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26/7/25

Date: 26.07.2025

To  
**The Registrar,**  
Binod Bihari Mahto Koyalanchal University (BBMKU),  
Dhanbad – 826004.

DSW  
M  
24/7/25

**Subject:** Submission of New FYUGP Syllabus (Semesters I & II) in Physics for Implementation from the Academic Session 2025–29 as per the State University of Jharkhand Regulation 2024.

**Sir,**

With reference to your letter no. **BBMKU/DSW/R/694/2025**, dated **07.05.2025**, the University Department of Physics had submitted the complete Four-Year Undergraduate Programme (FYUGP) syllabus in Physics (Semesters I to VIII) to your office on **15.05.2025**, in accordance with the State University of Jharkhand Regulation 2024.

The syllabus was thoroughly discussed and unanimously approved in the meeting of the Board of Studies (BoS) held on **14.05.2025** under the chairmanship of the undersigned.

In reference to the recent letter no. **BBMKU/DSW/R/1314/2025**, dated **24.07.2025**, please find enclosed the FYUGP syllabus in Physics (Semesters I & II), extracted from the earlier submitted full syllabus, in both soft and hard copies. It is duly approved by the BoS members in the same meeting held on **14.05.2025**, in accordance with the State University of Jharkhand Regulation 2024.

You are kindly requested to place the enclosed syllabus before the Academic Council for its approval and implementation from the academic session **2025–29**.

The resolution of the BoS meeting, along with a copy of the syllabus (Semesters I & II), is enclosed for your kind consideration and necessary action.

Thanking you.

Yours faithfully,

Dr. Rajendra Pratap  
26.7.2025

**(Dr. Rajendra Pratap)**

Head & Chairman, Board of Studies  
University Department of Physics  
BBMKU, Dhanbad

**Enclosures:**

1. Copy of the BoS Resolution dated 14.05.2025.
2. FYUGP Syllabus in Physics (Semesters I & II) as per the State University of Jharkhand Regulation 2024.



Date: 10.05.2025

## Notice

In response to letter BBMKU/DSW/R/694/2025, dated 07.05.2025, regarding the submission of the New FYUGP syllabus as per State University of Jharkhand Regulation 2024 to the concerned office, a meeting of the **Board of Studies** is scheduled on **14.05.2025 (Wednesday)**, at **12:30 p.m.** in the University Department of Physics, BBM University, Dhanbad, to discuss and finalize the following agenda items:

1. Preparation of New FYUGP syllabus for UG, Semesters **I to VIII** as per State University of Jharkhand Regulation 2024, effective from the academic session 2025-29 onwards.

All respected members are requested to be present.

*[Signature]*  
10/05/25

*[Signature]*  
10.05.2025

(Dr. Rajendra Pratap)

Head, University Dept. of Physics  
University Department of Physics  
BBMK University, Dhanbad

*[Signature]*  
10/05/25

*[Signature]*  
10/5/2025

*[Signature]*  
10/5/2025

Sayantan Sircar  
10/05/2025

Date: 14.05.25

Resolution of the Board of Studies Meeting  
University Department of Physics, BBM KU,  
Dhanbad.

In reference to letter no. BBM KU/DSW/R/694/2025, dated 07.05.2025, regarding the submission of the new Four-Year Undergraduate Programme (FYUGIP) syllabus as per the State University of Jharkhand Regulation 2024, a meeting of the Board of Studies (BOS) of Physics was held on 14.05.2025 (Wednesday) at 12:30 PM under the chairmanship of Dr. Rajendra Pratap, Head of the Department, in the University Department of Physics, BBM KU, Dhanbad.

The following members were present in the meeting:

1. Dr. Rajendra Pratap - Chairman Date 14.05.2025
2. Dr. D. K. Giri - Member Signature 14/05/25
3. Dr. Ajay Prasad - Member Signature 14/05/25
4. Dr. K. Bandyopadhyay - Member Signature 14/05/2025
5. Dr. Uma Mageswari - Member Signature 14/05/2025
6. Dr. Sayantan Sil - Member Signature 14/05/2025

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After thorough discussion and deliberation, the following resolution was passed unanimously:

Resolution:

The Board of Studies of the University Department of Physics hereby recommends the newly prepared FYUGP syllabus for Undergraduate Semesters I to VIII, in accordance with the State University of Jharkhand Regulation 2024, for implementation from the academic session 2025-2029, subject to approval.

It is further resolved to submit the syllabus to the Registrar, BBM KU, Dhanbad, for necessary consideration and approval by the Academic Council, followed by its implementation from the academic session 2025 onwards.

The meeting concluded with a vote of  
thanks proposed by Dr. D.K. Giri.

~~Datal~~  
14.05.2025  
Chairman

Head  
University Department of Physics  
B.B.M.K. University, Dhanbad  
University Department of  
Physics  
BBMKU, Dhanbad.

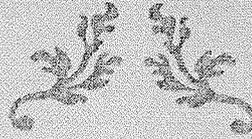
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14/05/2025



FYUGP  
PHYSICS HONOURS/ RESEARCH  
&  
ASSOCIATED CORE COURSE  
&  
ELECTIVE COURSE  
&  
MDC (MULTIDISCIPLINARY COURSE)

FOR UNDER GRADUATE COURSES UNDER  
BINOD BILARI MAHTO KOYALANCHAL UNIVERSITY, DHANBAD



Implemented from  
Academic Session 2025-2029

*Chaitanya*  
14/05/2025

*gopm*  
14/05/25

*Kumar*  
14/5/25

*Ar2*  
14/5/25

*Radhika*  
14/5/25

*Sayantan Sri* 14/05/2025

**Table 1 A: Credit Framework for the first three years of FYUGP:**

Academic Level	Level of Courses	Semester	MLI: Discipline Specific Courses - Core or Major (60)	AC: Associated core courses from discipline/ Interdisciplinary/ vocational (8)	ELC: Elective courses may be opted from four paths [Follow table 4, 5 & 6] (16)	MDC: Multidisciplinary Courses (From a pool of Courses) (9)	AEC: Ability Enhancement Courses (Modern Indian Language and English) (8)	SEC: Skill Enhancement Courses (9)	VAC: Value Added Courses (6)	IKS: (i) Indian Knowledge System (2) & (ii) Social awareness (2)	RC: Research Courses (12)	AMJ: Advanced Courses instead of Research (12)	Total Credits	IAP: Internship/Apprenticeship/ Project/ Vocational course/ Dissertation (4)
	1	2	3 (80)	4 (32)	5	6	7	8	9	10	11	12	13	
Level 100-199: Foundation or Introductory courses	I	4	4	-	-	3	2	3	2	2	-	-	20	
	II	4	-	4	-	3	2	3	2	2	-	-	20	
Exit Point: Undergraduate Certificate provided with Summer Internship/ Project/ Vocational course/ Dissertation (4 credits)														
Level 200-299: Intermediate level courses	III	4+4	-	4	3	2	3	-	-	-	-	-	20	4
	IV	4+4+4	-	4	-	2	2	-	-	-	-	-	20	
Exit Point: Undergraduate Diploma provided with Summer Internship/ Project/ Vocational course/ Dissertation (4 credits)														
Level 300-399: Higher-level courses	V	4+4+4+4	-	4	-	-	-	-	-	-	-	-	20	
	VI	4+4+4+4	-	4	-	-	-	-	-	-	-	-	20	
Exit Point: Bachelor's Degree with Summer Internship/ Project/ Vocational course/ Dissertation (4 credits)													120	+4

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Session 2025-2029 onwards

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*Handwritten signature and date: Sayantan Saha 14/05/2025*

SEMESTER WISE COURSES OF STUDY FOR FOUR YEAR UNDERGRADUATE PROGRAMME  
2025 onwards

Table 2: Semester-wise Course Code and Credit Points for Single Major during the First Three Years of FYUGP

Semester	Common, Introductory, Major, Minor, Vocational & Internship Courses		Credits	
	Code	Papers	Paper	Semester
I	AEC-1	Language and Communication Skills (MIL-1; Modern Indian language Hindi/ English)	2	20
	VAC-1	Value Added Course- 1	2	
	IKS-1	Indian Knowledge System-1/Social Awareness Activities	2	
	SEC-1	Skill Enhancement Course- 1	3	
	MDC-1	Multi-disciplinary Course- 1	3	
	AC-1	Associated core courses from discipline/ Interdisciplinary/ vocational	4	
	MJ-1	Major paper 1 (Disciplinary/ Interdisciplinary Major)	4	
II	AEC-2	Language and Communication Skills (MIL-1; Modern Indian language English/ Hindi)	2	20
	VAC-2	Value Added Course-2	2	
	IKS-2	Social Awareness Activities/ Indian Knowledge System-1	2	
	SEC-2	Skill Enhancement Course-2	3	
	MDC-2	Multi-disciplinary Course-2	3	
	AC-2	Associated core courses from discipline/ Interdisciplinary/ vocational	4	
	MJ-2	Major paper 2 (Disciplinary/ Interdisciplinary Major)	4	
III	AEC-3	Language and Communication Skills (MIL-2; MIL including TRL)	2	20
	SEC-3	Skill Enhancement Course-3	3	
	MDC-3	Multi-disciplinary Course-3	3	
	ELC-1	Elective courses from discipline/ Interdisciplinary/ vocational	4	
	MJ-3	Major paper 3 (Disciplinary/ Interdisciplinary Major)	4	
	MJ-4	Major paper 4 (Disciplinary/ Interdisciplinary Major)	4	
	AEC-4	Language and Communication Skills (MIL-2; MIL including TRL)	2	
VAC-3	Value Added Course-3	2		
ELC-2	Elective courses from discipline/ Interdisciplinary/ vocational	4		
MJ-5	Major paper 5 (Disciplinary/ Interdisciplinary Major having IKS)	4		
MJ-6	Major paper 6 (Disciplinary/ Interdisciplinary Major)	4		
MJ-7	Major paper 7 (Disciplinary/ Interdisciplinary Major)	4		
V	ELC-3	Elective courses from discipline/ Interdisciplinary/ vocational	4	20
	MJ-8	Major paper 8 (Disciplinary/ Interdisciplinary Major)	4	
	MJ-9	Major paper 9 (Disciplinary/ Interdisciplinary Major)	4	
	MJ-10	Major paper 10 (Disciplinary/ Interdisciplinary Major)	4	
	MJ-11	Major paper 10 (Disciplinary/ Interdisciplinary Major)	4	
VI	ELC-4	Elective courses from discipline/ Interdisciplinary/ vocational	4	20
	MJ-12	Major paper 12 (Disciplinary/ Interdisciplinary Major)	4	
	MJ-13	Major paper 13 (Disciplinary/ Interdisciplinary Major)	4	
	MJ-14	Major paper 14 (Disciplinary/ Interdisciplinary Major)	4	
	MJ-15	Major paper 15 (Disciplinary/ Interdisciplinary Major)	4	
Total Credits, excluding one Internship (IAP) of 4 credits			120	120

Session 2025-2029 onwards

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**Abbreviations:**

AEC	Ability Enhancement Courses
SEC	Skill Enhancement Courses
IAP	Internship/Apprenticeship/ Project
IKS	Indian Knowledge System
MDC	Multidisciplinary Courses
ELC	Elective Courses
MJ	Major Disciplinary/interdisciplinary Courses
AC	Associated core courses from discipline/ Interdisciplinary/ vocational
AMJ	Advanced Major Disciplinary/interdisciplinary Courses
RC	Research Courses
JOC	Skill based Job Oriented Courses

**AEC (Ability enhancements courses)- 2 Credits**

- Full marks – 50, Pass Marks – 20
- In AEC the students of all faculties will have to select either Hindi or English in Semester -1 and those students who have opted Hindi will have to select English as AEC in Semester -2 and vice versa. For 3<sup>rd</sup> and 4<sup>th</sup> semester student can opt Sanskrit, Urdu, Bengali, English, Hindi or TRL.
- In 4<sup>th</sup> semester there will be AEC-3 will include Language and Communication Skill in Hindi and English.

• No internal examination will be conducted.

**VAC (Value added Courses)- 2 Credits**

- Full marks – 50, Pass Marks – 20
- For 1<sup>st</sup> semester – “Understanding India” ; For 2<sup>nd</sup> Semester – “Health, Wellness, Yoga & Sports”
- For 4<sup>th</sup> Semester – “Environmental Studies”

• No internal examination will be conducted.

**SEC (Skill Enhancement Courses) – 3 Credits**

- Full Marks – 75, Pass Marks – 30
- Digital Education or Mathematical & Computational Thinking Analysis is selected as SEC. Student will have to select or opt either of the two subjects for semester – I, II and III in no case both subjects will be allowed to opt.

• No internal examination will be conducted.

**MDC (Multidisciplinary Courses) – 3 credits**

- Full Marks – 75, Pass Marks – 30
- A student will study three different subjects in the multidisciplinary courses during first three semesters.

• No internal examination will be conducted.

**Indian Knowledge System (IKS) & Awareness Module**

The National Education Policy 2020 (NEP 2020) integrates the Indian Knowledge System (IKS) into education at all levels. A 2-credit IKS course introduces students to India's cultural, scientific, and philosophical heritage.

A 2-credit Awareness Module covers social ethics and common rules, balancing broad and in-depth topics. Part 1 (10 hours) includes road safety, diversity, cleanliness, financial management, and basic first aid.

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Prerna  
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Sayantan Saha  
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**Table 4: Suggested list of Associated Core (AC) for SCIENCE Discipline**

S.N.	Major (M)	Associated Core (AC)
1	Botany	Chemistry
		Zoology
2	Zoology	Chemistry
		Botany
3	Chemistry	Physics/Botany
		Mathematics/Zoology
4	Physics	Mathematics/Statistics
		Chemistry
5	Mathematics	Chemistry/Computer Science
		Physics/Statistics/Economics
6	Statistics	Mathematics
		Computer Science/Physics
7	Geology	Chemistry/Physics
		Geography

**SEMESTER WISE COURSES OF STUDY FOR FOUR YEAR UNDERGRADUATE PROGRAMME 2025 onwards****Table 5: Semester-wise Course Code and Credit Points and Marks distribution of Associated core courses**

S.N.	Semester	Paper	Credits	Full Marks		Pass Marks	
				Theory (Internal+ End Sem)	Practical End Sem.	Theory (Internal+ End Sem)	Practical
1.	I/II	AC-1/AC-2	3+1	15+60	25	30	10

- *\*For internal examinations, the written examination will carry 10 marks, and class performance and attendance will carry 5 marks.*
- *No internal or mid-semester examination will be conducted for practical papers.*

**Table 6: Semester wise Course Code and Credit Points and Marks distribution of Elective courses**

S.N.	Semester	Paper	Credits	Full Marks		Pass Marks	
				Theory (Internal+ End Sem)	Practical End Sem.	Theory (Internal+ End Sem)	Practical
1.	III/IV	ELC-1/ELC-2	3+1	15+60	25	30	10
2.	V/VI	ELC-3/ELC-4	3+1	15+60	25	30	10
3.	VII/VIII	ELC-5/ELC-6	3+1	15+60	25	30	10

- *\*For internal examinations, the written examination will carry 10 marks, and class performance and attendance will carry 5 marks.*
- *No internal or mid-semester examination will be conducted for practical papers.*

Session 2025-2029 onwards

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VI	MJ-9: Practical	Practical	1	-	-	25	-	-	10	
	MJ-10: Theory	Statistical Mechanics	3	15 (10+5)*	60	-	6	24	-	
	MJ-10: Practical	Practical	1	-	-	25	-	-	10	
	MJ-11: Theory	Analog Electronics	3	15 (10+5)*	60	-	6	24	-	
	MJ-11: Practical	Practical	1	-	-	25	-	-	10	
	MJ-12: Theory	Digital Electronics	3	15 (10+5)*	60	-	6	24	-	
	MJ-12: Practical	Practical	1	-	-	25	-	-	10	
	MJ-13: Theory	Elements of Modern Physics	3	15 (10+5)*	60	-	6	24	-	
	MJ-13: Practical	Practical	1	-	-	25	-	-	10	
	MJ-14: Theory	Quantum Mechanics and Applications	3	15 (10+5)*	60	-	6	24	-	
	MJ-14: Practical	Practical	1	-	-	25	-	-	10	
	MJ-15: Theory	Classical Dynamics	3	15 (10+5)*	60	-	6	24	-	
	MJ-15: Practical	Practical	1	-	-	25	-	-	10	
	EXIT POINT: BACHELOR'S DEGREE									

- \*For internal examinations, the written examination will carry 10 marks, and class performance and attendance will carry 5 marks.
- No internal or mid-semester examination will be conducted for practical papers.

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A.S.D  
14/05/25Gadgil  
14/5/25Kumbh  
14/5/25S.G.P.  
14/05/25Rajesh  
14/05/25Sayantra Sii  
14/05/2025

**Table 8 B: Fourth Year Papers and Examination Structure for Physics Major with Bachelor's Degree (Honours):**

Year	Semester	Physics Major		Examination Structure				Pass Marks		
		Code	Papers	Credits	Internal (Mid Semester) Theory (F.M.)	End Semester Theory (F.M.)	End Semester Practical (F.M.)	Internal Theory (Mid Sem.)	End Sem. Theory	End sem. Practical
4th	VII	MJ-16: Theory	Advanced Mathematical Physics-I	3	15 (10+5)*	60	-	6	24	-
		MJ-16: Practical	Practical	1	-	-	25	-	-	10
		MJ-17: Theory	Solid State Physics	3	15 (10+5)*	60	-	6	24	-
		MJ-17: Practical	Practical	1	-	-	25	-	-	10
		MJ-18: Theory	Nuclear and Particle Physics	3	15 (10+5)*	60	-	6	24	-
		MJ-18: Practical	Practical	1	-	-	25	-	-	10
		MJ-19: Theory	Atomic and Molecular Physics (Quantum Approach) and Laser Physics	3	15 (10+5)*	60	-	6	24	-
		MJ-19: Practical	Practical	1	-	-	25	-	-	10
	VIII	MJ-20: Theory	Advanced Mathematical Physics-II	3	15 (10+5)*	60	-	6	24	-
		MJ-20: Practical	Practical	1	-	-	25	-	-	10
		AMJ-1: Theory	Advanced Quantum Mechanics	3	15 (10+5)*	60	-	6	24	-
		AMJ-1: Practical	Practical	1	-	-	25	-	-	10
		AMJ-2: Theory	Advanced Theoretical Physics-I (Electrodynamics & Statistical Mechanics)	3	15 (10+5)*	60	-	6	24	-
		AMJ-2: Practical	Practical	1	-	-	25	-	-	10
		AMJ-3: Theory	Advanced Theoretical Physics-II (Condensed Matter Physics & Nuclear and Particle Physics)	3	15 (10+5)*	60	-	6	24	-
		AMJ-3: Practical	Practical	1	-	-	25	-	-	10

**EXIT POINT: BACHELOR'S DEGREE (HONOURS)**

- \*For internal examinations, the written examination will carry 10 marks, and class performance and attendance will carry 5 marks.
- No internal or mid-semester examination will be conducted for practical papers.

Session 2025-2029 onwards

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14/05/2025  
Sayantan Sircar

**General Instructions**

1. The Semester Internal Theory Examination will be of 1-hour duration.
2. There shall be only one Practical Examination of 3-hour duration in each semester for each paper separately.
3. One external and one internal examiner will conduct the Practical Examinations.
4. There will be only one Semester Internal Examination in Major, Minor, and Research Courses, which will be organized at the college/institution level.
5. Out of **100 marks**, the **Semester Internal Theory Examination** (each of 1 hour) will carry **15 marks for practical subjects and 25 marks for non-practical subjects.**
6. The **15 marks** in the Theory Examination of practical subjects may include **10 marks** from the **Written Examination/Assignment/Project/Tutorial**, wherever applicable, and **5 marks** based on **attendance/overall class performance** during the semester.
7. The **25 marks** in the Theory Examination of non-practical subjects may include **20 marks** from the **Written Examination/Assignment/Project/Tutorial**, wherever applicable, and **5 marks** based on **attendance/overall class performance** during the semester.
8. To convert attendance into marks, a suggestive range is provided below:
  - Attendance up to 45%: 1 mark
  - 45% < Attendance ≤ 55%: 2 marks
  - 55% < Attendance ≤ 65%: 3 marks
  - 65% < Attendance ≤ 75%: 4 marks
  - Attendance above 75%: 5 marks

Session 2025-2029 onwards

Gopal  
14/5/25Kumar  
14/5/25DGM  
14/05/25

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Asad  
14/5/25Siddhant  
14/5/25Sayantrao Sir  
14/05/2025

- ✦ Revise the knowledge of calculus, vectors, vector calculus, probability and probability distributions. These basic mathematical structures are essential in solving problems in various branches of Physics as well as in engineering.

### SKILLS TO BE LEARNED

- ✦ Training in calculus will prepare the student to solve various mathematical problems.
- ✦ He/she shall develop an understanding of how to formulate a physics problem and solve the given mathematical equation arising out of it.

### COURSE CONTENT

**Differential Equations:** First Order and Second Order Differential Equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with Constant Coefficients. Wronskian and general solution. (7 Lectures)

Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. (4 Lectures)

**Vector Calculus:** Scalar and Vector Fields. 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. (10 Lectures)

**Vector Integration:** Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, 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 applications. (10 Lectures)

**Orthogonal Curvilinear Coordinates:** Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl, and Laplacian in Cartesian, Spherical, and Cylindrical Coordinate Systems. (5 Lectures)

**Dirac Delta function and its properties:** Definition of Dirac delta function. Representation as a limit of a Gaussian function and rectangular function. Properties of the Dirac delta function. (5 Lectures)

**Introduction to probability:** Independent random variables: Probability distribution functions; binomial, Gaussian, and Poisson, with examples. Mean and variance. Dependent events: Conditional Probability. Bayes' Theorem and the idea of hypothesis testing. (4 Lectures)

### 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. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
5. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
6. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
7. Mathematical Physics, Goswami, 1st edition, Cengage Learning.
8. Engineering Mathematics, S. Pal and S.C. Bhunia, 2015, Oxford University Press.
9. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
10. Essential Mathematical Methods, K.F. Riley & M.P. Hobson, 2011, Cambridge Univ. Press.
11. Mathematical Physics, H.K. Dass and R. Verma, S. Chand & Company.
12. Mathematical Physics, B.S. Rajput, Pragati Prakashan, 21<sup>st</sup> Edition, 2009.
13. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
14. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.

Session 2025-2029 onwards

AED 14/5/25
   
 Gopal 14/5/25
   
 Kumbh 14/5/25
   
 Jyoti 14/05/25
   
 Sayantan Sii 14/05/2025

Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods	Solution of linear and quadratic equations, solving $\alpha = \tan \alpha; I = I_0 \left( \frac{\sin \alpha}{\alpha} \right)^2$ in optics.
Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolation	Evaluation of trigonometric functions e.g. $\sin \theta, \cos \theta, \tan \theta, \text{etc.}$
Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal and Simpson rules), Monte Carlo method	Given Position with equidistant time data to calculate velocity and acceleration and vice versa. Find the area of B-H Hysteresis loop
Solution of Ordinary Differential Equations (ODE) First order Differential equation Euler, modified Euler and Runge-Kutta (RK) second and fourth order methods	<p>First order differential equation</p> <ul style="list-style-type: none"> <li>• Radioactive decay</li> <li>• Current in RC, LC circuits with DC source</li> <li>• Newton's law of cooling</li> <li>• Classical equations of motion</li> </ul> <p>Attempt the following problems using the RK 4 order method:</p> <ul style="list-style-type: none"> <li>• Solve the coupled differential equations <math>\frac{dx}{dt} = y + x - \frac{x^3}{3}; \frac{dy}{dx} = -x</math></li> </ul> <p>or four initial conditions <math>x(0) = 0, y(0) = -1, -2, -3, -4</math>. Plot <math>x</math> vs <math>y</math> for each of the four initial conditions on the same screen for <math>0 \leq t \leq 15</math></p> <p>The differential equation describing the motion of a pendulum is <math>\frac{d^2\theta}{dt^2} = -\sin(\theta)</math>. The pendulum is released from rest at an angular displacement <math>\alpha</math>, i.e. <math>\theta(0) = \alpha</math> and <math>\dot{\theta}(0) = 0</math>. Solve the equation for <math>\alpha = 0.1, 0.5</math> and <math>1.0</math> and plot <math>\theta</math> as a function of time in the range <math>0 \leq t \leq 8\pi</math>. Also plot the analytic solution valid for small <math>\theta, (\sin(\theta)) = \theta</math>.</p>

### Reference Books:

1. Introduction to Numerical Analysis, S. S. Sastry, PHI Learning Pvt. Ltd., 5th ed., 2012.
2. Schaum's Outline of Programming with C++, J. Hubbard, McGraw-Hill, 2000.
3. Numerical Recipes in C: The Art of Scientific Computing, W. H. Press, S. A. Teukolsky, W. T. Vetterling, and B. P. Flannery, Cambridge University Press, 3rd ed., 2007.
4. A First Course in Numerical Methods, U. M. Ascher and C. Greif, PHI Learning, 2012.
5. Elementary Numerical Analysis, K. E. Atkinson, Wiley India Edition, 3rd ed., 2007.
6. Numerical Methods for Scientists and Engineers, R. W. Hamming, Courier Dover Publications, 1973.
7. An Introduction to Computational Physics, T. Pang, Cambridge University Press, 2nd ed., 2006.
8. Computational Physics, D. Walker, Scientific International Pvt. Ltd., 1st ed., 2015.

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- ✦ Understand the principle of superposition of waves, so thus describe the formation of standing waves.
- ✦ Explain several phenomena we can observe in everyday life that can be explained as wave phenomena.
- ✦ Use the principles of wave motion and superposition of waves.
- ✦ Recapitulate and learn the special theory of relativity- postulates of the special theory of relativity, Lorentz transformations on space-time and other four vectors, four-vector notations, space-time invariant length, length contraction, time dilation, mass-energy relation, Doppler effect, light cone and its significance, problems involving energy- momentum conservations.

### SKILLS TO BE LEARNED

- ✦ Learn the concepts of elasticity of solids and viscosity of fluids.
- ✦ Develop skills to understand and solve the equations of Newtonian gravity and central force problem.
- ✦ Learn about inertial and non-inertial systems.
- ✦ Acquire basic knowledge of oscillation.
- ✦ Learn about superposition of two Collinear Harmonic Oscillations.
- ✦ Superposition of two Perpendicular Harmonic Oscillations.
- ✦ Learn about Wave Motion in general.
- ✦ Learn about Velocity of Waves.
- ✦ Learn about acoustics of buildings, growth and decay of sound.
- ✦ Acquire knowledge of Superposition of Two Harmonics Waves.
- ✦ Develop the basic concepts of special theory of relativity and its applications to dynamical systems of particles.

### COURSE CONTENT

- Collisions:** Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames. (2 Lectures)
- Elasticity:** Relation between Elastic constants. Twisting torque on a Cylinder or Wire. (2 Lectures)
- Flexure of Beam:** Bending of beam, Cantilever-loaded at one end and loaded at middle. (3 Lectures)
- Surface Tension:** Ripples and Gravity waves, Determination of surface tension by Jaeger's and Quincke's methods. Temperature dependence of surface tension. (3 Lectures)
- Fluid Motion:** Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube. (2 Lectures)
- Motion under Central Force:** Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). (3 Lectures)
- Oscillations:** SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor. (5 Lectures)
- Non-Inertial Systems:** Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Coriolis force and centrifugal force. Effect of centrifugal force due to rotation of the earth. Coriolis force on a freely falling body. Geographical effects of Coriolis force (qualitative). (3 Lectures)

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**PHYSICS-MI-2: PRACTICAL**

Credit: 01 Lectures: 30(15X2)

*Instructions to Question Setters***End Semester Examination (ESE): 25 Marks**

There will be one Practical Examination of 3 hours duration. Evaluation of the Practical Examination will be as per the following guidelines:

Experiment	= 15 marks
Practical record notebook	= 05 marks
Viva-voce	= 05 marks

**Note: No internal or mid-semester examination will be conducted for the practical paper**

1. To measure the volume of a sphere/cylinder using vernier caliper.
2. To measure the diameter of a thick wire using screw gauge.
3. To determine the Height of a Building using a Sextant.
4. To study the random error in observations.
5. To study the Motion of Spring and calculate (a) Spring constant, (b)  $g$  and (c) Modulus of rigidity.
6. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
7. To determine the Young's Modulus of a Wire by suitable method.
8. To determine the Modulus of Rigidity of a Wire by suitable method.
9. To determine the elastic Constants of a wire by Searle's method.
10. To determine the value of  $g$  using Bar Pendulum.
11. To determine the value of  $g$  using Kater's Pendulum.
12. To determine the frequency of an electric tuning fork by Melde's experiment and verify  $\lambda^2-T$  law.
13. To study Lissajous Figures.

**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 Edn., 2011, Kitab Mahal.
4. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
6. B.Sc. Practical Physics, N. N. Ghosh, Bharati Bhawan Publishers.
7. B.Sc. Practical Physics, C. L. Arora, S. Chand & Company, 19th Edition, 1995, Reprint 2014.

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- ✦ In the laboratory course, after acquiring knowledge of how to handle measuring instruments (like screw gauge, vernier callipers, travelling microscope) student shall embark on verifying various principles learnt in theory. Measuring 'g' using Bar Pendulum, Kater's pendulum and measuring elastic constants of materials, viscous properties of liquids etc.

### SKILLS TO BE LEARNED

- ✦ Learn the concepts of vector calculus.
- ✦ Learn the concepts of elasticity of solids and viscosity of fluids.
- ✦ Develop skills to understand and solve the equations of Newtonian gravity and central force problem.
- ✦ Acquire basic knowledge of oscillation.
- ✦ Have an understanding of basic concepts of Special Theory of Relativity.

### COURSE CONTENT

**Vector Analysis:** Triple Scalar product, Triple Vector product, gradient, divergence, Curl and their physical significance, scalar and vector fields, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem. **(10 Lectures)**

**Ordinary Differential Equations:** 1st order homogeneous differential equations. 2<sup>nd</sup> order homogeneous differential equations with constant coefficients. **(4 Lectures)**

**Central force field:** Motion of a particle in a central force field –two body problem. Kepler's Laws and their deduction. **(4 Lectures)**

**Oscillations:** Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. **(4 Lectures)**

**Elasticity:** Elastic constants and their interrelations, Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion, Torsional pendulum. **(8 Lectures)**

**Fluids:** Surface Tension: Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature. Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of liquid with temperature. **(8 Lectures)**

**Special Theory of Relativity:** Galilean transformations. Postulates of Special Theory of Relativity. Lorentz transformation, Length contraction. Time dilation. Relativistic addition of velocities. **(7 Lectures)**

### Reference Books:

1. Mathematical Physics, H K Das and Dr. Rama Verma, S. Chand and Company Limited.
2. Mathematical Physics, B D Gupta, Vikash Publishing House, 4<sup>th</sup> edition.
3. Mathematical Physics, B.S. Rajput, Pragati Prakashan, 21<sup>st</sup> Edition, 2009.
4. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning.
5. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
6. University Physics, F.W. Sears, M.W. Zemansky and H.D. Young, 13/e, 1986. Addison-Wesley.
7. Mechanics Berkeley Physics, v.1: Charles Kittel, et. al. 2007, Tata McGraw-Hill.

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**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 Edn, 2011, Kitab Mahal
  4. B.Sc. Practical Physics, N. N. Ghosh, Bharati Bhawan Publishers.
  5. B.Sc. Practical Physics, C. L. Arora, S. Chand & Company, 19<sup>th</sup> Edition, 1995, Reprint 2014.
  6. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
  7. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
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**Reference Books:**

1. Physics text books for class 11<sup>th</sup> and 12<sup>th</sup> NCERT, New Delhi, revised editions 2022.
2. Concepts of Physics, Part-I and Part-II, H. C. Verma, 2020, Bharati Bhawan.
3. Elements of Properties of Matter, D. S Mathur, 2010, S. Chand & Co.
4. Fundamentals of Physics with Applications, Arthur Beiser, 2010, Tata McGraw-Hill publishing Co. Ltd.
5. Optics by Ajay Ghatak, New Delhi, 1998 Tata McGraw-Hill publishing Co. Ltd.
6. Electricity and Magnetism, A S Mahajan, A. A. Rangwala, 2017 McGraw Hill, New Delhi.
7. An Introduction to Astrophysics, Baidyanath Basu, Tanuka Chattopadhyay, Sudhindra Nath Biswas, Second Edition, 2010, PHI Learning Private Limited.

**Additional Books for reference:**

1. Mechanics (in SI units) - (Berkeley Physics course-volume 1), Charles Kittel, Walter Dknight etc, Tata McGraw Hill publication, 2017, second edition
2. Fundamental of General Properties of Matter, H.R Gulati, R Chand and Co, Fifth edition (1977).
3. A Text book of Optics by Subrahmanyam N., BrijLal and M. N. Avadhanulu,

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**FORMAT OF QUESTION PAPER FOR END-SEMESTER UNIVERSITY EXAMINATIONS**

Question format for 50 Marks:

F.M. =50	Subject/ Code Time=2Hrs.	Exam Year
<b>General Instructions:</b>		
i. Group A carries very short answer type compulsory questions.		
ii. Answer 3 out of 5 subjective/ descriptive questions given in Group B.		
iii. Answer in your own words as far as practicable.		
iv. Answer all sub parts of a question at one place.		
v. Numbers in right indicate full marks of the question.		
<u>Group A</u>		
1.		[5x1=5]
i. ....		
ii. ....		
iii. ....		
iv. ....		
v. ....		
<u>Group B</u>		
2. ....		[15]
3. ....		[15]
4. ....		[15]
5. ....		[15]
6. ....		[15]
Note: There may be subdivisions in each question asked in Theory Examination.		

Question format for 60 Marks:

F.M. =60	Subject/ Code Time=3Hrs.	Exam Year
<b>General Instructions:</b>		
i. Group A carries very short answer type compulsory questions.		
ii. Answer 3 out of 5 subjective/ descriptive questions given in Group B.		
iii. Answer in your own words as far as practicable.		
iv. Answer all sub parts of a question at one place.		
v. Numbers in right indicate full marks of the question.		
<u>Group A</u>		
1.		[5x1=5]
i. ....		
ii. ....		
iii. ....		
iv. ....		
v. ....		
2. ....		[5]
3. ....		[5]
<u>Group B</u>		
4. ....		[15]
5. ....		[15]
6. ....		[15]
7. ....		[15]
8. ....		[15]
Note: There may be subdivisions in each question asked in Theory Examination.		

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*Handwritten signatures and dates:*  
 A.S.N. 14/5/25  
 A. S. 14/5/25  
 K. M. 14/5/25  
 J. P. 14/05/25  
 Sayantan S. 14/05/25