कोटा विश्वविद्यालय, कोटा

UNIVERSITY OF KOTA, KOTA

Curriculum Framework, Syllabus, Scheme and Course Details

पाठ्यक्रम रूपरेखा, प्रक्रीया एवं विवरण

As per the Choice Based Credit System (CBCS) Design in accordance with Learning Outcome Based Curriculum Framework (LOCF) of National Education Policy (NEP-2020)

Faculty of Science

विज्ञान संकाय

M.Sc. (Physics)

स्नातकोत्तर – भौतिक विज्ञान

Program Code : PHY11750P

पाठ्यक्रम कोड : PHY11750P

First Semester (July-December, 2025)
Second Semester (January-June, 2026)

प्रथम सेमेस्टर (जुलाई-दिसंबर, 2025)

द्वितीय सेमेस्टर (जनवरी-जून 2026)

Edition: 2025

संस्करण : 2025

Program Code: PHY11750P

Title of Program: M.Sc. (Physics)

Level of Program: PG

Type of Program: Regular

Duration of the Program: The course M.Sc. (Physics) shall consist of Four Semesters (two academic years) as per National Education Policy 2020.

Eligibility for Admission: The basic eligibility for admission to the program is B.Sc. with Physics, Chemistry and Mathematics with minimum marks for GENERAL category candidates of Rajasthan-55%; Other state-60%; SC/STOBC/SOBC-Minimum Pass Marks. The admission in the course is based on the merit of the percentage obtained in their B.Sc. course. Also the students with Four-year Bachelor of Science and Teacher Education (B.Sc.-B.Ed.) degree with Physics as a compulsory subject in three years are also eligible for admission. The eligibility is subjected to the rules provided in the University Admission Policy 2025-26 or Commissionerate, College Education, Government of Rajasthan Admission Policy 2025-2026.

Medium of Instruction and Examination: English.

Qualification Level of the Program: NHEQF Level 6.5

Total Credit of Program of M.Sc. (Physics) : 100

Objectives of the Program: Physics is fundamental to all physical sciences which explain the nature. Physicists have to be competent enough to design and build new instruments, from satellites to measure the properties of planetary atmospheres to record-breaking intense magnetic fields for the study of condensed matter. Most of the conveniences of modern life are based directly on the understanding provided by physics. Many techniques used in medical imaging are derived directly from physics instrumentation. Even the internet is a spin-off from the information processing and communications requirement of high-energy particle physics. The objective of the program is to equip the students with pure and applied knowledge of Physics.

Program Outcomes (POs): This program aims to provide a thorough understanding of Physics of both pure and applied nature with extensive theoretical and experimental knowledge in major areas of Physics with specialization in different branches of Physics like Energy Studies, Materials Science, Microwave Electronics, High Energy Physics, Advanced Electronics, etc. The students after completing the program shall find placements in premier research institutes and companies in India and abroad, qualify NET/GATE/JEST examinations and will be eligible for M.Tech., Ph.D., teaching and research, etc.

Program Specific Outcome (PSOs): The students will get the specific knowledge and specialized in one branch among the Energy Studies, Materials Science, Microwave Electronics, High Energy Physics, Advanced Electronics, etc. including the enhancement in their ability, research aptitude, etc.

Structure of the Program: The M.Sc. (Physics) program consists of:

(i) Core and applied courses of theory as well as practical components which are compulsory for all students.

(ii) The Discipline Centric Core (DCC), Discipline Specific Elective (DSE), Generic Elective (GEC), Dissertation/Project/Field Study (DPR), Skill Enhancement Course (SEC), Ability Enhancement Course (AEC), Seminars (SEM), Internship/On-Job Experience (IOJ) along with Research Credit Course (RCC) interms of research project/paper presentation are incorporated in the curriculum of courses.

(iii) The program contains different components of NEP-2020 namely Continuous Assessment and Grading System, End of Semester Evaluation, Semester Grade Point Average (SGPA), Cumulative Grade Point Average (CGPA), Laboratory work or Practical component, Academic Bank of Credits (ABC), Elective/optional components, creditisation of extended curricular and Co-Curricular activities, practical and Industrial focus, field work component, practical hands on training, ability enhancement components, research aptitude enhancement, etc.

Program Structure with Distribution of Marks and Credits

First Semester (First Year)

Course Code	Course Type	Course Nomenclature	Duration of End Sem. Exam	Teaching Hrs per Week & Credit			Distribution of Marks			Min. Pass Marks	
				L	P	C	Conti. Assess.	Sem. Assess.	Total Marks	Conti. Assess.	Sem. Assess.
PHY1001T	DCC	Mathematical Methods in Physics	3 Hrs	4	--	4	30	70	100	12	28
PHY1002T	DCC	Classical Mechanics	3 Hrs	4	--	4	30	70	100	12	28
PHY1003T	DCC	Quantum Mechanics	3 Hrs	4	--	4	30	70	100	12	28
PHY1004T	DCC	Classical Electrodynamics-I	3 Hrs	4	--	4	30	70	100	12	28
PHY1005P	DCC	Physics Laboratory-I	6 Hrs	--	16	8	--	200	200	--	100
First Semester Total				**16**	**16**	**24**	**120**	**480**	**600**	**--**	**--**

Second Semester (First Year)

Course Code	Course Type	Course Nomenclature	Duration of End Sem. Exam	Teaching Hrs per Week & Credit			Distribution of Marks			Min. Pass Marks	
				L	P	C	Conti. Assess.	Sem. Assess.	Total Marks	Conti. Assess.	Sem. Assess.
PHY2001T	DCC	Statistical Mechanics	3 Hrs	4	--	4	30	70	100	12	28
PHY2002T	DCC	Classical Electrodynamics -	3 Hrs	4	--	4	30	70	100	12	28

		II									
PHY2003T	DCC	Advanced Quantum Mechanics-I	3 Hrs	4	--	4	30	70	100	12	28
PHY2004T	DCC	Atomic & Molecular Physics	3 Hrs	4	--	4	30	70	100	12	28
PHY2005P	DCC	Physics Laboratory-II	6 Hrs	--	16	8	--	200	200	--	100
CBCS Paper (To be elected from Pool-A, mentioned at University website i.e. www.uok.ac.in)			--	2	--	2	--	50	50	--	20
Second Semester Total				**18**	**16**	**26**	**120**	**530**	**650**	**--**	**--**
First and Second Semester (First Year) Total				**34**	**32**	**50**	**240**	**1010**	**1250**	**--**	**--**

Third Semester (Second Year)

Course Code	**Course Type**	**Course Nomenclature**	**Duration of End Sem. Exam**	**Teaching Hrs/ Week & Credit**			**Distribution of Marks**			**Min. Pass Marks**	
				L	**P**	**C**	**Conti. Assess.**	**Sem. Assess.**	**Total Marks**	**Conti. Assess.**	**Sem. Assess.**
PHY3001T	DCC	Nuclear Physics – I	3 Hrs	4	--	4	30	70	100	12	28
PHY3002T	DCC	Advanced Quantum Mechanics-II: Quantum Field Theory	3 Hrs	4	--	4	30	70	100	12	28
PHY3003T	DCC	Solid State Theory	3 Hrs	4	--	4	30	70	100	12	28
PHY3004T	**Elective-I (any one among the following)**										
	DSE	A] Energy Studies-I	3 Hrs	4	--	4	30	70	100	12	28
	DSE	B] Material Science-I	3 Hrs	4	--	4	30	70	100	12	28
	DSE	C] Microwave Electronics-I	3 Hrs	4	--	4	30	70	100	12	28
	DSE	D] High Energy Physics-I	3 Hrs	4	--	4	30	70	100	12	28
	DSE	E] Advanced Electronics-I	3 Hrs	4	--	4	30	70	100	12	28
PHY3005P	DCC	Physics Laboratory-III	6 Hrs	--	16	8	--	200	200	--	100
CBCS Paper (To be elected from Pool-B, mentioned at University website i.e. www.uok.ac.in)			--	2	--	2	--	50	50	--	20
Third Semester Total				**18**	**16**	**26**	**120**	**530**	**650**	**--**	**--**

Fourth Semester (Second Year)

Course Code	**Course Type**	**Course Nomenclature**	**Duration of End Sem. Exam**	**Teaching Hrs/ Week & Credit**			**Distribution of Marks**			**Min. Pass Marks**	
				L	**P**	**C**	**Conti. Assess.**	**Sem. Assess.**	**Total Marks**	**Conti. Assess.**	**Sem. Assess.**
PHY4001T	DCC	Nuclear Physics-II	3 Hrs	4	--	4	30	70	100	12	28
PHY4002T	DCC	Solid State Physics	3 Hrs	4	--	4	30	70	100	12	28
PHY4003T	DCC	Lasers Physics	3 Hrs	4	--	4	30	70	100	12	28
PHY4004T	DSE	**Elective-II (any one among the following)**									
	DSE	A] Energy Studies-II	3 Hrs	4	--	4	30	70	100	12	28

	DSE	B] Material Science-II	3 Hrs	4	--	4	30	70	100	12	28
	DSE	C] Microwave Electronics-II	3 Hrs	4	--	4	30	70	100	12	28
	DSE	D] High Energy Physics-II	3 Hrs	4	--	4	30	70	100	12	28
	DSE	E] Advanced Electronics-II	3 Hrs	4	--	4	30	70	100	12	28
PHY4005P		**Physics Laboratory-IV**									
	DCC	(i) Laboratory Component (Compulsory)	6 Hrs	--	8	4	--	100	100	--	50
		Elective (any one among the following)									
	DPR	Industrial Component*		--	--	4	100	--	--	50	--
	RCC	Research Project*	--	--	--	4	100	--	--	50	--
	SEC	Instrument design of PG level**	--	--	8	4	100	--	--	50	--
	IOJ	Innovative model**	--	--	--	4	100	--	--	50	--
	AEC	Book Review (University of Kota physics curriculum based book)***	--	--	--	4	100	--	--	50	--
	SEM	Conference paper presentation****	--	--	--	4	100	--	--	50	--
	RCC	Research paper publication****	--	--	--	4	100	--	--	50	--
Fourth Semester Total				**16**	**16**	**24**	**220**	**380**	**600**	**--**	**--**
Third and Fourth Semester (Second Year) Total				**34**	**32**	**50**	**340**	**910**	**1250**	**--**	**--**
GRAND TOTAL (All Four Semesters)				**68**	**64**	**100**	**580**	**1920**	**2500**	**--**	**--**

*The Industrial component or Research Project contains 4 credits with 8 hours per week workload (i.e. 1 Credit = Thirty hours in the entire semester and no specific assignment in the weekly time table). The student will have to undertake industrial/technical training/Research project work during these hours on a regular basis. The student will have to submit a report, which will be evaluated by a board of atleast two internal examiners including concern HoD. The format of report may contain objectives, Industry/Institute details, methodology, Result & discussions, Conclusions, acknowledgement, feedback and reference (if any) along with certificates from the concerned industry.

** The Instrument design of PG level or Innovative model based elective course contains 4 credits with 8 hours per week workload (i.e. 1 Credit = Thirty hours and workload will be carried out in the entire semester). The concern HoD will allocate the students to the available faculty members of the Department for this purpose. The student will have to submit a report, which will be evaluated by a board of two internal examiners (concern teacher and HoD).

***The Book Review (University of Kota physics curriculum based book) contains 4 credits with 8 hours per week workload (i.e. 1 Credit = Thirty hours in entire semester and no workload of teacher will be counted). The HoD will also assign a mentor teacher to such student. The concern HoD/mentor will allocate the book as per the request of the student. The

student will have to submit a report, which will be evaluated by a board of two internal examiners (concern mentor and HoD).

****The Conference paper presentation or Research paper publication contains 4 credits with 8 hours per week workload (i.e. 1 Credit = Thirty hours in entire semester and no workload of teacher will be counted). The HoD will assign a mentor teacher to the student. The student will have to submit the paper including the participation certificate (in case of conference paper category), which will be evaluated by a board of two internal examiners (concern mentor and HoD).

Note: The allotment of an elective component reserve with the department, which depends upon the availability of faculty members, infrastructure and laboratory facility available to run the elective.

CBCS Paper Descriptions: In Second and Third semester, each student needs to adopt one course of 2 credit of his/her choice from Pool-A and Pool-B (as mentioned at the University website i.e. www.uok.ac.in), respectively so that their total credit of PG course becomes 100 (96+04). The students are also promoted by allowing to take the 02 credit courses from the Govt.'s National online Platform like SWAYAM, NPTEL (e.g MOOCs), etc. The evaluation from these agencies will be directly considered for the semester evaluation purpose of the student for second and third semesters of such 2 credit courses. After completing the course, the student needs to submit his/her credit certificate and Awards list to his/her department/college compulsorily before the last date of submit the examination form. The fee for such online portal courses will be paid by the student and will be other than to his/her prescribed examination/admission fee of the University for second and third semester examination/admission. The mode of evaluation of each 02 credit course under choice based category will be totally internal only. For the evaluation purpose, the student must have to submit a detailed project report/assignment of his/her 02 credit course to the concern college/department and it will be evaluated by concern college/department on the basis of such reports internally to assign the marks/grade. These marks/grade will be filled online on the university examination portal similarly as being done for the other internal marks filling for theory paper. The choice of such paper is subjected to the approval of the concern Principal/HoD i.e. the final decision of such allotment is subjected to the convenience or availability/suitability of the course at their College/Department.

Teaching Methodologies: The classroom teaching would be through conventional lectures or information and communication technologies (ICT). The lecture would be such that the student should participate actively in the discussion. Student seminars would be conducted and scientific discussions would be arranged to improve their communicative skills and subjective knowledge. In the laboratory, instructions would be given for the experiments followed by demonstration and finally the students have to do the experiments individually.

Attendance: Every teaching faculty handling a course shall be responsible for the maintenance of attendance Register for candidates who have registered for the course. Each student should earn 75% attendance in the courses of a particular semester failing which he or she will not be permitted to appear in the End-Semester Examinations. The attendance will be monitored by the concern Head of the Department/Principal of College or any competent authorities, as applicable. However, it shall be open to the authorities to grant exemption to a candidate who has failed to obtain the prescribed attendance for valid reasons.

Marks and workload Component: Maximum marks of a theory and practical paper shall be decided on the basis of their contact hours/credit per week. One teaching hour per week shall equal to one credit and carry 25 maximum marks (in case of theoretical course) and therefore, four teaching hours/paper per week shall carry 100 maximum marks for each theory paper/course. Each two contact hours per week for laboratory or practical work shall be equal to one credit per week and carry 25 maximum marks and therefore, sixteen/eight teaching hours per week shall carry 200/100 maximum marks for laboratory or practical work with 8/4 credits.

Scheme of Examinations: The examination shall be divided into two parts in which the first part is continuous assessment or internal assessment and the second part is end semester assessment or external assessment. The schemes for the internal and external examinations shall be as under:

a) The assessment of the student for theory paper shall be divided into two parts in which the first part is continuous assessment or internal assessment (30% of maximum marks) and the second part is semester assessment or external assessment (70% of maximum marks). For practical papers there will be only one external assessment (100% of maximum marks).

b) The internal assessment for each theory paper shall be taken by the teacher concerned in the Department during each semester. There will be two components of internal assessment; one by test having 20% weightage (20 marks) and another by Seminar / assignment / presentation / quiz / group discussion / viva-voce/ small projects/ scientific model/poster preparation/ Innovative Ideas/ Skill based demonstration / Industry oriented work / Field visits etc. of 10% weightage (10 marks), for theory paper in each semester. The internal assessment test shall be of one hour duration for each paper and shall be taken according to the academic calendar notified by the University / Departments. There will be no internal examination in the practical paper.

c) A student who remains absent (defaulter) or fails or wants to improve the marks in the internal assessment may be permitted to appear in the desired paper(s) (only one time) in the same semester with the permission of the concerned Head of the Department/Principal of College or any competent authorities. A defaulter/improvement fee of Rupees 250/- per paper shall be charged from such candidates. Duly forwarded application of such candidates by the teacher concerned shall be submitted to HOD or any competent authorities who may permit the candidate to appear in the internal

assessment after depositing the defaulter/ improvement fee. A record of such candidates shall be kept in the Department.

d) The end semester examination or external assessment shall be of three hours duration for each theory paper and six hours duration for practical paper. The practical examination shall be taken by the panel of at least one external and one internal examiner at the end of each semester, nominated by Controller of Examination, University of Kota, Kota.

e) Credits once earned will stand EARNED in the student's record and will be submitted to his/her **Academic Bank of Credits (ABC)** after declaration of result of each semester by Controller of Examination, University of Kota, Kota. ABC account of each student must be opened and each student has to submit his/her ABC ID details at the time of filling the examination form for the first semester.

f) The syllabus for each theory paper is divided into five independent units and each theory question paper will be divided into two sections as mentioned below:

- **Section-A** shall have 01 question comprising 10 parts taking two parts from each unit with no internal choice. Each question shall be of two marks and the total marks of this section will be 20 marks (10 x2). This section will be compulsory in the paper.
- **Section-B** There will be five long answer type questions and examiners are advised to set one question with internal choice (may have subdivisions) from each unit. The weight of each question of 10 marks hence the total weightage of the section is 50 marks (10 x5).

g) The pattern of question paper of internal and external shall be as follows:

<table>
<tr><td colspan="2">Continuous Assessment Weightage</td><td>End Semester Examination or External Assessment Weightage</td><td>Total Marks (Total credits)</td></tr>
<tr><td colspan="2">Regular Students</td><td rowspan="2">Paper based External Evaluation (End term examination)</td><td rowspan="2"></td></tr>
<tr><td>Mid-Term</td><td>Seminar / assignment / presentation / quiz / group discussion / viva-voce/ small projects/ scientific model/poster preparation/ Innovative Ideas/ Skill based demonstration / Industry oriented work / Field visits etc.</td></tr>
<tr><td>20</td><td>10</td><td>70</td><td>100 (04)</td></tr>
</table>

(A) Continuous or Internal Assessment: 30% weightage of Maximum Marks (30 Marks out of 100 Maximum Marks). The Mid term (20 marks) is taken as:

Mid Term (Internal Continuous Assessment) Test 20…….

Duration of Exam: 1.00 Hr **Max. Marks: 20**
Class: M.Sc. (Physics) **Semester:**
Subject: **No. of Students:** **Teacher:**

Note: The question paper contains three sections as under:
Section-A: One compulsory question with 04 parts. Please give short answers in maximum 50 words for each part.
Section-B: 03 questions to be attempted having answers approximately in 500 words with internal choice.

SECTION A

Q.1(a)		2
(b)		2
(c)		2
(d)		2
	SECTION B	
Q.2		4
	OR	
Q.3		4
	OR	
Q.4		4
	OR	

(B) Semester or External Assessment: 70% weightage (70 Marks out of 100 Max. Marks)

Duration of Examination: 3 Hours **Max. Marks: 70**

SECTION-A: 10x2=20
(Answer all questions)
(Two questions from each unit with no internal choice)
Q. No. 1
(i) ……..…… **2 Mark**
(ii) ……..…… **2 Mark**
(iii) ……..…… **2 Mark**
(iv)……..…… **2 Mark**
(v)……..…… **2 Mark**
(vi)……..…… **2 Mark**
(vii)……..…… **2 Mark**
(viii)……..…… **2 Mark**
(ix)……..…… **2 Mark**
(x)……..…… **2 Mark**

SECTION-B: 5x 10 =50
(Answer all questions)
(One question from each unit with internal choice)
(Maximum two sub-divisions only)

Q. No. 2. . …….....……

Or

…….....…….

10 Marks

Q. No. 3. …….....……

Or

…….....……...

10 Marks

Q. No. 4. …….....……

Or

…….....……...…… **10 Marks**

Q. No. 5. …….....……

Or

…….....……...

10 Marks

Q. No. 6. …….....

Or

…….....

10 Marks

Distribution of Marks for Practical Examinations:

Duration of Exam: 06 Hours **Maximum Marks: 200**

(a) For I/II/III Semester		
S. No.	**Name of Exercise**	**Marks**
1.	Exercise	**120**
2.	Viva-voce	**50**
3.	Practical Record	**30**
	Total Marks	**200**
(b) For IV Semester (Compulsory laboratory component)		
4.	Exercise	**60**
5.	Viva-voce (practical)	**25**
6.	Practical Record	**15**
7.	Industrial Component or Research Project or Instrument design of PG level or Innovative model or Book Review (University of Kota physics curriculum based book) or Conference paper presentation or Research paper publication course	**100**
	Total Marks	**200**

Rules regarding determination of results:

1. To Pass in a subject, a candidate is required to obtain at least 40% marks in theory and internal separately and 50% in practical examinations separately.
2. All Candidates will be automatically promoted from odd semester to even semester i.e. from I Semester to II Semester and III Semester to IV Semester irrespective of

their result as applicable.

3. Eligibility to promote from even Semester to odd Semester i.e. II to III Semester will be decided as per the results of both (first and second) semesters taken together.
4. A candidate who has failed in I year (I and II first and second together) but has passed 50% of Credits is eligible to promote in III Semester.
5. If a student secures full Credits in first year he/she will be promoted with the remarks"PASS" to second year.
6. If a student secures minimum 50% of total credits in the first year, he/she will be promoted with the remarks "BACK PROMOTED" in the second year (III semester).
7. Otherwise, the student will be "EX-STUDENT" or "N.C." as the case may be with the remark "FAIL"
8. If a candidate fails to clear any course(s)/paper(s) in odd/even semester in the first attempt, he/she is allowed to clear the back paper(s) in two more consecutive attempts in odd/even semester respectively (total maximum attempts allowed three or as per University of Kota, Kota rules)
9. (a) In case of Result declared as fail/Due in Theory papers, internal marks will be carry forwarded.
   (b) In case of fail/ Due in internal examination, the students needs to appear in internal and external examinations both in next attempt.
10. Candidate desiring scrutiny of the result and/or revaluation of their answer-books should apply as per prescribed procedure.
11. In case of any mistake being detected during the preparation of the marks sheet or brought to notice afterwards, the University will be fully empowered to correct the same. (Ord. 169H)
12. (*)Star shown against paper/subject denotes failure in that paper/subject.
13. (#)Hash shown against paper/subject denotes marks after Revaluation.
14. Other Rules and Regulation related to examination shall be applicable as per the Program/Syllabus.
15. Students are to appear in only those paper/subject in which He/She is failed even as a Ex-Student.
16. Grace Marks as per the Rules and Regulation of the university.
17. **For more details, please see the rules as prescribed by Examination Department of the University of Kota, Kota.**
18. GRADING AND PASSING RULES UNDER CHOICE BASED CREDIT SYSTEM (CBCS).

Letter Grade	Grade Points	Description	Range of Marks (%)
O	10	Outstanding	90-100
A+	9	Excellent	80-89,99
A	8	Very Good	70-79.99
B+	7	Good	60-69.99

B	6	Above Average	50-59.99
C	5	Average	45-49.99
P	4	Below Average/Pass	40-44.99
F	0	Fail	0-39.99
U	0	Unfair Means	--
W	0	Withdrawn	--
Ab	0	Absent	Absent

19. The calculation SGPA and CGPA will be calculated on the credit weighted average of the grade points obtained with letter grades countable in CGPA based on EoSE only.

$$SGPA = \sum_{i=1}^{n} C_i P_i / \sum_{i=1}^{n} C_i$$

Where C_i : Number of credits earned of the course in a semester;

P_i: Grade point earned by the student in the course.

CREDIT POINT : EARNED CREDIT x GRADE POINT

CGPA = $SGPA \sum_{i=1}^{n} C_i P_i / \sum_{i=1}^{n} C_i$ (of ALL Semesters for Cumulative Grade).

M.Sc. (Physics) Semester I

Course code : PHY1001T

Course Title : Mathematical Methods in Physics

Credit of Course : 4

Type of Course: Discipline Centric Core (DCC)

Qualification Level of the Course : NHEQF Level 6.5

Course Objective: The aim of the course is to develop the students's mathematical skills, required for various branches of physics. Such mathematical and numerical methods are complex variables & functions analysis, integral transforms (Fourier and Laplace), error and numerical analysis, differential equations, curve fitting, etc.

Learning Course Outcomes: This course will help the students in getting the fundamental and applied mathematical and numerical method's knowledge. The student will be capable of applying his/her knowledge in different branches of physics like quantum mechanics, condensed matter physics, etc. The students would be able to understand complex variables & functions analysis, integral transforms (Fourier and Laplace), error analysis, solutions of linear and differential equations, numerical integration and differentiation numerical analysis, curve fitting, linear vector spaces, eigen vectors and eigen value problems, etc.

Course Syllabus

Unit-I

Analytic function and the Cauchy-Riemann equations, Cauchy's integral theorem, Taylor's and Laurent series, Cauchy's residues theorem, singular points, poles, residues, evaluation of definite integrals

Unit-II

Fourier series, Fourier integral, Fourier Transform, Fourier sine and cosine transform, inversion formula for Fourier sine and cosine transforms, change of scale property, shifting theorem, multiple Convolution theorem, Fourier transform of the derivatives of a function.

Unit-III

Laplace transform, first and second shifting theorems, inverse Laplace transform-first and second shifting theorems, Laplace transform and inverse Laplace transform of derivative and integral of function, Convolution theorem

Unit-IV

Error Analysis, Computer Arithmetic, Linear ordinary differential equations, Second-order homogeneous and nonhomogeneous differential equations with constant and variable coefficients, Numerical Integration and Differentiation, Trapezoidal & Simpson's rule, Runga-Kutta method, Simultaneous and Higher order equations.

Unit-V

Bisection method, Newton-Raphson Method, Solution of Linear equations, Curve fitting, Least squares approximation, Linear Vector spaces, Eigen vectors and Eigen Value problems, Caley Hamilton theorem.

Text/Reference books:

1. Introduction to Mathematical Physics by Charlie Harper (PHI), 1972.
2. Applied Mathematics for Engineers and Physicists by Louis A. Pipes and Lawrence R. Harvill, (Third Edition, McGraw-Hill Book Company), 1970.
3. Advanced Engineering Mathematics by E Kreyszig (John-Wiley), 1983.
4. Mathematical Physics by Eygene Butkov (Addison-Wesley Publishing Company), 1968.
5. Mathematical Methods in Physics ByArfken and Weber, (Academic Press, 5th Ed.), 2001.
6. Complex Variables & Functions: Churechill, Brown, Varchy
7. Computer Based Numerical Algorithms: Krishnamurthy E.V., (East West Press)
8. Elementary Numerical Analysis: Conte de Boor.
9. Statistical Analysis: A Computer Oriented Approach: Affi A.A., Academic Press,
10. Introduction to Data Analysis and Statistical Inference : Morris C., Rolpn J., Prentice Hall, 1981.
11. Introduction to Numerical Analysis: Atkinson E., John Wiley 1978.
12. Elementary Computer Assisted Statistics: Scalzo F., Von Nostrand Reinhod Co. Ltd.
13. Essential Computer Mathematics : Seymour Lipshutz, Schaum's Outline Series, McGraw Hill.
14. Mathematical Physics, B.S. Rajput, Pragati Prakashan, Meerut.
15. Mathematical Physics, B.D. Gupta, Vikas Publishing House, Ghaziabad (U.P.).
16. Introductory Methods of Numerical Analysis: S.S.Sastry.

E-Resources:

17. https://math.libretexts.org/Bookshelves/Analysis/Complex_Variables_with_Applications_(Orloff)/02%3A_Analytic_Functions/2.06%3A_Cauchy-Riemann_Equations.
18. https://phys.libretexts.org/Bookshelves/Mathematical_Physics_and_Pedagogy/Complex_Methods_for_the_Sciences_(Chong)/09%3A_Contour_Integration/9.02%3A_Cauchy's_Integral_Theorem.
19. https://math.libretexts.org/Bookshelves/Analysis/Complex_Variables_with_Applications_(Orloff)/08%3A_Taylor_and_Laurent_Series/8.07%3A_Laurent_Series.
20. https://www.sciencedirect.com/topics/engineering/cauchys-residue-theorem.
21. https://www.youtube.com/watch?v=QDgVGmvA4GM.
22. https://www1.spms.ntu.edu.sg/~ydchong/teaching/10_fourier_transform.pdf.
23. https://math.libretexts.org/Bookshelves/Differential_Equations/Introduction_to_Partial_Differential_Equations_(Herman)/09%3A_Transform_Techniques_in_Physics/9.05%3A_Properties_of_the_Fourier_Transform.
24. https://math.libretexts.org/Bookshelves/Differential_Equations/Differential_Equations_for_Engineers_(Lebl)/6%3A_The_Laplace_Transform/6.1%3A_The_Laplace_Transform.
25. https://math.libretexts.org/Bookshelves/Differential_Equations/Differential_Equations_for_Engineers_(Lebl)/6%3A_The_Laplace_Transform/6.2%3A_Transforms_of_derivatives_and_ODEs.
26. https://www.studocu.com/row/document/federal-university-of-petroleum-resources-effurun/engineering-maths/error-analysis-and-computer-arithmetic-errors-in-computation-cs-101/130158728.
27. https://www.mathcentre.ac.uk/resources/uploaded/mccp-richard-2.pdf.

28. https://math.libretexts.org/Courses/Mount_Royal_University/Calculus_for_Scientists_II/2%3A_Techniques_of_Integration/2.5%3A_Numerical_Integration_-_Midpoint%2C_Trapezoid%2C_Simpson's_rule.
29. https://www.sciencedirect.com/topics/mathematics/runge-kutta-method.
30. https://www.geeksforgeeks.org/engineering-mathematics/difference-between-bisection-method-and-newton-raphson-method/.
31. https://pubs.acs.org/doi/10.1021/acs.jchemed.8b00649.
32. https://open.umn.edu/opentextbooks/textbooks/linear-transformations-on-vector-spaces.
33. https://www.slideshare.net/slideshow/cayleyhamilton-theorem-eigenvalues-eigenvectors-and-eigenspace/244676275.

Course Code : PHY1002T

Course Title : Classical Mechanics

Credit of Course : 4

Type of Course: Discipline Centric Core (DCC)

Qualification Level of the Course : NHEQF Level 6.5

Course Objective: The aim of the course is to develop the students's advanced methods of mechanics, required for various branches of physics. Such methods are essential in advanced level physics.

Learning Course Outcomes: This course will help the students in getting the fundamental and applied knowledge of various fields of advanced mechanics. The student will be capable of applying his/her knowledge in different branches of physics like quantum mechanics, applied optics, etc. The students would be able to understand degree of freedom, generalised coordinates, Lagrangian and Hamiltonian dynamics, small oscillations analysis, Canonical transformation, planar and spatial motion of a rigid body, special theory of relativity, etc

Course Syllabus

Unit-I

Principle of Least Action, Lagrange's equation and its applications, Generalized, coordinates, Lagrangian of a system of particles, Symmetry and Conservation laws, Central field problems, Scattering cross-section, Rutherford Formula, Laboratory and CM Frame, two body problem, Kepler problem, Generalized momentum, Legendre transformation.

Unit-II

Small oscillations, normal coordinates and its applications, Orthgonal transformation, Coupled Oscillators, Free forced and parametric oscillations, Damped Oscillations, Forced oscillations under friction, Vibrations of molecules.

Unit-III

Hamiltonian, Hamilton's Canonical equations, Canonical transformations, Hamilton's variational principle, Derivation of Lagrange's and Hamiltonian, Method of Lagrange's multipliers. Canonical transformation, integral in variants of poincare: Lagrange's and Poisson brackets as canonical invariants, Equation of motion in Poisson bracket formulation, Infinitesimal contact transformation and generators of symmetry, Liouville's theorem,

Unit-IV

Hamilton-Jacobi equation and its applications, Action angle, variable adiabatic invariance of action variable : The Kepler problem in action angle variables, Eulerian angles, Euler theorem, Eigen values of the inertia tensor, Euler equations, Force free motion of a rigid body, Rigid body dynamics- moment of inertia tensor, non-inertial force, Psuedo Force, Coriolis Force, Holonomic and nonholonomic constraints, D-Alembert's Principle, Extension of Hamilton's Principle for nonconservative and nonholonomic systems.

Unit-V

Special theory of relativity- Lorentz transformations, Four Vector Formulation, Lagrangianand Hamiltonian of a charged particle in presence of EM Fields, Field transformations, relativistic kinematics and mass–energy equivalence, stress tensor, energy momentum tensor, relative motion of charged particle in EM fields.

Text/Reference books:

1. Mechanics by Landau & Lifshitz
2. **Classical Mechanics, H. Goldstein, C. P. Poole and J. Safko, Classical Mechanics, 3rd Edition, Pearson (2018).**
3. Mechanics by A Sommerfeld (Academic Press), 1952.
4. Classical Mechanics by Puranic, Tata Mc Graw Hill.
5. Classical Mechanics: A.K. Ray Chaudhary.
6. Classical Mechanics, P.S. Joag and N.C. Rana, 1st Edition, McGraw Hill (2010).
7. Classical Mechanics, J.C. Upadhyaya, Himalaya Publishing House, New Delhi (1999).
8. Classical Mechanics, B.D. Gupta and Satya Prakash, Keder Nath Publishers, Meerut, Revised Edition (2015).

E-Resources:

9. https://www.sicyon.com/resources/library/physics/LagrMechanics.pdf
10. https://commons.library.stonybrook.edu/cgi/viewcontent.cgi?params=/context/egp/article/1003/&path_info=CM_merged.pdf.
11. https://egyankosh.ac.in/bitstream/123456789/99213/1/Unit-8.pdf.
12. https://phys.libretexts.org/Courses/University_of_California_Davis/UCD%3A_Physics_9HA__Classical_Mechanics/8%3A_Small_Oscillations/8.4%3A_Coupled_Oscillators_and_Normal_Modes.
13. https://phys.libretexts.org/Bookshelves/Classical_Mechanics/Variational_Principles_in_Classical_Mechanics_(Cline)/15%3A_Advanced_Hamiltonian_Mechanics/15.03%3A_Canonical_Transformations_in_Hamiltonian_Mechanics.
14. https://www.lehman.edu/faculty/dgaranin/Mechanics/Hamiltonian_mechanics.pdf.
15. https://galaxiesbook.org/chapters/I-02.-Elements-of-Classical-Mechanics_4-Hamiltonian-mechanics.html.

16. https://ebooks.inflibnet.ac.in/phyp01/chapter/hamilton-jacobi-equation-action-angle-variables/.
17. https://egyankosh.ac.in/bitstream/123456789/104617/1/Unit-9.pdf.
18. https://toc.library.ethz.ch/objects/pdf03/e01_978-81-322-2079-4_01.pdf

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Course code : PHY1003T

Course Title : Quantum Mechanics

Credit of Course : 4

Type of Course: Discipline Centric Core (DCC)

Qualification Level of the Course : NHEQF Level 6.5

Course Objective: The aim of the course is to impart the knowledge of foundations of quantum mechanics including its need and justifications, required for the analysis of various branches of physics.

Learning Course Outcomes: This course will help the students in getting the fundamental and applied knowledge of quantum mechanics. The student will be capable of applying his/her knowledge in different branches of physics. The students would be able to understand the concepts of quantum mechanical system of quantum mechanics, operators of expectation values of physical quantities, uncertainty relations, Schrodinger equation's needs and applications, perturbation theory, Pauli matrices, symmetry transformation and conservation laws, tensor operators, etc.

Course Syllabus

Unit-I

Superposition of amplitudes, States of a quantum mechanical system, representation of quantum mechanical states, properties of quantum mechanical amplitude, operators and change of state, postulates, essential definitions and commutation relations, quantum conditions and uncertainty relation, Co-ordinate and momentum representation of operators& position, momentum and angular momentum, invariance under space and time translations and space rotation, time dependence of expectation values.

Unit-II

Schrodinger equation, Simple Harmonic Oscillator, central field problem-hydrogen atom, Energy quantization, Variational technique, application to Hydrogen and Helium atom, WKB method for one dimensional problem, application to bound states (Bohr-Sommerfeld quantization) and the barrier penetration -alpha decay.

Unit-III

Hamiltonian matrix and the time evolution of Quantum mechanical States: Hermiticity of the Hamiltonian matrix, Time independent perturbation of an arbitrary system, simple matrix

examples of time independent perturbation, energy states of a two state system, Ammonia molecule as an example of two state system diagonalizing of energy matrix, Pauli matrices.

Unit-IV

Time dependent Perturbation: Transitions in a two state system, The Fermi Golden rule, Adiabatic and Sudden Perturbation,phase space, emission and absorption of radiation, induced dipole transition and Spontaneous emission of radiation, energy width of a quasi stationary state.

Unit-V

Compatible observables and constants of motion, symmetry transformation and conservation laws, invariance under space and time translations and space rotation, Angular momentum operators and their Eigen values, matrix representations of the angular momentum operators and their Eigen states, composition of angular momentum, Clebsch-Gordon coefficients tensor operators and Wigner Eckart theorem, Selection Rules.

Text/Reference books:

1. Quantum Mechanics by L I Schiff (Mcgraw-Hill), III ed., 1968
2. Quantum Mechanics Theory and Applications by A. K. Ghatak and S. Lokanathan (Third Edition, 1997, Mcmillan India Limited)
3. Quantum Mechanics: A modern approach by Ashok Das and A.C. Milissionos (Gordan and Breach Science Publishers),1992.
4. Quantum Mechanics An Introduction by Walter Grenier (Third ed., 1994, Springer)
5. Modern Quantum Mechanics by J.J. Sakurai (Addison-Wesley, 1999)
6. Quantum Physics (atoms, molecules…) R. Eisberg and R. Resnick (J. Wiley), 2005.
7. Quantum Mechanics by P. A. M Dirac
8. Quantum Mechanics by Merzbekar
9. Quantum Mechanics by N.Zettili (Wiley Publication).
10. Quantum Mechanics: Non relativistic theory: L.D. Landau & E. M. Lifshitz
11. Quantum Mechanics: Thankapann (New Age International publication).
12. Quantum Mechanics, V.K. Thankappan, Wiley Eastern Ltd. (1986).

E-Resources:

13. https://www.lancaster.ac.uk/staff/schomeru/lecturenotes/Quantum%20Mechanics%20Lecture%20Notes.pdf.
14. https://www2.ph.ed.ac.uk/~ldeldebb/docs/QM/lect1.pdf.
15. https://chem.libretexts.org/Courses/University_of_California_Davis/Chem_107B%3A_Physical_Chemistry_for_Life_Scientists/Chapters/4%3A_Quantum_Theory/4.10%3A_The_Schr%C3%B6dinger_Wave_Equation_for_the_Hydrogen_Atom.
16. https://www.tcm.phy.cam.ac.uk/~bds10/aqp/lec10.pdf.
17. https://www.feynmanlectures.caltech.edu/III_08.html.
18. https://courses.cit.cornell.edu/mse5470/2015_ece4070_mse5470_primernotes_perturbation_bandstructure_dj.pdf.
19. https://ocw.mit.edu/courses/8-06-quantum-physics-iii-spring-2018/89ef6d5958ee59bae9a91345 3d8c8e4_ MIT8_06S18ch4.pdf.

20. http://elearn.psgcas.ac.in/nptel/courses/video/115103104/lec28.pdf.
21. https://www.physics.udel.edu/~jim/PHYS425_20S/Class%20Notes/Notes_21.pdf.
22. https://homepages.iitb.ac.in/~shukla/qmech2_chap1.pdf.
23. http://www.doylegroup.harvard.edu/edm//amo2013/files/Selection-rules-and-Wigner-Eckhart-and-Tensor-Operators.pdf.

Course code : PHY1004T

Course Title : Classical Electrodynamics-I

Credit of Course : 4

Type of Course: Discipline Centric Core (DCC)

Qualification Level of the Course : NHEQF Level 6.5

Course Objective: The aim of the course is to develop the concepts and formulations of the classical electrodynamics and introduce basic mathematical concepts related to electromagnetic vector fields.

Learning Course Outcomes: This course will impart the knowledge of basic principles of classical electrostatics. The students would be able to understand the concepts of mathematical methods related to electromagnetic vector fields, Boundary Value Problems in Electrostatics, Electrostatics of Macroscopic Media Dielectrics, Magnetostatics principles, Maxwell's equations and Conservation Laws, Green function analysis, etc.

Course Syllabus

Unit-I

Electrostatics: Electric field, Gauss law, Differential form of Gauss law, curl of electric field, the scalar potential, surface distribution of charges and dipoles and discontinuities in the electric field and potential, Poisson and Laplace equations, Green's Theorem, Uniqueness of the solution with Dirichlet or Neumann Boundary conditions, Formal so1ution of Electrostatic Boundary value problem with Green's Function, Electrostatic potential energy and energy density, capacitance.

Unit-II

Boundary Value Problems in Electrostatics: Methods of Images, Point charge in the presence of a grounded conducting sphere point charge in the presence of a charge insulated conducting sphere, Point charge near a conducting sphere at fixed potential, conducting sphere in a uniform electric field by method of images. Green function for the sphere, General solution for the potential, Conducting sphere with Hemispheres at different potential, orthogonal functions and expansion**.**

Unit-III

Multipoles, Electrostatics of Macroscopic Media Dielectrics: Multiple expansion, multipole expansion of the energy of a charge distribution in an external field, Elementary treatment of electrostatics with permeable media, Boundary value problems with dielectrics, Molar polarizability, and electric susceptibility, Models for molecular polarizability, Electrostatic energy in dielectric media

Unit-IV

Magnetostatics: Introduction and definition, Biot& Savart's law, the differential equation of magnetostatics and Ampere's law, Vector potential and Magnetic induction for a circular current loop, Magnetic fields of a localized current distribution, Magnetic moment, Force and torque on and energy of a localized current distribution in an external magnetic induction, Macroscopic equations, Boundary conditions on B and H, Methods of solving Boundary-value problems in magnetostatics, Uniformly magnetized sphere, Magnetized sphere in an external field, Permanent magnets, Magnetic shielding, spherical shell of permeable material in an uniform field.

Unit-V

Time varying fields, Maxwell's equations and Conservation Laws: Energy in a magnetic field, Vector and Scalar potentials, Gauge transformations, Lorentz gauge, Coulomb gauge, Green functions for the wave equation, Derivation of the equations of Macroscopic Electromagnetism, Poynting's theorem and conservations of energy and momentum for a system of charged particles and EM fields, Conservation laws for macroscopic media, Electromagnetic field tensor, Transformation of four potentials and four currents, Tensor description of Maxwell's equation.

Text/Reference books:

1. Classical clectrodynamics by J.D. Jackson, (John Wiley & Sons), II Ed., 1975.
2. Classical Electricity and Magnetism by Panofsky & Philips, (Indian Book, New Delhi), 1962.
3. Introduction to Electrodynamics by Griffiths, (Pearson Education), 2005.
4. Classical theory of fields by Landau &Lifshitz, (Pergaman Press, New York), 1960.
5. Electrodynamics of Continuous Media by Landau & Lifshitz, (Pergaman Press New York), 1960.
6. Elements of Electromagnetics by Mathew N.O. Sadiku, (Oxford Univ. Press), II ed., 1999.
7. Principles and applications of electromagnetic fields by P & C – Robert Plonsey and R.E Collins, McGraw Hill (1961).
8. Electromagnetic Waves and Radiating Systems by E. C. Jordan and K. G. Balmain, 2nd Edition, Pearson (1968).

E-Resources:

7. https://engineering.purdue.edu/wcchew/ece604s23/EMFTEDX020823R.pdf.
8. https://sites.astro.caltech.edu/~golwala/ph106bc/ph106bc_notes_2023.pdf.
9. https://www.phys.lsu.edu/~jarrell/COURSES/ELECTRODYNAMICS/Chap2/chap2.pdf.
10. https://galileoandeinstein.phys.virginia.edu/Elec_Mag/2022_Lectures/EM_20_Spherical_Greens_Function.html.
11. http://www.phys.nthu.edu.tw/~thschang/notes/ED05.pdf.

12. https://physics.uwo.ca/~mhoude2/courses/PDF%20files/astro9620/Ch3-Magnetostatics.pdf
13. https://www.phys.lsu.edu/~jarrell/COURSES/ELECTRODYNAMICS/Chap4/chap4.pdf.
14. http://www.phys.nthu.edu.tw/~thschang/notes/ED04.pdf.
15. https://www.phys.lsu.edu/~jarrell/COURSES/ELECTRODYNAMICS/Chap6/chap6.pdf.
16. https://physicspages.com/pdf/Relativity/Electromagnetic%20field%20tensor%20-%20four- potential.pdf.

Course code : PHY1005P

Course Title : Physics Laboratory-I

Credit of Course : 8

Type of Course: Discipline Centric Core (DCC)

Qualification Level of the Course : NHEQF Level 6.5

Course Objective: The aim of the course is to develop the practical skills by giving the hands on experiences about various experiments.

Learning Course Outcomes: This course will help the students in practical exposure to the physics experiments. The students would be able to perform, record and analyse the experimental results, understand basic concepts of physics and process, estimate the error and bounds on the experiments, deduce the experimental results using graphs and tables, extend the scope if the outcomes are not as per expectations, collaboratively handling the equipments, understand the importance of the good and rich data, applied part of the experimental scope, etc.

List of Experiments

1. To study the potential energy curve for end on magnetic interaction.
2. To study the Fourier analysis of sinusoidal, square and triangular wave.
3. To study (a) the excitations of normal modes and frequency splitting measurements using coupled oscillator and (b) the frequency of energy transfer as a function of coupling strength using coupled oscillator.
4. To study the dispersion curve for a beaded string to calculate the average mass per unit length of the beaded string and to find out cutoff frequency.
5. Study of Double stage R.C. Coupled amplifier for: (i). Frequency response (ii) the amplitude characteristics.
6. To study the waveform characteristics of multivibrators (Astable, Mono-stable and Bi-stable) and determine its frequency by varying R.
7. To study a various types of Oscillators (like Hartley etc.).

8. To study frequency response of Low pass filter, Band pass filter, High pass filter and Band elimination.
9. Study of clipping and clamping circuit.
10. Study of operational amplifier circuits.
11. Study of Lissajous figure using C. R. O.
12. Verify the various theorems of Boolean algebra.
13. Verify the D'morgans theorem.
14. Implement the Boolean expression and verify the truth table.
15. Study the various combinational circuits-Half Adder, Half subtractor, Full Adder, Full subtractor, Parity Generator, Parity Checker.
16. Study the advanced combination circuits-Multiplexer, Demultiplexer, Encoder, Decoder.
17. Study the various code converters & verify the truth table-Binary to BCD converter, Binary to Gray codes and Binary to EX-3.
18. Study the weighted code converter.
19. Study the flip flops and verify the truth table-R-S,D,J-K, T and Master slave.
20. Study the various registers using flip-flop-Serial in Serial out, Serial in Parallel out, Parallel in Parallel out, Parallel in Serial out
21. Study the various synchronous counters using flip-flop-Binary up, Binary down, Mod-10
22. Study the various asynchronous counters using flip flop- Binary up, Binary down.
23. Study the special counters-Ring counter and Twisted ring counter (Johnson counter).
24. To study the A/D & D/A converters also calculate resolution & error percentage in observation.
25. To study the behavior of V I characteristics of UJT.
26. To study the output and transfer characteristics of a FET.
27. To measure the input and output characteristics of BJT.
28. To draw the V-I characteristics of a DIAC / TRIAC / SCR / Optocoupler.
29. To study and plot the characteristics of Photo-Diode.
30. Any other experiments of the equivalent standard can be set.

Text/References:

1. Lab and component manuals.
2. Advanced Practical Physics Vol. I and II by S.P. Singh, Pragati Prakashan, Meerut.
3. Hand book of Electronics, Gupta and Kumar, Pragati Prakashan, Meerut.
4. Digital Logic and Computer design by Morris Mano, PHI, New Delhi.

E-Resources:

1. https://www.omegaelectronics.net/pro-category/physics-laboratory-experimental-set-ups-es.
2. https://www.electronics-tutorials.ws.
3. https://www.electronics-notes.com/articles/basic_concepts/.