, and statistical physics.

PSO5: Communication and Documentation

Communicate scientific ideas clearly in oral and written formats to both scientific and non-scientific audiences.

Prepare lab reports, project presentations, scientific posters etc using proper scientific conventions.

Interpret and explain graphical data, simulation results, and mathematical derivations effectively.

PSO6: Application of Science in society and Industry

Apply physics principles to develop solutions for society and industry .

Understand industrial applications of physics in electronics, optics, nuclear energy, and environmental monitoring.

Use interdisciplinary knowledge to address real-world problems through scientific intervention, research and technological advancement.

PSO7: Lifelong Learning and Career Readiness

Continuously upgrade skills and knowledge in response to emerging trends in physics, computational methods, and medical technologies.

Prepare for competitive exams (e.g., GATE, NET, JAM) or pursue further education and research in core and applied physics.

Develop adaptability to work in academic, research, clinical, or industrial environments with confidence.

PSO8: Teamwork and Multidisciplinary Collaboration

Collaborate effectively in multi-disciplinary teams, especially in areas like biomedical engineering, software development, and healthcare innovation.

Share knowledge, divide responsibilities, and integrate diverse skills to achieve common goals in laboratory and project settings.

Foster interpersonal skills to work constructively with peers, faculty, and industry professionals.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2024-25)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: Punjabi (Compulsory)

COURSE CODE- FPHL-1421

COURSE OUTCOMES

CO1:';kfjs d/ ozr' g[[[;se d/ eftsk Gkr Bz{ gVQkT[D dk wB'oE ftfdnkoEhnK nzdo eftsk gqsh fdbu;gh, ;{M Bz{ g?dk eoBk j? sK fe T[j nkX[fBe d"o ftu ub ojhnK ekftXkoktK ns/ ethnK pko/ frnkB jk;b eo ;eD.fJ; dk j'o wB'oE eftsk dh ftnkfynk, ftPb/PD s/ w[bzeD dh gqfefonk s'A ikD{ eokT[Dk th j? sK fe T[j ;wekbh ;wki dhnK ;wZf;nktK Bz{ ;wM ;eD ns/ nkb'uBkswe fdqPNh pDk ;eD.

CO2:';kfjs d/ ozr' g[[[;se d/ ejkDh Gkr B{z f;b/p; ftu Pkfwb eo e/ ftfdnkoEhnK nzdo ejkDh gVQD dh o[uh Bz{ g?dk eoBk j? ns/ ejkDh irs Bkb i'VDk j?.

CO3:g?oQk ouBk ns/ g?oQk gVQ e/ gqPBK d/ T[so d/D dk wBo'E ftfdnkoEhnK dh p[ZXh B{z shyD eofdnK T[BK dh fbyD gqfsGk B{z T[ikro eoBk j?.

CO4:X[Bh ftT[As gVQD Bkb ftfdnkoEh X[BhnK dh T[ukoB gqDkbh s'A tke| j'Dr/.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2024-25)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: Punjabi (Compulsory)

COURSE CODE- FPHL-1421

Credits: 2-0-0 **Max Marks: 50 (ESE Marks:35, CA: 15)**

Examination Time: 3 Hours **Pass Mark: 13**

nze tzv ns/ gohfyne bJh jdkfJsK

1H gqPB gZso d/ uko ;?ePB j'Dr/.;?ePB A-D sZe d/ gqPB :{fBN I-IV ftu'A g[ZS/ ikDr/. jo ;?ePB ftu d' gqPB g[ZS/ ikDr/.

2H ftfdnkoEh B/ eZ[b gzi gqPB eoB/ jB. jo ;?ePB ftu'A fJe gqPB eoBk bkIwh j?. gzitK gqPB fe;/ th ;?ePB ftu'A ehsk ik ;edk j?.

3H jo/e gqPB d/ 7 nze jB.

4H g/go ;?ZN eoB tkbk i/eo ukj/ sK gqPBK dh tzv nZr'A tZX s'A tZX uko T[g gqPBK ftu eo ;edk j?.

gkmeqw ns/ gkm g[;seK

:{fBN-I

;kfjs d/ ozr (;zgkHvk wfjb f;zx),Gkr gfjbk (eftsk),
oth ;kfjs gqekPB,nzfwqs;o.
(ਪ੍ਰਸੰਗ ਸਹਿਤ ਵਿਆਖਿਆ, ;ko)
(vkH jfoGiB f;zx, gkP, ;[oihs gkso eth gkm eqw dk fjZ;k BjhA jB) **7 nze**

:{fBN-II

;kfjs d/ ozr (;zgkHvk wfjb f;zx),Gkr gfjbk (ejkDh),
oth ;kfjs gqekPB,nzfwqs;o.
(;ko,ftPk t;s{)
(e'Jh fJe ;tko,x'NDk, nkgDk nkgDk fjZ;k ejkDhnK gkm eqw dk fjZ;k BjhA jB) **7 nze**

:{fBN-III

g?oQk ouBk
g?oQk gVQ e/ gPqFBK d/ T[so. **7 nze**

:{fBN-IV

(T) gzikph X[Bh ftT[As LgfoGkPk s/ T[ukoB nzr
(n) ;to, ftnziB **7 nze**

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2024-25)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: BASIC PUNJABI (In lieu of Punjabi(Compulsory))

COURSE CODE - FPHL-1031

Course outcomes

CO1: w[ZYbh gzikph gVQkT[D dk wB'oE ftfdnkoEhnK B{z gzikph GkPk B{z f;ykT[D dh gqfefonk ftu gk e/ fJe j'o GkPk f;ZyD dk w"ek gqdkB eoBk j?. ftfdnkoEhnK B{z g?Ash nZyoh, nZyo eqw, g?o fpzdh tkb/ toD ns/ g?o ftu g?D tkb/ toD ns/ wksoktK (wZ[Ybh ikD gSkD) brk\o (fpzdh, fNZgh, nZXe) dh gSkD ns/ tos'A s'A ikD{ eotkfJnk ikt/rk.

CO2: ftfdnkoEhnK B{z gzikph Ppd pDso dh wZ[Ybh ikD gSkD (;kXkoB Ppd, ;z:[es Ppd, fwPos Ppd,w{b Ppd,nr/so ns/ fgS/so) s'A ikD{ eotkfJnk ikt/rk.

CO3: ftfdnkoEhnK B{z fBZs tos'A dh gzikph Ppdktbh L pkIko, tgko, foPs/Bks/, y/sh ns/ j'o XzfdnK nkfd Bkb ;zpzXs s'A ikD{ eotkfJnk ikt/rk.

CO4: ftfdnkoEhnK B{z gzikph ftu j|s/ d/ ;Zs fdBK d/ BK, pkoQK wjhfBnK d/ BK, oZ[sK d/ BK, fJe s'A ;" sZe frDsh PpdK ftu f;ykT[Dk j?.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2024-25)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: BASIC PUNJABI (In lieu of Punjabi(Compulsory))

COURSE CODE - FPHL-1031

Credits: 2-0-0 **Max Marks: 50 (ESE Marks:35, CA: 15)**

Examination Time: 3 Hours **Pass Mark: 13**

nze tzv ns/ gohfyne bJh jdkfJsK

1H gqPB gZso d/ uko ;?ePB j'Dr/.;?ePB A-D sZe d/ gqPB :{fBN I-IV ftu'A g[ZS/ ikDr/. jo ;?ePB ftu d' gqPB g[ZS/ ikDr/.

2H ftfdnkoEh B/ eZ[b gzi gqPB eoB/ jB. jo ;?ePB ftu'A fJe gqPB eoBk bklwh j?. gzitK gqPB fe;/ th ;?ePB ftu'A ehsk ik ;edk j?.

3H jo/e gqPB d/ 7 nze jB.

4H g/go ;?ZN eoB tkbk i/eo ukj/ sK gqPBK dh tzv nZr'A tZX s'A tZX uko T[g gqPBK ftu eo ;edk j?.

gkmeqw

:{fBN-I

g?Ash nZyoh, nZyo eqw, g?o fpzdh tkb/ toD ns/ g?o ftu g?D tkb/ toD ns/ wksqtK (wZ[Ybh ikD gSkD) brk\o (fpzdh, fNZgh, nZXe) L gSkD ns/ tos'A . 7 nze

:{fBN-II

gzikph Ppd pDso L wZ[Ybh ikD gSkD (;kXkoB Ppd, ;z:[es Ppd, fwPos Ppd, w{b Ppd, nr/so ns/ fgS/so) 7 nze

:{fBN-III

fBZs tos'A dh gzikph Ppdktbh L pklko, tgko, foPs/ Bks/, y/sh ns/ j'o XzfdnK nkfd Bkb ;zpzXs. 7 nze

:{fBN-IV

j|s/ d/ ;Zs fdBK d/ BK, pkoQK wjhfBnK d/ BK, oZ[sK d/ BK, fJe s'A ;" se frDsh PpdK ftu . 7 nze

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2024-25)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: Punjab History and Culture (From Earliest Times to C 320)

(Special paper in lieu of Punjabi Compulsory)

(For those students who are not domicile of Punjab)

COURSE CODE: FPHL-1431

COURSE OUTCOMES

After completing Semester I and course on Punjab History and Culture students of History will be able to identify and have a complete grasp on the sources & writings of Ancient Indian History of Punjab.

CO1: Identify and understand the sources and physical features of Punjab
CO 2: To study the earliest civilisation (Indus Valley Civilization) and original home of Aryans
CO 3: To examine the Social, Religious and Economic life during Early and Later Vedic Age
CO 4: To comprehend the Buddhist, Jain and Hindu faith and their relevance in the modern times

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2024-25)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: Punjab History and Culture (From Earliest Times to C 320)

(Special paper in lieu of Punjabi Compulsory)

(For those students who are not domicile of Punjab)

COURSE CODE: FPHL-1431

Credits: 2-0-0 **Max Marks: 50 (ESE Marks:35, CA: 15)**

Examination Time: 3 Hours **Pass Mark: 13**

Instructions for the Paper Setter:

1. Question paper shall consist of four Units
2. Examiner shall set 8 questions in all by selecting Two Questions of equal marks from each Unit.
3. Candidates shall attempt 5 questions in 600 words, by at least selecting One Question from each Unit and the 5th question may be attempted from any of the four Units.
4. Each question will carry 7 marks

Unit-I

1. Physical features of the Punjab
2. Sources of the ancient history of Punjab

Unit-II

3. Harappan Civilization: social, economic and religious life of the Indus Valley People.
4. The Indo-Aryans: Original home

Unit-III

5. Social, Religious and Economic life during Early Vedic Age.
6. Social, Religious and Economic life during Later Vedic Age.

UNIT-IV

7. Teachings of Buddhism
8. Teachings of Jainism

Suggested Readings

- B.N. Sharma, Life in Northern India, Delhi. 1966.
- Budha Parkash, Glimpses of Ancient Punjab, Patiala, 1983.
- Chopra, P.N., Puri, B.N., & Das,M.N.(1974). A Social, Cultural & Economic History of India, Vol. I, New Delhi: Macmillan India.
- L. M Joshi (ed.), History and Culture of the Punjab, Art-I, Patiala, 1989 (3rd edition)
- L.M. Joshi and Fauja Singh (ed.), History of Punjab, Vol.I, Patiala 1977.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2024-25)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: COMMUNICATIVE ENGLISH

COURSE CODE: Course Code: FPHL -1102

Course Outcomes

After Completing the course the students will be:

CO 1: able to enhance their vocabulary through vocabulary-building exercises
CO2: able to improve their writing skills by writing letters and reports
CO3: able to enhance their reading and analysing power of texts through guided reading by the study of "Making Connections" by Kenneth J. Pakenham
CO4: acquainted with the techniques of effective essay writing

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2024-25)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: COMMUNICATIVE ENGLISH

COURSE CODE: Course Code: FPHL -1102

Credits: 2-0-0 **Max Marks: 50 (ESE Marks:35, CA: 15)**

Examination Time: 3 Hours **Pass Mark: 13**

Instructions for the Paper Setters: -

Eight questions of equal marks (Specified in the syllabus) are to be set, two from each of the four Units (I-IV). Questions may be subdivided into parts (not exceeding four).

Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section. Each question has a weightage of 7 marks.

UNIT-I

"Word List", "Correct Usage of Commonly used words and Phrases" from the chapter "Vocabulary" given in *The Written Word* by Vandana R. Singh

UNIT-II

Letter- writing as prescribed in *The Written Word* by Vandana R. Singh

Report writing as prescribed in *The Written Word* by Vandana R. Singh

UNIT-III

Unit-I from *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition

UNIT-IV

Unit-II from *Making Connections: A Strategic Approach to Academic Reading* by Kenneth J. Pakenham, Second Edition

Prescribed Text books:

The Written Word by Vandana R. Singh, Oxford University Press, New Delhi.

Making Connections: A Strategic Approach to Academic Reading by Kenneth J.Pakenham, Second Edition

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (PHYSICS) (FYIP) (SEMESTER–I)
COURSE TITLE: MECHANICS
COURSE CODE: FPHL-1393

COURSE OUTCOMES:
After passing this course, students will be able to:
CO1: Understand the concept of inertial frames and calculations of displacement, velocity and acceleration in various coordinate systems. Students will be able to know the laws of motion and relative motion by using Galilean transformations. They will learn various conservation laws and their application to variable mass systems.
CO2: They will understand elastic scattering in the lab and centre of mass systems. They will understand the physics of the rotational motion of a body by studying Euler's equations and the Moment of inertia tensor.
CO3: Learn the effects of gravitational force and other fundamental forces of nature. They will learn the concept of the centre of mass, central forces, and the motion of particles under a central force, as well as determine the turning points of orbit. They will be able to understand planetary motion by solving differential equations of orbits and studying Kepler's laws.
CO4: They will understand the origin of fictitious forces in non-inertial frames and their consequences on acceleration due to gravity, the motion of a particle on earth, and Foucault's pendulum as a real-life illustration of fictitious forces.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: MECHANICS

COURSE CODE: FPHL-1393

Credits: 4-0-0 **Max Marks: 100 (ESE Marks:70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks. **Note:** Students can use Non-Scientific calculators or logarithmic tables.

Unit- I

Co-ordinate Systems and Motion of a particle: Reference frames, Inertial frames; Displacement, velocity& acceleration in Cartesian, Plane polar, Spherical& Cylindrical coordinate systems Area and Volume in these coordinate systems. Solid angle. Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance of space &time intervals, Newton's laws of motion and conservation laws.

Fundamentals of Dynamics: Momentum of variable-mass system: motion of the rocket. Dynamics of a system of particles: internal & external forces and momentum conservation, Centre of Mass, Impulse.

Unit- II

Collisions: Elastic and inelastic collisions between particles, Relationship of velocities, angles and energiesof the colliding particles in the Centre of Mass and Laboratory frames.

Rotational Dynamics: Angular momentum of a particle and system of particles and torques due to internal forces. Principle of conservation of angular momentum, Rotation about a fixed axis, Moment of Inertia.Kinetic energy of rotation, Motion involving both translation and rotation, Rotational motion of a rigid body in general, Rotation of angular momentum vector about a fixed axis, Angular momentum and kinetic energy of a rigid body about principal axes, Euler's equations, Precession and Elementary Gyroscope.Motion of a spinning top.

Unit- III

Gravitation Fields and Potentials: Law of gravitation. Gravitational potential energy, Inertial and gravitational mass. Potential energy and force between a point mass and spherical shell, a point mass and solid sphere. Gravitational and electrostatic self-energy, Gravitational energy of uniform sphere.

Central Force Motion: Forces in nature (Qualitative). Conservative forces. Central Forces.Motion of a particle under a central force field, Two-body problem and its reduction to one-body problem and its solution, Reduced mass, Equation of motion of a reduced mass under central force and energy. Differential equation of the orbit, Equation of orbit under inverse square force field, turning points, Kepler's Laws, Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness.

Unit- IV

Non-Inertial Systems: Non-inertial frames. Fictitious forces in non-inertial frames having translational and uniform rotational motion. Laws of Physics in rotating coordinate systems. Centrifugal force. Effect of rotation of earth on acceleration due to gravity, Effect of Coriolis force

on a particle falling freely under gravity.Effect of Coriolis force on a particle moving on the surface of earth, Foucault's pendulum and its equation of motion.

Reference Books:

1. An introduction to Mechanics, D. Kleppner, R.J. Kolenkow, 2012, McGraw-Hill.
2. Mechanics, Berkeley Physics, Vol.1, C.Kittel, W.Knight, et. al. 2007, Tata McGraw-Hill.
3. Physics, Resnick, Halliday and Walker 9/e. 2010, Wiley.
4. Analytical Mechanics, G.R.Fowles and G.L. Cassiday. 2005, Cengage Learning.
5. Feynman Lectures, Vol.1, R.P. Feynman, R.B. Leighton, M.Sands, 2008, Pearson Education.
6. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (PHYSICS) (FYIP) (SEMESTER–I)
COURSE TITLE: THERMAL PHYSICS
COURSE CODE: FPHL-1394

COURSE OUTCOMES

After passing this course the students will be able to:

CO1: Understand thermodynamic systems, properties, and equilibrium. Apply energy conservation principle through the First Law. Analyze heat and work interactions. Explore reversible and irreversible processes, Carnot cycle, and efficiency. Grasp the Second Law and its implications for temperature scales and thermodynamic processes.

CO2: Comprehend entropy, its implications on thermodynamic processes, and the Second Law. Analyze thermodynamic potentials, their properties, and applications in various systems. Apply thermodynamic concepts to phase transitions and equilibrium conditions.

CO3: Apply Maxwell's relations to derive thermodynamic properties and relationships. Analyze gas behavior using Maxwell-Boltzmann distribution, equipartition theorem, and degrees of freedom. Connect theoretical concepts to experimental observations and real-world applications.

CO4: Understand and differentiate between free expansion and throttling processes. Apply Joule-Thomson effect to real gases, including inversion temperature and cooling. Analyze adiabatic demagnetization as a cooling technique.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (PHYSICS) (FYIP) (SEMESTER–I)
COURSE TITLE: THERMAL PHYSICS
COURSE CODE: FPHL-1394

Credits: 4-0-0 **Max Marks: 100 (ESE Marks: 70, CA: 30)**
Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:
Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.
Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT–I

Law of Thermodynamics: Extensive and Intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamic & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential Form, Internal Energy, First Law & Various Processes, Applications of First Law: General Relation between CpAndCv, Work Done during Isothermal and Adiabatic Processes, Carnot engine & efficiency, Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Application of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.Concept of Entropy, Clausius Theorem, Clausius Inequality, Second Law of Thernodynamics in terms of Entropy, Entropy of a perfect gas, Principle of increase of Entropy, Entropy Changes in Reversible and Irreversible processes with examples, Entropy Changes in Reversible and Irreversible Processes, Principle of Increase of Entropy, Temperature-Entropy diagrams for Carnot's Cycle, Third Law of Thermodynamics Unattainability of Absolute Zero

UNIT–II

Thermodynamic Potentials & Maxwell's Thermodynamic Relations: Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy, Their Definitions, Properties and Applications, Derivations and applications of Maxwell's Relations, Maxwell's Relations: (1) Clausius Clapeyron equation, (2) Values of Cp-Cv, (3) TdS Equations, (4) Surface Films and Variation of Surface Tension with Temperature, (5) Energy Equations, (6) Change of Temperature during Adiabatic Process.

UNIT–III

Magnetic Work, First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations. Joule's Experiment Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment Joule Thomson Effect for Ideal and Van der Waal Gases. Temperature of Inversion. Joule Thomson Cooling.Adiabatic demagnetization.

UNIT–IV

Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in anIdeal Gas and its Experimental Verification. Doppler Broadening of Spectral Lines andStern's Experiment Mean, RMS and Most Probable Speeds.Degrees of Freedom Law of Equi-partition of Energy. Specific heats of Gases

Text and Reference Books:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
3. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
4. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
5. Heat Thermodynamics & Statistical Physics, Brij Lal and Subramaniam, 1st Edn., 2008, S. Chand.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: MATHEMATICAL PHYSICS-I

COURSE CODE: FPHL-1335

CO1: Understand the concept of function plotting and series approximations using Taylor and binomial series. Students will learn to solve first-order differential equations (separable, homogeneous, exact/inexact) and second-order linear differential equations using operator methods and Wronskian concepts.

CO2: They will learn advanced techniques for solving second-order differential equations using the methods of undetermined coefficients and variation of parameters. Students will also understand Euler's differential equations and solve systems of simultaneous differential equations. Additionally, they will grasp fundamental concepts of vector algebra including scalar and vector products and their geometric interpretations.

CO3: Learn the basics of vector calculus including directional derivatives, gradient, divergence, curl, and Laplacian. Students will understand and apply vector identities and evaluate double and triple integrals, including change of order and Jacobians.

CO4: They will apply vector integration to compute line, surface, and volume integrals. Students will understand and verify the Gauss divergence theorem, Green's theorem, and Stokes' theorem. They will also learn the formulation of vector operators in orthogonal curvilinear coordinate systems like Cartesian, spherical, and cylindrical.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: MATHEMATICAL PHYSICS-I

COURSE CODE: FPHL-1335

Credits: 4-0-0 **Max Marks: 100 (ESE Marks:70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.

Unit-I

Calculus:Plotting of functions. Approximation: Taylor and binomial series (statements only). First Order Differential equations (variable separable, homogeneous, non- homogeneous),exact and inexact differential equations and Integrating Factor.

Second Order Differential equations-1: Homogeneous Equations with constant coefficients. Wronskian and general solution.Particular Integral with operator method

Unit-II

Second Order Differential equations-2: Method of undetermined coefficients and variation method of parameters. Euler differential equation and simultaneous differential equations of First and Second order.

Vector Algebra: Properties of vectors. Scalar product and vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields.

Unit III

Vector Calculus:Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation.Divergence and curl of a vector field. Del and Laplacian operators. Vector identities.

Vector Integration-1: Ordinary Integrals of Vectors. Double and Triple integrals, change of order of integration, Jacobian.Notion of infinitesimal line.

Unit IV

Vector Integration-2: Surface and volume elements.Line, surface and volume integrals of Vector fields Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their verification (no rigorous proofs).

Orthogonal Curvilinear Coordinates:

Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

Reference Books:

1. Mathematical Methods for Physicists,G.B.Arfken, H.J.Weber, F.E.Harris,2013, 7th Edn., Elsevier.
2. An introduction to ordinary differential equations, E.A.Coddington, 2009, PHI learning
3. Differential Equations, George F. Simmons, 2007, McGraw Hill.
4. Advanced Engineering Mathematics,D.G.Zill and W.S.Wright, 5 Ed.,2012,Jones and Bartlett Learning
5. Mathematical Physics, Goswami, 1st edition, Cengage Learning

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: ORGANIC CHEMISTRY

COURSE CODE: FPHM-1086

Course outcomes:

After Completing the Course the students will be able to

CO1: learn about the basic chemistry of organic chemistry.

CO2: interpret the reactions and properties of alcohols and Phenols and provide basic knowledge of organic reaction mechanisms.

CO3: understand preparations and reactions of ethers and epoxides, understand cleavages in ethers, the ring opening reactions of epoxides.

CO4: to resolve the different enantiomers and differentiate between dextrorotatory-leavorotatory chiral and achiral compounds, understand the concept of isomerism, conformation and configuration.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: ORGANIC CHEMISTRY

COURSE CODE: FPHM-1086

Credits: 3-0-1 **Max Marks: 100 (ESE Marks:40, Practical:30,CA: 30)**

Examination Time: 3 Hours **Pass Mark: 14**

Instructions for the Paper Setters: Eight questions of equal marks (Sixteen marks each) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section. Each question carries 14 marks.

UNIT-I

Basics concepts of Organic Chemistry: Classification and Nomenclature of organic compounds. Electronic Effects: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation. Reactive intermediates: carbocations, carbanions, free radicals. Electrophiles and Nucleophiles. Nucleophilicity and basicity. Relative strengths of acids and bases, concept of p*K*a, effect of substituents and steric effects of substituents.

UNIT-II

Chemistry of functional groups–I: Selective methods of preparation: dehydration of alcohols, dehydrohalogenation of alkyl halides with complete mechanistic discussion. (E mechanism), Saytzeff's rule. Reactions: addition of hydrogen halides (Markovnikov's and anti-Markovnikov's addition), halogen addition to alkenes, epoxidation of alkenes. Acidity of acetylene, Birch reduction, addition of hydrogen halides and water to alkynes, Diels-Alder reaction.

UNIT-III

Chemistry of functional groups–II: Ethers and Epoxides: methods of their formation, Chemical reactions Cleavage and autoxidation, Zeisel's method, Acids and base catalysed ring opening of epoxide, Alkyl Halides, Types of Nucleophilic Substitution (SN1, SN2) reactions, solvent effect, substitution and elimination as competing reactions. Principles of nucleophilic addition to carbonyl groups: acetal formation, cyanohydrins formation; reactions with primary and secondary amines, Witting reaction, aldol condensation

UNIT-IV

Stereochemistry: Introduction, Conformations of ethane and butane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Configuration: Geometrical and Optical isomerism, Molecular chirality, optical activity, absolute and relative configuration, the Cahn-Ingold Perlog R-S notional system, physical properties of enantiomers, naming stereo isometric alkenes by the E/Z system.

Books suggested

1. R.T. Morison and R.N Boyd, Organic Chemistry.
2. I.L. Finar, Organic Chemistry, Vol. I- IV
3. J. March, Advanced Organic Chemistry, Reactions Mechanism and Structure.
4. F.A. Carey, Organic Chemistry.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: Organic Chemistry (LAB)

COURSE CODE: FPHM-1086

Course Outcomes

Students will be able to analyze the given organic compound through

CO1: understand the basics of Qualitative analysis

CO2: detection of elements (N, S and halogens) in organic compounds.

CO3: detection of functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide) in simple organic compounds

CO4: preparation of their derivatives

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: Organic Chemistry (LAB)

COURSE CODE: FPHM-1086

Credits: 3-0-1 **Max Marks: 30**

Examination Time: 3 Hours **Pass Mark: 11**

Instruction for practical examiner: Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same should be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

General Guidelines for Practical Examination

The preliminary examination of physical and chemical characteristics (Physical state, colour and odour), elemental analysis (nitrogen, sulphur, chlorine, bromine, iodine), solubility tests including acid-base reactions, classification tests involving functional reactivity other than acid-base test. The following categories of compounds should be analysed: phenols, carboxylic acids, carbonyl compounds- ketones and aldehydes, aromatic amines, amides.

Suggested Book:

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
2. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. Practical Organic Chemistry, 5 th Ed. Pearson (2012)
3. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).
4. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: COMPUTER FUNDAMENTALS AND PC SOFTWARE (THEORY)

COURSE CODE: FPHM-1126

Course Outcomes:

CO1: Understand the basic concepts of computers including their generations, classifications, and applications. Students will be able to identify the functional units of a computer system and explain the interrelation between hardware and software using block diagrams of CPU, memory, input/output, and communication devices.

CO2: Students will understand the types and functions of system and application software, various programming languages, and hardware devices. They will be able to identify and describe the working of input, output, and storage devices along with their classifications such as impact/non-impact printers and magnetic/optical storage media.

CO3: Learn the purpose and types of operating systems including Windows GUI and command-line interfaces. Students will be able to perform basic to advanced tasks in word processor such as document formatting, inserting elements, using macros, mail merge, and printing setup for professional document creation.

CO4: They will understand the structure and design of presentations using slideware, including inserting multimedia and formatting slides. They will also learn to use spreadsheet for data organization, formula application, data analysis using functions, charts, and pivot tables.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: COMPUTER FUNDAMENTALS AND PC SOFTWARE (THEORY)

COURSE CODE: FPHM-1126

Credits: 3-0-1 **Max Marks: 100 (ESE Marks:40, Practical:30,CA: 30)**

Examination Time: 3 Hours **Pass Mark: 14**

Instructions for the Paper Setters: Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section. Each question carries 8 marks.

Unit-I

Introduction to Computer, Generations of Computers, Classification of Computers, Computer Applications: Computer as a system, basic concepts– hardware and software, functional units, and their interrelation. Block diagram showing Central Processing Unit, Memory, and Input/Output Devices, Communication devices.

Unit-II

Software: System software and Application software. Programming languages. Hardware: Input Devices- Keyboard, mouse, pens, touch screens, Bar Code reader, joystick, source data automation, (MICR, OMR, OCR), screen assisted data entry: portable/handheld terminals for data collection, voice recognition systems Output Devices: Display Monitors, Printers, Impact Printers, Non-impact Printers, Plotters, Voice Output Systems, Projectors, Terminals. Storage Devices: Concept of storage units (bit, byte, KB, MB etc.), Primary storage, Secondary storage, Magnetic storage devices, and Optical Storage Devices.

Unit-III

Operating System: meaning, purpose, Windows GUI, Command-line, Powershell overview. File, Word Processor: Overview, creating, saving, opening, importing, exporting and inserting files, formatting pages, paragraphs and sections, indents and outdents, creating lists and numbering. headings, styles, fonts and font size; editing, positioning, and viewing texts; finding and replacing text; inserting page breaks, page numbers, bookmarks, symbols, and dates; using tables, header, footer, macros, mail-merge; printing setup

Unit-IV

Slideware: Presentation overview, entering information, presentation creation, opening and saving presentation; inserting audio and video, shapes, different views, formatting; playing slides. Spreadsheet overview, Editing, Formatting, freeze panes, using formulas and functions, sorting and filtering, pivot tables, charts and Graphs.

Recommended Books:

1. P.K. Sinha, Computer Fundamentals : concepts, systems and applications, BPB Publications
2. E Balagurusamy, FUNDAMENTALS OF COMPUTERS Tata McGraw Hill Education Private Limited New Delhi.
3. Peter Norton, Introduction to Computers, McGraw Hill Education
4. MS–Office _ BPB Publications.
5. Gurvinder Singh & Rachpal Singh, Windows-Based Computer Courses.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: COMPUTER FUNDAMENTALS AND PC SOFTWARE (PRACTICAL)

COURSE CODE: FPHM-1126

Course Outcomes:

CO1: Use Windows OS through GUI and command line for system navigation and file management.

CO2: Create and format documents using advanced features of word processor.

CO3: Organize and analyze data using formulas, functions, and tools in spreadsheets.

CO4: Design interactive presentations using multimedia and formatting features in slideware.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP)) (SEMESTER–I)

COURSE TITLE: COMPUTER FUNDAMENTALS & PC SOFTWARE (PRACTICAL)

COURSE CODE: FPHM-1126

Credits: 3-0-1 **Max Marks: 30**

Examination Time: 3 Hours **Pass Mark: 11**

Instruction for practical examiner: Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same should be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar. Two questions of equal marks strictly as per the syllabus and based on the practical exercises covered in the semester. Questions may be subdivided into parts (not exceeding four). Candidates will attempt ONE question, explain their answer by writing on the answer sheet, and then implement the same on the computer. Examiner will evaluate both the answers (theory as well as practical). The viva should also be conducted alongside, and the student is asked viva questions related to the question and the solution he/she is working on during the exam. Students will prepare a report after analyzing print and social media advertisements along with the local market survey to understand the desktop/laptop vendors and prices. Arrange the options available as per price/performance preferences.

Lab exercises based on:

1. Practice the Windows Operating System command line and the GUI for user interaction, personalization and file management
2. Document preparation with word processor using the features mentioned in the syllabus
3. Spreadsheet processing with spreadsheet using the features mentioned in the syllabus
4. Presentation preparation with slideware using the features mentioned in the syllabus

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: PHYSICS LAB-I

COURSE CODE: FPHP-1397

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: Students will demonstrate the ability to conduct a specific experiment from a given list, applying theoretical knowledge and practical skills to accurately complete the procedure and obtain reliable results.

CO2: Students will be able to articulate the theoretical background and principles underlying the chosen experiment.

CO3: Students will demonstrate their understanding of the experiment through oral questioning and discussion.

CO4: Students will maintain a well-organized and accurate practical file documenting all experiments conducted.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: PHYSICS LAB-I

COURSE CODE: FPHP-1397

Credits: 0-0-3 **Max Marks: 100 (ESE Marks: 70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

Instructions to Practical Examiner: Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar

General Guidelines for Practical Examination

I. The distribution of marks is as follows:

i) One experiment 30 Marks

ii) Brief Theory 15 Marks

iii) Viva–Voce 15 Marks

iv) Record (Practical file) 10 Marks

II. There will be one session of 3 hours duration. The paper will have one session and will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.

III. Number of candidates in a group for practical examination should not exceed 20.

IV. In a single group no experiment be allotted to more than three examinee in any group.

LIST OF EXPERIMENTS

1. Use of Vernier calliper, screw gauge and travelling microscope.
2. To determine the Moment of Inertia of a Flywheel.
3. To find Young's modulus of the material of a rectangular bar by bending.
4. To determine the Modulus of Rigidity of a Wire by Maxwell‟s needle.
5. To determine the value of g using Bar Pendulum.
6. To determine the value of g using Kater‟s Pendulum.
7. To find the efficiency of an electric kettle with varying input voltage.
8. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton disc method.
9. To determine Stefan's constant using Boltzmann's law.
10. To Study the variation of Thermo-Emf of a thermocouple with difference of temperature of its two Junctions using a null method and also calibrate the thermocouple in a specified temperature range.
11. To find unknown low resistance using Carey Foster's bridge without calibrating the bridge-wire.

Reference Books:

1. Practical Physics, C.L. Arora, S. Chand & Co.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2024-25)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: FOUNDATION COURSE

COURSE CODE: VACF-1491

Course Outcomes

After the completion of this Audit course, students will be able to

CO 1. Learn how past societies, systems, ideologies, governments, cultures and technologies were built, how they operated, and how they have changed

CO2. understand how the rich history of the world helps us to paint a detailed picture of where we stand today.

CO3 . Understand the Vedic theism, Upanishads Philosophy and doctrines of Jainism, Buddhism and Sikhism

CO4. Acquire knowledge of women rights and courage to face day to day challenges

- acknowledge the changes in society, religion and literature in the renaissance period and the importance of empathy and compassion for humanity
- learn about the prominent Indians (Men and Women) who contributed significantly in freedom struggle, education, economic development and in the formation and evolution of our nation
- understand meaning of race and how that concept has been used to justify exclusion, inequality, and violence throughout history and the origin of civil right movements to fight for equality, liberty and fraternity
- critically evaluate the socio-political and economic issues at global level and its implications in the present
- upgrade and enhance learning technological skills and striking a balance between technology and their well being
- take pride in learning the saga of Indian Past Culture and Heritage
- understand the rich legacy of KMV and its progressive endeavours.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2024-25)

Master of Science (PHYSICS) (FYIP) (SEMESTER–I)

COURSE TITLE: FOUNDATION COURSE

COURSE CODE: VACF-1491

Credits: 2-0-0 **Max Marks: 50 (ESE Marks:35, CA: 15)**

Examination Time: 1 Hour **Pass Mark: 13**

SYLLABUS

Module I Being a Human: Introduction & Initial Assessment

- Introduction to the programme
- Initial Assessment of the students through written answers to a couple of questions

Module 2 The Human Story

- Comprehensive overview of human intellectual growth right from the birth of human history
- The wisdom of the Ancients
- Dark Middle Ages
- Revolutionary Renaissance
- Progressive modern times
- Most momentous turning points, inventions and discoveries

Module 3 The Vedas and the Indian Philosophy

- Origin, teachings and significance of *The Vedas*
- Upnishads and Puranas
- Karma Theory of *The Bhagwad Gita*
- Main tenets of Buddhism & Jainism
- Teachings of Guru Granth Sahib

Module 4 Changing Paradigms in Society, Religion & Literature

- Renaissance: The Age of Rebirth
- Transformation in human thought
- Importance of humanism
- Geocentricism to heliocentricism
- Copernicus, Galileo, Columbus, Darwin and Saint Joan
- Empathy and Compassion

o Module 5 Woman: A Journey through the Ages

- Status of women in pre-vedic times
- Women in ancient Greek and Roman civilizations
- Women in vedic and ancient India
- Status of women in the Muslim world
- Women in the modern world
- Crimes against women
- Women labour workforce participation
- Women in politics
- Status of women- our dream

o Module 6 Makers of Modern India

- Early engagement of foreigners with India
- Education: The first step to modernization

- Railways: The lifeline of India
- Raja Ram Mohan Roy, Gandhi, Nehru, Vivekanand, Sardar Patel etc.
- Indira Gandhi, Mother Teresa, Homai Vyarawala etc.
- The Way Ahead

o Module 7 Racism: Story of the West

- European beginnings of racism
- Racism in the USA - Jim Crow Laws
- Martin Luther King Jr. and the battle against racism
- Apartheid and Nelson Mandela
- Changing face of racism in the modern world

o Module 8 Modern World at a Glance: Political & Economic Perspective

- Changing world order
- World War I & II
- UNO and The Commonwealth
- Nuclear Powers; Terrorism
- Economic Scenario: IMF, World Bank
- International Regional Economic Integration

o Module 9 Technology Vis a Vis Human Life

- Impact of technology on modern life
- Technological gadgets and their role in our lives
- Technology and environment
- Consumerism and materialism
- Psychological and emotional consequences of technology
- Harmonizing technology with ethics and humaneness

o Module 10 My Nation My Pride

- Indian Past Culture and Heritage
- Major Discoveries (Medicinal and Scientific)
- Vedic Age
- Prominent Achievements
- Art, Architecture and Literature

o Module 11 The KMV Experience

- Rich Legacy of KMV
- Pioneering role in women emancipation and empowerment
- KMV Contribution in the Indian Freedom Struggle
- Moral, cultural and intellectual heritage of KMV
- Landmark achievements
- Innovative initiatives; international endeavours
- Vision, mission and focus
- Conduct guidelines for students

o Module 12 Final Assessment, Feedback & Closure

- Final multiple-choice quiz
- Assessment through the same questions asked in the beginning
- Feedback about the programme from the students
- Closure of the programme

o PRESCRIBED READING

- ***The Human Story*** published by Dawn Publication

SEMESTER-II

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2024-25)

Master of Science (PHYSICS) (FYIP) (SEMESTER–II)

COURSE TITLE: PUNJABI (COMPULSORY)

COURSE CODE: FPHL-2421

Course Outcomes

CO1: nkX[fBe fJeKrh g[[[;se Bz{ gVQkT[D dk wB'oE ftfdnkoEhnK nzdo fJeKrh gqsh fdbu;gh, ;{M Bz{ g?dk eoBk j?.

CO2 nkX[fBe fJeKrh g[[[;se Bz{ gVQkT[D dk wB'oE ftfdnkoEhnK nzdo fJeKrh gqsh fdbu;gh, ;{M Bz{ g?dk eoBk j?.

CO3: w[jkto// / nykD dh tos'A Bkb rZbpks ftu gogZesk nkT[Adh j?.fJj ftfdnkoEhnK dh rZbpks ftu fByko fbnkT[D dk ezw eoBr/.

CO4: Ppd Pq/DhnK Bz{ gVQkT[D dk wB'oE ftfdnkoEhnK nzdo gzikph GkPk dh nwhoh dk ns/ pkohehnK Bz{ ;wMD bJh tZyo/ -tZyo/ f;XKsK dk ftek; eoBk j?.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2024-25)

Master of Science (PHYSICS) (FYIP) (SEMESTER–II)

COURSE TITLE: PUNJABI (COMPULSORY)

COURSE CODE: FPHL-2421

Credits: 2-0-0 **Max Marks: 50 (ESE Marks:35, CA: 15)**

Examination Time: 3 Hours **Pass Mark: 13**

nze tzv ns/ gohfyne bJh jdkfJsK

1H gqPB gZso d/ uko ;?ePB j'Dr/.;?ePB A-D sZe d/ gqPB :{fBN I-IV ftu'A g[ZS/ ikDr/. jo ;?ePB ftu d' gqPB g[ZS/ ikDr/.

2H ftfdnkoEh B/ eZ[b gzi gqPB eoB/ jB. jo ;?ePB ftu'A fJe gqPB eoBk bkIwh j?. gzitK gqPB fe;/ th ;?ePB ftu'A ehsk ik ;edk j?.

3H jo/e gqPB d/ 7 nze jB.

4H g/go ;?ZN eoB tkbk i/eo ukj/ sK gqPBK dh tzv nr'A tZX s'A tZX uko T[g gqPBK ftu eo ;edk j?.

gkmeqw ns/ gkm g[;seK

:{fBN-I

nkX[fBe fJeKrh, ;zgkde o"PB bkb nj{ik, r[o{ BkBe d/t :{Bhtof;Nh, nzfwqs;o ;[jkr, I|oBkwk, fJZe n?stko fJeKrhnK gVQkJhnK ikDrhnK.

(;ko,ftPk t;s{) 7 nze

:{fBN-II

nkX[fBe fJeKrh, ;zgkde o"PB bkb nj{ik, r[o{ BkBe d/t :{Bhtof;Nh, nzfwqs;o pzp e/;, i[ZshnK dk I'Vk, eZu dk riok fJeKrhnK gVQkJhnK ikDrhnK.

(;ko,ftPk t;s{) 7 nze

:{fBN-III

(T) w[jkto// / nykD

(n) xo/b{ fuZmh gZso 7 nze

:{fBN-IV

(T) Ppd Pq/DhnK L BKt,gVBKt,fefonk,ftP/PD

(n) Ppd Pq/DhnKL fefonk ftP/PD,;zpzXe,:'ie,ft;fwe 7 nze

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2024-25)

Master of Science (PHYSICS) (FYIP) (SEMESTER–II)

COURSE TITLE: BASIC PUNJABI (IN LIEU OF PUNJABI(COMPULSORY))

COURSE CODE: FPHL-2031

Course outcomes

CO1: Ppd P/qDhnK L gSkD ns/ tos'A (BKt, gVBKt, fefonk, ftP/PD, fefonk ftP/PD, ;pzXe, :'ie ns/ ft;fwe) Bz{ gVQkT[D dk wB'oE ftfdnkoEhnK nzdo gzikph GkPk dh nwhoh dk ns/ pkohehnK Bz{ ;wMD bJh tZyo/ -tZyo/ f;XKsK dk ftek; eoBk j?/.

CO2: ftfdnkoEh gzikph tke pDso (;kXkoB tke, ;z:[es tke, fwPos tke, fpnkBhnk tke, gqPB tkue tke ns/ j[ewh tke) dh gfoGkPk ns/ fJ; dh pDso s'A ikD{ j'Dr/ ns/ T[BQK dh GkPk s/ geV wip{s j't/rh.

CO3: g?oQk ouBk ns/ ;zy/g ouBk dk wB'oE ftfdnkoEhnK dh p[ZXh B{z shyD eofdnK T[BK dh fbyD gqfsGk B{z T[ikro eoBk j?.

CO4: xo/b{ ns/ d|soh fuZmh gZso fbyD dk wB'oE ftfdnkoEhnK B{z fJ; ebk ftu fBg[zB eoBk j? ı nykD ns/ w[jkto/ dh tos'A Bkb rZbpks ftu gogZesk nkT[Adh j?.fJj ftfdnkoEhnK dh rZbpks ftu fByko fbnkT[D dk ezw eoBr/.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2024-25)

Master of Science (PHYSICS) (FYIP) (SEMESTER–II)

COURSE TITLE: BASIC PUNJABI (IN LIEU OF PUNJABI(COMPULSORY))

COURSE CODE: FPHL-2031

Credits: 2-0-0 **Max Marks: 50 (ESE Marks:35, CA: 15)**

Examination Time: 3 Hours **Pass Mark: 13**

nze tzv ns/ gohfyne bJh jdkfJsK

1H gqPB gZso d/ uko ;?ePB j'Dr/.;?ePB A-D sZe d/ gqPB :{fBN I-IV ftu'A g[ZS/ ikDr/. jo ;?ePB ftu d' gqPB g[ZS/ ikDr/.

2H ftfdnkoEh B/ eZ[b gzi gqPB eoB/ jB. jo ;?ePB ftu'A fJe gqPB eoBk bklwh j?. gzitK gqPB fe;/ th ;?ePB ftu'A ehsk ik ;edk j?.

3H jo/e gqPB d/ 7 nze jB.

4H g/go ;?ZN eoB tkbk i/eo ukj/ sK gqPBK dh tzv nZr'A tZX s'A tZX uko T[g gqPBK ftu eo ;edk j?.

gkmeqw

:{fBN-I

Ppd P/qDhnK L gSkD ns/ tos'A (BKt, gVBKt, fefonk, ftP/PD, fefonk ftP/PD, ;pzXe, :'ie ns/ ft;fwe) 7 nze

:{fBN-II

gzikph tke pDso L w[ZYbh ikD gSkD

(T) ;kXkoB tke, ;z:[es tke ns/ fwPos tke (gSkD ns/ tos'A)

(n) fpnkBhnk tke, gqPB tkue tke ns/ j[ewh tke (gSkD ns/ tos'A) 7 nze

:{[fBN-III

g?oQk ouBk

;zy/g ouBk 7 nze

:{fBN-IV

fuZmh gZso (xo/b{ ns/ d|soh)

nykD ns/ w[jkto/ (fb;N Bkb BZEh j?) 7 nze

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2024-25)

Master of Science (PHYSICS) (FYIP) (SEMESTER–II)

COURSE TITLE: PUNJAB HISTORY AND CULTURE (C. 320 TO 1000 A.D.)
(SPECIAL PAPER IN LIEU OF PUNJABI COMPULSORY)
(FOR THOSE STUDENTS WHO ARE NOT DOMICILE OF PUNJAB)

COURSE CODE: FPHL-2431

COURSE OUTCOMES

After completing Semester II and course on Ancient History of Punjab students will be able to understand:

CO 1: The reasons and impact of Alexander's invasions and to comprehend various factors leading to rise and fall of empires and emergence of new dynasties and their administration specifically of Maurya rule in general and Ashok in particular

CO 2: art and architecture of Gupta period and the Indo-Greek style of architecture under Gandhara School

CO 3: To have an insight into the socio-cultural history under Harshvardhan and punjab under the stated period

CO 4: To enable students to have thorough insight into the various forms/styles of Architecture and synthesis of Indo - Greek Art and Architecture in Punjab

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2024-25)

Master of Science (PHYSICS) (FYIP) (SEMESTER–II)

COURSE TITLE: PUNJAB HISTORY AND CULTURE (C. 320 TO 1000 A.D.)
(SPECIAL PAPER IN LIEU OF PUNJABI COMPULSORY)
(FOR THOSE STUDENTS WHO ARE NOT DOMICILE OF PUNJAB)

COURSE CODE: FPHL-2431

Credits: 2-0-0 **Max Marks: 50 (ESE Marks:35, CA: 15)**
Examination Time: 3 Hours **Pass Mark: 13**

Instructions for the Paper Setter:

1. Question paper shall consist of four Units
2. Examiner shall set 8 questions in all by selecting Two Questions of equal marks from each Unit.
3. Candidates shall attempt 5 questions in 600 words, by at least selecting One Question from each Unit and the 5th question may be attempted from any of the four Units.
4. Each question will carry 7 marks

Unit-I

1. Alexander's Invasion's and Impact
2. Administration of Chandragupta Maurya with special reference to reforms introduced by Ashok

Unit-II

3. The Kushans: Gandhar School of Art
4. Gupta Empire: Golden Period-Social and cultural life, Art and Architecture)

Unit-III

5. The Punjab under Harshvardhana-Society and Religion During the time of Harshvardhana
6. Socio-cultural History of Punjab from 7th to 1000 A.D.

UNIT IV

7. Development of Languages and Education with Special reference to Taxila
8. Development to Art and Architecture

Suggested Readings

- B.N. Sharma: *Life in Northern India*, Delhi. 1966
- Budha Parkash, *Glimpses of Ancient Punjab*, Patiala, 1983.
- L. M Joshi (ed), *History and Culture of the Punjab*, Art-I, Punjabi University, Patiala, 1989 (3rd edition)
- L.M. Joshi and Fauja Singh (ed.), *History of Punjab*, Vol.I, Punjabi University, Patiala, 1977.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2024-25)

Master of Science (PHYSICS) (FYIP) (SEMESTER–II)

COURSE TITLE: COMMUNICATIVE ENGLISH

COURSE CODE: FPHL-2102

Course Outcomes

At the end of this course, students will be able to:

CO1: distinguish the main points from the supporting details and the irrelevant information from the relevant one through Note-Taking

CO2: learn the skills and strategies of effective writing by paragraph writing

CO3: enhance their reading and analyzing power of texts through guided reading through the study of "Making Connections" by Kenneth J. Pakenham

CO4: be acquainted to the techniques of effective essay writing

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2024-25)

Master of Science (PHYSICS) (FYIP) (SEMESTER–II)

COURSE TITLE: COMMUNICATIVE ENGLISH

COURSE CODE: FPHL-2102

Credits: 2-0-0 **Max Marks: 50 (ESE Marks:35, CA: 15)**

Examination Time: 3 Hours **Pass Mark: 13**

Instructions for the Paper Setters: -

Eight questions of equal marks (Specified in the syllabus (Units: I-IV)) are to be set, two in each of the four Sections. Questions may be subdivided into parts (not exceeding four).

Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section. Each question has a weightage of 7 marks.

UNIT-I

Practical question on Note Making, Summarizing and Abstracting as given in The Written Word by Vandana R. Singh

UNIT-II

Practical question on Paragraph writing as prescribed in The Written Word by Vandana R. Singh

UNIT-III

Theoretical questions based on ABC of Good Notes as prescribed in The Written Word by Vandana R. Singh, Unit-III from Making Connections: A Strategic Approach to Academic Reading by Kenneth J. Pakenham, Second Edition

UNIT-IV

Practical question on Essay writing from The Written Word by Vandana R. Singh,
Unit - IV from Making Connections: A Strategic Approach to Academic Reading by Kenneth J. Pakenham, Second Edition.

Prescribed Text books:

- The Written Word by Vandana R. Singh, Oxford University Press, New Delhi
- Making Connections: A Strategic Approach to Academic Reading by Kenneth J. Pakenham, second edition.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (FYIP) PHYSICS (SEMESTER–II)
COURSE TITLE: ELECTRICITY AND MAGNETISM
COURSE CODE: FPHL-2393

COURSE OUTCOMES

Course Outcomes: Electricity and Magnetism

After passing this course the students will be able to:

CO1: understand vector calculus and vector algebra and its applications in electricity and magnetism. The students will be able to solve the electrostatic problems with the help of Gauss law and Coulomb's law.

CO2: understand the applications of scalar potential for the calculation of electric field and electric potential due to an arbitrary charge distribution.

CO3: solve the problems with the help of method of images and understand the conduction of electric current and fundamental laws of electricity and relate the electric and magnetic fields in two inertial frames of reference.

CO4: able to understand electric field, potential and polarization of different media and related quantities.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (PHYSICS) (FYIP) (SEMESTER–II)
COURSE TITLE: ELECTRICITY AND MAGNETISM
COURSE CODE: FPHL-2393

Credits: 4-0-0 **Max Marks: 100 (ESE Marks: 70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.

Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT-I

Calculus of vectors: Introduction to gradient, divergence and curl; their physical significance. Rules for vector derivatives, useful relations involving gradient, divergence and curl. Fundamental theorem for gradients, Gauss's and Stoke's theorems (statements only). Electric Field and Electric Potential: Conservation and quantization of charge. Coulomb's law.

Electric field: Electric field lines, Electric flux. Gauss's law with applications to charge distributions with spherical, cylindrical and planar symmetry. Conservative nature of Electrostatic field. Electrostatic potential. Potential as line integral of field, potential difference.Derivation of the field from the potential. Potential of a point and line charge distribution, uniformly charged disc, spherical shell and solid sphere. Energy associated with an electric field. Electrostatic energy of a system of charges and of a charged sphere. The Uniqueness Theorem.Differential form of Gauss's law. Laplace's and Poisson's equations.Potential and electric field of a dipole. Force and torque on a dipole.

UNIT-II

Electric Fields Around Conductors: Conductors in an electrostatic field. Equipotential Surfaces.Method of Electrical Images for finding the potential and its application to Plane Infinite Sheet.

Dielectric Properties of Matter: Dielectrics.Effect of electric field on dielectrics. Electric field due to polarisation of dielectric, Polarisationvector. Dielectricconstant, Relation between electrical Susceptibility and Dielectric constant.Capacitor (parallel-plate, spherical and cylindrical) filled with dielectric. Dipole moment of an atom. Atomic polarizability, polarizing field in Dielectric.Clausius-Mosotti formula, Gauss's law for dielectrics.Permittivity of dielectric.Energy stored in a capacitor. Electric energy density. Displacement vector D. Relation between E, P and D.

UNIT-III

Magnetic Field: Definition of Magnetic Field B.Force on a (1) point charge (2) current carrying wire in a magnetic field. Torque on a current loop in a uniform magnetic field.Biot-Savart's Law and its simple applications: straight wire and circular loop. Current loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Magnetic force between current elements.Ampere's Circuital law and its application to (i) Solenoid and (ii) Toroid. Properties of B: curl and divergence. Vector Potential. **Magnetic Properties of Matter**: Response of various substances to magnetic fields. Magnetic dipole moment of current loop, Energy of magnetic dipole in external magnetic field.Magnetic dipole moment of atom.Orbital magnetic moment of an electron.Bohr Magneton. Types of magnetic materials.Properties of diamagnetic, paramagnetic and ferromagnetic substances. Magnetisation vector (M), Magnetic Intensity(H), Magnetic Susceptibility and Permeability.Relation between B, H, M. B-H curve and hysteresis.

UNIT-IV

Electrical Circuits: AC circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR circuit.

Fields of Moving Charges: Measurement of charge in motion, Electric field in different frames of references. Electric field due to moving charge. Relation between electric fields in two inertial frames, Interaction between moving charges.

Reference Books:

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhary, 2012, Tata McGraw
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
3. Introduction to Electrodynamics, D.J. Griffiths, 3rdEdn., 1998, Benjamin Cummings.
4. Feynman Lectures Vol.2, R.P. Feynman, R.B Leighton, M. Sands,2008, Pearson Education

5. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press
6. Electricity and Magnetism, J.H.Fewkes&J.Yarwood, Vol.I, 1991, Oxford Univ. Press
7. Electricity and Magnetism: A.K. Sikri. Pradeep Publications. 8. Electricity and Magnetism: A.S Mahajan and A.A Rangwala. Tata McGraw Hill

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (PHYSICS) (FYIP) (SEMESTER–II)
COURSE TITLE: WAVES AND OSCILLATIONS
COURSE CODE: FPHL-2394

COURSE OUTCOMES

After passing this course the student will be able to:

CO1: demonstrate Lissajous figures by mechanical and analytical method with different cases.

CO2: understand fundamental description of harmonic oscillator, damped, forced and N- coupled oscillators with real examples from everyday life i.e. vibration isolation, shocker etc.

CO3: solve differential equations of forced oscillations & to obtain related quantities.

CO4: understand the concept of coupled oscillators and wave motion. Students will also be able to apply the concept of waves and oscillations to any type of waves like e. m. waves, mechanical waves.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–II)

COURSE TITLE: WAVES AND OSCILLATIONS

COURSE CODE: FPHL-2394

Credits: 4-0-0 **Max Marks: 100 (ESE Marks: 70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A- D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section. Each question carries 14 marks.

UNIT-I

Damped Oscillations: Superposition of two SHM by vector addition, superposition of two perpendicular SHM, Polarization, Lissajous figures–superposition of many SHMs, complex number notation and use of exponential series. Damped motion of mechanical and electrical oscillator, heavy damping, critical damping. Damped single harmonic oscillator, amplitude decay, logarithmic decrement, relaxation time, energy decay, Q value, rate of energy decay equal to work rate of damping force, problems.

UNIT-II

Forced Oscillations: Transient and steady state behaviour of a forced oscillator, Variation of displacement and velocity with frequency of driving force, frequency dependence of phase angle between force and (a) displacement, (b) velocity, Vibration Insulation – Power supplied to oscillator, Q-value as a measure of power absorption bandwidth, Q-value as amplification factor of low frequency response.

UNIT-III

Coupled Oscillations: Stiffness (or Capacitance) coupled oscillators, normal coordinates, degrees of freedom, normal modes of vibration, general method of finding normal modes, forced vibrations of two coupled oscillators, linear oscillations (two masses coupled by three springs) and their normal modes, transverse oscillations (one mass coupled with two springs, two masses coupled with three springs) and respective normal modes, N-coupled oscillators (longitudinal and vertical oscillations) and their normal modes and properties, inductance coupling of electrical oscillators, wave motion as the limit of coupled oscillations.

UNIT-IV

Wave Motion: The wave equation, transverse waves on a string, the string as a forced oscillator, characteristic impedance of a string, reflection and transmission of transverse waves at a boundary , impedance matching, insertion of quarter wave element, standing waves on a string of fixed length, normal modes and eigen frequencies. Energy in a normal mode of oscillation, wave groups, group velocity, dispersion, wave group of many components, bandwidth theorem, Doppler effect, sound waves in gases.

Reference Books:

1. The Physics of Vibrations and Waves- H.J. Pain, John Wiley, Chichester, 1999
2. Vibrations and Waves in Physics- I.G. Main-Cambridge University, Cambridge, 1993.
3. Berkeley Physics Course Vol. III (Waves)-Frank S Crawford Jr-Frank S. Crawfold Jr, 1970.
4. Vibrations and Waves, George C King, Wiley Publication 2009.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (FYIP) PHYSICS (SEMESTER–II)

COURSE TITLE: MATHEMATICAL PHYSICS-II

COURSE CODE: FPHL-2335

Course Outcomes:

CO1: Understand the concept of Fourier series and the orthogonality of sine and cosine functions. Students will be able to expand periodic functions using Fourier series, determine Fourier coefficients for even and odd functions, and apply Parseval's identity to the summation of infinite series.

CO2: They will learn the Frobenius method for solving second-order linear differential equations with singular points. Students will understand the Legendre, Bessel, Hermite, and Laguerre differential equations along with important properties and recurrence relations of Legendre polynomials.

CO3: Learn the expansion of functions in terms of Legendre polynomials and the properties of Bessel functions of the first kind. Students will understand the generating functions, recurrence relations, zeros, and orthogonality of special functions, and apply Beta and Gamma functions in evaluating special integrals.

CO4: They will understand and solve partial differential equations using the method of separation of variables. Students will be able to solve Laplace's equation in rectangular geometry, wave equations for vibrating systems, and the 1D heat conduction equation for physical applications.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (PHYSICS) (FYIP) (SEMESTER–II)
COURSE TITLE: MATHEMATICAL PHYSICS-II
COURSE CODE: FPHL-2335

Credits: 4-0-0 **Max Marks: 100 (ESE Marks: 70, CA: 30)**
Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:
Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries **14 marks.**
Note: Students can use Non-Scientific calculators or logarithmic tables**.**

Unit-I
Fourier Series: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only).Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients.Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. Parseval Identity and its application to summation of infinite series.

Unit-II
Frobenius Method and Special Functions: Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations.

Unit-III
Special Functions-2: Expansion of function in a series of Legendre Polynomials. Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions (Jo(x) and J1(x)) and Orthogonality
Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions.

Unit-IV
Partial Differential Equations: Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular geometry. Solution of wave equation for vibrational modes of a stretched string, rectangular and circular membranes. Solution of 1D heat flow equation (equation not to be derived).

Reference Books:
1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
2. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
3. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
4. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
5. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
6. Mathematical methods for Scientists & Engineers, D.A.McQuarrie, 2003, Viva Books

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–II)

COURSE TITLE: INORGANIC CHEMISTRY

COURSE CODE: FPHM-2086

COURSE OUTCOMES:

After completing this course the students will be able to

CO1: Describe VBT, VSEPR theory and predict the geometry of simple molecules & molecular orbital theory of homonuclear diatomic molecules, explain, predict & draw structures of simple ionic compounds.

CO2: To enrich the factual knowledge of chemistry related to theories of coordination complexes and calculation of C.F.S.E.

CO3: To develop an understanding of the concepts of structure and bonding of inorganic complexes and calculate microstates and spectroscopic terms.

CO4: To familiarize with p-acid ligands.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (PHYSICS) (FYIP) (SEMESTER–II)
COURSE TITLE: INORGANIC CHEMISTRY
COURSE CODE: FPHM-2086

Credits: 3-0-1 **Max Marks: 100 (ESE Marks:40, Practical:30,CA: 30)**
Examination Time: 3 Hours **Pass Mark: 14**

Instructions for the Paper Setters:
Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. **Each question carries 8 marks.**
Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT- I
Introduction, Werner's coordination theory, naming of co-ordinate complexes. Co-ordination numbers 1-12 and their stereo-chemistries. Factors affecting co-ordination number and stereochemistry. Configurational Isomers, Conformational isomerism, VSPER theory, molecular orbital theory applied to homo-nuclear diatomic molecules. Bonding in metal complexes, Valence bond theory for co-ordinate complexes, inner and outer orbital complexes, Electro-neutrality and back bonding, limitations of V.B. theory.

UNIT- II
Stability of coordination compoundsIntroduction, Stability constant, stepwise stability constant, overall stability constant. Factors affecting the stability of metal ion complexes with general ligands, HSAB principle.Crystal field theory- Splitting of d-orbitals in octahedral, tetrahedral, cubic and square planar fields of ligands. Calculation of C.F.S.E. in high spin and low spin octahedral and High spin tetrahedral complexes, factors affecting the 10 Dq Value. Structural effects of crystal field splitting- Jahn-Teller distortion, variation of Ionic radii with increase in atomic number. Paramagnetism, diamagnetism, ferro and anti-ferromagnetism.

UNIT- III
Microstates and spectroscopic terms, a calculation of spectroscopic terms for d1 - d10 electronic configurations, L S coupling, Hund's rule for finding the ground state terms, Electronic spectral properties of Ist transition series, Orgel Diagrams for d1 - d10 systems, for weak field octahedral and tetrahedral complexes, limitations of C.F.T.

UNIT- IV
p -Acid Ligands definition Carbon monoxide complexes, bonding in linear MCO groups, polynuclear metal carbonyls, vibrational spectra, carbonyl hydrides and halides. Metal-metal bonding, metal metal multiple bonding, Structure of high nuclearity carbonyl clusters, counting of electrons in carbonyl clusters.

Text and Reference Books:
1. J.E. Huheey, Inorganic Chemistry, 3rd Ed.
2. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry.
3. B.E. Douglas and D.H. McDaniel, Concepts and Models of Inorganic Chemistry

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–II)

COURSE TITLE: INORGANIC CHEMISTRY (LAB)

COURSE CODE: FPHM-2086

Course outcomes:

Students will be able

CO1: To develop technical skills relevant to quantitative analysis.

CO2: Will have knowledge of cations and anions.

CO3: To separate and identify the various ions present in the mixture.

CO4: To perform confirmatory tests of various ions present in the mixture.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–II)

COURSE TITLE: INORGANIC CHEMISTRY LAB

COURSE CODE: FPHM-2086

Credits: 0-0-1 **Max Marks: 30**

Examination Time: 3 Hours **Pass Mark: 11**

Instructions to Practical Examiner

Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar

General Guidelines for Practical Examination

I. The distribution of marks is as follows:

i) One experiment 15 Marks

ii) Brief Theory 5 Marks

iii) Viva–Voce 5 Marks

iv) Record (Practical file) 5 Marks

II. There will be one session of 3 hours duration. The paper will have one sessioN.

III. Number of candidates in a group for practical examination should not exceed 20.

IV. In a single group no experiment be allotted to more than three examinee in any group.

1. Identification of cations and anions in a mixture which may contain four ions (cations and anions).

2. Perform systematic group analyses to identify the cations in the mixture. Any cation from Group I, Group II (Group IIA and IIB) Group IV, Group V and Group VI may be present.

Reference Books:

Vogel's book on Inorganic Qualitative Analysis

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–II)

COURSE TITLE: INTRODUCTION TO PROGRAMMING IN C (THEORY)

COURSE CODE: FPHM-2126

Course Outcomes:

CO1: Understand the basics of computer programming, including algorithms, flowcharts, program structures, and the development lifecycle. Students will be able to write and execute C programs using IDEs and command-line tools and understand C tokens, data types, symbolic constants, and preprocessor directives.

CO2: Gain the ability to use control structures like loops, conditional statements, and switch cases effectively. Students will understand storage classes, array manipulation, and string operations, including usage of library string functions.

CO3: Learn the concepts of functions and recursion in C programming. Students will be able to use pointers effectively for data handling, understand pointer operations with arrays, and apply dynamic memory allocation techniques.

CO4: Develop skills to use structures, unions, and file handling in C. Students will be able to process complex data using user-defined types and perform file operations with both text and binary files.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–II)

COURSE TITLE: INTRODUCTION TO PROGRAMMING IN C (THEORY)

Course Code: FPHM-2126

Credits: 3-0-1 **Max Marks: 100 (ESE Marks:40, Practical:30,CA: 30)**

Examination Time: 3 Hours **Pass Mark: 14**

Instructions for the Paper Setters :-

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Unit-I

Introduction:-Introduction to Computer Programming, concept of algorithm, flow chart, program structure, Program Development life cycle - Compiling and executing programs using IDE, command line

Fundamentals: Token, Character set, Identifiers and Keywords, Constants, Variables, Expressions, Statements, Symbolic Constants; Data types, declaring variables, initializing variables, types of integers, types of floats, strings, characters C Preprocessor directives: #define Statement, Conditional Compilation, include Files typedef, enum, Type Casting

Operations and Expressions: Arithmetic operators, Unary operators, Relational Operators, Logical Operators, Assignment and Conditional Operators, Data Input and Output statements, Library functions

Unit-II

Control Statements: Preliminaries, While, Do–while and For statements, Nested loops, If–else, Switch, Break– Continue statements.

Program Structure Storage Class: Automatic, external and static variables, multiple file programs.

Arrays: Defining, processing an array, passing arrays to a function, multi–dimensional arrays,

Strings: String declaration, string functions and string manipulation.

Unit-III

Functions: Brief overview, defining, accessing functions, passing arguments to function, variable scope, specifying argument data types, function prototypes, recursion.

Pointers: Fundamentals, pointer declaration, passing pointer to a function, pointer and one-dimensional arrays, operation on pointers, pointers & multi–dimensional arrays of pointers, passing functions, dynamic memory management.

Unit-IV

Structures & Unions: Defining and processing a structure, user defined data types, structures and pointers, passing structures to functions, self-referenced structure, unions, Arrays and Structures,

File handlingin C:- Introduction, file input/output function, binary file and text file.

References:

1. R.S. Salaria, Applications Programming in C, Khanna Book Publishing Co. (P) Ltd., Delhi.
2. Byron Gotterfied, Programming in C, Tata McGraw Hill Publishing Company Ltd., Delhi.
3. Yashvant Kanetkar, Let Us C, BPB Publications, Delhi.
4. Dennis Ritchie, Brian Kernighan, C Programming Language, Prentice Hall India

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–II)

COURSE TITLE: INTRODUCTION TO PROGRAMMING IN C (LAB)

COURSE CODE: FPHM-2126

Course Outcomes:

CO1: Demonstrate the ability to compile, execute, and debug C programs using an IDE, and apply C preprocessor directives and expressions in simple programs.

CO2: Implement control structures, loops, and storage classes to develop structured and efficient C programs.

CO3: Apply arrays, strings, functions, and pointers to solve problems involving modular and dynamic data handling.

CO4: Use structures, unions, and file handling techniques to manage and process complex data in C programming.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–II)

COURSE TITLE: INTRODUCTION TO PROGRAMMING IN C (PRACTICAL)
COURSE CODE: FPHM-2126

Credits: 3-0-1 **Max Marks: 30**
Examination Time: 3 Hours **Pass Mark: 11**
Instructions for the examiners: -

Two questions of equal marks strictly as per the syllabus and based on the practical exercises covered in the semester. Questions may be subdivided into parts (not exceeding four). Candidates will attempt ONE question, explain their answer by writing on the answer sheet, and then implement the same on the computer. Examiner will evaluate both the answers (theory as well as practical). The viva will also be conducted one-on-one alongside, and the student asked viva questions related to the question and the solution he/she is working on during the exam.

Lab Exercises based on Implementation of C:

1. Compiling and executing programs using IDE
2. C Preprocessor directives
3. Operations & Expressions
4. Data Input and Output statements
5. Control Statements
6. Program Structure Storage Class
7. Arrays & Strings
8. Functions & Pointers
9. Structures & Unions
10. File handling in C

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (PHYSICS) (FYIP) (SEMESTER–II)
COURSE TITLE: PHYSICS LAB-II
COURSE CODE: FPHP-2397

Course Outcomes:
After passing this course, students will be able to:
CO1: Students will demonstrate the ability to conduct a specific experiment from a given list, applying theoretical knowledge and practical skills to accurately complete the procedure and obtain reliable results.
CO2: Students will be able to articulate the theoretical background and principles underlying the chosen experiment.
CO3: Students will demonstrate their understanding of the experiment through oral questioning and discussion.
CO4: Students will maintain a well-organized and accurate practical file documenting all experiments conducted.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–II)

COURSE TITLE: PHYSICS LAB-II

COURSE CODE: FPHP-2397

Credits: 0-0-3 **Max Marks: 100 (ESE Marks: 70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

General Guidelines for Practical Examination

I. The distribution of marks is as follows:

i) One experiment 30 Marks

ii) Brief Theory 15 Marks

iii) Viva–Voce 15 Marks

iv) Record (Practical file) 10 Marks

II. There will be one session of 3 hours duration. The paper will have one session and will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.

III. Number of candidates in a group for practical examination should not exceed 12.

IV. In a single group no experiment be allotted to more than three examinee in any group.

LIST OF EXPERIMENTS

1. Use a Multimeter for measuring (a) Resistance, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. To study the characteristics of a RC Circuit.
3. To compare capacitances using De Sauty's bridge.
4. Measurement of field strength and its variation in a solenoid.
5. To verify the Thevenin and Norton theorems.
6. To verify the Superposition, and Maximum power transfer theorems.
7. To determine self-inductance of a coil by Anderson's bridge.
8. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q And (d) Band width
9. To study the response curve of a parallel LCR circuit and determine its a Anti resonant frequency and (b) Quality factor Q
10. To study C.R.O as a display and measuring device by reading sine and square waves.
11. To determine the capacity of a capacitor by discharging through voltmeter.
12. To find the capacity of a capacitor using flashing and quenching of a neon lamp.
13. To determine the frequency of an electric tuning fork by Melde‟s experiment and verifyλz–T law.
14. To investigate the motion of coupled oscillators.
15. To study Lissajous Figures.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House

2. A Text Book of Practical Physics, I. Prakash& Ramakrishna, 11th Ed., 2011, KitabMahal

3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinmann Educational Publishers

4. Engineering Practical Physics, S. Panigrahi and B. Mallick, 2015, Cengage Learning

5. A Laboratory Manual of Physics for undergraduate classes, D.P. Khandelwal, 1985, Vani Pub.

6. Practical Physics, C.L. Arora, S. Chand & Company.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–III)

COURSE TITLE: Electromagnetic Theory

COURSE CODE: FPHL-3391

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: apply Faraday's Law and Maxwell's Equations (both differential and integral forms) to evaluate electromagnetic field behavior in time-varying and static conditions, and interpret the physical significance of displacement current and vector/scalar potentials.

CO2: demonstrate understanding of electromagnetic wave equations and their solutions in free space, dielectric, and conducting media, including the concepts of wave impedance, skin depth, and the Poynting theorem.

CO3: analyze the reflection, refraction, and transmission of electromagnetic waves at dielectric boundaries (normal and oblique incidences), apply Fresnel's equations, and understand wave propagation in plasmas and ionized gases.

CO4: describe and differentiate between linear, circular, and elliptical polarization, and evaluate the use of optical components such as Nicol prisms and wave plates for manipulating polarization in anisotropic media.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (PHYSICS) (FYIP) (SEMESTER–III)
COURSE TITLE: Electromagnetic Theory
COURSE CODE: FPHL-3391

Credits: 4-0-0 **Max Marks: 100 (ESE Marks:70, CA: 30)**
Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:
Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.
Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT-I
Faraday's law & Maxwell Equations: Faraday's law of Electromagnetic Induction, a stationary circuit in time varying field, a moving conductor in a static magnetic field, a moving circuit in a time varying magnetic field. Expression for Self inductance, a circuit containing self inductance& energy stored in magnetic field, Mutual inductance and reciprocity theorem, Magnetic energy density, Ampere's law for time varying current, Concept & significance of Displacement Current, Maxwell Equations in differential & integral forms, Vector and Scalar Potentials. Gauge Transformations: Lorentz & Coulomb Gauge. Electromagnetic Boundary Conditions at Interface between two loss-less linear media and interface between a dielectric and perfect conductor.

UNIT-II
Electromagnetic Wave & Wave propagation : Wave equations & their solutions, Transverse nature of EM wave. EM wave through vacuum & isotropic dielectric medium, refractive index, dielectric constant and wave impedance. Time Harmonic Electromagnetic.Electromagnetic wave equations in conducting & non-conductiong medium. Flow of EM power: Poynting Theorem & Poynting Vector, instantaneous & average power density, Concept of relaxation time & Skin depth. Physical Concept of Electromagnetic energy density.

UNIT-III
Reflection and Refraction of waves : Wave propagation through dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index, application to propagation through ionosphere. Normal and oblique incidence at a plane dielectric boundary: perpendicular & parallel polarization cases, Reflection & Refraction of plane waves at plane interface between two dielectric media - Laws of Reflection & Refraction, Fresnel's formulae for perpendicular & parallel polarization, Brewster's law, Reflection & Transmission coefficients in normal incidences. Total internal reflection, evanescent waves.

UNIT-IV
Polarization, production and Detection of EM Waves : Polarization of Electromagnetic Waves : Description of Linear, Circular and Elliptical Polarization. Production & detection of Plane, Circularly and Elliptically Polarized light. Uniaxial and Biaxial Crystals, light propagation in Uniaxial Crystal. Double Refraction.Polarization by Double Refraction. NicolPrism. Ordinary& extraordinary refractive indices. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates.

Reference Books:

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
2. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
3. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
4. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill
5. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
6. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer
7. Electromagnetic Fields & Waves, P.Lorrain&D.Corson, 1970, W.H.Freeman& Co.
8. Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.
9. Field and wave electromagnet of by David & Cheng, Addison Wesley Publication,1996.
10. Principles of optics, Max born and Emil wolf, 7th edition,1999,Pergamon press.
11. Optics, Ajoy Ghatak,2008,tata McGraw Hill.
12. Fundamental of Optics, A.Kumar, H.R.Gulati and DR Khanna,2011.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–III)

COURSE TITLE: Optics

COURSE CODE: FPHL-3392

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: explain the electromagnetic nature of light, coherence, wavefronts, and apply superposition principles to analyze interference patterns in systems like Young's double-slit, Lloyd's Mirror, Fresnel's Biprism, and thin films.

CO2: gain the ability to solve problems involving Fresnel and Fraunhofer diffraction (single slit, double slit, multiple slits, diffraction grating, and circular apertures) and apply concepts such as resolving power, Rayleigh criterion, and Bragg's law in real-world contexts.

CO3: describe the transverse nature of light and analyze polarization through reflection, refraction, and birefringent materials using Nicol prisms and wave plates. They will also evaluate optical activity and determine specific rotation using a polarimeter.

CO4: explain the principles of holography and laser operation (including types and characteristics), and analyze light transmission through optical fibers using concepts like total internal reflection and numerical aperture.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (PHYSICS) (FYIP) (SEMESTER–III)
COURSE TITLE: OPTICS
COURSE CODE: FPHL-3392

Credits: 4-0-0 **Max Marks: 100 (ESE Marks:70, CA: 30)**
Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:
Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.
Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT-I
Wave Optics: Electromagnetic nature of light. Definition and properties of wave front.HuygensPrinciple.Temporal and Spatial Coherence, Superposition of N coherent waves. Interference: Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism.Principle of optical reversibility; Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Anti-reflection coatings, Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index.

UNIT-II
Interferometer: (1)Michelson Interferometer (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes, Fabry-Perot interferometer and Etalon. Diffraction: Introduction, Fraunhoffer diffraction at a single slit, double slit and N slits, Fraunhoffer diffraction missing orders. Diffraction grating, Missing orders, dispersive power, Rayleigh Criterion for resolving power, resolving power of a diffraction grating.X-ray diffraction and Bragg's law. Diffraction from a circular slit.

UNIT-III
Fresnel Diffraction:. Fresnel's Diffraction Integral and its Fraunhoffer Approximation, Fourier Optics, Fresnel's Half-Period Zones for PlaneWave, Theory of a Zone Plate: Multiple Foci of a Zone Plate.Fresnel diffraction pattern of a straight edge, a long narrow slit, circular aperture and opaque disk-Posson spot. Polarization: Transverse nature of light, Polarization by reflection and refraction, Brewster's Law, Malus Law, Double refraction, Nicol Prism, Elliptically and circularly polarized light, Quarter-wave and half-wave plates, production and detection of polarized light, Optical activity, specific rotation, Half shade polarimeter.

UNIT-IV
Holography: Principle of Holography. Recording and Reconstruction Method, Theoryof Holography as Interference between two Plane Waves, Point source holograms. Lasers: Spontaneous and stimulated emission, Einstein coefficients, Main components of a laser, optical resonator, population inversion, monochromaticity of a laser beam, Helium-Neon laser, ruby and CO2 laser. Fibre optics, total internal reflection, optical fiber, numerical aperture, glass and optical fibres.

Reference Books:
1. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill

2. Principles of Optics, Max Born and Emil Wolf, 7thEdn., 1999, Pergamon Press.
3. Optics, AjoyGhatak, 2008, Tata McGraw Hill.
4. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.
5. Optics, E. Hecht, 2008, 4th Edition, Pearson Education.
6. Schaum's Outline of Theory and Problems of Optics, E. Hecht, 1998 McGraw Hill.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–III)

COURSE TITLE: MATHEMATICAL PHYSICS-III

COURSE CODE: FPHL-3393

After completing this course, student will be able to

CO 1. Determine continuity, differentiability and analyticity of a complex function, find the derivative of a function and understand the properties of elementary complex functions.

CO 2. Evaluate a contour integral using parametrization, fundamental theorem of calculus and Cauchy's integral formula and Find the Taylor series of a function and determine its radius of convergence. Determine the Laurent series expansion of a function in different regions, find the residues and use the residue theory to evaluate a contour integral and real integral.

CO 3. Understand the properties of Fourier transforms and use these to solve boundary value problems.

CO 4. Understand the properties of Laplace transforms and use these to solve boundary value problems.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–III)

COURSE TITLE: MATHEMATICAL PHYSICS-III

COURSE CODE: FPHL-3393

Credits: 4-0-0 **Max Marks: 100 (ESE Marks:70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.

Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT-I

Statistics and probability: Sample space, Events, probability in discrete sample space, discrete random variables, Binomial distribution, mean, variance and moments, binomial coefficients, random walk, Poisson's distribution, mean, variance, mode, median, recurrence relations and applications, Continuous Distributions, Probability distribution function, mean, variance and mode, Normal Distribution, standard normal distribution.

UNIT-II

Complex Integration: Analyticity and Cauchy-Riemann Conditions for complex numbers, Examples of analytic functions, Singular functions: poles and branch points, order of singularity, branch cuts.Integration of a function of a complex variable, Cauchy's Inequality, Cauchy's Integral formula, Simply and multiply connected region, Laurent and Taylor's expansion, Residues and Residue Theorem, Application in solving Definite Integrals.

UNIT-III

Fourier Transforms: Fourier Integral theorem, Fourier Transform. Examples: Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral, Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem, Properties of Fourier transforms (translation, change of scale, complex conjugation, etc.), Three dimensional Fourier transforms with examples. Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat Flow Equations.

UNIT-IV

Laplace Transforms: Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Dirac Delta function, Periodic Functions, Convolution Theorem, Inverse LT, Application of Laplace Transforms to Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits.

Reference Books:

- Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
- Mathematics for Physicists, P. Dennery and A.Krzywicki, 1967, Dover Publications
- Complex Variables, A.S.Fokas & M.J.Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
- Complex Variables and Applications, J.W. Brown & R.V. Churchill, 7th Ed. 2003, Tata McGraw-Hill
- First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, 1940, Jones & Bartlett

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (PHYSICS) (FYIP) (SEMESTER–III)
COURSE TITLE: Introduction to Glass Science and Glass Ceramics
COURSE CODE: FPHM-3394

COURSE OUTCOMES:
After passing this course, students will be able to:
Course Outcomes:
After completing this course a student will be able to
CO1: Select appropriate raw materials for different types of glass based on their bonding nature (metallic, covalent, ionic) and amorphous/crystalline characteristics.
CO2: Utilize temperature-enthalpy relationships to design energy-efficient thermal processing protocols in glass manufacturing industries. Enables students to predict glass formation tendencies in new compositions for applications such as solar panels, optical fibers, or biomedical devices.
CO3: learn about historical developments in glasses. They will learn about physical and thermal properties of glasses.
CO4: Will learn about the commercial applications of the glasses and role of indian industries in glass technology.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

M.Sc. (PHYSICS) (FYIP) (SEMESTER–III)

Session-2026-27

Introduction to Glass Science and Glass Ceramics

Course Code: FPHM-3394

Credits: 3-0-1 Max Marks: 100 (ESE Marks: 40 (Theory), 30 (Practical) CA: 30)

Examination Time: 3 Hours Pass Mark: 14

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to a

ttempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 8 marks.

Note: Students can use Non-Scientific calculators or logarithmic tables.

Unit I

Classification of Materials on the basis of structure: Crystalline Vs Non. Crystalline, Nature of Bonding in Materials: Metallic, ionic, covalent and mixed bonding, amorphous materials, Definition of Glass, Glasses found in nature.

Unit II

Enthalpy/Temperature (V-T) Diagram, Glass transition and crystallization temperature, Zachariasen Structural Theories of Glass Formation, Glass-forming oxides and the concept of glass formers, modifiers, and intermediates, Nucleation and Crystal Growth.

Unit III

Historical development of glasses, Types of glasses, Glass Preparation methods, Determination of Physical properties and thermal characterization, glass ceramics.

Unit IV

Applications of glass and important commercial compositions, Role of Indian industries, Challenges faced, future scope, Open Problems

Reference Books:

1. Fundamentals of Inorganic Glasses by Arun K. Varshneya and John C. Mauro
2. Introduction to Glass Science and Technology by J.E. Shelby
3. Glass Science by Robert H. Doremus

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

M.Sc. (PHYSICS) (FYIP) (SEMESTER–III)

Session-2026-27

Introduction to Glass Science and Glass Ceramics

Course Code: FPHM-3394 (P)

Credits: 0-0-1 **Max Marks: 30**

Examination Time: 3 Hours **Pass Mark: 11**

COURSE OUTCOMES

After successful completion of this lab, the student will be able to:

CO1: Perform batch calculations for glass preparation.

CO2: Demonstrate hands-on skills in laboratory procedures for preparation of glass and glass ceramics.

CO3: Carry out lapping and polishing of glass samples.

CO4: Understand and apply the principles of absorption spectroscopy.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

M.Sc. (PHYSICS) (FYIP) (SEMESTER–III)

Session-2026-27

Introduction to Glass Science and Glass Ceramics

Course Code: FPHM-3394 (P)

Credits: 0-0-1 **Max Marks: 30**

Examination Time: 3 Hours **Pass Marks: 11**

General Guidelines for Practical Examination

I. The distribution of marks is as follows:

i) One experiment 10 Marks

ii) Brief Theory 10 Marks

iii) Viva–Voce 5 Marks

iv) Record file 5 Marks

LIST OF EXPERIMENTS:

1. Learn the principles and methods of batch calculations for glass preparation.
2. Prepare a 10 g batch of borosilicate glass.
3. Synthesize glass–ceramics from the prepared borosilicate glass.
4. Perform lapping and polishing of glass samples.
5. Conduct absorption spectroscopy on the prepared glass specimens.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (PHYSICS) (FYIP) (SEMESTER–III)
COURSE TITLE: PYTHON PROGRAMMING
COURSE CODE: FPHM-3125

COURSE OUTCOMES:
After passing this course, students will be able to:

CO1: set up the Python development environment, write and execute basic Python scripts, use data types (int, float, complex, lists, tuples), and perform arithmetic and logical operations with appropriate input/output handling.
CO2: demonstrate the ability to manipulate strings and dictionaries, apply control statements (if-else, loops, loop control keywords), and handle user input effectively.
CO3: create and utilize user-defined and built-in functions, use lambda functions and recursion, organize code with modules and packages, and apply modular programming techniques to solve problems.
CO4: demonstrate proficiency in reading/writing text and CSV files, using file handling functions (`read()`, `write()`, `seek()`, etc.), and applying modules like `os` and `sys` for directory and system-level operations. Basic graphics handling will also be introduced.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (FYIP) PHYSICS (SEMESTER–III)

COURSE TITLE: PYTHON PROGRAMMING

COURSE CODE: FPHM-3125

Credits: 3-0-1 **Max Marks: 100 (ESE Marks:40; Prac:30; CA: 30)**

Examination Time: 3 Hours **Pass Mark: 14**

Instructions

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Unit I

Introduction to python and Setting up the Python development Environment, Basic syntax, interactive shell, editing, saving, and running a script, Concept of data types, Declaring and using Numeric data types: int, float, complex Lists and Tuples and their basic operations, Python console Input / Output. Arithmetic operators and expressions, Conditions, Comparison operators, Logical Operators, Is and In operators.

Unit II

String Handling, Unicode strings, Strings Manipulation:- compare strings, concatenation of strings, Slicingstrings in python, converting strings to numbers and vice versa. Dictionaries Control statements: if-else, NestedIf-Else, Loops (for, while) Loop manipulation using pass, continue, break and else

Unit III

Built in function and modules in python, user defined functions, passing parameters, arguments and return values; formal vs actual arguments, Lamda function in python, Recursion, organizing python codes using functions, Programming using functions, modules and external packages

Unit IV

Files: manipulating files and directories, os and sys modules; text files: reading/writing text and numbersfrom/to a file; creating and reading a formatted file (csv or tab separated) understanding read functions, read(), readline() and readlines() Understanding write functions, write() and writelines() Manipulating filepointer using seek. Introduction to graphics.

Books Recommended:

1. Lutz, M., Learning Python, 5th edition.
2. Beazley, D., Python cookbook, 3rd Edition.
3. Beazley, D., Python Essential Reference, 4th edition.
4. Zelle, J., Python programming: An Introduction to computer science, 2nd Edition.
5. Mortelli, A., Python in a Nutshell, 2nd Edition

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–III)

COURSE TITLE: PYTHON PROGRAMMING LABORATORY

COURSE CODE: FPHM-3125

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: Develop algorithms to solve basic mathematical problems including separation of odd and even numbers, summation of N natural numbers, and generation of the Fibonacci series.*

CO2: Solve algebraic equations such as quadratic and cubic equations, and evaluate mathematical functions (e.g., exp(x), log(x), sin(x), cos(x)) using Taylor series expansion.*

CO3: Perform basic data manipulation tasks such as arranging numbers in ascending/descending order, and finding maximum and minimum values from a given set of numbers.*

CO4: Apply matrix operations including calculation of determinants, inverse of a 3×3 matrix, and implement elementary numerical and statistical methods for basic data analysis.*

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–III)

COURSE TITLE: PYTHON PROGRAMMING LABORATORY

COURSE CODE: FPHM-3125

Credits: 3-0-1 **Max Marks: 100 (ESE Marks:40; Prac:30; CA: 30)**

Examination Time: 3 Hours **Pass Mark: 12**

Instructions to Practical Examiner

The question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar

General Guidelines for Practical Examination

I. The distribution of marks is as follows:

i) One experiment 15 Marks

ii) Brief Theory 5 Marks

iii) Viva–Voce 5 Marks

iv) Record (Practical file) 5 Marks

II. There will be one session of 3 hours duration. The paper will have one session and will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.

III. Number of candidates in a group for practical examination should not exceed 12.

IV. In a single group no experiment be allotted to more than three examinee in any group.

Basic Mathematics Problems: Separation of odd and even numbers, Summation of N Natural numbers; Generating Fibonacci series, Roots of quadratic and Cubic equations; Evaluating various mathematical functions: exp(x), log(x), sin(x), cos (x) etc using Taylor series expansion; Arranging numbers in ascending and descending orders; finding maximum/minimum of numbers, for matrix operations; determinants, inverse of 3x3 matrix, elementary numerical methods and statistical methods.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (PHYSICS) (FYIP) (SEMESTER–III)
COURSE TITLE: PHYSICAL CHEMISTRY
COURSE CODE: FPHM-3085

COURSE OUTCOMES:
After passing this course, students will be able to:

CO1: Understand and apply the fundamental concepts of chemical thermodynamics including system variables, laws of thermodynamics, enthalpy, heat capacity, adiabatic and isothermal processes, Joule-Thomson effect, and Carnot cycle efficiency.
CO2: Analyze thermo-chemical processes such as heats of reaction, combustion, neutralization, solution, and formation using thermochemical equations, Hess's Law, bond enthalpies, and Kirchoff's equation; apply the second and third laws of thermodynamics to calculate entropy changes and determine spontaneity of chemical processes.
CO3: Evaluate spontaneity and equilibrium in chemical systems using thermodynamic potentials (Helmholtz and Gibbs free energy), chemical potential, entropy of mixing, equilibrium constants (Kp, Kc), and apply Le Chatelier's principle and Gibbs phase rule to interpret phase diagrams.
CO4: Apply principles of chemical kinetics and electrochemistry to determine reaction rates, reaction order, activation energy, catalytic behavior, and conductance; analyze electrochemical cells, electrode potentials, EMF, and conductometric titrations for various chemical systems.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (PHYSICS) (FYIP) (SEMESTER–III)
COURSE TITLE: PHYSICAL CHEMISTRY
COURSE CODE: FPHM-3085

Credits: 3-0-1 **Max Marks: 100 (ESE Marks:40; Prac:30; CA: 30)**
Examination Time: 3 Hours **Pass Mark: 12**

Instructions
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

UNIT-I
Chemical Thermodynamics: System and surroundings properties and variables of a system, laws of thermodynamics, Enthalpy of a system, heat capacity, Isothermal & adiabatic processes in ideal gases, Joule-Thomos effect, Carnot cycle, thermodynamic efficiency. Thermo-Chemistry: heat of reaction at constant volume and pressure thermochemical equations, calculations of E from H & vice versa, Hess's law of heat summation, heat of formation, heats of combustion, heat of solution, heat of neutralization of acids & bases, heat of formations of ions, heat of reaction from bond enthalpies, dependence of H & E for a reaction (Kirchoff's equation). II & III law of thermodynamics: Entropy, dependence of entropy on variables of a system, Entropy change in ideal gases, entropy of mixing for ideal gases, entropy change in physical transformations, Entropy change in chemical reactions, absolute Entropies, residual entropy.

UNIT-II
Spontaneity, Equilibrium and Phase Rule: General conditions for Equilibrium and Spontaneity, Helmholtz free energy (A) for reactions, Gibbs free energy.Chemical potential, Gibbs free energy and entropy of mixing of ideal gases. The Equilibrium constants Kp and Kc of real gases Temperature dependence of Equilibrium constant. The Lechatelier principle. Phase Rule: Gibbs Phase rule, derivation of phase rule, one component system, the water system, the sulphur system, two components system-simple eutectic diagram.

UNIT-III
Chemical Kinetics: Measurement of reaction rate, order, molecularity of reaction, first order reactions, second order reactions, third order reactions. Methods of determination of order, effect of temperature, activation energy, catalysis, Homogeneous catalysis in gases, homogenous catalysis insolutions, Numericals.

UNIT-IV
Electro Chemistry: Faraday's law of electrolysis, transference numbers determination of transference numbers, electrolytic conductance, variation of conductance with concentration and temperature, equivalent conductance at infinite dilution. Degree of ionization & conductance. Application of conductance measurements, Ionic product of water, hydrolysis constant, solubility & solubility product, conductometric titrations. Electrochemical Cells: Reversible & Irreversible

cells, standard cells (Weston, NHE & Calomel) cell reaction & EMF, single electrode potential & its calculations, thermodynamic & EMF.

Reference Books:

1. Physical Chemistry by Samuel H, Carl P. Prutton Americ Inc. Co.
2. Physical chemistry by Glassstone, The MacmillianPressLtd.
3. Kinetics and Mechanism by frost A and Pearson R.G, Wiley Eastern Pvt. Ltd.
4. Chemical Kinetics by K.J. Laidler, Harper andRow.
5. Physical Chemistry, Gilberg W. Castellian Addison- Wesley Publishing Co.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (PHYSICS) (FYIP) (SEMESTER–III)
COURSE TITLE: PHYSICAL CHEMISTRY LAB
COURSE CODE: FPHM-3085

COURSE OUTCOMES:
After passing this course, students will be able to:

CO1: Perform acid-base titrations to standardize solutions and determine properties of water samples, such as alkalinity and hardness, using appropriate volumetric techniques.

CO2: Apply principles of surface chemistry and adsorption to determine surface area and study the distribution of solutes (e.g., iodine, benzoic acid) between immiscible solvents.

CO3 Analyze physical properties of liquids such as viscosity and surface tension using viscometry and stalagmometry techniques to determine composition and molecular interactions in liquid mixtures.

CO4: Measure thermal and optical properties including heat of neutralization, refractive index, specific and molar refraction, and apply them to determine composition and thermodynamic parameters of chemical systems.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–III)

COURSE TITLE: PHYSICAL CHEMISTRY LABORATORY

COURSE CODE: FPHM-3085

Credits: 0-0-1 **Max Marks: 30**
Examination Time: 3 Hours **Pass Mark: 10**

Instructions to Practical Examiner

The question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar

General Guidelines for Practical Examination

I. The distribution of marks is as follows:

i) One experiment 15 Marks

ii) Brief Theory 5 Marks

iii) Viva–Voce 5 Marks

iv) Record (Practical file) 5 Marks

II. There will be one session of 3 hours duration. The paper will have one session and will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.

III. Number of candidates in a group for practical examination should not exceed 12.

IV. In a single group no experiment be allotted to more than three examinees in any group.

1. To standardize the given solution of hydrochloric acid (HCl) and sodium hydroxide (NaOH).
2. To find out the total alkalinity of a given water sample (tap water).
3. To determine temporary, permanent and total hardness of a given water sample (tap water).
4. To determine surface area of given solid (charcoal) by adsorption of acetic acid (CH3COOH) from aqueous solutions.
5. To determine the distribution coefficient of iodine (I2) between carbon tetrachloride (CCl4) and water (H2O).
6. To study the distribution of benzoic acid between water (H2O) and toluene and determine its molecular state of benzoic acid.
7. Determination of coefficient of viscosity of given liquid at room temperature with Ostwald's viscometer (ethyl acetate and methanol).
8. To find out the concentration of given mixture consisting of two liquids by viscosity measurements (benzene, nitrobenzene).
9. To determine viscosity of different mixture of ethanol (C2H5OH) and water (H2O) and determine composition at maximum hydrogen bonding.
10. To study variation of viscosity of aqueous sucrose solutions at various concentrations and determine the concentration of sucrose in given unknown solution.
11. To determine the % yield of oil extracted from mustard seeds with Soxhlet apparatus.
12. To determine surface tension of given liquid by drop number method using Stalagmometer at room temperature (methanol and toluene)

13. To determine the percentage composition of a given mixture of two liquids by surface tension measurement (benzene, nitrobenzene).
14. To determine percentage composition of a given mixture of two liquids by Stalagmometer measurement (methanol and water).
15. To determine heat neutralization of strong acid and strong base (HCl and NaOH) using Dewar flask as calorimeter.
16. To determine the refractive index of ethyl acetate and carbon tetrachloride by Abb's refractometer and find out specific and molar refraction.
17. To determine composition of unknown mixture of two liquids by refractive index measurements (ethyl acetate and carbon tetrachloride).
18. To determine % composition of unknown mixture of two liquids by surface tension measurements (water and ethanol).
19. To determine surface tension of given liquids by double capillary rise method (benzene, toluene, ethyl acetate and nitrobenzene).
20. To determine heat of neutralization of weak acid (CH3COOH) and hence calculate heat of ionization

Reference: J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publication house

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–III)

COURSE TITLE: PHYSICS LAB-III

COURSE CODE: FPHP-3396

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: verify Malus's law, determine specific rotation using a polarimeter, and analyze the polarization of light by reflection, identifying the polarizing angle at an air-glass interface.

CO2: study atomic spectra using diffraction gratings (Hg and Na lamps), measure angles of minimum deviation and prism angle, and analyze Newton's rings to determine the radius of curvature of a lens.

CO3: determine the refractive index of liquids using total internal reflection with Wollaston's air film and explore optical path variations due to interference and diffraction phenomena.

CO4: verify Stefan's law, observe electromagnetic induction in damped oscillators, study capacitor charging/discharging, and determine the electron's charge-to-mass (e/m) ratio using a solenoid.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–III)

COURSE TITLE: PHYSICS LAB-III

COURSE CODE: FPHP-3396

Credits: 3-0-0 **Max Marks: 100 (ESE Marks: 70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

Instructions to Practical Examiner

Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar

General Guidelines for Practical Examination

I. The distribution of marks is as follows:

i) One experiment 30 Marks

ii) Brief Theory 15 Marks

iii) Viva–Voce 15 Marks

iv) Record (Practical file) 10 Marks

II. There will be one session of 3 hours duration. The paper will have one session and will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.

III. Number of candidates in a group for practical examination should not exceed 20.

IV. In a single group no experiment be allotted to more than three examinee in any group.

Practicals:

1. To verify the Malus law for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To study spectrum of Hg vapour lump using diffraction grating.
4. To study spectrum of Sodium vapour lump using diffraction grating.
5. To find the angle of minimum deviation & angle of prism.
6. To study Newton's fringes and determine the radius of curvature of a lens.
7. To determine the refractive index of liquid by total internal reflection using Wollaston's airfilm.
8. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
9. To verify the Stefan`s law of radiation and to determine Stefan's constant.
10. To study Electromagnetic induction in a damped oscillator.
11. Study of charging and discharging of a capacitor.
12. To determine the e/m ratio of an electron using solenoid.
13. To find wavelength of He -Ne Laser light using Young's double slit experiment.
14. To study the variation of refractive index with the wavelength of spectral lines of mercury source and hence calculate the Cauchy's constants A and B.

Reference Books:

1.Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.

2.Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

3.A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed., 2011, Kitab Mahal

4.Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–IV)

COURSE TITLE: Analog Systems & Applications

COURSE CODE: FPHL-4391

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: explain the physical properties of p-n junctions, derive expressions for barrier potential and current, and analyze diode-based circuits such as rectifiers, voltage regulators, LEDs, photodiodes, and solar cells.

CO2: evaluate transistor configurations (CB, CE, CC), determine current gains (α, β), apply load line analysis, and design biasing circuits for amplifier applications using BJT models.

CO3: analyze RC-coupled amplifier frequency response, study feedback effects, and design sinusoidal oscillators (RC phase shift, Hartley, Colpitts) using Barkhausen's criterion. They will also understand the functional characteristics of operational amplifiers.

CO4: design and analyze op-amp applications such as inverting/non-inverting amplifiers, adder/subtractor, differentiator, integrator, oscillators, and comparators. They will also understand resistive networks and A/D conversion using methods like the successive approximation technique.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (PHYSICS) (FYIP) (SEMESTER–IV)
COURSE TITLE: Analog Systems & Applications
COURSE CODE: FPHL-4391

Credits: 4-0-0 **Max Marks: 100 (ESE Marks:70, CA: 30)**
Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:
Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.
Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT-I
Semiconductor Diodes: P and N type semiconductors. Energy Level Diagram.Conductivity and Mobility, Concept of Drift velocity.PN Junction Fabrication (Simple Idea).Barrier Formation in PN Junction Diode.Static and Dynamic Resistance. Current Flow Mechanism in Forward and Reverse Biased Diode. Drift Velocity. Derivation for Barrier Potential, Barrier Width and Current for Step Junction. Two-terminal Devices and their Applications: (1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, (2) Zener Diode and Voltage Regulation.Principle and structure of (1) LEDs, (2) Photodiode, (3) Solar Cell.

UNIT-II
Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations.Current gains α and β Relations between α and β. Load Line analysis of Transistors.DC Load line and Q-point.Physical Mechanism of Current Flow.Active, Cutoff and Saturation Regions. Amplifiers: Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias.Transistor as 2-port Network.h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains.Classification of Class A, B & C Amplifiers.

UNIT-III
Coupled Amplifier: RC-coupled amplifier and its frequency response. Feedback in Amplifiers: Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise. Sinusoidal Oscillators: Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators. Operational Amplifiers (Black Box approach): Characteristics of an Ideal and Practical Op-Amp. (IC 741) Openloop and Closed-loop Gain.Frequency Response.CMRR. Slew Rate and concept of Virtual ground.

UNIT-IV
Applications of Op-Amps: (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Zero crossing detector (8) Wein bridge oscillator. Conversion: Resistive network (Weighted and R-2R Ladder). Accuracy and Resolution. A/D Conversion (successive approximation).

Reference Books:

1.Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2.Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
3.Solid State Electronic Devices, B.G.Streetman&S.K.Banerjee, 6th Edn.,2009, PHI Learning
4.Electronic Devices & circuits, S.Salivahanan&N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
5.OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
6.Electronic circuits: Handbook of design & applications, U.Tietze, C.Schenk,2008, Springer
7.Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India
8.Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–IV)

COURSE TITLE: Elements of Modern Physics

COURSE CODE: FPHL-4392

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: explain key quantum phenomena such as blackbody radiation, photoelectric effect, Compton scattering, and de Broglie's hypothesis. They will also analyze experiments like Davisson-Germer and double-slit interference with particles to understand wave-particle duality.

CO2: derive and interpret the Heisenberg uncertainty principle, analyze the limitations of classical trajectories, and apply the time-independent Schrödinger equation to calculate physical observables such as probability densities and energy levels for simple systems.

CO3: solve problems involving particles in potential wells (infinite box), tunneling phenomena, and apply the uncertainty principle to nuclear stability. They will understand the structure and binding energy of nuclei using liquid drop and shell models.

CO4: describe nuclear decay modes (alpha, beta, gamma), energy generation through fission and fusion, and the principles of laser operation including population inversion, metastable states, and specific laser systems like He-Ne and Ruby lasers.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (PHYSICS) (FYIP) (SEMESTER–IV)
COURSE TITLE: Elements of Modern Physics
COURSE CODE: FPHL-4392

Credits: 4-0-0 **Max Marks: 100 (ESE Marks:70, CA: 30)**
Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:
Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.
Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT I
Planck's quantum, Planck's constant and light as a collection of photons; Balckbody Radiation; Quantum theory of Light; Photo-electric effect and Compton scattering. DeBroglic wavelength and matter waves; Davisson- Germer experiment.Wave description of particles by wave packets.Group and Phase velocities and relation between them. Two Slit experiment with electrons, photons and atoms, Probability. Wave amplitude and wave functions.

UNIT II
Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables): Derivation from Wave Packets impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle- application to virtual particles and range of an interaction. Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension.

UNIT III
One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as example; Quantum mechanical scattering and tunnelling in one dimension-across a step potential & rectangular potential barrier. Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, Liquid Drop model: semi-empirical mass formula and binding energy, Nuclear Shell Model and magic numbers.

UNIT IV
Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus. Fission and fusion- mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions driving stellar energy (brief qualitative discussions). Lasers: Einstein’s A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion.Three-Level and Four-Level Lasers.Ruby Laser and He- Ne Laser.

Reference Books

1.Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2.Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
3.Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
4.Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
5.Quantum Mechanics: Theory & Applications, A.K.Ghatak&S.Lokanathan, 2004, Macmillan

Additional Books for Reference

1.Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2004, PHI Learning.
2.Theory and Problems of Modern Physics, Schaum`s outline, R. Gautreau and W. Savin, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd.
3.Quantum Physics, Berkeley Physics, Vol.4. E.H.Wichman, 1971, Tata McGraw-Hill Co.
4.Basic ideas and concepts in Nuclear Physics, K.Heyde, 3rd Edn., Institute of Physics Pub.
5.Six Ideas that Shaped Physics: Particle Behave like Waves, T.A.Moore, 2003, McGraw Hill

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–IV)

COURSE TITLE: Special Theory of Relativity

COURSE CODE: FPHL-4393

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: explain the failure of Newtonian relativity, describe key experiments (Michelson-Morley, Fizeau), derive and apply Lorentz transformations, and analyze relativistic effects such as length contraction, time dilation, simultaneity, and the Doppler effect.

CO2: apply mass-energy equivalence and relativistic momentum-energy relations, transform physical quantities between inertial frames, and interpret space-time intervals using Minkowski geometry and four-vectors.

CO3: understand the transformation of electromagnetic fields, derive and interpret Maxwell's equations in covariant four-vector and four-tensor form, and explain the electromagnetic field tensor and gauge invariance in a relativistic context.

CO4: explain the principle of equivalence, analyze gravitational redshift and Mercury's perihelion precession, and interpret Einstein's field equations using tensors and metrics, with an introduction to cosmological implications such as Hubble's law and spacetime curvature.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (PHYSICS) (FYIP) (SEMESTER–IV)
COURSE TITLE: Special Theory of Relativity
COURSE CODE: FPHL-4393

Credits: 4 -0-0 **Max Marks: 100 (ESE Marks:70, CA: 30)**
Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:
Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.
Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT-I
The Lorentz Transformations: Newtonian relativity; Instances of its failure in electromagnetism; Attempts to locate the absolute frame of reference; Fizeau's experiment; Michelson-Morley experiment & Ether Drag Hypothesis; Lorentz-Fitzgerald contraction; Einstein's basic postulates of relativity and geometric derivation of Lorentz transformations; Length contraction; Relativity of simultaneity; Synchronization and time dilation; Einstein's velocity addition rule; Transformation of acceleration; Aberration (relativistic) of star light and Relativistic Doppler effect; Twin paradox and its resolution.

UNIT-II
Relativistic Dynamics: Variation of mass with velocity; Mass energy equivalence; Relativistic formulae for momentum and energy; Transformation of momentum, energy and force; Transformation of electromagnetic fields; Magnetism as a relativistic phenomenon; Illustrative examples. Structure of Space-time and Principle of Equivalence: Concept of Minkowski space; Geometrical interpretation of Lorentz transformations of space & time; Geometrical representation of simultaneity, contraction and dilation; Space-like, time like and light-like intervals; Four vectors; Concept of world lines.

UNIT-III
Relativity & Electromagnetism:- Transformation of differential operators; Invariance of D' Alembertian operator; Maxwell's equations & Gauge transformations; Equations of motion for potentials & ; Lorentz Condition; Lorentz transformations of space and time in four vector form; Transformations of charge, current density, Lorentz equations in co-variant form; Invariance of Maxwell's equations in terms four vectors; Electromagnetic field tensor; Maxwell's equations in co-variant four tensor form.

UNIT-IV
General Relativity: Principle of general co-variance; Principle of equivalence; Equality of inertial & gravitational masses; gravitational mass of photons; gravitational red shift; Precession of the perihelion of Mercury; Newton's equations of motion as an approximation of geodesic equations; Einstein's summation convention; metric tensor; Curvature tensor, G; Euclidean and Non- Euclidean geometry, Hubble's law and expansion of the universe.

Reference Books:

1. Mechanics: Berkeley Physics Course Vol-I by C. Kittel, W.D. Knight, M.A. Ruderman, C.A. Helmholtz and B.J. Moyer, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2011.
2. The Special Theory of Relativity by S. Banerji & A. Banerjee, Prentice Hall India, 2010.
3. Introduction to Special Relativity by R. Resnick, Wiley India Pvt. Ltd, 2007.
4. The Feymann Lectures on Physics: R.P. Feymann, R.B. Leighton and M. Sands, Vol. I & II, Narosa Publishing House, New Delhi, 1963.
5. Special Relativity by A.P. French, W.W. Norton and Company Inc., New York, 1968.
6. Relativistic Mechanics by Satya Prakash, Pragati Prakashan, Meerut
7. Classical Mehanics by H. Goldstein, Narosa Publishing House, Delhi, 1988.
8. Space-time Physics, J. A. Wheeler and G. N. Taylor
9. Gravitation, C.W. Misner, Kip Thorne and J. A. Wheeler, W.H. Freeman and Co., 1973
0. Introduction to The Theory of Relativity, P.G. Bergmann and Albert Einstein, Dover Books in Physics
11. Space, Time and Gravitation, A. S. Eddington, Oxford University Press

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (PHYSICS) (FYIP) (SEMESTER–IV)
COURSE TITLE: INTRODUCTION TO MOLECULAR SPECTROSCOPY
COURSE CODE: FPHM-4085

COURSE OUTCOMES:
After passing this course, students will be able to:

CO 1: Explain the fundamental principles of molecular spectroscopy and the interaction of electromagnetic radiation with matter.
CO2: Interpret IR and UV-Visible spectra to identify functional groups and electronic transitions in organic compounds.
CO3: Analyze 1H and 13C NMR spectra to deduce structural information about organic molecules.
CO4: Apply mass spectrometry principles to identify molecular masses, isotope patterns, and fragmentation pathways of organic compounds.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (PHYSICS) (FYIP) (SEMESTER–IV)
COURSE TITLE: INTRODUCTION TO MOLECULAR SPECTROSCOPY
COURSE CODE: FPHM-4085

Credits: 3-0-1 **Max Marks: 100 (ESE Marks:40; Prac:30; CA: 30)**
Examination Time: 3 Hours **Pass Mark: 12**

Instructions for the Paper Setters: Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question should be of 8 marks

UNIT-I
Infra-red Spectroscopy: Introduction, Principles of molecular spectroscopy, electromagnetic spectrum/ radiation, Infrared spectroscopy, modes of bending and stretching, how bond strength and masses of the bonded atoms affect the IR absorption frequency, Hooke's law, Oscillator strength.FTIR, Assignment of IR frequencies to simple compounds.

UNIT-II
UV and Visible Spectroscopy: Introduction, Beer – Lambert's Law, Grotthus – Draper law, molar extinction coefficient, Frank Condon Principle, Ground and first excited electronic states of diatomic molecules, relationship of potential energy curves to electronic spectra.Chromophores, auxochromes, electronic spectra of polyatomic molecules, red-shift, blue-shift, hypo and hyperchromic effect.Woodward rules for conjugated dienes and α, β- unsaturated carbonyl groups.

UNIT-III
Nuclear Magnetic Resonance Spectroscopy: Introduction to 1H NMR spectroscopy, The nuclear spin, Larmor frequency, the NMR isotopes, population ofnuclear spin levels, measurement techniques (CW andFT methods). Deuterated solvent, Nuclear shielding and 1H Chemical Shifts, range of typical chemical shifts, effects of molecular structure on 1H chemical shifts, ring currents, interpreting 1H NMR spectra, spin-spin splitting, coupling constant.13C NMR spectroscopy and chemical shifts.

UNIT-IV
Mass Spectroscopy: Introduction, Ionization methods, mass analysis, isotope abundance, Metastable ions, fragmentation patterns for aliphatic compounds, amines, aldehydes, ketones, esters, amides, nitriles, carboxylic acids ethers, aromatic compounds, McLafferty rearrangement, general rules predicting the fragmentation patterns.
Structure elucidation of selected compounds using spectroscopic techniques discussed in sections A-D.

Reference Books:
1. John R. Dyer, Applications of Absorption Spectroscopy of Organic Compounds. Books for additional reading: 1. F.A. Carey, Organic Chemistry.
2. C.N. Banwell "Fundamentals of Molecular Spectroscopy".
3. W. Kemp, "Organic Spectroscopy".
4. D. H. Williams, I. Pleming, "Spectroscopic Methods in Organic Chemistry".

5. D. L. Pavia, G.M. Lampan and G. S. Kriz, “Introduction to Spectroscopy” HartcourtCollege Publishers, 2001.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–IV)

COURSE TITLE: QUANTITATIVE ESTIMATION METHODS

COURSE CODE: FPHM-4085

CO1: Demonstrate proficiency in classical titrimetric methods for quantitative chemical analysis.
CO2: Analyze functional groups in organic compounds through appropriate analytical techniques.
CO3: Apply back-titration and complexometric titration methods for the estimation of inorganic and organic compounds
CO4: Identify and separate compounds based on their physicochemical properties using chromatographic techniques.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–IV)

COURSE TITLE: QUANTITATIVE ESTIMATION METHODS

COURSE CODE: FPHM- 4085

Credits: 0-0-1 **Max Marks: 30**

Examination Time: 3 Hours **Pass Mark: 10**

Instructions to Practical Examiner

Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar

General Guidelines for Practical Examination

I. The distribution of marks is as follows:

i) One experiment 15 Marks

ii) Brief Theory 5 Marks

iii) Viva–Voce 5 Marks

iv) Record (Practical file) 5 Marks

II. There will be one session of 3 hours duration. The paper will have one session and will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.

III. Number of candidates in a group for practical examination should not exceed 12.

IV. In a single group no experiment be allotted to more than three examinee in any group.

1. Quantitative estimation of sugar (glucose) using Fehling's solution
2. Quantitative estimation of amino acid (glycine) using Sorensen formol titration
3. Quantitative estimation of hydroxyl group
4. Determination of iodide in iodised table salt by microtitration of iodine with thiosulphate (back-titration with iodine).
5. Determination of calcium by EDTA.
6. Chromatographic (TLC, Paper) identification of dyes
7. Saponification value for a dark-coloured specimen of fat

Suggested Books

1. Practical Organic Chemistry by F.G. Mann and B.C. Saunders.
2. Handbook of Property Estimation Methods for Chemicals: Environmental Health Sciences by Donald Mackay, Robert S. Boethling, (1 st Edition).
3. Systematic Lab Experiments in Organic Chemistryby S. Arun (2010).
4. Vogel's Textbook of Practical Organic Chemistry, 5 th edition.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–IV)

COURSE TITLE: R PROGRAMMING

COURSE CODE:FPHM-4125

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: install and configure R and RStudio, use help functions, and work with vectors, matrices, lists, and control structures such as loops and conditionals.

CO2: demonstrate the ability to create and manipulate data frames, apply functions to data structures, use factors and tables, and write user-defined functions in R for specific computational tasks.

CO3: Students will be proficient in reading/writing data (CSV/text), using built-in math and statistical functions, performing linear algebra operations, and writing simulation programs including the use of object-oriented programming (S3/S4).

CO4: generate and customize different types of plots (bar, histogram, scatter, etc.), save visual outputs, and address performance and memory optimization issues using functional programming and debugging techniques.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–IV)

COURSE TITLE: R PROGRAMMING

COURSE CODE: FPHM-4125

Credits: 3-0-1 **Max Marks: 100 (ESE Marks:40; Prac:30; CA: 30)**

Examination Time: 3 Hours **Pass Mark:14**

Instructions:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question is of 8 marks.

UNIT-I

Downloading and installation of R and RStudio. Introducing to R, and Rstudio. Help functions in R, Vectors, Common Vector Operations, Using all and any function, subletting of vector. Creating matrices, Matrix operations, Applying Functions to Matrix Rows and Columns, Adding and deleting rows and columns, lists, Creating lists, general list operations, Accessing list components and values, applying functions to lists, recursive lists.

UNIT-II

Creating Data Frames – Matrix-like operations in frames, Merging Data Frames, Applying functions toData frames, Factors and Tables, factors and levels, Common functions used with factors Control statements: Loops, looping Over Nonvector Sets, if-else, writing user defined function, scope of the variable, Rscript file.

UNIT-III

Input/ Ouput: scan () , readline () Function, recursion, replacement functions, Printing to the Screen Readingand writing CSV and text file. Math functions, function for statistical distributions, linear algebra operations onvector and matrices, Basic of simulation, simulation programming in R: Built random variable generator, object –oriented programming: S3 generic functions, writing S3 and S4 Classes.

UNIT-IV

String manipulation, Graphics in R: Graph Syntax (title, xlabel, ylabel, pch, lty, col.), Simple graphics (Bar, Multiple Bar, Histogram, Pie, Box-Plot, Scatter plot, qqplot), Low-level and High-Level plot functions, par() command to generate multiple plots. Customizing graphs, saving graph to file, performance enhancement: speed and memory, functional programming and memory issue, Debugging.

Books Recommended:

1. Dennis, B., The R Student Companion, Taylor & Francis Group, 2013.
2. Matloff, N., The Art of R Programming: A Tour of Statistical Software Design, 2011.
3. William. L. J. P., R for Everyone: Advanced Analytics and Graphics, Addison- Wesley Data & Analytics Series. 2014.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–IV)

COURSE TITLE: R PROGRAMMING LABORATORY

COURSE CODE: FPHM-4125

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: Apply Taylor series expansion to compute values of mathematical functions such as exponential, logarithmic, and trigonometric functions (e.g., exp(x), log(x), sin(x), cos(x)).*

CO2: Implement basic computational techniques for data operations including sorting, searching, and determining maximum and minimum values.*

CO3: Simulate statistical experiments to estimate integrals, compute sample-based statistics such as mean, variance, and p-values from various probability distributions.*

CO4: Analyze and visualize data using graphs, perform statistical analysis including frequency distribution, correlation, and linear regression, and manage data using file handling techniques.*

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–IV)

COURSE TITLE: R PROGRAMMING LABORATORY

COURSE CODE: FPHM-4125

Credits: 3-0-1 **Max Marks: 100 (ESE Marks:40; Prac:30; CA: 30)**

Examination Time: 3 Hours **Pass Mark: 12**

Instructions to Practical Examiner

Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar

General Guidelines for Practical Examination

I. The distribution of marks is as follows:

i) One experiment 15 Marks

ii) Brief Theory 5 Marks

iii) Viva–Voce 5 Marks

iv) Record (Practical file) 5 Marks

II. There will be one session of 3 hours duration. The paper will have one session and will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.

III. Number of candidates in a group for practical examination should not exceed 12.

IV. In a single group no experiment be allotted to more than three examinee in any group.

Evaluating mathematical functions: exp(x), log(x), sin(x), cos(x), etc using Taylor series expansion; sorting, searching, maximum, minimum of numbers, Simulation: find integration, mean, variance of statistic based on a sample drawn from various distribution, p-values; graphs of functions; file handling; statistical analysis: graphical representation of data frequency distribution, correlations linear regression

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–IV)

COURSE TITLE: PHYSICS LAB-IV

COURSE CODE: FPHP-4396

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: Study the V-I characteristics of PN junction diodes, Zener diodes, LEDs, solar cells, and tunnel diodes, and demonstrate their practical applications in circuits such as rectifiers and voltage regulators, including calculation of efficiency and power.

CO2: Construct and test op-amp-based circuits including inverting amplifiers, integrators, differentiators, and analog simulators for differential equations, while studying gain, frequency response, and practical implementation.

CO3: Perform experiments related to blackbody radiation, photoelectric effect, and determine Planck's constant using LEDs and photo-detectors. They will also verify the tunneling effect and explore threshold frequencies.

CO4: Determine the ionization potential of mercury, e/m ratio using magnetic methods, and the elementary charge using the Millikan oil drop experiment, applying both classical and quantum principles to interpret the results.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–IV)

COURSE TITLE: PHYSICS LAB-IV

COURSE CODE: FPHP-4396

Credits: 3-0-0 **Max Marks: 100 (ESE Marks: 70, CA: 30)**

Examination Time: 3 Hours **Pass Mark: 25**

Instructions to Practical Examiner

Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar

General Guidelines for Practical Examination

I. The distribution of marks is as follows:

i) One experiment 30 Marks

ii) Brief Theory 15 Marks

iii) Viva–Voce 15 Marks

iv) Record (Practical file) 10 Marks

II. There will be one session of 3 hours duration. The paper will have one session and will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.

III. Number of candidates in a group for practical examination should not exceed 12.

IV. In a single group no experiment be allotted to more than three examinee in any group.

Practicals:

1. To study V-I characteristics of PN junction diode, and Light emitting diode.
2. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
3. Study of V-I & power curves of solar cells, and find maximum power point & efficiency.
4. To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain
5. To design inverting amplifier using Op-amp (741,351) and study its frequency response
6. To investigate the use of an op-amp as an Integrator.
7. To investigate the use of an op-amp as a Differentiator.
8. To design a circuit to simulate the solution of a 1st/2nd order differential equation.
9. Measurement of Planck's constant using black body radiation and photo-detector
10. Photo-electric effect: photocurrent versus intensity and wavelength of light and threshold frequency.
11. To determine the Planck's constant using LEDs of at least 4 different colours.
12.. To determine the ionization potential of mercury.
13. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
14. To setup the Millikan oil drop apparatus and determine the charge of an electron.
15. To show the tunneling effect in tunnel diode using I-V characteristics.

Reference Books:

1.Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
2.OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
3.Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.
4.Electronic Devices & circuit Theory, R.L. Boylestad& L.D. Nashelsky, 2009, Pearson

5. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
6. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
7. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011,Kitab Mahal

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–IV)

COURSE TITLE: MEDICAL PHYSICS

COURSE CODE: FPHP-4390

COURSE OUTCOMES:

After passing this course, students will be able to:

CO1: explain the biomechanics of body movement, stability, muscle dynamics, energy balance, and physiological systems like respiration and circulation using physical concepts such as force, pressure, and energy.

CO2: analyze sound production, hearing mechanisms, visual optics of the eye, and the nervous system's electrical functioning, including how these systems are utilized in medical diagnostics like ultrasound and EEG.

CO3: explain the production, interaction, and detection of x-rays and radiation, the principles of radiological devices (X-ray tubes, CT, MRI, PET), and the physical basis of imaging technologies and radiotherapy equipment.

CO4: demonstrate understanding of radiation units, biological effects of radiation, and principles of safe exposure, monitoring, and protection, including the use of dosimeters and shielding in therapeutic and diagnostic environments.

SKILL ENHANCEMENT COURSE

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
(Session-2026-27)
Master of Science (PHYSICS) (FYIP) (SEMESTER–IV)
COURSE TITLE: Medical Physics
COURSE CODE: FPHL-4390

Credits: 3-0-0 **Max Marks: 100 (ESE Marks:70, CA: 30)**
Examination Time: 3 Hours **Pass Mark: 25**

Instructions for the Paper Setters:
Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.
Note: Students can use Non-Scientific calculators or logarithmic tables.

Unit-I

PHYSICS OF THE BODY-I
Mechanics of the body: Skeleton, forces, and body stability. Muscles and the dynamics of body movement, Physics of body crashing. Energy household of the body: Energy balance in the body, Energy consumption of the body, Heat losses of the body, Pressure system of the body: Physics of breathing, Physics of cardiovascular system.
PHYSICS OF THE BODY-II
Acoustics of the body: Nature and characteristics of sound, Production of speech, Physics of the ear, Diagnostics with sound and ultrasound. Optical system of the body: Physics of the eye. Electrical system of the body: Physics of the nervous system, Electrical signals and information transfer.

Unit- II

PHYSICS OF DIAGNOSTIC AND THERAPEUTIC SYSTEMS-I
X-RAYS: Electromagnetic spectrum – production of x-rays, x-ray Bremsstrahlung, Characteristic x-ray, X-ray tubes: Coolidge tube (x-ray tube design, tube cooling stationary mode, Rotating anode x-ray tube, Tube rating), quality and intensity of x-ray. X-ray generator circuits, half wave and full wave rectification, filament circuit, kilo voltage circuit, high frequency generator – exposure timer, HT cables.

Unit- III

RADIATION PHYSICS: Radiation units - exposure - absorbed dose – units: rad, gray - 57 relative biological effectiveness - effective dose - inverse square law - interaction of radiation with matter - linear attenuation coefficient. Radiation Detectors -Thimble chamber- condenser chambers – Geiger counter – Scintillation counter – ionization chamber – Dosimeters – survey methods – area monitors – TLD and semiconductor detectors.

MEDICAL IMAGING PHYSICS: X-ray diagnostics and imaging, Physics of nuclear magnetic resonance (NMR) – NMR imaging – MRI Radiological imaging – Radiography – Filters – grids – cassette – X-ray film – film processing – fluoroscopy – computed tomography scanner – principle function – display – generations – mammography. Ultrasound imaging – magnetic resonance imaging – thyroid uptake system – Gamma camera (Only Principle, function and display) (9 Lectures)

Unit - IV

RADIATION THERAPY PHYSICS: Radiotherapy – kilo voltage machines – deep therapy machines – Telecobalt machines – Medical linear accelerator. Basics of Teletherapy units – deep x-ray, Telecobalt units, medical linear accelerator – Radiation protection – external beam characteristics – phantom – dose maximum and build up – bolus – percentage depth dose – tissue – air ratio – back scatter factor.

RADIATION AND RADIATION PROTECTION: Principles of radiation protection – protective materials-radiation effects – somatic, genetic stochastic & deterministic effect, Personal monitoring devices – TLD film badge – pocket dosimeter. Radiation dosimetry, Natural radioactivity, Biological effects of radiation, Radiation monitors.

PHYSICS OF DIAGNOSTIC AND THERAPEUTIC SYSTEMS-II Diagnostic nuclear medicine: Radiopharmaceuticals for radioisotope imaging, Radioisotope imaging equipment, Single photon and positron emission tomography. Therapeutic nuclear medicine: Interaction between radiation and matter Dose and isodose in radiation treatment

Reference Books:

• Medical Physics, J.R. Cameron and J.G.Skofronick, Wiley (1978)
• Basic Radiological Physics Dr. K. Thayalan - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi (2003)
• Christensen's Physics of Diagnostic Radiology: Curry, Dowdey and Murry - Lippincot Williams and Wilkins (1990)
• Physics of the human body, Irving P. Herman, Springer (2007).
• Physics of Radiation Therapy : F M Khan - Williams and Wilkins, 3rd edition (2003)
• The essential physics of Medical Imaging: Bushberg, Seibert, Leidholdt and Boone Lippincot Williams and Wilkins, Second Edition (2002)
• The Physics of Radiology-H E Johns and Cunningham.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–V)

COURSE TITLE: QUANTUM MECHANICS AND APPLICATIONS

COURSE CODE: FPHL-5391

COURSE OUTCOMES

CO1. Demonstrate the formulation and physical interpretation of quantum mechanical wave functions using the Schrödinger equation.

CO2: Compute expectation values and investigate the role of quantum operators and commutation relations in measurement processes.

CO3: Analyze stationary and non-stationary quantum states using time-independent and time-dependent Schrödinger equations.

CO4: Examine free-particle wave packets and establish the significance of Fourier analysis and the Heisenberg uncertainty principle in quantum mechanics.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–V)

COURSE TITLE: QUANTUM MECHANICS AND APPLICATIONS

COURSE CODE: FPHL-5391

Examination Time: 3 Hours	**Max Marks: 100**	**ESE Marks: 70**
Credits: 4-0-0	**CA: 30**	**Pass Mark: 25**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.

Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT-I

Time dependent Schrodinger equation: Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function, Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions, Normalization, Linearity and Superposition Principles, Eigenvalues and Eigenfunctions, Position, momentum and Energy operators; commutator of position and momentum operators; Expectation values of position and momentum, Wave Function of a Free Particle.

Time independent Schrodinger equation-Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; wave packets, Fourier transforms and momentum space wavefunction; Position-momentum uncertainty principle.

UNIT-II

General discussion of bound states in an arbitrary potential- continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem-square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions using Frobenius method; Hermite polynomials; ground state, zero point energy & uncertainty principle.

UNIT-III

Quantum theory of hydrogen-like atoms: time independent Schrodinger equation in spherical polar coordinates; separation of variables for second order partial differential equation; angular momentum operator & quantum numbers; Radial wavefunctions from Frobenius method; shapes of the probability densities for ground & first excited states; Orbital angular momentum quantum numbers l and m; s, p, d,.. shells.

UNIT-IV

Atoms in Electric & Magnetic Fields: Electron angular momentum. Space quantization, Electron Spin and Spin Angular Momentum, Larmor's Theorem, Spin Magnetic Moment, Stern-Gerlach Experiment, Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton.

Atoms in External Magnetic Fields: Normal and Anomalous Zeeman Effect, Paschen Back and Stark Effect (Qualitative Discussion only).

Many electron atoms: Pauli's Exclusion Principle, Symmetric & Antisymmetric Wave Functions, Periodic table, Fine structure, Spin orbit coupling, Spectral Notations for Atomic States, Total

angular momentum, Vector Model, Spin-orbit coupling in atoms L-S and J-J couplings, Hund's Rule, Term symbols, Spectra of Hydrogen and Alkali Atoms (Na etc.).

Reference Books:

- A Text book of Quantum Mechanics, P.M.Mathews and K.Venkatesan, 2nd Ed., 2010, McGraw Hill
- Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
- Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
- Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India.
- Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
- Quantum Mechanics: Foundations & Applications, Arno Bohm, 3rd Edn., 1993, Springer
- Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press Additional Books for Reference
- Quantum Mechanics, Eugen Merzbacher, 2004, John Wiley and Sons, Inc.
- Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson Education
- Quantum Mechanics, Walter Greiner, 4th Edn., 2001, Springer

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–V)

COURSE TITLE: DIGITAL SYSTEMS AND APPLICATIONS

COURSE CODE: FPHL-5392

COURSE OUTCOMES

CO1: Explain the working principle and applications of the Cathode Ray Oscilloscope (CRO), distinguish between analog and digital circuits, and analyze the fundamentals of integrated circuits, number systems, and basic logic gates.

CO2: Apply Boolean algebra and Karnaugh maps to simplify digital logic circuits, and design combinational logic circuits such as multiplexers, decoders, encoders, adders, and subtractors.

CO3: Analyze and design sequential logic circuits using flip-flops, shift registers, counters, and IC 555 timer circuits for basic digital electronic applications.

CO4: Describe the organization of computer memory and input/output systems, explain the architecture and operation of the Intel 8085 microprocessor, and interpret basic assembly language instructions and timing diagrams.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–V)

COURSE TITLE: DIGITAL SYSTEMS AND APPLICATIONS

COURSE CODE: FPHL-5392

Examination Time: 3 Hours	**Max Marks: 100**	**ESE Marks: 70**
Credits: 4-0-0	**CA: 30**	**Pass Mark: 25**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.

Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT I

Introduction to CRO: Block Diagram of CRO. Electron Gun, Deflection System and Time Base.Deflection Sensitivity. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference. Integrated Circuits (Qualitative treatment only): Active & Passive components. Discrete components.Wafer.Chip.Advantages and drawbacks of ICs. Scale of integration: SSI, MSI, LSI and VLSI (basic idea and definitions only). Classification of ICs. Examples of Linear and Digital lCs. Digital Circuits: Difference between Analog and Digital Circuits. Binary Numbers.Decimal to Binary and Binary to Decimal Conversion.BCD, Octal and Hexadecimal numbers. AND, OR and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNORGates and application as Parity Checkers.

UNIT II

Boolean algebra: De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products.Idea of Minterms and Maxterms.Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map. Data processing circuits: Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders. Arithmetic Circuits: Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders.Half& Full Subtractors, 4-bit binary Adder/Subtractor.

UNIT III

Sequential Circuits: SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JK Flip-Flop. Timers: IC 555: block diagram and applications: Astable multivibrator and Monostable multivibrator. Shift registers: Serialin-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits). Counters (4 bits): Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter.

UNIT IV

Computer Organization: Input/Output Devices. Data storage (idea of RAM and ROM).Computermemory.Memory organization &addressing.MemoryInterfacing.Memory Map. Intel 8085 Microprocessor Architecture: Main features of 8085. Block diagram. Components. Pin-out diagram. Buses.Registers.ALU.Memory. Stack memory. Timing & Control circuitry.Timingstates.Instruction cycle, Timing diagram of MOV and MVI. Introduction to Assembly Language: 1 byte, 2 byte &3 byte instructions.

Reference Books:

- Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, Tata McGraw
- Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
- Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
- Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, 2001, PHI Learning
- Logic circuit design, Shimon P. Vingron, 2012, Springer.
- Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
- Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–V)

COURSE TITLE: MATHEMATICAL PHYSICS-III

COURSE CODE: FPHL-5393

After completing this course, student will be able to

CO 1. Determine continuity, differentiability and analyticity of a complex function, find the derivative of a function and understand the properties of elementary complex functions.

CO 2. Evaluate a contour integral using parametrization, fundamental theorem of calculus and Cauchy's integral formula and Find the Taylor series of a function and determine its radius of convergence. Determine the Laurent series expansion of a function in different regions, find the residues and use the residue theory to evaluate a contour integral and real integral.

CO 3. Understand the properties of Fourier transforms and use these to solve boundary value problems.

CO 4. Understand the properties of Laplace transforms and use these to solve boundary value problems.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–V)

COURSE TITLE: MATHEMATICAL PHYSICS-III

COURSE CODE: FPHL-5393

Examination Time: 3 Hours	**Max Marks: 100**	**ESE Marks: 70**
Credits: 4-0-0	**CA: 30**	**Pass Mark: 25**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.

Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT-I

Statistics and probability: Sample space, Events, probability in discrete sample space, discrete random variables, Binomial distribution, mean, variance and moments, binomial coefficients, random walk, Poisson's distribution, mean, variance, mode, median, recurrence relations and applications, Continuous Distributions, Probability distribution function, mean, variance and mode, Normal Distribution, standard normal distribution.

UNIT-II

Complex Integration: Analyticity and Cauchy-Riemann Conditions for complex numbers, Examples of analytic functions, Singular functions: poles and branch points, order of singularity, branch cuts.Integration of a function of a complex variable, Cauchy's Inequality, Cauchy's Integral formula, Simply and multiply connected region, Laurent and Taylor's expansion, Residues and Residue Theorem, Application in solving Definite Integrals.

UNIT-III

Fourier Transforms: Fourier Integral theorem, Fourier Transform. Examples, Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral, Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem, Properties of Fourier transforms (translation, change of scale, complex conjugation, etc.), Three dimensional Fourier transforms with examples. Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat Flow Equations.

UNIT-IV

Laplace Transforms: Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Dirac Delta function, Periodic Functions, Convolution Theorem, Inverse LT, Application of Laplace Transforms to Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits.

Reference Books:

- Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
- Mathematics for Physicists, P. Dennery and A.Krzywicki, 1967, Dover Publications
- Complex Variables, A.S.Fokas & M.J.Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
- Complex Variables and Applications, J.W. Brown & R.V. Churchill, 7th Ed. 2003, Tata McGraw-Hill
- First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, 1940, Jones & Bartlett

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

(Session-2026-27)

Master of Science (PHYSICS) (FYIP) (SEMESTER–III)

COURSE TITLE: Applied Glass Science

COURSE CODE: FPHM-5394

Course Objectives

After completion of the course, students will be able to:

CO1: Explain the optical properties of glass and their significance in communication technologies, including optical fibers, mobile phone display glass, and chemically strengthened glasses used in modern communication devices.

CO2: Analyze the properties and applications of display-grade glasses and transparent conducting materials used in LED, LCD, OLED, and flat-panel display technologies, with emphasis on their role in advanced electronic displays.

CO3: Evaluate the optical and functional properties of glasses used in optoelectronics and photonics, including photochromic and electrochromic glasses, optical filters, and glass-based sensing materials.

CO4: Interpret the principles and applications of bioactive and smart glasses in healthcare, radiation protection, and energy-related technologies, and assess their importance in the development of advanced functional materials.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)
MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–V)
COURSE TITLE: APPLIED GLASS SCIENCE
COURSE CODE: FPHM-5394

Credits: 3-0-1 **Max Marks: 100 (ESE Marks: 40 (Theory), 30 (Practical) CA: 30)**
Examination Time: 3 Hours **Pass Mark: 14**

Instructions for the Paper Setters:
Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 8 marks.

UNIT I: Glass in Communication Industry: Introduction to communication materials, Basics of optical properties (Refractive index and dispersion, absorption and transmission of light, Reflection and scattering losses, Optical band gap and color centers) required for communication devices, Optical fiber technology: Principle and working, types of optical fibers, Glass in mobile phone technology (Chemically strengthened glass, Gorilla glass technology, Touchscreen glass), Scratch and impact resistance,

UNIT II: Glasses in LED/LCD and Flat-Screen Display Industry: Types of display technologies, Properties of display-grade glass, Glass substrates for LED and LCD systems, Thin-film transistor (TFT) glass, OLED and flat-panel display technologies, flexible and folding display glass, Transparent conducting materials: Indium tin oxide (ITO), Fluorine-doped tin oxide (FTO), Anti-reflective and anti-glare coatings

UNIT III: Glasses in Optoelectronics and Photonics Industry: Introduction to optoelectronic materials, Optical transmission and absorption in glass, Photochromic and electrochromic glasses, Optical filters: Low-pass optical filters, High-pass optical filters, Band-pass filters, Interference filters, Infrared and ultraviolet filtering glasses, Glass materials for sensors

UNIT IV: Bioactive and Smart Glasses: Bioactive and biocompatible glasses, Glasses for medical and dental applications, Smart glasses: thermochromic and electrochromic materials, Radiation shielding and protective glasses, Environmental and energy-related applications of functional glasses

Reference Books:

1. Fundamentals of Inorganic Glasses by Arun K. Varshneya and John C. Mauro
2. Introduction to Glass Science and Technology by J.E. Shelby
3. Glass Science by Robert H. Doremusw

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
M.Sc. (PHYSICS) (FYIP) Semester V
Session-2026-27
Applied Glass Science Lab
Course Code: FPHM-5394 (P)

CO1 Determine the density of different glass samples using standard experimental techniques and analyze the influence of composition on density.

CO2 Measure and evaluate the optical properties of glass samples, including refractive index and optical band gap, using appropriate characterization methods.

CO3 Investigate the luminescence behavior of glass materials and interpret emission characteristics for potential optical and photonic applications.

CO4 Perform thermal analysis of prepared glass samples and interpret thermal parameters such as glass transition, crystallization, and stability.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
M.Sc. (PHYSICS) (FYIP) Semester V
Session-2026-27
Applied Glass Science Lab
Course Code: FPHM-5394 (P)

Credits: 0-0-1 **Max Marks: 30**
Examination Time: 3 Hours **Pass Mark: 11**

Instructions to Practical Examiner
Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar

General Guidelines for Practical Examination
I. The distribution of marks is as follows:
i) One experiment 10 Marks
ii) Brief Theory 5 Marks
iii) Viva–Voce 10 Marks
iv) Record (Practical file) 5 Marks
II. There will be one sessions of 3 hours duration. The paper will have one session and one experiment is to be allotted by the external examiner.
III. Number of candidates in a group for practical examination should not exceed 20.
IV. In a single group no experiment is allotted to more than three examinees in any group.

List of experiments-

1. To do the measurement of density of glasses.
2. To calculate band gap and refractive index of glasses.
3. To study luminescence in glasses.
4. Thermal analysis of prepared glass samples.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–V)

COURSE TITLE: QUANTUM LAB

COURSE CODE: FPHP-5395

COURSE OUTCOMES

CO1 Develop and implement C/C++/Scilab programs to solve Schrödinger equations for various quantum systems and obtain energy eigenvalues and eigenfunctions numerically.

CO2 Analyze quantum mechanical models such as the hydrogen atom, screened Coulomb potential, anharmonic oscillator, and Morse potential through numerical simulations and graphical interpretation of wave functions.

CO3 Interpret computational results by evaluating bound-state energies, wave functions, and the influence of potential parameters on quantum systems.

CO4 Perform and analyze quantum physics experiments including Electron Spin Resonance (ESR), Zeeman Effect, tunnel diode tunneling characteristics, and quantum efficiency measurements of CCDs, and correlate experimental observations with quantum mechanical principles.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–V)

COURSE TITLE: QUANTUM LAB

COURSE CODE: FPHP-5395

Credits: 0-0-3 **Max Marks: 75** **ESE Marks: 60**

Examination Time: 3 Hours **CA: 15** **Pass Mark: 21**

Instructions to Practical Examiner

Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar

General Guidelines for Practical Examination

I. The distribution of marks is as follows:

i) One experiment 30 Marks

ii) Brief Theory 10 Marks

iii) Viva–Voce 15 Marks

iv) Record (Practical file) 5 Marks

II. There will be one session of 3 hours duration. The paper will have one session and will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.

III. Number of candidates in a group for practical examination should not exceed 20.

IV. In a single group no experiment is allotted to more than three examinees in any group.

List of experiments-

Use C/C++/Scilab for solving the following problems based on Quantum Mechanics like

1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom. Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wavefunctions. Remember that the ground state energy of the hydrogen atom is ≈ -13.6 eV. Take e = 3.795 (eVÅ) 1/2, ħc = 1973 (eVÅ) and m = $0.511x10^6$ eV/c^2.
2. Solve the s-wave radial Schrodinger equation for an atom. Where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential. Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wavefunction. Take e = 3.795 (eVÅ) 1/2, m = $0.511x10^6$ eV/c^2, and a = 3 Å, 5 Å, 7 Å. In these units ħc = 1973 (eVÅ). The ground state energy is expected to be above -12 eV in all three cases.
3. Solve the s-wave radial Schrodinger equation for a particle of mass m. For the anharmonic oscillator potential for the ground state energy (in MeV) of a particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose m = 940 MeV/c^2 , k = 100 MeV fm^{-2}, b = 0, 10, 30 MeV fm^{-3} In these units, cħ = 197.3 MeV fm. The ground state energy I expected to lie between 90 and 110 MeV for all three cases.
4. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule. Where μ is the reduced mass of the two-atom system for the Morse potential. Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant

digits. Also plot the corresponding wave function. Take: m = 940×10^6 eV/C^2, D = 0.755501 eV, α = 1.44, r_0 = 0.131349 Å

Laboratory based experiments:

5. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
6. Study of Zeeman Effect: with external magnetic field; Hyperfine splitting.
7. To show the tunneling effect in tunnel diode using I-V characteristics.
8. Quantum efficiency of CCDs

Reference Books:

- Schaum's outline of Programming with C++. J.Hubbard, 2000,McGraw-Hill Publication
- Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal., 3rd Edn., 2007, Cambridge University Press.
- An introduction to computational Physics, T.Pang, 2nd Edn.,2006, Cambridge Univ. Press
- Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific & Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández.2014 Springer.
- Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S. Chand & Co.
- Scilab Image Processing: L.M.Surhone.2010 Betascript Publishing ISBN:978-6133459274

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–V)

COURSE TITLE: DIGITAL ELECTRONICS LAB

COURSE CODE: FPHP-5396

COURSE CODE

CO1 Operate and utilize electronic test instruments such as CROs and multimeters to measure electrical parameters and test the functionality of basic electronic devices.

CO2 Design, implement, and analyze digital logic circuits using logic gates, Boolean algebra, Karnaugh maps, combinational circuits, and sequential circuits.

CO3 Develop and verify digital systems including adders, subtractors, flip-flops, counters, shift registers, and timer-based circuits using standard ICs and electronic components.

CO4 Write, execute, and debug 8085 microprocessor programs for arithmetic operations, data handling, subroutine implementation, interrupt handling, and other fundamental applications.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–V)

COURSE TITLE: DIGITAL ELECTRONICS LAB

COURSE CODE: FPHP-5396

Credits: 0-0-3 **Max Marks: 100** **ESE Marks: 70**

Examination Time: 3 Hours **CA: 30** **Pass Mark: 25**

Instructions to Practical Examiner

Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar

General Guidelines for Practical Examination

I. The distribution of marks is as follows:

i) One experiment 30 Marks

ii) Brief Theory 10 Marks

iii) Viva–Voce 15 Marks

iv) Record (Practical file) 5 Marks

II. There will be one sessions of 3 hours duration. The paper will have one session and will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.

III. Number of candidates in a group for practical examination should not exceed 20.

IV. In a single group no experiment is allotted to more than three examinees in any group.

List of experiments-

1. To measure (a) Voltage, and (b) Time period of a periodic waveform using CRO.
2. To test a Diode and Transistor using a Multimeter.
3. To design a switch (NOT gate) using a transistor.
4. To verify and design AND, OR, NOT and XOR gates using NAND gates.
5. To design a combinational logic system for a specified Truth Table.
6. To convert a Boolean expression into logic circuit and design it using logic gate ICs.
7. To minimize a given logic circuit.
8. Half Adder, Full Adder and 4-bit binary Adder.
9. Half Subtractor, Full Subtractor, Adder-Subtractor using Full Adder I.C.
10. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.
11. To build JK Master-slave flip-flop using Flip-Flop ICs
12. To build a 4-bit Counter using D-type/JK Flip-Flop ICs and study timing diagram.
13. To make a 4-bit Shift Register (serial and parallel) using D-type/JK Flip-Flop ICs.
14. To design an astable multivibrator of given specifications using 555 Timer.
15. To design a monostable multivibrator of given specifications using 555 Timer.
16. Write the following programs using 8085 Microprocessor

a) Addition and subtraction of numbers using direct addressing mode
b) Addition and subtraction of numbers using indirect addressing mode
c) Multiplication by repeated addition.
d) Division by repeated subtraction.
e) Handling of 16-bit Numbers.
f) Use of CALL and RETURN Instruction.

g) Block data handling.
h) Other programs (e.g. Parity Check, using interrupts, etc.).

Reference Books:

- Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGraw Hill.
- Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
- Microprocessor Architecture Programming and applications with 8085, R.S. Goankar, 2002, Prentice Hall.
- Microprocessor 8085:Architecture, Programming and interfacing, A. Wadhwa, 2010, PHI Learning.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

SEMESTER–V

PHYSICS (INTERNSHIP (02 WEEKS)

Course code: FPHI-5397

Credits: 0-0-2 **Max Marks: 50 (ESE Marks: 50)**

Examination Time: 3 Hours **Pass Mark: 18**

Students will undergo training / Internship for a period of 2 weeks in academic institutes/ industries.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–VI)

COURSE TITLE: SOLID STATE PHYSICS

COURSE CODE: FPHL-6391

On successful completion of the module students should be able to

CO1: Explain the crystal structure of solids by describing crystal systems, lattice types, unit cells, Miller indices, reciprocal lattice, Brillouin zones, and the principles of X-ray diffraction using Bragg's law.

CO2: Analyze the lattice dynamics and magnetic properties of materials by explaining phonon vibrations, specific heat theories, and the classical and quantum models of dia-, para-, ferri-, and ferromagnetism.

CO3: Interpret the dielectric, optical, and ferroelectric properties of materials by relating polarization mechanisms, dielectric response, optical dispersion, plasma oscillations, and ferroelectric phenomena to their applications.

CO4: Apply the concepts of elementary band theory to distinguish conductors, semiconductors, and insulators, and evaluate the electrical transport properties, Hall effect, and the fundamental principles of superconductivity.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–VI)

COURSE TITLE: SOLID STATE PHYSICS

COURSE CODE: FPHL-6391

Examination Time: 3 Hours	**Max Marks: 100**	**ESE Marks: 70**
Credits: 4-0-0	**CA: 30**	**Pass Mark: 25**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.

Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT-I

Crystal Structure: Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. Atomic and Geometrical Factor.

UNIT-II

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T^3 law, **Magnetic Properties of Matter**: Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia– and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss.

UNIT-III

Dielectric Properties of Materials: Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena. Application: Plasma Oscillations, Plasma Frequency, Plasmons, TO modes. **Ferroelectric Properties of Materials:** Structural phase transition, Classification of crystals, Piezoelectric effect, Pyroelectric effect, Ferroelectric effect, Electrostrictive effect, Curie-Weiss Law, Ferroelectric domains, PE hysteresis loop.

UNIT-IV

Elementary band theory: Kronig Penny model, Band Gap. Conductor, Semiconductor (P and N type) and insulator, Conductivity of Semiconductor, mobility, Hall Effect, Measurement of conductivity (04 probe method) & Hall coefficient. **Superconductivity**: Experimental Results, Critical Temperature, Critical magnetic field, Meissner effect, Type I and type II Superconductors, London's Equation and Penetration Depth, Isotope effect, Idea of BCS theory (No derivation)

Reference Books:

- Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
- Elements of Solid State Physics, J.P. Srivastava, 2nd Edition, 2006, Prentice-Hall of India
- Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
- Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
- Solid-state Physics, H. Ibach and H. Luth, 2009, Springer
- Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–VI)

COURSE TITLE: STATISTICAL MECHANICS

COURSE CODE: FPHL-6392

Course Outcomes

By the end of the course, students will be able to:

CO1: Explain the fundamental concepts of classical statistical mechanics, including macrostates, microstates, phase space, Maxwell–Boltzmann statistics, partition function, thermodynamic functions, and the law of equipartition of energy, and apply them to ideal gases and finite-level systems.

CO2: Analyze the behavior of bosonic systems using Bose–Einstein statistics by interpreting Bose–Einstein condensation, the thermodynamic properties of degenerate Bose gases, photon gas, and the derivation of Planck's radiation law.

CO3: Apply Fermi–Dirac statistics to describe the properties of fermionic systems, including electron gases in metals, specific heat of metals, relativistic Fermi gases, and the physics of white dwarf stars and the Chandrasekhar mass limit.

CO4: Evaluate the classical and quantum theories of thermal radiation by explaining blackbody radiation, radiation laws, Planck's quantum theory, and deriving the fundamental radiation laws from Planck's distribution.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–VI)

COURSE TITLE: STATISTICAL MECHANICS

COURSE CODE: FPHL-6392

Examination Time: 3 Hours	**Max Marks: 100**	**ESE Marks: 70**
Credits: 4-0-0	**CA: 30**	**Pass Mark: 25**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.

Note: Students can use Non-Scientific calculators or logarithmic tables.

Unit I

Classical-Statistics: Macrostates and Microstates, Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Sackur-Tetrode equation. Saha's Ionization Formula. Law of Equipartition of Energy (with proof)Applications to Specific Heat of gas and solids and its Limitations, Thermodynamic Functions of a Finite Level System, Negative Temperature. **(24 Lectures)**

Unit II

Bose-Einstein Statistics: B-E Distribution law, Thermodynamic functions of a strongly degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description), Radiation as a photon gas and Thermodynamic functions of photon gas. Bose derivation of Planck's law. **(12 Lectures)**

Unit III

Fermi-Dirac Statistics: Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly degenerate Fermi Gas, Fermi Energy Electron gas in a Metal, Specific Heat of Metals, Relativistic Fermi gas, White Dwarf Stars, Chandrasekhar Mass Limit**.** **(12 Lectures)**

Unit IV

Theory of Radiation: Properties of Thermal Radiation and Radiation Pressure. Blackbody Radiation and its spectral distribution. Kirchhoff law. Stefan-Boltzmann law and its thermodynamic proof. Wien's Displacement law. Wien's Distribution law. Rayleigh-Jean's Law. Ultraviolet Catastrophe. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation Deduction of Wien's Distribution Law, Rayleigh-Jean's Law, Stefan-Boltzmann Law and Wien's Displacement law from Planck's law. **(12 Lectures)**

References for Theory: Essential Readings:

1. Statistical Mechanics: R.K. Pathria and P. D. Beale (Academic Press)
2. Introductory Statistical Mechanics: R. Bowley and M. Sanchez (Oxford Univ. Press)
3. Statistical Physics: F. Mandl (Wiley)
4. A treatise on Heat: M.N. Saha and B.N. Srivastava (Indian Press)
5. Problems and Solutions on Thermodynamics andStatistical Mechanics: Lim Yung-Kou

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–VI)

COURSE TITLE: NUCLEAR AND PARTICLE PHYSICS

COURSE CODE: FPHL-6393

COURSE OUTCOMES

CO1: Explain the structure and properties of atomic nuclei and analyze nuclear stability using concepts such as binding energy, liquid drop model, and nuclear forces.

CO2: Interpret radioactive decay processes including alpha, beta, and gamma decay, and apply conservation laws and selection rules to nuclear transitions.

CO3: Analyze the interaction of radiation with matter and evaluate the working principles and applications of radiation detectors and particle accelerators.

CO 4: Describe the origin and properties of cosmic rays and elementary particles and explain fundamental particle interactions using concepts such as quarks, leptons, strangeness, and particle conservation laws.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–VI)

COURSE TITLE: NUCLEAR AND PARTICLE PHYSICS

COURSE CODE: FPHL-6393

Examination Time: 3 Hours **Max Marks: 100** **ESE Marks: 70**

Credits: 4-0-0 **CA: 30** **Pass Mark: 25**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.

Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT-I

Structure and Properties of the Nucleus: Structure of the nucleus: Discovery of the nucleus, composition, basic properties; charge, mass, size, spin, magnetic moment, electric quadrupole moment, binding energy, binding energy per nucleon and its observed variation with mass number of the nucleus, coulomb energy, volume energy, surface energy, other corrections, explanation of the binding energy curve, liquid drop model of the nucleus. 15 Lectures

UNIT-II

Radioactivity:The radioactive decay law, decay constant and half life; methods of measurement of half life, spectra of emitters. Alpha decay: Basic decay process, Geiger-Nuttal law, Gamow's explanation, angular momentum and parity in a decay, energy release in alpha decay. Beta decay: Fermi's theory, angular momentum and parity selection rules, neutrino and antineutrino, non conservation of parity in beta decay and its experimental verification. Gamma decay: Energetics of a decay, elementary theory of multiple transitions, angular momentum and parity selection rules, internal conversion, nuclear absorption and fluorescence, Mössbauer effect, energy levels. 15 Lectures

UNIT-III

Interaction of Radiation with Matter:Energy loss of particles in passage through matter, stopping power of matter for charged particles, energy range relationship and straggling. Interaction of gamma radiation with matter: photoelectric effect, Compton effect and pair production. Thomson scattering and Rayleigh scattering. Detectors and Accelerators: Detectors for charged particles: ion chamber, Geiger counter, cloud chamber, photographic emulsions, bubble chamber and Solid State Nuclear Track Detectors. Need for accelerators: Cockroft, Walton, Van de Graff, cyclic accelerators, cyclotron, synchrocyclotron, variable energy cyclotron, phase stability, superconducting magnets. 15 Lectures

UNIT-IV

Cosmic Rays and Elementary Particles: Discovery of cosmic rays: hard and soft components, discovery of muon, pion, heavy mesons and hyperons, mass and life time determination for muon and pion. Primary Cosmic Rays: Extensive air showers, solar modulation of primary cosmic rays, effect of earth's magnetic field on the cosmic ray trajectories. Resonance Particles: Discovery and important properties, Strangeness, conservation of strangeness in particle interactions, quark hypothesis, high energy electron scattering from protons, basic interactions of quark and leptons, interrelation between particle physics and cosmology. 15 Lectures

Reference Books:

1. R.D. Evans: Atomic Nucleus, Krieger Publishing Co. 2003

2. K.S. Krane: Introductory Nuclear Physics, Wiley 2008.
3. P. Mermier and E. Sheldon: Physics of Nuclei and Particles, Academic Press, 2013.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–VI)

COURSE TITLE: FABRICATION OF ELECTRONIC DEVICES

COURSE CODE: FPHL-6394

COURSE OUTCOMES

CO1: Explain crystal growth and epitaxial growth techniques used in semiconductor fabrication, and evaluate their impact on material quality and device performance.

CO2: Analyze diffusion, thermal oxidation, and ion implantation processes for semiconductor doping and junction formation in integrated circuit manufacturing.

CO3: Evaluate metallization and etching techniques employed in microelectronic device fabrication, including their advantages, limitations, and reliability considerations.

CO4: Describe lithography and IC fabrication processes and apply the principles of layer formation, pattern transfer, and device isolation in integrated circuit technology.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–VI)

COURSE TITLE: FABRICATION OF ELECTRONIC DEVICES

COURSE CODE: FPHL-6394

Examination Time: 3 Hours **Max Marks: 100** **ESE Marks: 70**

Credits: 4-0-0 **CA: 30** **Pass Mark: 25**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.

Note: Students can use Non-Scientific calculators or logarithmic tables.

UNIT-I

Crystal growth: Czochralski and Bridgman techniques, Float Zone growth, Distribution coefficients, Zone refining, Wafer preparation and specifications. Epitaxy: importance of lattice matching in epitaxy, CVD of Si, Thermodynamics of vapour phase growth, defects in epitaxial growth, MBE technology. **15 Lectures**

UNIT-II

Diffusion: Fick's diffusion equation in one-dimension, Atomistic models of diffusion, analytic solution of Fick's law for different cases. Diffusivities of common dopants in Si and SiO_2. Diffusion enhancements and retardation, Thermal Oxidation: Deal-Grove model of oxidation. Effects of dopants during oxidation, oxidation induced defects, Ion Implantation: channeling and projected range of ions, implantation damage, Rapid Thermal Annealing (RTA). **15 Lectures**

UNIT-III

Metallization applications: Gates and interconnections, Metallization choices, metals, alloys and silicides, deposition techniques, metallization problems, step coverage, electromigration, Etching: Dry and wet chemical etching, Reactive Plasma Etching, Ion enhanced etching and ion induced etching. **15 Lectures**

UNIT-IV

Optical lithography: photoresists, Contact and proximity printers, projection printers, Mask alignment, X-ray and electron beam lithography, Fundamental considerations for IC processing: Building individual layers, Junction and Trench isolation of devices. **15 Lectures**

Text and Reference Books:

1. The Science and Engineering of Microelectronics Fabrication - SA Campbell – Oxford University Press–1996
2. VLSI Technology - SM Sze - - McGraw Hill International Editions –1988

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–VI)

COURSE TITLE: BIOLOGICAL PHYSICS

COURSE CODE: FPHL-6395

COURSE OUTCOMES

CO1: Explain the fundamental principles of living systems including cellular organization, metabolism, reproduction, evolution, scaling laws, and interactions between organisms and their environment.

CO2: Analyze the structure and function of biomolecules and apply mathematical and computational models to biological processes such as transcription, translation, signaling, and molecular transport.

CO3: Evaluate biological systems as complex networks by studying metabolic, regulatory, and signaling interactions, systems biology approaches, and models of cellular dynamics.

CO4: Interpret multicellular organization, neural systems, ecosystems, and evolutionary processes using concepts of dynamical systems, information processing, genotype–phenotype relationships, and evolutionary models.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–VI)

COURSE TITLE: BIOLOGICAL PHYSICS

COURSE CODE: FPHL-6395

Examination Time: 3 Hours **Max Marks: 100** **ESE Marks: 70**

Credits: 4-0-0 **CA: 30** **Pass Mark: 25**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.

Note: Students can use Non-Scientific calculators or logarithmic tables.

Unit-I

The boundary, interior and exterior environment of living cells. Processes: exchange of matter and energy with environment, metabolism, maintenance, reproduction, evolution. Self-replication as a distinct property of biological systems. Time scales and spatial scales. Universality of microscopic processes and diversity of macroscopic form. Types of cells. Multicellularity. Allometric scaling laws. **15 Lectures**

Unit-II

Metabolites, proteins and nucleic acids. Their sizes, types and roles in structures and processes. Transport, energy storage, membrane formation, catalysis, replication, transcription, translation, signaling. Typical populations of molecules of various types present in cells, their rates of production and turnover. Energy required to make a bacterial cell. Simplified mathematical models of transcription and translation, small genetic circuits and signaling pathways. Random walks and applications to biology. Mathematical models to be studied analytically and computationally.

15 Lectures

Unit-III

At the level of a cell: The numbers of distinct metabolites, genes and proteins in a cell. Complex networks of molecular interactions: metabolic, regulatory and signalling networks. Dynamics of metabolic networks; the stoichiometric matrix. Living systems as complex organizations; systems biology. Models of cellular dynamics. The implausibility of life based on a simplified probability estimate, and the origin of life problem. **15 Lectures**

Unit-IV

At the level of a multicellular organism:Numbers and types of cells in multicellular organisms. Cell types as distinct attractors of a dynamical system. Stem cells and cellular differentiation. Pattern formation and development. Brain structure: neurons and neural networks. Brain as an information processing system. Associative memory models. Memories as attractors of the neural network dynamics. At the level of an ecosystem and the biosphere: Foodwebs. Feedback cycles and selfsustaining cosystems. The mechanism of evolution: variation at the molecular level, selection at the level of the organism. Models of evolution. The concept of genotype-phenotype map. Examples. **15 Lectures**

Reference Books:

1. Physics in Molecular Biology; Kim Sneppen & Giovanni Zocchi (CUP 2005)
2. Biological Physics: Energy, Information, Life; Philip Nelson (W H Freeman & Co, NY, 2004)

3. Physical Biology of the Cell (2nd Edition), Rob Phillips et al (Garland Science, Taylor & Francis Group, London & NY, 2013) 60
4. An Introduction to Systems Biology; Uri Alon (Chapman and Hall/CRC, Special Indian Edition, 2013)
5. Evolution; M. Ridley (Blackwell Publishers, 2009, 3rd edition)

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–VI)

COURSE TITLE: BASICS OF ARTIFICIAL INTELLIGENCE

COURSE CODE: FPHL-6396

After completing this course, student will be able to

CO1: Explain the fundamental concepts of Artificial Intelligence, including its history, types, ethical considerations, and distinguish AI, Machine Learning, and Deep Learning, with emphasis on their applications in physics and scientific research.

CO2: Apply Python programming concepts to develop simple programs for data processing, visualization, graph plotting, and basic error analysis relevant to physics and AI applications.

CO3: Analyze scientific data using appropriate data handling, preprocessing, statistical methods, and visualization techniques to extract meaningful information and interpret results.

CO4: Apply fundamental machine learning techniques, including supervised and unsupervised learning algorithms, to solve basic scientific problems and interpret their applications in physics, such as experimental data prediction, pattern recognition, and astronomical image analysis.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE (PHYSICS) (FYIP) (SEMESTER–VI)

COURSE TITLE: BASICS OF ARTIFICIAL INTELLIGENCE

COURSE CODE: FPHL-6396

Credits: 3-0-1 **Max Marks: 100 (ESE Marks: 40 (Theory), 30 (Practical) CA: 30)**

Examination Time: 3 Hours **Pass Mark: 14**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 14 marks.

UNIT I

Introduction to Artificial Intelligence: Definition and history of AI, Types of AI: Narrow AI, General AI, Applications of AI in daily life, AI in scientific research and Physics, Difference between AI, Machine Learning, and Deep Learning, Ethical issues in AI, Physics-Oriented Applications, AI in astronomy, AI in material science, AI in medical physics, AI in weather prediction and climate studies

UNIT II

Basics of Python Programming for AI: Introduction to Python, Variables, data types, operators, Conditional statements and loops, Functions and modules, Lists, tuples, dictionaries, File handling basics, Plotting graphs using Python, Error analysis using Python

UNIT III

Data Handling and Visualization: Introduction to data science concepts, Data collection and preprocessing, Basics of statistics for AI, Data visualization techniques, Graph plotting and interpretation

UNIT IV

Introduction to Machine Learning: Concept of Machine Learning, Supervised and unsupervised learning, Training and testing datasets, Regression and classification, Overfitting and underfitting, Introduction to neural networks, Simple Algorithms, Linear Regression, Decision Trees, K-Means Clustering, Physics Applications, Predicting experimental outcomes, Pattern recognition in spectra, Image analysis in astronomy

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)

M.Sc. (PHYSICS) (FYIP) Semester V

Session-2026-27

COURSE TITLE: BASICS OF ARTIFICIAL INTELLIGENCE

COURSE CODE: FPHL-6396 (P)

COURSE OUTCOMES

CO1: Develop basic Python programs using appropriate programming constructs to solve simple computational problems relevant to physics and artificial intelligence.

CO2: Apply Python tools to plot, analyze, and interpret experimental data, including performing linear regression for scientific data analysis.

CO3: Build and evaluate simple machine learning models for prediction and apply basic image classification techniques to solve introductory AI problems.

CO4: Design and present an AI-based mini-project involving data visualization and analysis, demonstrating the ability to process, visualize, and communicate scientific data effectively.

Master of Science (Semester System) (12+3+2 System of Education with multiple Entries and Exits)
M.Sc. (PHYSICS) (FYIP) Semester V
Session-2026-27
COURSE TITLE: BASICS OF ARTIFICIAL INTELLIGENCE
COURSE CODE: FPHL-6396 (P)

Credits: 0-0-1 **Max Marks: 30**
Examination Time: 3 Hours **Pass Mark: 11**

Instructions to Practical Examiner
Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar

General Guidelines for Practical Examination
I. The distribution of marks is as follows:
i) One experiment 10 Marks
ii) Brief Theory 5 Marks
iii) Viva–Voce 10 Marks
iv) Record (Practical file) 5 Marks
II. There will be one sessions of 3 hours duration. The paper will have one session and one experiment is to be allotted by the external examiner.
III. Number of candidates in a group for practical examination should not exceed 20.
IV. In a single group no experiment is allotted to more than three examinees in any group.

List of Experiments
1. Basic Python programming exercises
2. Plotting and analyzing experimental data
3. Linear regression using Python
4. Simple ML model for prediction
5. Image classification demo
6. AI-based data visualization mini-project

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE PHYSICS (FYIP) (SEMESTER–VI)

COURSE TITLE: SOLID STATE PHYSICS LAB

COURSE CODE: FPHP-6391

COURSE OUTCOMES

CO1: Perform experimental measurements of magnetic susceptibility and magnetic hysteresis to understand magnetic behavior in solids and liquids.

CO2: Analyze dielectric, ferroelectric, and piezoelectric responses of functional materials using modern characterization techniques.

CO3: Apply SPR-based methods for the determination of optical constants and thin-film refractive indices.

CO4: Evaluate semiconductor properties through Hall effect and four-probe measurements and correlate the results with electronic band structure.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE PHYSICS (FYIP) (SEMESTER–VI)

COURSE TITLE: SOLID STATE PHYSICS LAB

COURSE CODE: FPHP-6391

Examination Time: 3 Hours	**Max Marks: 100**	**ESE Marks: 70**
Credits: 3-0-0	**CA: 30**	**Pass Mark: 25**

Instructions to Practical Examiner

Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar

General Guidelines for Practical Examination

I. The distribution of marks is as follows:

i) One experiment 30 Marks

ii) Brief Theory 10 Marks

iii) Viva–Voce 15 Marks

iv) Record (Practical file) 5 Marks

II. There will be one session of 3 hours duration. The paper will have one session and will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.

III. Number of candidates in a group for practical examination should not exceed 20.

IV. In a single group no experiment is allotted to more than three examinees in any group.

List of experiments-

1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)
2. To measure the Magnetic susceptibility of Solids.
3. To determine the Coupling Coefficient of a Piezoelectric crystal.
4. To measure the Dielectric Constant of a dielectric Materials with frequency
5. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance (SPR)
6. To determine the refractive index of a dielectric layer using SPR
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.
9. To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to 150C) and to determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE PHYSICS (FYIP) (SEMESTER–VI)

COURSE TITLE: LAB ON STATISTICAL MECHANICS

COURSE CODE: FPHP-6391

COURSE OUTCOMES

CO1: Implement computational methods to model interacting and non-interacting particle systems in statistical mechanics.

CO2: Compute and interpret thermodynamic properties from partition functions and statistical ensembles.

CO3: Compare classical and quantum statistical distributions through numerical simulations and graphical analysis.

CO4: Evaluate the emergence of macroscopic behavior from microscopic dynamics, including equilibrium, fluctuations, and transport phenomena.

Master of Science (Semester System) (12+5 System of Education with multiple Entries and Exits)

(Session-2026-27)

MASTER OF SCIENCE PHYSICS (FYIP) (SEMESTER–VI)

COURSE TITLE: LAB ON STATISTICAL MECHANICS

COURSE CODE: FPHP-6391

Examination Time: 3 Hours	**Max Marks: 100**	**ESE Marks: 70**
Credits: 0-0-3	**CA: 30**	**Pass Mark: 25**

Instructions to Practical Examiner

Question paper is to be set on the spot jointly by the external and internal examiners. Two copies of the same to be submitted for the record to COE office, Kanya Maha Vidyalaya, Jalandhar

General Guidelines for Practical Examination

I. The distribution of marks is as follows:

i) One experiment 30 Marks

ii) Brief Theory 10 Marks

iii) Viva–Voce 15 Marks

iv) Record (Practical file) 5 Marks

II. There will be one sessions of 3 hours duration. The paper will have one session and will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.

III. Number of candidates in a group for practical examination should not exceed 20.

IV. In a single group no experiment is allotted to more than three examinees in any group.

List of experiments-

Use C/C++/Scilab/Python/other numerical simulations for solving the problems based on Statistical Mechanics like:

1. Computational analysis of the behavior of a collection of particles in a box that satisfy Newtonian mechanics and interact via the Lennard-Jones potential, varying the total number of particles N and the initial conditions:

a) Study of local number density in the equilibrium state (i) average; (ii) fluctuations

b) Study of transient behavior of the system (approach to equilibrium)

c) Relationship of large N and the arrow of time

d) Computation of the velocity distribution of particles for the system and comparison with the Maxwell velocity distribution.

2. Plot the probability of various macrostates in coin-tossing experiment (two level systems) versus number of heads with 4, 8, 16 coins etc.

3. Computation of the partition function Z(b) for the systems with a finite number of single particle levels (e.g., 2 level, 3 level etc.) and finite number of non-interacting particles N under Maxwell-Boltzmann/ Fermi-Dirac/Bose Einstein statistics:

a) Study the behavior of Z(b), average energy, C_v, and entropy and its dependence upon the temperature, total number of particles N and the spectrum of single particle energy states.

b) Plot the probability of occupancy of all the states w.r.t. temperature.

4. Plot the Maxwell speed distribution function at different temperatures in a 3-dimension system. Calculate the average speed, root mean square and most probable speed

5. Plot Specific Heat of Solids w.r.t temperature
a) Dulong-Petit law,
b) Einstein distribution function
c) Debye distribution function
6. Plot the following functions with energy at different temperatures
a) Maxwell-Boltzmann distribution
b) Fermi-Dirac distribution
c) Bose-Einstein distribution
7. Plot the distribution of particles w.r.t. energy (dN/de versus e) in 3 Dimensions for
a) Relativistic and non-relativistic bosons both at high and low temperature.
b) Relativistic and non-relativistic fermions both at high and low temperature.
8. Plot Planck's law of Blackbody radiation w.r.t. wavelength/frequency at different temperatures. Compare it with Rayleigh-Jean's Law and Wien's distribution law for a given temperature.

References for Laboratory work:

1. Elementary Numerical Analysis: K.E. Atkinson (Wiley)
2. Introduction to Modern Statistical Mechanics: D. Chandler (Oxford University Press)
3. Thermodynamics, Kinetic Theory and Statistical Thermodynamics: F. W. Sears and G. L. Salinger (Narosa)