E.M.G. YADAVA WOMEN'S COLLEGE, MADURAI – 625 014.

(*An Autonomous Institution – Affiliated to Madurai Kamaraj University*)

Re-accredited **(3rd Cycle)** with Grade **A+** & **CGPA 3.51** by NAAC

DEPARTMENT OF PHYSICS

CBCS with OBE

MASTER OF SCIENCE

PROGRAMME CODE - OPP

COURSE STRUCTURE

(w.e.f. 2022 – 2023 Batch onwards)

CRITERION - I

1.2.2 Details of Programmes offered through Choice Based Credit System (CBCS) / Elective Course System

Syllabus copies with highlights of contents focusing on Elective Course System

To be Noted:

HIGHLIGHTED	COURSE
	Elective

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E.M.G. YADAVA WOMEN'S COLLEGE, MADURAI -14.

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CBCS AND OBE
DEPARTMENT OF PHYSICS- PG
(w.e.f.2022-2023 Batch onwards)

VISION

To enhance the knowledge of physics in teaching and research through holistic education

MISSION

- ✓ Imparting quality education both in theoretical as well as experimental physics
- ✓ Providing students with rigorous and comprehensive courses that allow them to perform at a high level
- ✓ Striving for excellence in performance based teaching and research

Programme Educational Objectives(PEOs)
M.Sc.,

S.No	On completion of the programme ,the student will be able to
PEO1	To Specialize knowledge and expertise to identify formulate, analyze and implement on the problems.
PEO2	To pursue higher studies in related fields of physics
PEO3	To enhance leadership quality to handle all kind of circumstances in diverse interdisciplinary learning environment
PEO4	To achieve successful employability in private/Government institutions or as on entrepreneur
PEO5	To inculcate the sense of ethics and effective communication skills

Programme Outcomes (POs) with Graduate Attributes

S.No	Graduate Attributes	On completion of the programme ,the student will be able to
PO1	Knowledge base	Exploration of knowledge and skills in their respective disciplines
PO2	Problem Analysis and Investigation	Acquire knowledge to analyze and solve problems to their respective field
PO3	Communication skills and design	Ability to carry out advance tasks and project successfully
PO4	Individual and Team work	Adequate project training, research activities in relevant skill sector and creating employable abilities
PO5	Professionalism, Ethics and Equality	Developing socio economic ethics executing their actions in all their decisions
PO6	Life long learning	Lifelong independent and reflective learning skills in their career.

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Programme Specific Outcomes (PSOs) with Graduate Attributes

S.No	Graduate Attributes	On completion of the programme ,the student will be able to
PSO1	Knowledge base	Develop experimental and data analysis skills through laboratory experiments
PSO2	Problem Analysis and Investigation	Recognize the importance of mathematical approaches and computing to describe the concept of physics
PSO3	Communication skills and design	Acquire subject knowledge and caliber sought by industry and education field
PSO4	Individual and Team work	Perform independent and group activities of projects to experience the aspects of research and to develop their presentation
PSO5	Professionalism, Ethics and Equality	Applying professional ethics contributing society to develop equity
PSO6	Life long learning	Recognizing the need and life long learning to solve real life problems

Eligibility for Admission : Pass in B.Sc., Physics

Duration of the Course
The students shall undergo prescribed courses of study for the period of two academic years under CBCS semester pattern with Outcome Based Education.

Medium of Instruction: English

System: Choice Based Credit System with Outcome Based Education

Courses of Study with Credit Distribution

Category	No. of Courses	No. of Credits
Core	16	64
Discipline Specific Elective course	4	16
Inter Disciplinary Course	2	4
Project	1	6
Total	**23**	**90**

Nature of the Course
Courses are classified according to the following nature
1. Knowledge & Skill
2. Employability Oriented

3. Entrepreneurship Oriented

Outcome Based Education (OBE) & Assessment

Students understanding must be built on and assessed for wide range of learning activities, which includes different approaches and are classified along several bases, such as

1. **Based on purpose:**

- ✓ Formative (Internal tests, Assignment, Seminar, Quiz, Documentation, Case lets, ICT based Assignment, Mini Projects administered during the learning process)

- ✓ Summative (Evaluation of students learning at the end of instructional unit)

2. **Based on Domain knowledge: (Post Graduate Up to K5 Levels)**

Assessment through K1, K2,K3 , K4 &K5

Evaluation

Continuous Internal Assessment Test (CIA) : **25 marks**

Summative (External) : **75 marks**

Total : **100 marks**

CIA-Continuous Internal Assessment : 25 Marks

Components	Marks
Test (Average of three tests) (Conduct for 150 marks and converted into 15 marks)	15
Assignment	5
Seminar	5
Total	**25**

- ✓ Centralized system of Internal Assessment Tests
- ✓ There will be a three Internal Assessment Tests
- ✓ Duration of Internal Assessment Test will be 1 ¼ hours for Test I and 2 ½ hours for Test II and Test III
- ✓ Students shall write retest on the genuine grounds if they are absent in either Test I or Test II and Test III with the approval of Head of the department.

Question Paper Pattern for Continuous Internal Assessment Test I

Section	Marks
A – Multiple Choice Question (4x1 mark)	4
B– Short Answer (3x2 marks)	6
C – Either Or type (2/4 x 5 marks)	10
D – Open Choice type (1/2 x10 Marks)	10
Total	**30**

Question Paper Pattern for Continuous Internal Assessment Test II and Test III

Section	Marks
A – Multiple Choice Question (8x1Mark)	8
B – Short Answer (6 x 2 marks)	12
C – Either Or type (4/8 x 5 marks)	20
D – Open Choice type (2/4 x 10 Marks)	20
Total	**60**

Question Paper Pattern for Summative Examination

Section	Marks
A – Multiple Choice Questions (10x1mark)	10
B – Short Answer Questions without choice (5 x 2 Marks)	10
C – Either or type (5 X 5marks)	25
D – Open Choice type(3 out of 5 X 10 Marks)	30
Total	**75**

In respect of summative examinations passing minimum is 45% for post graduate and in total, aggregate of 50%.

Latest Amendments and Revisions as per UGC and TANSCHE Norms is taken into considerations in Curriculum preparation.

EVALUATION (PRACTICAL) -For core and Generic Elective course

Internal (Formative) : 40 marks
External (Summative) : 60 marks
Total :100 marks

Question Paper Pattern for Internal Practical Examination: 40 Marks

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S.No	Components	Marks
1	Model test - I	10
2	Model test - II	10
3	Observation note	10
4	Record book	10
	Total	**40**

Question Paper Pattern for External Practical Examination (Major): 60 Marks

S.No	Components	Marks
1	Experimental Procedure	20
2	Readings	20
3	Calculation	15
4	Result	5
	Total	**60**

Question Paper Pattern for External Practical Examination (Major): 60 Marks

In respect of external examinations passing minimum is 35% for Post Graduate Courses and in total, aggregate of 40%.

Latest amendments and revisions as per **UGC** and **TANSCHE** norm is taken into consideration to suit the changing trends in the curriculum.

Distribution of Marks in % with K levels CIAI, II, III & External Assessment

Blooms Taxonomy	Internal Assessment			External Assessment
	I	II	III	
Knowledge(K1)	8%	8%	8%	5%
Understanding(K2)	28%	12%	8%	14%
Apply(K3)	44%	40%	24%	27%
Analyze(K4)	20%	40%	40%	27%
Evaluate(K5)	-	-	20%	27%

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BLUE PRINT FOR INTERNAL ASSESSMENT - I
Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C	Section D	Total
			MCQs (No Choice)		Short Answers (No Choice)		(Either or Type)	(Open Choice)	
			No. of Questions	K-Level	No. of Questions	K-Level			
1	CLO 1	Up to K 4	2 2	K1 K2	1 1 1	K1 K2 K3	2 (K2) 2(K3) (Each set of questions mustbe in the same level)	1(K3) 1(K4)	
No. of Questions to be asked			4		3		4	2	13
No. of Questions to be answered			4		3		2	1	10
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		20	20	50

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BLUE PRINT FOR INTERNAL ASSESSMENT – II
Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl. No	CLOs	K- Level	Section A		Section B		Section C	Section D	Total
			MCQs (No Choice)		Short Answers (No Choice)		(Either or Type)	(Open Choice)	
			No. of Questions	K- Level	No. of Questions	K- Level			
1	CLO 2	Up to K 4	2 2	K1 K2	1 2	K1 K2	2(K3) 2(K4)	1(K3) 1(K4)	
2	CLO 3	Up to K 4	2 2	K1 K2	1 2	K1 K2	2(K3) 2(K4) (Each set of questions must be inthe same level)	1(K3) 1(K4)	
No. of Questions to be asked			8		6		8	4	26
No. of Questions to be answered			8		6		4	2	20
Marks for each question			1		2		5	10	
Total Marks for each section			8		12		40	40	100

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BLUE PRINT FOR INTERNAL ASSESSMENT – III
Articulation Mapping - K Levels with Course Learning Outcomes (CLOs)

Sl.No	CLOs	K- Level	Section A MCQs (No Choice)		Section B Short Answers (No Choice)		Section C (Either or Type)	Section D (Open Choice)	Total
			No. of Questions	K- Level	No. of Questions	K- Level			
1	CLO 4	Up to K5	2 2	K1 K2	1 1 1	K1 K2 K3	2(K3) 2(K4)	1(K4) 1(K5)	
2	CLO 5	Up to K5	2 2	K1 K2	1 1 1	K1 K2 K3	2(K3) 2(K4) (Each set of questions must be inthe same level)	1(K4) 1(K5)	
No. of Questions tobe asked			8		6		8	4	26
No. of Questions tobe answered			8		6		4	2	20
Marks for each question			1		2		5	10	
Total Marks for each section			8		12		40	40	100

Distribution of Marks with K Levels CIA I, CIA II and CIA III

CIA	K Levels	Section- A MCQ (No choice)	Section -B Short Answer (No choice)	Section- C (Either or Type)	Section-D (Open Choice)	Total Marks	% of Marks
I	K1	2	2			4	**8**
	K2	2	2	10	-	14	**28**
	K3		2	10	10	22	**44**
	K4				10	10	**20**
	Marks	**4**	**6**	**20**	**20**	**50**	**100**
II	K1	4	4			8	**8**
	K2	4	8			12	**12**
	K3			20	20	40	**40**
	K4			20	20	40	**40**
	Marks	**8**	**12**	**40**	**40**	**100**	**100**
III	K1	4	4			8	**8**
	K2	4	4			8	**8**
	K3		4	20		24	**24**
	K4			20	20	40	**40**
	K5				20	20	**20**
	Marks	**8**	**12**	**40**	**40**	**100**	**100**

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Articulation Mapping - K Levels with Course Learning Outcomes (CLOs) for Internal Assessment (IDC)

Sl. No	CLOs	K- Level	Section A		Section B		Section C	Section D	Totall
			MCQs (No choice)		Short Answers (No choice)		(Either/or Type)	(open choice)	
			No. of Questions	K-Level	No. of Questions	K-Level			
1	CLO 1	Up to K4	2	K1			2(K3&K3) 2(K3&K3 2 (K4&K4) 2 (K5&K5)	1(K3)	
2	CLO 2	Up to K4	2	K1				1(K4)	
3	CLO 3	Up to K4			2	K2		1(K4)	
4	CLO 4	Up to K5			2	K2		1(K5)	
5	CLO 5	Up to K5			2	K2		1(K5)	
No. of Questions to be asked			4		3		8	5	20
No. of Questions to be answered			4		3		4	2	13
Marks for each question			1		2		5	10	
Total Marks for each section			4		6		20	20	50 (Marks)

Distribution of Section-wise Marks with K Levels for Internal Assessment (IDC)

K Levels	Section A (MCQ'S) (No choice)	Section B (Short Answer) (No choice)	Section C (Either or Type)	Section D (Open Choice)	Total Marks	% of Marks
K1	4				**4**	**4**
K2		6			**6**	**6**
K3			20	10	**30**	**30**
K4			10	20	**30**	**30**
K5			10	20	**30**	**30**
Total Marks	**4**	**6**	**40**	**50**	**100**	

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Articulation Mapping - K Levels with Course Learning Outcomes (CLOs) for External Assessment

Sl. No	CLOs	K- Level	Section A		Section B		Section C	Section D	Total
			MCQs (No choice)		Short Answers (No choice)		(Either/or Type)	(open choice)	
			No. of Questions	K-Level	No. of Questions	K-Level			
1	CLO 1	Up to K4	2	K1&K2	1	K1	2 (K2& K2)	1(K3)	
2	CLO 2	Up to K4	2	K1&K2	1	K2	2(K3& K3)	1(K4)	
3	CLO 3	Up to K4	2	K1&K2	1	K3	2 (K3 &K3)	1(K4)	
4	CLO 4	Up to K5	2	K1&K2	1	K4	2 (K4 & K4)	1(K5)	
5	CLO 5	Up to K5	2	K1&K2	1	K5	2 (K5 & K5)	1(K5)	
No. of Questions to beasked			10		5		10	5	30
No. of Questions to beanswered			10		5		5	3	23
Marks for each question			1		2		5	10	
Total Marks for each section			10		10		25	30	75 (Marks)

Distribution of Section-wise Marks with K Levels for External Assessment

K Levels	Section A (MCQ'S) (No choice)	Section B (Short Answer) (No choice)	Section C (Either or Type)	Section D (Open Choice)	Total Marks	% of Marks
K1	5	2	-	-	**7**	**5**
K2	5	2	10	-	**17**	**14**
K3	-	2	20	10	**32**	**27**
K4	-	2	10	20	**32**	**27**
K5	-	2	10	20	**32**	**27**
Total Marks	**10**	**10**	**50**	**50**	**120**	**100**

K1- Remembering and recalling facts with specific answers.

K2- Basic understanding of facts and stating main ideas with general answers.

K3- Application oriented- Solving Problems, Justifying the statement and derivingInferences.

K4- Examining, analyzing, presentation and make inferences with evidences.

K5- Evaluating, making Judgments based on criteria

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CBCS AND OBE

DEPARTMENT OF PHYSICS- PG

M.Sc PHYSICS

(w.e.f.2022-2023 Batch onwards)

COURSE STRUCTURE-SEMESTER WISE

Sem	Category	Course Code	Course Title	Teaching hrs(Per week)	Exam duration (hrs)	Marks allotted			Credits
						C.A	S.E	Total	
I	**CORE**	22OPPH11	Mathematical Physics-I	5	3	25	75	100	4
	CORE	22OPPH12	Classical Mechanics	5	3	25	75	100	4
	CORE	22OPPH13	Advanced Electronics	5	3	25	75	100	4
	CORE		*General Physics Practical-I	4	-	-	-	-	
	CORE		*Electronics Practical-I	4	-	-	-	-	
	DSEC		**DSEC -I**	5	3	25	75	100	4
	IDC	22OPPHID1	Renewable Energy Resources	2	3	25	75	100	2
II	**CORE**	22OPPH21	Mathematical Physics – II	5	3	25	75	100	4
	CORE	22OPPH22	Thermodynamics & Statistical Mechanics	5	3	25	75	100	4
	CORE	22OPPH23	Electromagnetic theory	5	3	25	75	100	4
	CORE	22OPPH21P	*General Physics Practical-I	4	4	40	60	100	4
	CORE	22OPPH22P	*Electronics Practical-I	4	4	40	60	100	4
	DSEC		**DSEC -II**	5	3	25	75	100	4
	IDC	22OPPHID2	Astronomy and Astrophysics	2	3	25	75	100	2
	CORE	22OPPH31	Solid State Physics - I	6	3	25	75	100	4

III	**CORE**	22OPPH32	Quantum Mechanics-I	6	3	25	75	100	4
	CORE	22OPPH33	Nuclear Physics	5	3	25	75	100	4
	CORE		* General Physics Practical-II	4	-	-	-	-	-
	CORE		*Electronics Practical -II	4	-	-	-	-	-
	DSEC		**DSEC -III**	5	3	25	75	100	4
IV	**CORE**	22OPPH41	Solid State Physics - II	6	3	25	75	100	4
	CORE	22OPPH42	Quantum Mechanics-II	6	3	25	75	100	4
	CORE	22OPPH43	Molecular Spectroscopy	5	3	25	75	100	4
	CORE	22OPPH41P	* General Physics Practical -II	4	4	40	60	100	4
	CORE	22OPPH42P	*Electronics Practical -II	4	4	40	60	100	4
	DSEC		**DSEC -IV**	5	3	25	75	100	4
		22OPPHPR4	Project	-	3	20	80	100	6
			Total	**120**					**90**

* Practical examinations are conducted only in even semesters

DSEC: Discipline Specific Elective Course:

DSEC - I has to be chosen in Semester I from the following:

1. Numerical Methods -22OPPHDSE1A
2. Programming in C++ - 22OPPHDSE1B

DSEC -II has to be chosen in Semester II from the following:

1. Instrumentation -22OPPHDSE2A
2. Medical Physics - 22OPPHDSE2B

DSEC - III has to be chosen in Semester III from the following:

1. Nano physics -22OPPHDSE3A
2. Crystallography - 22OPPHDSE3B

DSEC - IV has to be chosen in Semester IV from the following:

1. Microprocessor -22OPPHDSE4A
2. Solar energy - 22OPPHDSE4B

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Department of Physics				Class: I M,Sc Physics				
Sem	**Category**	**Course Code**	**Course Title**	**Credits**	**Hrs**	**CIA**	**External Exam**	**Total**
I	DSE	22OPPHDSE1A	Numerical methods	4	5	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	**Employability Oriented**	**Entrepreneurship oriented**
✓		

Course Objectives:

1. To provide suitable and effective methods called Numerical Methods, for obtaining approximate representative numerical results of the problems.
2. To analyze different interpolation techniques.
3. To recall the curve fitting procedures.
4. To rejuvenate the concepts of numerical integration and differentiation.
5. To solve partial differential equations.

Unit	Course Contents	Hours	K Level	CLO
I	**Solution of Algebraic and Transcendental Equations** The Bisection Method–The Method of False position- The Iteration Method –Newton Raphson Method –Ramanujan's Method-The secant Methods-Solution to system of Nonlinear equations-The method of iteration	15	Upto K4	CLO1
II	**Interpolation** Finite Differences-Forward Differences – Backward differences – Central Differences – Detection of errors by use of difference tables-Differences of a polynomial – Newton's formula for interpolation –Central difference interpolation formula-Gauss's central difference formula-detection of errors.	15	Upto K4	CLO2
III	**Least squares and B-splines** Fitting a straight Line-Nonlinear Curve Fitting- Curve Fitting by a sum of Exponentials-Weighted least square approximation-Linear Weighted Least squares approximation-Nonlinear Weighted Least squares approximation-Least square solution - Representations of B-splines-computation of B-splines - chebyshev Polynomials -Economization of power series.	15	Upto K4	CLO3
IV	**Numerical integration and linear system of equations** Numerical integration – Trapezoidal rule – Simpson's 1/3 rule-Simpson's 3/8 rule – Error Analysis- Solution of linear systems-Direct Methods – Matrix Inversion Method-Gauss elimination Method–Solution of linear system Iterative Methods – The Eigen value problem.	15	Upto K5	CLO4

V	**Numerical solution of ordinary and partial differential equations** Introduction-solution by Taylor's series – Picard's method of successive approximations – Euler's method – Modified Euler's method –Error estimates for the Euler method-Runge kutta methods-Laplace's equation- Jacobi's Method – Gauss-Seidel Method.	15	Upto K5	CLO5

Book for study:

1.Sastry .S.S, *Introductory methods of Numerical analysis,* Prentice Hall of India private limited ,New Delhi, Fourth Edition , 2005.

Unit : I **Chapter 2** **2.2-2.7,2.12,2.12.1**

Unit : II **Chapter 3** **3.3,3.3.1- 3.3.3,3.4- 3.7,3.7.1**

Unit : III **Chapter 4** **4.2.1 - 4.2.3,4.3,4.3.1,4.3.2,4.5.1- 4.5.3, 4.7.1,4.7.2**

Unit : IV **Chapters 5,6 5.4,5.4.1 - 5.4.3, 6.3,6.3.1,6.3.2,6.4,6.5**

Unit : V **Chapters 7,8 7.1- 7.4,7.4.1,7.4.2,7.5,8.3 - 8.3.2**

Reference Books:

1. Arumugam .S, Somasundaram .A, Thangapandian Issac.A, *Numerical methods*,Sci Tech Publications India Pvt Ltd,Chennai,Second Edition,2002.

2. Burden.R.L,&Faires.T.D, *Numerical analysis*,Thomson Asia Pvt Ltd, Seventh Edition, Bangalore, 2002.

3.Kandasamy.P, Thilagavathi.K,Gunavathy.k, *Numerical methods*,S.Chand&company Ltd**,**New Delhi ,Third Edition, 2005.

4. Sankara Rao.K, *Numerical methods for scientists and engineers*, Prentice hall India, New Delhi ,Second Edition ,2004.

5. Veerarajan Ramachandran, *Numerical methods*, Tata Mc Graw Hill Ltd.,

New Delhi ,Second Edition, 2006.

Web Resources:

1. **http://www.math.utep.edu/Faculty/nsharma/public_html/m4329_lect03.pdf**
2. **https://en.wikibooks.org/wiki/Introduction_to_Numerical_Methods/Interpolation**
3. https://pages.mtu.edu/~shene/COURSES/cs3621/NOTES/spline/B-spline/bspline-basis.html
4. https://www.youtube.com/watch?v=3d6DsjIBzJ4
5. https://www.youtube.com/watch?v=aY6Y66cc4rE

E-books:

1. http://www.aerostudents.com/courses/applied-numerical analysis/IntroductoryMethodsOf

NumericalAnalysis.pdf

2. https://drive.google.com/file/d/1V6ceyYISDU9bbbsm4WRks2RpCOzYifv7/view
3. http://www.ikiu.ac.ir/public-files/profiles/items/090ad_1410599906.pdf

Pedagogy:

Group Discussions, Quiz, Assignment, Brain Storming Activity. Seminar

Rationale for Nature of the course:

It is the area of mathematics and computer science that creates , analyses and implements algorithms for obtaining numerical solutions to problems involving continuous variables. it is concerned with all aspects of the numerical solution of a problem, from the theoretical development and understanding of numerical methods to their practical implementation as reliable and efficient computer programs.

Activities to be given

1.To Strengthen the students to solve the problems.
2.Enhancing the students to solve iteration methods.

Course Learning Outcomes(CLOs)

On the successful completion of the course. Students will be able to

CLOs	Course Learning outcomes	Knowledge level(According to Blooms Taxonomy)
CLO1	Remembering the basics of the algebraic and transcendental equations.	Up to K4
CLO2	Understanding the Forward, Backward and central differences of interpolation.	Up to K4
CLO3	Acquire knowledge about the Least squares and B-splines.	Up to K4
CLO4	Analyze the differential equation using an appropriate numerical method and root finding methods.	Up to K5
CLO5	Evaluating the simultaneous solutions for different types of numerical methods.	Up to K5

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving Problems
K4 –Examining, analyzing, presentation and make inferences with evidences
K5 – Evaluate , making Judgments based on criteria.

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Mapping of Course Learning Outcomes(CLOs) with Program Outcomes(POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	2	3	3
CLO2	3	3	3	2	3	3
CLO3	3	3	3	3	1	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	2	2	3

1. Basic level 2.Intermediate level 3. Advance level

Lecture Plan

Units	Course Contents	Hours	Total Hours	Pedagogy
I	The Bisection Method	3	15	Chalk and Talk
	The Method of False position-The Iteration Method	3		Chalk and Talk
	Newton Raphson	3		Chalk and Talk
	Method Ramanujan's Method -The secant Methods-	3		Chalk and Talk
	Solution to system of Nonlinear equations -The method of iteration	3		Chalk and Talk
II	Finite Differences-Forward Differences	3	15	Chalk and Talk
	Backward differences – Central Differences	3		Chalk and Talk
	Differences of a polynomial-Newton's formula for interpolation	3		Chalk and Talk
	Central difference interpolation formula	3		Chalk and Talk
	Gauss's central difference formulae	3		Chalk and Talk
III	Fitting a straight Line-Nonlinear Curve Fitting- Curve Fitting by a sum of Exponentials	3	15	Seminar
	Weighted least square approximation-Linear Weighted Least squares approximation	3		Brain storming activity
	Nonlinear Weighted Least squares approximation-Least square solution	3		Chalk and Talk
	Representations of B-splines-computation of B-splines	3		Seminar
	chebyshev Polynomials -Economization of power series.	3		Chalk and Talk & Seminar
IV	Numerical integration – Trapezoidal rule – Simpson's 1/3 rule	3	15	Chalk and Talk
	Simpson's 3/8 rule-Error Analysis	3		Chalk and Talk& Seminar
	Solution of linear systems-Direct Methods	3		Chalk and Talk & Group Discussion

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	Matrix Inversion Method- Gauss elimination Method	3		Chalk and Talk & Group
	Solution of linear system Iterative Methods – The Eigen value problem	3		Chalk and Talk
V	Introduction-solution by Taylor's series –	3	15	Seminar
	Picard's method of successive approximations- Euler's method	3		Chalk and Talk & Seminar
	Modified Euler's method-Error estimates for the Euler method	3		Chalk and Talk
	Runge kutta methods-Laplace's equation	3		Chalk and Talk
	Jacobi's Method-Gauss-Seidel Method	3		Chalk and Talk & Seminar

Annexure -7

Department of Physics				Class: I M,Sc Physics				
Sem	**Category**	**Course Code**	**Course Title**	**Credits**	**Hrs**	**CIA**	**External Exam**	**Total**
I	DSE	22OPPHDSE1B	Programming in C++	4	5	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	**Emplability Oriented**	**Entrepreneurship oriented**
	✔	

Course Objectives:

1. The course is designed to provide the knowledge of C++ language.
2. To develop skill for developing the different programs.
3. To appreciate and apply the programming concepts.
4. To know overloading, inheritance concepts.
5. The student will be able to envelop logical thinking.

Unit	Course Contents	Hours	K Level	CLO
I	**Principles of Oop, Tokens, Expressions and Control Structures** Procedural Vs object oriented programming – Basic concepts of object oriented programming – Benefits of OOP – object oriented Languages – Applications of OOP –A simple C++ Program-Output operator-The i/o stream file-Name space-Return type of main()-structure of C++ program – Basic data types –User-defined data types-Derived data types-Declaration variables-Reference variables-Operators in C++-Scope resolution operator-Manipulators-Expression and their types – Control Structure.	15	Upto K4	CLO1
II	**Functions and Classes** Introduction-The main Function –Function prototyping-Call by Reference-Return by reference-Inline functions–Default arguments–Const arguments-functions Overloading – Specifying a class – Defining member functions –Nesting of member functions-arrays within a class.	15	Upto K4	CLO2
III	**Constructors and Destructors, Operator Overloading** Constructors– Mutiple constructor in a class-Constructors with default arguments-Copy Constructor-dynamic Constructor–destructors-Defining operator overloading-overloading unary operator-overloading binary operators-overloading binary operators using friend functions-	15	Upto K4	CLO3

	Rules for over loading operators –type conversion-Basic to class type-Class to basic type-One class to another class type.			
IV	**Inheritance, Pointers** Introduction of Inheritance-Defining derived classes-single inheritance-Multilevel inheritance-Multiple inheritance-Hierarchical inheritance-Hybrid inheritance-abstract classes-pointers –Declaring and initializing pointers- Manipulation pointers-arrays of pointers-pointers and strings-pointers to functions	15	Upto K5	CLO4
V	**Managing console I/O Operations, Files** C++ stream classes- unformatted I/O operations-overloaded operators-Put() and get() functions-getline() and write() functions-Formatted console I/O operations-Defining field width:width()-Setting precision:Precision()-Filling and padding:fill()-formatting flags,Bit-fields and setf()-Classes for file stream operations-opening and closing a file-opening file using constructor-opening files using open()-Detecting end-of-file-Updating a file:Random acess-Error handling during file operations-Command-line arguments.	15	Upto K5	CLO5

Book for study:

1. Balagurusamy.E, *Object Oriented Programming with C++*, Tata Mc Graw Hill Company, New Delhi , Fourth Edition, 2011.

Unit : I Chapters (1.3-1.8,2.3,2.6,3.5-3.7,3.10,3.12-3.14,3.17,3.19,3.24)

Unit : II Chapters (4.1-4.9,5.3,5.4,5.7,5.9)

Unit : III Chapters (6.2,6.4-6.5,6.7-6.8,6.11,7.2-7.5,7.7-7.8)

Unit : IV Chapters (8.1-8.3,8.5-8.8,8.10,9.2-9.4,9.6)

Unit : V Chapters (10.3,10.4,10.5,11.2-11.4,11.8-11.10)

Reference books:

1.Herbert Schildt, *The Complete Reference C++*, Tata Mc Graw Hill Company, New Delhi ,Fourth Edition,2009.

2.Mike McGrath, *C++ Programming in easy steps*, Dreamtech Press, New Delhi,Third Edition,2011.

3.Radha Ganesan.P ,*Programming with C ++* , Scitech Publication**,** Chennai**,**First Edition,2002.

4**.**Ravichandran.D, *Programming with C++*, Tata Mc Graw Hill Company, New Delhi,Second Edition,2002.

5. Robert Laffore, *Object oriented programming using C++*,Sams publishing, carmal Indiana, Fourth Edition,2002.

Web Resources:

1.**https://msbrijuniversity.ac.in/assets/uploads/newsupdate/ConstructorandDestructors.pdf**
2.https://msbrijuniversity.ac.in/assets/uploads/newsupdate/InheritanceinC++.pdf
3. **https://stackoverflow.com/questions/2879700/c-array-of-pointers**
4. https://www.youtube.com/watch?v=2j5Ic2V7wq4
5.https://www.youtube.com/watch?v=ns3k-Lz7qWUttps://www.youtube.com/watch?v=C08I_N0HxF8

E-books:

1. file:///D:/Users/EMG/Downloads/toaz.info-balaguruswamy-object-oriented-programming -with-c-fourth-editionpdf-pr_757ceed746e55e6343d344c3a68f9e4a.pdf
2. https://books.google.com.sl/books?id=ZQ6UWN6_nGYC&printsec=frontcover#v=onepage&q&f=false
3. https://docs.google.com/file/d/0ByYLraYXu0PHYVJHcEFtcFFCNVE/edit?resourcekey=0-nHyVtTRABz2Vrg0Lx8voYQ

Pedagogy :

Chalk and Talk, Seminar, Quiz, Group Discussion.

Rationale for Nature of the course:

Contemporary research in physics and related sciences almost always involves the use of computers. They are used for data collection and analysis, numerical analysis, simulations, and symbolic manipulation. Computational physics has become a third way of doing physics and complements traditional modes of theoretical and experimental physics.

Activities to be given

1.Enrich the students to solve different programs in C++ language.
2.Upgrading the students knowledge to the overloading and inheritance concepts.

Course Learning Outcomes(CLOs)

On the successful completion of the course. Students will be able to

CLOs	Course Learning outcomes	Knowledge level(According to Blooms Taxonomy)
CLO1	Remembering the Basic concepts of OOP, Derived data type, Expressions and Control Structures.	Up to K4
CLO2	Understanding the various type's functions and classes.	Up to K4
CLO3	Applying the knowledge of Constructors, Destructors and operator overloading.	Up to K4
CLO4	Analyze the concept of Inheritance and Pointers.	Up to K5
CLO5	Evaluate the managing console I/O Operations, and Files.	Up to K5

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving Problems
K4 –Examining, analyzing, presentation and make inferences with evidences
K5 – Evaluate , making Judgments based on criteria.

Mapping of Course Learning Outcomes(CLOs) with Program Outcomes(POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	2	2	3	3
CLO2	3	3	3	2	3	3
CLO3	3	3	3	2	3	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	2	3

1. Basic level 2.Intermediate level 3. Advance level

Lecture Plan

Units	Course Contents	Hours	Total Hours	Pedagogy
I	Procedural Vs object oriented programming – Basic concepts of object oriented programming – Benefits of OOP	3	15	Seminar
	object oriented Languages – Applications of OOP –A simple C++ Program	3		Chalk and Talk
	Output operator-The i/o stream file-Name space-Return type of main()	3		Chalk and Talk& Group discussion
	structure of C++ program – Basic data types –User-defined data types-Derived data types	3		Chalk and Talk
	Declaration variables-Reference variables-Operators in C++-Scope resolution operator-Manipulators-Expression and their types – Control Structure.	3		Chalk and Talk, Seminar
II	**Signal Generators:** Introduction – Variable AF Oscillator	3	15	Chalk and Talk
	Introduction-The main Function –Function prototyping	3		Chalk and Talk
	Call by Reference-Return by reference	3		Group discussion
	Inline functions–Default arguments–Const arguments-functions Overloading	3		Seminar
	Specifying a class – Defining member functions	3		Chalk and Talk

	Nesting of member functions-arrays within a class.	3		Chalk and Talk
III	Constructrs–Mutiple constructor in a class	3	15	Chalk and Talk
	Constructors with Default arguments-Copy Constructor-dynamic constructor	3		Group discussion
	Destructors-Defining operator overloading	3		Seminar
	overloading binary operators using friend functions-Rules for over loading operators	3		Chalk and Talk
	overloading binary operators using friend functions-Rules for over loading operators	3		Chalk and Talk
IV	Introduction of Inheritance-Defining derived classes-single inheritance-Multilevel inheritance	3	15	Chalk and Talk
	Multiple inheritance-Hierarchical inheritance	3		Chalk and Talk& Seminar
	Hybrid inheritance-abstract classes-pointers	3		Chalk and Talk & Group Discussion
	Declaring and initializing pointers- Manipulation pointers	3		Chalk and Talk & Group
	arrays of pointers-pointers and strings-pointers to functions.	3		Chalk and Talk
V	C++ stream classes- unformatted I/O operations-overloaded operators	3	15	Chalk and Talk
	Put() and get() functions-getline() and write() functions	3		Chalk and Talk & Seminar
	Formatted console I/O operations-Defining field width:width()	3		Chalk and Talk
	Setting precision:Precision()-Filling and padding:fill()-formatting flags,Bit-fields and setf()-	3		Seminar
	Classes for file stream operations-opening and closing a file-opening file using constructor	3		Chalk and Talk & Seminar

Annexure -7

Department of Physics				Class: I M,Sc Physics				
Sem	**Category**	**Course Code**	**Course Title**	**Credits**	**Hrs**	**CIA**	**External Exam**	**Total**
II	DSE	22OPPHDSE2A	Instrumentation	4	5	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	**Employability Oriented**	**Entrepreneurship oriented**
	✓	

Course Objectives:

1. To know about the Oscilloscope.
2. To understand the Signal Generators.
3. To gain knowledge about Measuring Instruments.
4. To study the type of Recorders
5. To learn about the Transducers

Unit	Course Contents	Hours	K Level	CLO
I	**Oscilloscope** Introduction-Block Diagram of Oscilloscope – Simple CRO – Vertical Amplifier – Horizontal Deflecting System – Triggered Sweep CRO – Trigger Pulse Circuit – Delay Line in Triggered Sweep – Typical CRT Connections – High Frequency CRT – Dual Beam CRO -Measurement of Frequency by Lissajous Method	15	Upto K4	CLO1
II	**Signal Generators** Introduction – Variable AF Oscillator – Basic Standard Signal Generator-Modern Laboratory Signal Generator – AF Sine and Square Wave Generator – Function Generator – Square and Pulse Generator – Random Noise Generator - Video Pattern Generator – Color Bar Generator.	15	Upto K4	CLO2
III	**Measuring instruments** Introduction – Output Power Meters – Field Strength Meter – Stroboscope – Phase Meter –Q Meter: factors errors- - impedance measurement – Susceptance method- RX Meters – Analog pH Meter.	15	Upto K4	CLO3
IV	**Recorders** Introduction – Strip Chart Recorder – Galvanometer Type Recorder – Null Type Recorder – Circular Chart Recorder – X-Y Recorder – Magnetic Recorders – Frequency Modulation Recording – Digital Data Recording.	15	Upto K5	CLO4
V	**Transducers** Introduction – Electrical Transducer – Selecting a Transducer – Resistive Transducer – Resistive Position	15	Upto K5	CLO5

	Transducer – Resistive Thermometer – Thermistor –Piezo Electrical Transducer – Photo Electric Transducer.			

Book for study:-

1. Kalsi.H.S, *Electronic Instrumentation*, Tata MC Graw Hill Publishing Company Limited, New Delhi, Second Edition, reprint 2005.

Unit : I **Chapter 7** **7.1, 7.4 -7.10, 7.12 - 7.15, 7.20**

Unit : II **Chapter 8** **8.1, 8.3, 8.4, 8.6 to 8.10**

Unit : III **Chapter 10** **10.1 to 10.5.10.7, 10.9**

Unit : IV **Chapter 12** **12.1 to 12.9**

Unit : V **Chapter 13** **13.1 to 13.5, 13.7,13.8, 13.15,13.16**

Book for Reference :-

1. Albert.D,Helfrick,William.D,Cooper, *Modern Electronics Intrumentation and Measurement techniques*, PHI Learning Private Limited, New Delhi, 2011, First Edition
2. Basudev Ghosh, *Fundamental Principles of Electronics*, Books and Allied (p) Ltd, Kolkata, Second Edition,2011.
3. Jose Robin.G, Ubald Raj .A , *Basic Electronics and Applied Electronics*, Indira Publication, Marthandam, Second Edition, 2004.
4. Rangan.C.S, Sarma.G.R,Mani.VSV, *Instrumentation Devices& systems* , Tata McGraw Hill Education Private Limited, New Delhi, Second Edition,2012.
5. Salivahanan.S,Sureshkumar.N, A.Vallavaraj, *Electronic devices &circuits*, Tata MC Graw Hill Publishing Company Limited, New Delhi, First Edition, 2011.

Web Resources:

1. https://www.tutorialspoint.com/electronic_measuring_instruments/electronic_measuring_instruments_basics_of_oscilloscopes.htm
2. http://www.hunter.cuny.edu/physics/courses/physics222/repository/files/pdf/ElectronicsLab8.pdf
3. https://www.taborelec.com/Different-Types-of-Signal-Generators
4. https://circuitglobe.com/classification-of-measuring-instruments.html
5. https://www.electrical4u.com/transducer-types-of-transducer

E-books:

1. https://toaz.info/doc-viewer
2. https://www.google.co.in/books/edition/Electronic_Devices_and_Circuits_second_e/z5nL2x7Z5X4C?hl=en&gbpv=1&printsec=frontcover
3. https://www.google.co.in/books/edition/A_Textbook_of_Applied_Electronics/ldGpLGVbs

DgC?hl=en&gbpv=1&printsec=frontcover

Pedagogy:

Chalk and Talk, Seminar, Quiz, Group Discussion.

Rationale for Nature of the course:

Students can pursue career in electronic industry, Instrumentation centres and Electrical ans Mechanical Industry.

Activities to be given

1. Enrich the students to handle oscilloscope and signal generators.
2. Practice the students to analyze recorders and transducers.

Course Learning Outcomes(CLOs)

On the successful completion of the course. Students will be able to

CLOs	Course Learning outcomes	Knowledge level(According to Blooms Taxonomy)
CLO1	Remembering the basics of CRO and Amplifiers	Up to K4
CLO2	Understanding the knowledge about Signal Generator	Up to K4
CLO3	Apply the knowledge in measuring instruments.	Up to K4
CLO4	Analyzing the performance of recorders	Up to K5
CLO5	Evaluate the working principle of various types of transducers.	Up to K5

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving Problems
K4 –Examining, analyzing, presentation and make inferences with evidences
K5 – Evaluate , making Judgments based on criteria.

Mapping of Course Learning Outcomes(CLOs) with Program Outcomes(POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	1	2	3	3
CLO2	3	3	2	2	2	3
CLO3	3	3	2	2	3	3
CLO4	3	2	3	2	3	3
CLO5	3	3	3	3	3	3

1. Basic level 2.Intermediate level 3. Advance level

Annexure -7

Lecture Plan

Units	Course Content	Hours	Total Hours	Pedagogy
I	**Oscilloscope :**Introduction-Block Diagram of Oscilloscope – Simple CRO – Vertical Amplifier	4	15	Chalk and Talk
	Horizontal Deflecting System – Triggered Sweep CRO	3		Chalk and Talk
	Trigger Pulse Circuit – Delay Line in Triggered Sweep	3		Chalk and Talk, seminar
	Typical CRT Connections – High Frequency CRT – Dual Beam CRO	3		Chalk and Talk seminar &
	Measurement of Frequency by Lissajous Method	2		Chalk and Talk.
II	**Signal Generators:** Introduction – Variable AF Oscillator	3	15	Chalk and Talk
	Basic Standard Signal Generator- Modern Laboratory Signal Generator	3		Chalk and Talk, seminar
	– AF Sine and Square Wave Generator	2		Chalk and Talk
	Function Generator – Square and Pulse Generator	3		Chalk and Talk, seminar
	Random Noise Generator - Video Pattern Generator	4		Chalk and Talk, seminar
III	**Measuring instruments:** Introduction – Output Power Meters	3	15	Chalk and Talk
	Field Strength Meter – Stroboscope – Phase Meter	3		Chalk and Talk
	Q Meter: factors errors- - impedance measurement – Susceptance method	5		Chalk and Talk
	RX Meters	2		Chalk and Talk, seminar
	Analog pH Meter	2		Chalk and Talk & Seminar
IV	**Recorders:** Introduction – Strip Chart Recorder	3	15	Chalk and Talk
	Galvanometer Type Recorder	3		Chalk and Talk & Seminar
	Null Type Recorder – Circular Chart Recorder	3		Chalk and Talk
	X-Y Recorder – Magnetic Recorders –	3		Chalk and Talk & Seminar
	Frequency Modulation Recording - Digital Data Recording	3		Chalk and Talk
V	**Transducers:** Introduction – Electrical Transducer – Selecting a Transducer	3	15	Chalk and Talk
	Resistive Transducer – Resistive Position Transducer	3		Chalk and Talk & Seminar
	Resistive Thermometer – Thermistor	3		Chalk and Talk, seminar
	Piezo Electrical Transducer	3		Chalk and Talk
	Photo Electric Transducer	3		Chalk and Talk & Seminar

Annexure -7

Department of Physics				Class: I M,Sc Physics				
Sem	**Category**	**Course Code**	**Course Title**	**Credits**	**Hrs**	**CIA**	**External Exam**	**Total**
II	DSE	22OPPHDSE2B	Medical physics	4	5	25	75	100

Nature of the Course		
Knowledge and Skill Oriented	**Employability Oriented**	**Entrepreneurship oriented**
	✓	

Course Objectives:

1. To Know about the system of human body
2. To Understand the concepts of diagnostic X-ray
3 .To Gain knowledge about the medical instruments
4. To Study the type of medical equipment's
5. To Learn about advanced bio-medical instrumentation

Unit	Course Contents	Hours	K Level	CLO
I	**Human physiological systems** Introduction-Cells and their structures-nature of cancer cells-Transport of ion through the cell membrane-Resting and action potential-Bioelectric potential-Nerve tissues and organs-Different system of human body.	15	Upto K4	CLO1
II	**Bio Potential Recorders** Characteristics of the recording system-Electrocardiography(ECG)-)-Electromyography(EMG)-Electroretinography(ERG)&Electrooculography(EOG)-Recorders with high accuracy- Recorders for off line analysis. Physiological Assist Devices: Pacemakers	15	Upto K4	CLO2
III	**Operation Theatre Equipments** Surgical diathermy-Shortwave diathermy –Microwave diathermy-Ultrasonic Diathermy- Therapeutic effect of heat-Ventilators-Anesthesia machine-Blood flowmeters-Cardiac output Measurements -Blood gas analysers -Oxymeters-Elements of intensive care monitoring -Bio-Telemetry: Elements of bio-telemetry system-Design of a bio-telemetry system- Radio telemetry Systems-Problems in implant telemetry-Uses of bio-telemetry.	15	Upto K4	CLO3
IV	**Specialised Medical Equipment**	15	Upto K5	CLO4

	Blood cell Counter-Electron Microscope-Radiation detectors-Digital thermometer-Audiometers-X-ray tube-X-ray machine-Radiography and fluoroscopy-Image Identifiers-Angiography-Application of X-ray examination.			
V	**Advances in Biomedical Instrumentation** Computers in Medicine-Lasers in Medicine-Endoscopes-Cryogenic Surgery-Nuclear Imaging techniques-Computer tomography-Thermography -Magnetic resonance imaging-Positron emission tomography-Digital substraction angiography-Biofeedback instrumentation	15	Upto K5	CLO5

Book for study:-

1. Arumugam.M,Biomedical Intrumentation,Anuradha Publications, Kumbokonam,Second Edition,2007.

Chapters:

Unit: I Chapter 1 1.1-1.8
Unit: II Chapter 4 4.2-4.3,4.5-4.8,5.2
Unit: III Chapter 6,8 6.2-6.6,6.8-6.11, 6.14-6.16,8.2-8.6
Unit: IV Chapter 7 7.2-7.4,7.6-7.13.
Unit : V Chapters 10 10.2-10.8,10.10-10.14.

Reference books:-

1. Anadanatarajan, *Biomedical instrumentation and Measurements*, PHIlearning private Limited, NewDelhi, FirstEdition, 2007.

2. Arora.M.P, *Biophysics*, Himalaya publishing House, Mumbai, First Edition,2011.

3.Cromwell.L,Pfeiffer.E.A,Weibell.F.J, *Biomedical Instrumentation and Measurements*,Prentice Hall of India Pvt Ltd,2006, New Delhi, Second Edition.

Some useful websites

Web Resources:

1. https://en.wikipedia.org/wiki/List_of_systems_of_the_human_body
2 https://en.wikipedia.org/wiki/Electrocardiography
3. https://www.nhs.uk/conditions/electrocardiogram
4. https://en.wikipedia.org/wiki/X-ray
5. https://www.physics-and-radio-electronics.com/physics/laser/applicationsoflasers.html

E-Books

1.https://books.google.co.in/books?id=I5598H1Nx70C&printsec=frontcover&redir_esc=y#v=onepage&q&f=false

2.https://pdfcoffee.com/biomedical-instrumentation-and-measurements-pdf-free.html

3.https://www.acsce.edu.in/acsce/wp-content/uploads/2020/03/Biomedical-Sensors-Instruments.pdf

Pedagogy :

Chalk and Talk, Seminar, Quiz, Group Discussion.

Rationale for Nature of the course:

This course is mainly work-related skill and essential technically principle of radiation and its achieve in the medical field

Activities to be given:

1. Train the students to handle the medical equipments.
2. Practice the students to analyze the system of human body.

Course Learning Outcomes(CLOs)

On the successful completion of the course. Students will be able to

CLOs	Course Learning outcomes	Knowledge level(According to Blooms Taxonomy)
CLO1	Understand the knowledge of basic system of human cells	Up to K4
CLO2	Apply the characteristics of bio potential recorders	Up to K4
CLO3	Demonstrate a working knowledge of theatre equipment's	Up to K4
CLO4	Study and analysis the X-rays machine	Up to K5
CLO5	Explain the different types of medical instrumentation	Up to K5

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving Problems
K4 –Examining, analyzing, presentation and make inferences with evidences
K5 – Evaluate , making Judgments based on criteria.

Annexure -7

Mapping of Course Learning Outcomes(CLOs) with Program Outcomes(POs)

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	1	2	3	3
CLO2	3	3	2	2	2	3
CLO3	3	3	2	2	3	3
CLO4	3	2	3	2	3	3
CLO5	3	3	3	3	3	3

1.Basic level 2.Intermediate level 3. Advance level

Lecture Plan

Units	Course content	Hours	Total Hours	Pedagogy
I	Introduction-Cells and their structures-nature of cancer cells	3	15	Chalk and Talk
	Transport of ion through the cell membrane	3		Chalk and Talk
	Resting and action potential	3		Chalk and Talk
	Bioelectric potential-Nerve tissues and organs	3		Chalk and Talk
	Different system of human body.	3		Chalk and Talk
II	Characteristics of the recording system-Electrocardiography(ECG	3	15	Chalk and Talk and Group discussion
	Electroencephalography(EEG)-Electromyography(EMG)	3		Chalk and Talk
	Electroretinography(ERG) &Electrooculography(EOG	3		Chalk and Talk and Group discussion
	Recorders with high accuracy-Recorders for off line analysis.	3		Chalk and Talk
	Physiological Assist Devices: Pacemakers-Pacemaker batteries	3		Chalk and Talk
III	Surgical diathermy-Shortwave diathermy – Microwave diathermy-Ultrasonic Diathermy	3	15	Chalk and Talk
	Therapeutic effect of heat-Ventilators-Anaesthesia machine-Blood flow meters	3		Chalk and Talk
	-Cardiac output Measurements-Pulmonary function analysers-Gas analysers-Blood gas analysers -Ox meters	3		Chalk and Talk and Group discussion
	Elements of intensive care monitoring -Bio-Telemetry:	3		Chalk and Talk
	Elements of bio-telemetry system-Design of a bio-telemetry system-Radio telemetry Systems-Problems in implant telemetry-Uses of bio-telemetry.	3		Chalk and Talk & Seminar

Annexure -7

IV	Blood cell Counter-Electron Microscope-Radiation detectors	3	15	Chalk and Talk
	Photometers and Colorimeters-Digital thermometer-Audiometers	3		Chalk and Talk & Seminar
	X-ray tube-X-ray machine.	3		Chalk and Talk and Group discussion
	Radiography and fluoroscopy-Image Identifiers-Angiography	3		Chalk and Talk & Seminar
	Application of X-ray examination.	3		Chalk and Talk
V	Computers in Medicine-Lasers in Medicine	3	15	Chalk and Talk and Group discussion
	Endoscopes-Cryogenic Surgery	3		Chalk and Talk & Seminar
	Nuclear Imaging techniques-Computer tomography	3		Chalk and Talk
	Thermography-Ultrasonic Imaging Systems-Magnetic resonance imaging	3		Chalk and Talk and Group discussion
	Positron emission tomography-Digital substraction angiography-Biofeedback instrumentation.	3		Chalk and Talk & Seminar