JAYARAJ ANNAPACKIAM COLLEGE FOR WOMEN (AUTONOMOUS)

A Unit of the Sisters of St. Anne of Tiruchirappalli
Accredited with 'A+' Grade (Cycle 4) by NAAC
DST FIST Supported College
Affiliated to Mother Teresa Women's University, Kodaikanal

PERIYAKULAM – 625 601, THENI DT.
TAMIL NADU.

SYLLABUS (2023-2026)

I - IV SEMESTER

M.Sc. PHYSICS

PG AND RESEARCH CENTRE OF PHYSICS

PG PROGRAMME OUTCOMES

PO. NO.	UPON COMPLETION OF THIS PROGRAMME THE STUDENTS WILL BEABLE TO
1.	Instill knowledge and evaluate analytically in their specific disciplines.
2.	Analyze and apply the acquired knowledge to solve the complex problems in professional and social life.
3.	Evolve new technologies in the specific discipline leading to innovation and employability.
4.	Develop critical thinking required to pursue research.
5.	Apply the computational skills, life skills to the challenging problems in life.
6.	Design and develop independent projects.

P.G. PROGRAMME SPECIFIC OUTCOMES

PSO. NO.	UPON COMPLETION OF THIS PROGRAM THE STUDENTS WILL BE ABLE TO	PO MAPPED
1.	Acquire in depth knowledge on the principles, phenomena and mechanisms involved in physics.	PO-1
2.	Apply and analyze the knowledge of physics to setup laboratory experiments and instill industrial exposure through internships.	PO-1 PO-2 PO-3
3.	Develop a thirst for research through independent projects.	PO-4 PO-6
4.	Gain additional knowledge on other science disciplines through interdisciplinary courses.	PO-3
5.	Equip themselves to prepare and appear for qualifying/competitive examinations	PO-5

P.G. COURSE PATTERN 2023 Onwards (UGC/ TANSCHE/ MTU)

Sem.	Part	Code	Title of the Course	Hours	Credit
I	A	23PPH1C01	Classical Mechanics	6	6
		23PPH1C02	Thermodynamics and Statistical Mechanics	6	5
		23PPH1P01	Practical-I	6	5
		23PPH1E1A/ 23PPH1E1B/ 23PPH1E1C	Elective Course - 1 Linear and Digital ICs and Applications Digital Communication Communication Electronics	6	3
	B	23PPH1SE1	SEC - 1 Materials Science	4	2
		23PAE1SK1	AEC - 1- Soft Skill	2	2
			Total	**30**	**23**
II	A	23PPH2C03	Mathematical Physics	6	5
		23PPH2C04	Quantum Mechanics - I	6	5
		23PPH2P02	Practical-II	6	5
		23PPH2ID1	**IDC:** Nano Materials and their Applications	6	3
	B	23PPH2SE2	SEC - 2 Medical Physics	4	2
		23PAE2SK2	AEC- 2 - Cyber Security	2	2
	C	23PSL4EP1	Extension Activity (Can be carried outside the class hours)	-	1
			Total	**30**	**23**
III	A	23PPH3C05	Quantum Mechanics - II	6	5
		23PPH3C06	Numerical Methods and MATLAB	6	5
		23PPH3P03	Practical-III	6	5
		23PPH3E2A/ 23PPH3E2B/ 23PPH3E2C	**Elective Course - 2:** Advanced Mathematical Physics Nonlinear Dynamics Biophysics	6	4
	B	23PPH3SE3	**SEC - 3**: Core Industry Module (Sewage and Waste Water Treatment and Reuse)	6	3
		23PPH3IN1/ 23PPH3IT1	Internship/Industrial Activity (Carried out in summer vacation at the end of Semester II) / (at least 10 Days)	-	2
			Total	**30**	**24**
IV	A	23PPH4C07	Nuclear and Particle Physics	6	5
		23PPH4C08	Condensed Matter Physics	6	5
		23PPH4C09	Spectroscopy	5	4
		23PPH4E3A/ 23PPH4E3B/ 23PPH4E3C	**Elective Course - 3:** Electromagnetic Theory Crystal growth and Thin Films Solar Energy Utilization	5	3
		23PPH4R01	Project with Viva Voce	6	3
	B	23PPH4SE4	**SEC - 4:** Training for Competitive Examinations	2	1
			Total	**30**	**21**
			Total for All Semesters	**120**	**91**

Remembering- K1; Understanding- K2; Applying- K3; Analyzing- K4; Evaluating- K5; Creating- K6

CONTINUOUS INTERNAL ASSESSMENT COMPONENT (CIA)

THEORY:

Component	Marks	Marks
Internal test I	40	Converted to 25
Internal test II	40	
Seminar	10	
Assignment/Term paper	5	
Attendance	5	
Total	**100**	**25**

PASSING MINIMUM FOR EXTERNAL SEMESTER EXAMINATION

PASSING MINIMUM

SEMESTER EXAMINATION		
Theory	50% out of 75 Marks (i.e. 37.5 Marks)	50% out of 100 Marks (i.e. 50 Marks)
Practical	50% out of 60 Marks (i.e. 30 Marks)	

PROJECT WORK

The ratio of marks for Internal and External Examination is 50:50.

The Internal Components of Project Work are given below:

THE INTERNAL COMPONENTS OF PROJECT

Components	Marks
First Review	10
Second Review	10
Final Review (Internal Viva Voce)	30
Total	**50**

External Valuation of Project Work

Components	Marks
Project Report	25
External Viva Voce	25
Total	**50**

Internship

Components		Marks
Internal	:	50 Marks
External	:	50 Marks
Total	**:**	**100 Marks**

INTERNAL COMPONENTS:

Components		Marks
Report Submission	:	25 Marks
Presentation and viva (internal)	:	25 Marks
External (Awarded by the Respective Guide / Intern site)	:	50 Marks

CONTINUOUS INTERNAL ASSESSMENT COMPONENT (CIA)

TRAINING FOR COMPETITIVE EXAMS (INTERNAL ONLY)

COMPONENTS	MAXIMUM MARKS
Test 1	40
Test 2	40
Panel Discussion	15
Class Activity	05

TEST TYPE	K LEVEL	NO OF QUESTIONS
Objective type questions	KI	15
Objective type questions	K2	15
Objective type questions	K3	10

PG - INTERNAL QUESTION PATTERN

Max. Marks - 40; **Duration - 2 Hours**

Section	Bloom's level	Course Outcome	Questions
A MCQs (10×1=10)	K1	CO1	1.
		CO1	2.
		CO1	3.
		CO1	4.
		CO1	5.
		CO1	6.
		CO1	7.
		CO1	8.
		CO1	9.
		CO1	10.
B Answer all the Questions (2×5=10)	K2	CO2	11. a) (or) 11. b)
	K3	CO3	12. a) (or) 12. b)
C Answer all the questions (2×10=20)	K4	CO4	13. a) (or) 13. b)
	K5, K6	CO5	14. a) (or) 14. b)

PG - INTERNAL QUESTION PATTERN (FULLY INTERNAL PAPERS)

Max. Marks - 40; **Duration - $1\frac{1}{2}$ Hours**

Section	Bloom's level	Course Outcome	Questions
A MCQs (10×1=10)	K1	CO1	1.
		CO1	2.
		CO1	3.
		CO1	4.
		CO1	5.
		CO1	6.
		CO1	7.
		CO1	8.
		CO1	9.
		CO1	10.
B Answer all the Questions (2×5=10)	K2	CO2	11. a) (or) 11. b)
	K3	CO3	12. a) (or) 12. b)
C Answer all the questions (2×10=20)	K4	CO4	13. a) (or) 13. b)
	K5, K6	CO5	14. a) (or) 14. b)

PG - EXTERNAL QUESTION PATTERN

For Credits 5 and above

Sections	Bloom's level	Course Outcome	Questions
A MCQs 15×1=15	K1	CO1	1
			2
			3
			4
			5
			6
			7
			8
			9
			10
			11
			12
			13
			14
			15
B Answer All the Questions 5×2=10	K2	CO2	16
			17
			18
			19
			20
C Answer ALL the Questions 5×5=25	K1	CO1	21. a)
			Or
			21. b)
	K2	CO2	22. a)
			Or
			22. b)
	K3	CO3	23. a)
			Or
			23. b)
	K4	CO4	24. a)
			Or
			24. b)
	K5	CO5	25. a)
			Or
			25. b)

D Answer All the Questions 5×10=50	K2	CO2	26. a)
			Or
			26. b)
	K3	CO3	27. a)
			Or
			27. b)
	K4	CO4	28. a)
			Or
			28. b)
	K5	CO5	29. a)
			Or
			29. b)
	K6	CO5	30. a)
			Or
			30. b)

PG - EXTERNAL QUESTION PATTERN

For Below 5 Credits

Sections	Bloom's level	Course Outcome	Questions
A MCQs 15×1=15	K1	CO1	1
			2
			3
			4
			5
			6
			7
			8
			9
			10
			11
			12
			13
			14
			15
B Answer ALL the Questions 5×6=30	K2	CO2	16. a)
			Or
			16. b)
	K3	CO3	17. a)
			Or
			17. b)
	K4	CO4	18. a)
			Or
			18. b)
	K5	CO5	19. a)
			Or
			19. b)
	K6	CO5	20. a)
			Or
			20. b)
C Answer All the Questions 3×10=30	K2	CO2	21. a)
			Or
			21. b)
	K4	CO4	22. a)
			Or
			22. b)
	K5	CO5	23. a)
			Or
			23. b)

CLASSICAL MECHANICS

Semester: I **Hours: 6**

Code : 23PPH1C01 **Credit: 6**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO -1	Define and recall fundamental concepts in classical mechanics.	PSO-1	K1
CO - 2	Explain the principles of classical mechanics in various contexts and articulate the relationships between different physical quantities.	PSO-2,	K2
CO - 3	Apply classical mechanics principles to solve problems and demonstrate the ability to use equations of motion and conservation laws.	PSO-2, PSO-3	K3
CO - 4	Analyze complex scenarios involving multiple forces and motions, breaking them down into components to understand and solve physics problems.	PSO-3, PSO-4	K4
CO - 5	Evaluate the validity and limitations of classical mechanics in explaining physical phenomena.	PSO-4, PSO-5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: I				**CLASSICAL MECHANICS**							**Hours: 6**
Code : 23PPH1C01											**Credit: 6**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO -1	5	4	3	5	3	2	5	4	3	2	4	3.64
CO - 2	5	3	4	5	3	2	4	5	3	2	4	3.64
CO - 3	5	5	4	5	2	3	4	5	5	3	2	3.91
CO - 4	5	3	4	4	3	2	4	3	5	5	4	3.82
CO - 5	5	4	4	4	3	2	3	3	4	5	5	3.82
Overall Mean Score												**3.77**

Result: The Score for this Course is **3.77** (High Relationship)

Note:

Mapping	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I: LAGRANGIAN AND HAMILTONIAN DYNAMICS

Constraints-Generalized co-ordinates- Principle of Virtual Work-D'Alembert's principle - Lagrange's equations from D'Alembert's principle - Procedure - Lagrange's equation in presence of non-conservative forces - Generalized potential-Hamilton's principle and Lagrange's equations. Generalized momentum & Cyclic co-ordinates - Conservation theorems - Hamiltonian function - Hamilton's equations - Examples - Routhian. **(18 Hours)**

UNIT II: VARIATIONAL PRINCIPLE

Calculus of variations and Euler-Lagrange's equations - Deduction of Hamilton's principle from D'Alembert's principle - Modified Hamilton's principle - Hamilton's equations from modified Hamilton's principle - Lagrange'sequations from variational principle for non-conservative systems - Lagrange's method of undetermined multipliers - Physical significance - Examples - Δ variation - Principle of leastaction. **(18 Hours)**

UNIT III: CANONICAL TANSFORMATIONS

Canonical & Legendre transformations - Generating functions - Procedure - Conditions - Bilinear invariant condition. Poisson's & Lagrange's brackets - Relation between them - Angular momentum - Invariance - Phase space - Liouville'stheorem. **(18 Hours)**

UNIT IV: SMALL OSCILLATIONS

Potential energy and equilibrium - 1D oscillator - Two coupled oscillators - Normal coordinates and normal modes - Examples. General theory of small oscillations - Secular and eigenvalue equation - Linear tri-atomic molecule. **(18 Hours)**

UNIT V: RIGID BODY DYNAMICS

Generalized co-ordinates of a rigid body - Reference systems - Euler's angles - Angular velocity - Angular momentum and Inertial Tensor- Principal moments of inertia - Rotational Kinetic energy - Symmetric bodies - Euler's equations. **(18 Hours)**

BOOK FOR STUDY

- Classical Mechanics, J. C. Upadhyaya, Himalaya Publishing House, Mumbai, 2003.

DETAILED REFERENCE

Classical Mechanics, J. C. Upadhyaya, Himalaya Publishing House, Mumbai, 2003.

UNIT - I: Chapter - 2: 2.1 to 2.11, Chapter - 3: All sections

UNIT - II: Chapter - 5: 5.1 to 5.11,

UNIT - III: Chapter - 6: 6.1 to 6.6, Chapter - 7: All sections

UNIT - IV: Chapter - 9: 9.1 to 9.6

UNIT - V: Chapter - 10: 10.1 to 10.11

BOOKS FOR REFERENCE

1. Classical Mechanics, H. Goldstein, Narosa Publications, New Delhi, 1984.
2. Classical Mechanics, N. C. Rana & P. S. Joag, Tata McGraw Hill Publications, New Delhi,1999.

THERMODYNAMICS AND STATISTICAL MECHANICS

Semester: I **Hours: 6**

Code : 23PPH1C02 **Credit: 5**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Acquire the fundamental knowledge about three types of statistics.	PSO-1	K1
CO - 2	Comprehend the concept of partition function, canonical and grand canonical ensembles.	PSO-1, PSO-2	K2
CO - 3	Apply the methods of statistical physics in other fields of physics and related fields.	PSO-2, PSO-3	K3
CO - 4	Analyze phase diagrams, phase transitions and explain the concept of B.E condensation.	PSO-3, PSO-4	K4
CO - 5	Derive the relation between thermodynamic parameters such as pressure, temperature, entropy from the distribution functions	PSO-4, PSO-5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: I				THERMODYNAMICS AND STATISTICAL MECHANICS							Hours: 6
Code : 23PPH1C02											Credit: 5
Course Outcomes	Programme Outcomes (PO)						Programme Specific Outcomes (PSO)					Mean Score of CO's
	1	2	3	4	5	6	1	2	3	4	5	
CO - 1	5	3	3	3	2	2	5	4	3	3	3	3.80
CO - 2	5	3	4	3	3	2	4	5	5	3	2	3.84
CO - 3	5	3	4	3	2	2	4	5	5	3	2	3.84
CO - 4	5	4	4	3	3	2	3	4	5	5	2	3.84
CO - 5	5	4	4	3	2	2	2	3	4	5	5	3.84
Overall Mean Score												3.83

Result: The Score for this Course is **3.83** (High Relationship)

Note:

Mapping	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

UNIT I: LAWS OF STATISTICS

Laws of thermodynamics - thermodynamic potentials and reciprocity relations - thermodynamic equilibrium - Nernst's heat theorem - Chemical potential. Identical particles and symmetry requirements - Bose-Einstein Statistics - Fermi-Dirac Statistics - Maxwell-Boltzmann Statistics - Evaluation of the constants α and β- Results of three statistics. **(18 Hours)**

UNIT II: METHOD OF ENSEMBLES

Micro canonical ensemble - Perfect gas in micro canonical ensemble - Gibbs paradox - Partition function and its correlation with thermodynamic quantities- Gibbs canonical ensemble - Thermodynamic functions for canonical ensemble - Partition function and their properties - Perfect monatomic gas in canonical ensemble - Grand canonical ensemble - Partition function and thermodynamic functions for grand canonical ensemble- Perfectgasingrand canonical ensemble-Comparison of ensembles. **(18 Hours)**

UNIT III: PHASE TRANSITION

Phase transition - Phase transitions of first and second kind - Critical exponent - Yang and Lee theory - The Ising model - Bragg-William's approximation - One dimensional Ising model. Energy and Pressure of the gas - Gas degeneracy - Bose Einstein Condensation. Thermal properties of Bose Einstein gas

(18 Hours)

UNIT IV: TRANSPORT THEORY AND IRREVERSIBLE PROCESSES

Boltzmann transport equation - Lorentz solution - Chambers equation - Sommerfeld theory - Electrical and thermal conductivity - Magneto resistance - Viscosity-Hall effect **(18 Hours)**

UNIT V: FLUCTUATIONS INTHERMODYNAMICS

Fluctuations in Energy, Pressure, Volume and Enthalpy - Probability - Brownian movement - Fokker Plank equation - Solution of Fokker Plank equation -Fourier analysis of a random function: Wiener-Khintchine theorem - Electrical noise - Nyquist's theorem. **(18 Hours)**

BOOK FORSTUDY

- Statistical Mechanics, S. L. Gupta & V. Kumar, 27th edition, Pragati Prakashan, Meerut, 2014.

DETAILED REFERENCE:

Statistical Mechanics, S. L. Gupta & V. Kumar, 27th edition, Pragati Prakashan, Meerut, 2014.

UNIT I: Chapter - A: A-1 to A-7; Chapter - 6: 6.1 to 6.5

UNIT II: Chapter - 3: 3.0, 3.0-2 to 3.0-4; 3.1, 3.1-3 to 3.1-5; 3.2, 3.2-1 to 3.2-3

UNIT III: Chapter - 8: 8.0 to 8.3; Chapter - 13: 13.1 to 13.7

UNIT IV: Chapter - 10: 10.1 to 10.8

UNIT V: Chapter - 12: 12.1 to 12.10

BOOKS FOR REFERENCE

1. Statistical Mechanics, B. K. Agarwal and M. Eisner, Third edition, New Delhi, 2013.
2. Statistical Mechanics, S. K. Sinha, Tata McGraw Hill, New Delhi,1990,
3. Statistical mechanics and properties of matter theory and applications, E. S. R. Gopal, Halsted Press (Wiley-Inter science), New York, 1974.
4. Statistical Mechanics, K. Huang, John Wiley & Sons, New York, 1988.
5. Statistical Physics, L.D. Landau & E.M. Lifshitz, Pergamon Press, London, 1989.

PRACTICAL -I

Semester: I **Hours: 6**

Code : 23PPH1P01 **Credit: 5**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Recall the analog and analog and digital principles to construct circuits and determine the physical quantities.	PSO - 1	K1
CO - 2	Illustrate the properties of materials by experiments and functioning of data processing circuits.	PSO - 1, PSO -2	K2
CO - 3	Apply the principles of electronics and concepts of non electronics to obtain quantitative results.	PSO - 3	K3
CO - 4	Examine the concepts/equations based on theoretical and mathematical physics and gives inferences.	PSO - 3, PSO - 4	K4
CO - 5	Work with analog and digital circuits.	PSO - 5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: I				**PRACTICAL -I**							**Hours: 6**
Code : 23PPH1P01											**Credits: 5**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	4	4	3	5	4	3	5	4	4	3	2	3.80
CO - 2	4	3	3	5	4	3	5	5	4	3	2	3.81
CO - 3	3	3	3	5	4	3	4	4	5	3	3	3.81
CO - 4	4	4	3	5	4	3	4	3	5	5	3	3.81
CO - 5	4	3	3	5	4	3	3	3	4	4	5	3.81
Overall Mean Score												**3.81**

Result: The Score for this Course is **3.81** (High Relationship)

Note:

Mapping	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

LIST OF PRACTICALS: (ANY NINE)

1. Study of the ApplicationsofIC555timer.
2. Simplification of long Boolean expression using Karnaugh map by means of logic circuits.
3. Construction of Multiplexer and De-Multiplexer using IC 74 series.
4. Determination of Dielectric loss of a capacitor using CRO
5. Construction of Wave form generators using IC741.
6. Solving the two different first order simultaneous equation using Op-Amp (Analog Computation).
7. Determination of Elastic constants of a glass plate using Cornu's method by obtaining Elliptical fringes.
8. Determination of Young's modulus and Poisson's ratio by Hyperbolic fringes-Cornu's method.
9. Determination of Mutual Inductance of a pair coils at various angles using Anderson's bridge.
10. Construction of Decoder and Encoder circuits using IC's
11. Study of important electrical characteristics of IC741
12. Measurement of wavelength of Diode Laser using Diffraction grating.

LINEAR AND DIGITAL ICs AND APPLICATIONS

Semester: I **Hours: 6**

Code : 23PPH1E1A **Credit: 3**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Recall the fundamentals and Principles pf Integrated chips, OP-Amp, Filters and Switching circuits.	PSO - 1, PSO - 2	K1
CO - 2	Describe the characteristics of Linear and Digital ICs.	PSO-1, PSO - 2	K2
CO - 3	Illustrate the functions of ICs in various fields.	PSO- 3, PSO - 4	K3
CO - 4	Analyse and design the applications of different types of ICs.	PSO - 4	K4
CO - 5	Summarize the appropriate technique of several ICs.	PSO- 4, PSO - 5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: I				LINEAR AND DIGITAL ICs & APPLICATIONS								Hours: 6
Code : 23PPH1E1A												Credit: 3
Course Outcomes	Programme Outcomes (PO)						Programme Specific Outcomes (PSO)					Mean Score of CO's
	1	2	3	4	5	6	1	2	3	4	5	
CO - 1	5	5	4	2	4	5	5	5	4	3	2	4.00
CO - 2	5	4	3	4	3	4	5	5	4	3	2	3.81
CO - 3	5	3	3	5	4	2	2	3	5	5	4	3.72
CO - 4	5	5	3	3	4	3	2	3	4	5	4	3.72
CO - 5	5	5	4	5	5	4	2	2	3	5	5	4.09
Overall Mean Score												3.86

Result: The Score for this Course is **3.86** (High Relationship)

Note:

Mapping	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs = Total of Mean Scores / Total No. of COs

UNIT I: INTEGRATED CIRCUITS AND OPERATIONAL AMPLIFIER

Introduction, Classification of IC 's, basic information of Op-Amp 741 and its features, the ideal Operational amplifier, Op-Amp internal circuit and Op-Amp. Characteristics. **(18 Hours)**

UNIT II: APPLICATIONS OF OP-AMP

LINEAR APPLICATIONS OF OP-AMP:

Solution to simultaneous equations and differential equations, Instrumentation amplifiers, V to I and I to V converters.

NON-LINEAR APPLICATIONS OF OP-AMP: Sample and Hold circuit, Log and Antilog amplifier, multiplier and divider, Comparators, Schmitt trigger, Multivibrators, Triangular and Square waveform generators. **(18 Hours)**

UNIT III: ACTIVE FILTERS & TIMER AND PHASE LOCKED LOOPS

ACTIVE FILTERS: Introduction, Butterworth filters - 1st order, 2nd order low pass and high pass filters, band pass, band reject and all pass filters.

TIMER AND PHASE LOCKED LOOPS: Introduction to IC 555 timer, description of functional diagram, monostable and astable operations and applications, Schmitt trigger, PLL - introduction, basic principle, phase detector/comparator, voltage-controlled oscillator (IC 566), low pass filter, monolithic PLL and applications of PLL **(18 Hours)**

UNIT IV: VOLTAGE REGULATOR & D to A AND A to D CONVERTERS

VOLTAGE REGULATOR: Introduction, Series Op-Amp regulator, IC Voltage Regulators, IC 723 general purpose regulators, Switching Regulator.

D to A AND A to D CONVERTERS: Introduction, basic DAC techniques -weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, A to D converters -parallel comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC, DAC and ADC Specifications. **(18 Hours)**

UNIT V: DIGITAL INTEGRATED CIRCUITS

Switching Circuits - 7400 TTL - Voltage Transfer Characteristics - TTL Parameters - TTL Overview - Open-collector Gates - Three-state TTL Devices - External Device for TTL Loads - TTL Driving External Loads - 74C00 CMOS - CMOS Characteristics - TTL-to-CMOS Interface - CMOS-to-TTL Interface. **(18 Hours)**

BOOKS FOR STUDY:

1. Linear Integrated Circuit,D. Roy Choudhury, Shail B. Jain, 4th edition, New Age International Pvt. Ltd, New Delhi, 2012.
2. OP-AMP and Linear Integrated Circuits,Ramakant A. Gayakwad, 4th edition, Prentice Hall / Pearson Education, New Delhi.2012.

3. A Textbook of Electrical technology, B.L. Theraja and A.K. Theraja, S. Chand & Co, 2004.
4. Principles of Electronics, V.K. Mehta and Rohit Mehta, S. Chand & Co, 12th Edition.2008.
5. Introduction to Integrated electronics (Digital & Analog), V. Vijayendra, S. Viswanathan Printers & Publishers Private Ltd, Reprint2008.

DETAILED REFERENCES:

1. Linear Integrated Circuit,D. Roy Choudhury, Shail B. Jain, 4th edition, New Age International Pvt. Ltd, New Delhi, 2012.

UNIT I:

Chapter 1: 1.2 - 1.4

Chapter 2:2.2 - 2.4

Chapter 3: 3.1 - 3.4

UNIT II:

Chapter 4: 4.7 - 4.9

Chapter 5: 5.2 - 5.6

2. Linear Integrated Circuit, D. Roy Choudhury, Shail B. Jain, 4th edition, New Age International Pvt. Ltd, New Delhi, 2012.

UNIT III:

Chapter 8: 8.1 - 8.5

Chapter 9: 9.1 - 9.7

3. OP-AMP and Linear Integrated Circuits, Ramakant A. Gayakwad, 4th edition, Prentice Hall / Pearson Education, New Delhi. 2012.

UNIT III:

Chapter 7: 7.1 - 7.10

4. Linear Integrated Circuit, D. Roy Choudhury, Shail B. Jain, 4th edition, New Age International Pvt. Ltd, New Delhi, 2012.

UNIT IV:

Chapter 6: 6.1- 6.5

Chapter 10: 10.1 - 10.5

5. Digital Principles and Applications, Donald P Leach, Albert Paul Malvino, Goutam Saha Eighth Edition.

UNIT V:

Chapter 14:14.1 - 14.13

BOOKSFOR REFERENCE

1. Design with operational amplifiers and analog integrated circuits,Sergio Franco McGraw Hill, New Delhi.1997.
2. Analysis and Design of Analog Integrated Circuits,Gray and Meyer, Wiley International, New Delhi.1995.
3. Digital Principles and Applications,Malvino and Leach, 5th Edition, Tata McGraw Hill, New Delhi,2005.
4. Digital Fundamentals,Floyd and Jain, 8th edition, Pearson Education, New Delhi.2009.
5. Integrated Electronics, Millman & Halkias, Tata McGraw Hill, 17th Edition,Reprint 2000.

DIGITAL COMMUNICATION

Semester: I **Hours: 6**

Code : 23PPH1E1B **Credit: 3**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Define the techniques of Fourier transform, convolution and sampling theorems in signal processing	PSO-1	K1
CO - 2	Explain the different information theories in the process of study of coding of information, storage and communication	PSO-1, PSO-2	K2
CO - 3	Compare the various methods of pulse modulation techniques	PSO-2, PSO-3	K3
CO - 4	Apply the error control coding techniques in detecting and correcting errors- able to discuss, analyze and compare the different error control coding	PSO-3, PSO- 4,	K4
CO - 5	Evaluate and compare the spread spectrum techniques for secure communications	PSO-4, PSO-5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: I				DIGITAL COMMUNICATION								Hours: 6
Code : 23PPH1E1B												Credit: 4
Course Outcomes	Programme Outcomes (PO)						Programme Specific Outcomes (PSO)					Mean Score of CO's
	1	2	3	4	5	6	1	2	3	4	5	
CO - 1	5	5	4	2	4	5	5	4	3	3	3	3.6
CO - 2	5	4	3	4	3	4	5	5	3	2	2	3.4
CO - 3	5	3	3	5	4	2	4	5	5	3	2	3.8
CO - 4	5	5	3	3	4	3	3	4	5	5	2	3.8
CO - 5	5	5	4	5	5	4	2	2	4	5	5	3.6
Overall Mean Score												3.6

Result: The Score for this Course is **3.6** (High Relationship)

Note:

Mapping	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

UNIT I: SIGNAL ANALYSIS

Fourier transforms of gate functions, delta functions at the origin - Two delta function and periodic delta function - Properties of Fourier transform - Frequency shifting -Time shifting - Convolution -Graphical representation - Convolution theorem - Time Convolution theorem -Frequency Convolution theorem -Sampling theorem. **(18 Hours)**

UNIT II: INFORMATION THEORY

Communication system - Measurement of information - Coding - Bandot Code CCITT Code -Hartley Law - Noise in an information Carrying Channel- Effects of noise- Capacity of noise in a channel - Shannon Hartley theorem -Redundancy.

(18 Hours)

UNIT III: PULSE MODULATION

Pulse amplitude modulation - natural sampling - Instantaneous sampling - Transmission of PAM Signals -Pulse width modulation - Time division multiplexing - Band width requirements for PAM Signals. Pulse Code Modulation -Principles of PCM -Quantizing noise - Generation and demodulation of PCM -Effects of noise - Commanding - Advantages and application. **(18 Hours)**

UNIT IV: ERROR CONTROL CODING

Introduction to Linear Block Codes, Hamming Codes, BCH Coding, RS Coding, Convolutional Coding, Coding Grain Viterbi Coding. **(18 Hours)**

UNIT V: SPREAD SPECTRUM SYSTEMS

Pseudo Noise sequences, generation and Correlation properties, direct sequence spread spectrum systems, frequency HOP Systems, processing gain, anti-jam and multipath performance. **(18 Hours)**

BOOKS FOR STUDY

1. Communication system, B.P. Lathi, Wiley Eastern.
2. Electronic Communication Systems, George Kennedy,3rd Edition, Mc Graw Hill.
3. Communication System, Simon Haykin,3rd Edition, John Wiley & Sons.
4. Electronic Communication System, George Kennedy and Davis, 4th Edition. Tata McGraw Hill,1988.
5. Principles of Communication System, Taub and Schilling, Second edition, Tata McGraw Hill.1991.

BOOKS FOR REFERENCE

1. Digital Communication, John Proakis, 3rd Edition, McGraw Hill, Malaysia,1995.
2. Digital Communication Techniques, M. K. Simen, Signal Design and Detection, Prentice Hall of India. 1999.
3. Electronics communications, Dennis Roddy and Coolen, Prentice Hall of India, 1995.
4. Advanced Electronics communication System, Tomasi, 4th Edition, Prentice Hall, Inc. 1998.
5. Microwave and Radar Engineering, M.Kulkarni, Umesh Publications.1988.

COMMUNICATION ELECTRONICS

Semester: I **Hours: 6**

Code : 23PPH1E1C **Credit: 3**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Recall the basic principles of electronic communication systems.	PSO - 1	K1
CO - 2	Explain the relationship between frequency, wavelength, and propagation in communication systems.	PSO -1, PSO - 2	K2
CO - 3	Apply modulation techniques to transmit signals effectively over different communication channels.	PSO - 2, PSO - 3	K3
CO - 4	Analyse and compare different types of modulation schemes in terms of efficiency and performance.	PSO - 3, PSO - 4	K4
CO - 5	Assess the suitability of various communication techniques for different applications.	PSO - 4, PSO - 5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: I				**COMMUNICATION ELECTRONICS**							**Hours: 6**
Code : 23PPH1E1C											**Credit: 3**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	5	4	2	4	5	5	4	3	3	3	3.6
CO - 2	5	4	3	4	3	4	5	5	3	2	2	3.4
CO - 3	5	3	3	5	4	2	4	5	5	3	2	3.8
CO - 4	5	5	3	3	4	3	3	4	5	5	2	3.8
CO - 5	5	5	4	5	5	4	2	2	4	5	5	3.6
Overall Mean Score												**3.6**

Result: The Score for this Course is **3.6** (High Relationship)

Note:

Mapping	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

UNIT I: ANTENNAS AND WAVE PROPAGATION

Radiation field and radiation resistance of short dipole antenna-grounded antenna-ungrounded antenna-antenna arrays-broadside and end side arrays-antenna gain-directional high frequency antennas-sky wave-ionosphere- Ecles and Larmor theory- Magneto ionic theory-ground wave propagation. **(18 Hours)**

UNIT II: MICROWAVES

Microwave generation - multi cavity Klystron - reflex klystron - magnetron travelling wave tubes (TWT) and other microwave tubes - MASER - Gunn diode - wave guides - rectangular wave guides-standing wave indicator and standing wave ratio (SWR) **(18 Hours)**

UNIT III: RADAR AND TELEVISION

Elements of a radar system-radar equation - radar performance Factors radar transmitting systems - radar antennas-duplexers-radar receivers and indicators-pulsed systems - other radar systems - colour TV transmission and reception-colour mixing principle - colour picture tubes - Delta gun picture tube - PIL colour picture tube - cable TV, CCTV and theatre TV. **(18 Hours)**

UNIT IV: OPTICAL FIBER

Propagation of light in an optical fibre-acceptance angle - numerical aperture-step and graded index fibres - optical fibres as a cylindrical wave guide - wave guide equations - wave guide equations in step index fibres - fibre losses and dispersion - applications. **(18 Hours)**

UNIT V: SATELLITE COMMUNICATION

Orbital satellites - geostationary satellites - orbital patterns - satellite system link models-satellite system parameters - satellite system link equation link budget-INSAT communication satellites. **(18 Hours)**

BOOKS FOR STUDY:

1. Handbook of Electronics, Gupta and Kumar, 2008.
2. Electronic communication systems, George Kennedy and Davis, 4thedition Tata McGraw Hill, 1988.
3. Principles of communication systems, Taub and Schilling, second edition, Tata Mc Graw Hill, 1991.
4. Microwave and radar engineering, M. Kulkarani, Umesh Publications, 1998.
5. Mono Chrome and colour television, R. R. Ghulathi

BOOKS FOR REFERENCE

1. Electronic communications, Dennis Roody and Coolen, Prentice Hall of India, IV edition, 1995.
2. Advanced electronics communication systems,Wayne Tomasi,Fourth edition, Prentice Hall of India, 1998
3. Electronics communications, Dennis Roddy and Coolen, Prentice Hall of India IV Edition.1995.
4. Advanced Electronics communication System,Wayne Tomasi,4th edition, Prentice Hall of India, 1998.
5. Electronic Devices and Circuits, S. Salivahanan, N. Suresh Kumar & A. Vallavaraj, Second Edition, Tata McGraw, Hill Publishing Company Limited, New Delhi, 2009.

MATERIALS SCIENCE

Semester: I **Hours: 4**

Code : 23PPH1SE1 **Credit: 2**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Identify the properties and uniqueness of optical, Polymeric, ceramic and new materials	PSO-1, PSO-2	K1
CO - 2	Explain the processing and applications of different materials	PSO-1, PSO-2	K2
CO - 3	Classify all the advanced materials and categories based on its application range	PSO-3, PSO-4	K3
CO - 4	Examine and develop the knowledge on the fabrication of different materials used in daily life	PSO-3, PSO-4	K4
CO - 5	Summarize the concept of various materials and to apply that in real-time process.	PSO-5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: I				**MATERIALS SCIENCE**								**Hours: 4**
Code : 23PPH1SE1												**Credit: 2**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO1	5	3	4	3	2	2	5	5	4	3	3	3.54
CO2	5	4	4	3	3	2	5	5	3	4	2	3.64
CO3	5	3	4	4	2	2	3	3	5	5	2	3.45
CO4	5	4	4	3	3	2	3	4	5	5	2	3.64
CO5	5	4	4	3	2	2	4	3	3	4	5	3.54
Overall Mean Score												**3.56**

Result: The Score for this Course is **3.56** (High Relationship)

Note:

Mapping	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I: OPTICAL MATERIALS

Importance of optical materials - Optical absorption in metal- semiconductors and insulators - optical modulators - Optical fibers - types- advantages and applications - Display devices and materials- LED - construction and advantages of LED - LCD - Photoelectric electron emission - photo emissive cell - Photo conductive and PIN photodiodes, Photovoltaic cells. (**12 Hours)**

UNIT II: POLYMERIC MATERIALS

Monomers - structure of Polymers and types of polymers - degree of polymerization - Geometry of Polymeric chains - molecular structure - characteristic property - Mechanism of Polymerization - Homo and Copolymerization - Condensation of polymerization- Additives in Polymers - Strengthening mechanism of polymers - Mechanical and thermal behaviour of polymers. **(12 Hours)**

UNIT III: CERAMIC MATERIALS

Ceramic: classification of ceramics - refractories - silicates and silica - glass and glass ceramics - thermal behavior of glasses- Glass transition temperature - Graphite, Fullerenes, Carbon Products and Hard Ceramics – clay - based ceramics - cement – concrete. **(12 Hours)**

UNIT IV: COMPOSITE MATERIALS

Composites - Types of Composites - large particle composites - fiber reinforced composites - polymer matrix composites and metal matrix composites, Applications of MMC - carbon/carbon composites, Hybrid and Structural composites **(12 Hours)**

UNIT V: NEW MATERIALS

Principle of shape memory alloys - hysteresis - two - way shape memory effect, super elasticity, reverse transformation, methods of processing, commercial examples of shape memory alloys and applications - bulk metallic glass: principle, Preparation and properties, examples and applications. **(12 Hours)**

BOOKS FOR STUDY

1. Materials Science, M. Arumugam, 3rd revised Edition, Anuradha Agencies,2002
2. Material science and Metallurgy,U.C. Jindal, Saurabh printers Pvt. Ltd, 2013.
3. Materials Science, V. Rajendran and A. Marikani, Tata McGraw Hill Education Pvt. Ltd.2004.

DETAILED REFERENCE

1. Materials Science,M. Arumugam, 3rd revised Edition, Anuradha Agencies, 2002

   UNIT I:

   Chapter 10: 10.1,10.2, 10.4-10.7

2. Material science and Metallurgy, U.C. Jindal, Saurabh printers Pvt. Ltd, 2013

   UNIT II:

   Chapter 11: 11.1- 11.10, 11.15

   UNIT III:

   Chapter 12: 12.1-12.7, 12.9.2 -12.10.4, 12.11-12.13

   UNIT IV:

   Chapter 13: 13.1-13.3, 13.5.1-13.5.2, 13.7, 13.8, 13.10- 13.13

3. Materials Science,V. Rajendran and A. Marikani, Tata McGraw Hill Education Pvt. Ltd.2004.

   UNIT V:

   Chapter 19: 19.1- 19.6, Chapter 24: 24.1- 24.5

BOOKS FOR REFERENCE

1. Electronic and optoelectronic properties of semiconductor structures, Jasprit Singh, Cambridge University Press, 2007.
2. Fiber-Reinforced Composites, P. K. Mallick, CRC Press, 2008.
3. Materials Science and Engineering, V. Raghavan, 4th Edition, Prentice-Hall India, New Delhi (For units 2, 3, 4 and 5) 2003.
4. Materials Science, G.K. Narula, K.S. Narula and V.K. Gupta, Tata McGraw-Hill, 1988.

SOFT SKILL

Semester: I **Hours: 2**

Code : 23PAE1SK1 **Credit: 2**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	State their short and long term goals	PSO-1	K1
CO - 2	Associate their social, interpersonal, cognitive, ethical, professional, reading and communication skills	PSO-4, PSO-5	K2
CO - 3	Administer their self - esteem and confidence	PSO-4	K3
CO - 4	Formulate their resumes wisely	PSO-5	K4
CO - 5	Assess the mock group discussions and interviews with a challenge to choose their right career	PSO-4	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: I				**SOFT SKILL**							**Hours: 2**
Code : 23PAE1SK1											**Credit: 2**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	3	4	4	4	4	5	4	4	4	4	5	3.72
CO - 2	3	4	3	4	3	4	3	4	4	4	4	3.63
CO - 3	3	4	3	4	3	4	3	4	3	4	4	3.54
CO - 4	3	4	4	4	3	4	3	4	3	4	4	3.63
CO - 5	3	3	4	3	4	4	3	4	3	3	4	3.45
Overall Mean Score												**3.59**

Result: The score for this course is **3.59** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

UNIT I: SOFT SKILLS-INTRODUCTION

What are soft skills? - Importance of Soft skills-Difference between hard skills and soft skills-Top 60 soft skills. SWOC analysis-Self-Discovery-Advantages of SWOC analysis-Identifying your soft skills. **(6 Hours)**

UNIT II: ATTITUDE AND PERCEPTION

what is attitude? -formation of attitudes-positive and negative attitudes -power of positive attitude-developing positive attitude-obstacles in developing positive attitudes-results of positive attitude-overcoming negative attitude and its impacts. Perception - factors influencing perception-changing and improving perception towards positive attitude. **(6 Hours)**

UNIT III: TIME AND STRESS MANAGEMENT

Value of time-Sense of time management-Difficulties in time management-Evils of not planning-Reasons for procrastination-Overcoming procrastination- Effective scheduling-Steps to and Tips for Time Management-Deciding upon priorities-Grouping activities. Stress-Definition -Causes of Stress-Effects of Stress-Signs of stress-Stress as appositive and negative reinforcer-spotting stress in you-Behaviours identified with stress- for stress management. **(6 Hours)**

UNIT IV: EMOTIONAL BALANCE-TEAM BUILDING AND LEADERSHIP QUALITIES

What is Emotional Intelligence? -Emotional IQ-Intellectual IQ-Why emotional balance is important-Benefits of Emotional IQ-Four important Elements of Emotional IQ-Control of your reaction to situation. Skills needed for teamwork-Role of a team leader-challenges faced in collaboration-advantages of team-spirit. **(6 Hours)**

UNIT V: INTERVIEW SKILLS, GROUP DISCUSSION, PREPARING RESUME/CV

Types of interview-One to one Interview-Interview panel-Dress code at interview-punctuality-interview etiquettes-Group Discussion- Why group discussion-Types of group discussion-Skills required-GD Etiquette-Movement and gestures to be avoided-initiating a GD-Resolving conflicts. Preparing Resume/CV-Tips.**(6 Hours)**

COURSE BOOK:

- Dr. K. Alex, *Soft skills,* Chand & company Pvt. Ltd., New Delhi, 2010.

BOOK FOR REFERENCE:

- Kumar, Suresh, Sreehari and Savithri. *Communication Skills and Soft Skills: An Integrated Approach,* Pearson India, 2010.

INTERNAL QUESTION PATTERN

SOFT SKILLS - 23PAE1SK1

INTERNAL COMPONENTS

Test 1	40
Test 2	40
Term Paper	5
Seminar	10
Attendance	5
Total	**100**

MATHEMATICAL PHYSICS

Semester: II **Hours: 6**

Code : 23PPH2C03 **Credit: 5**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Explain the importance of various mathematical tools	PSO - 1, PSO - 2	K1
CO - 2	Demonstrate proficiency in mathematical concepts underpinning theoretical physics	PSO - 2, PSO - 3	K2
CO - 3	Apply physics problems using qualitative and quantitative reasoning	PSO - 2, PSO - 3	K3
CO - 4	Analyze mathematical problems using the relevant formulae and theorems.	PSO - 3, PSO - 4	K4
CO - 5	Model and solve everyday problems extensively using the acquired knowledge	PSO - 4, PSO - 5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: II				**MATHEMATICAL PHYSICS**							**Hours: 6**
Code : 23PPH2C03											**Credit: 5**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO-1	5	4	3	4	3	3	5	5	4	4	3	3.90
CO-2	5	4	3	4	3	2	4	5	4	3	3	3.72
CO-3	5	4	3	4	3	2	5	5	4	3	3	3.81
CO-4	5	4	3	4	3	2	4	5	5	2	3	3.72
CO-5	5	4	3	4	3	2	5	5	4	2	3	3.72
Overall Mean Score												**3.77**

Result: The Score for this Course is **3.77** (High Relationship)

Note:

Mapping	1 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs = $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I: VECTOR ANALYSIS

Differential Vector Operators: Gradient- Divergence- Curl- Circular Cylinder Coordinates - Area law of planetary motion- Navier-Stokes Term- Spherical PolarCoordinates-∇,∇.,∇Xforacentralforce-MagneticVectorPotential. **(18 Hours)**

UNIT II: COMPLEX ANALYSIS

Complex Algebra- Permanance of the Algebraic form- Complex Conjugation - Function of a Complex Variable- De Moivre's formula- Cauchy Riemann conditions- Analytic Functions- Cauchy's Integral Theorem- Contour Integrals- Stoke's Theorem Proof- Cauchy- Goursat Proof- Multiply Connected Regions- Cauchy's Integral Formula - Derivatives- Morera's Theorem- Laurent Expansion Taylor's Expansion Schwarz Reflection Principle Analytic Continuation - Laurent Series – Singularities - Poles - Branch Points.**(18 Hours)**

UNIT III: MATRIX THEORY

Determinationofeigenvalues-Eigenvectorsandtheirproperties-Diagonalization of matrix - Eigen vectors of commuting matrices- Differential equation to eigen value problem- Cayley Hamilton theorem - Minimal polynomial – Condition for diagonalizability – Diagonalization of normal matrices - Matrix polynomial.

(18 Hours)

UNIT IV: DIFFERENTIAL EQUATIONS

Partial Differential Equations (PDE) - Examples of PDE's- Classes of PDE's and Characteristics - Nonlinear PDE's - Boundary Conditions - First order Differential Equations - Separation of variables - Exact Differential Equations - Linear First Order ODE's- Singular points - Separation of variables - Cartesian Coordinates- Circular Cylindrical Coordinates- Spherical Polar Coordinates- Singular Points- Series solutions - Fresenius method - Symmetry of Solutions- Limitations of Series Approach - Bessel's Equation - Regular and Irregular Singularities - Fuchs' Theorem. **(18 Hours)**

UNIT V: INTEGRAL TRANSFORMS

Fourier transform- Few properties of Fourier transform (shifting property, convolution property, Parseval's theorem)- Fourier transform of derivatives - Development of the inverse Fourier transform - Laplace transforms- Properties of Laplace transforms- Laplace transform of derivatives- Inverse Laplace transform - Properties of Inverse Laplace transform. **(18 Hours)**

BOOKS FOR STUDY:

1. Mathematical methods for Physicists, G.B. Arfken & H.J. Weber, VIth Edition, ELSEVIER, A division of Reed Elsevier India Pvt. Ltd, 2004
2. Matrices and tensors in Physics, A.W. Joshi, Revised III Edition, New age International Publishers, 2002.
3. Mathematical Physics with Classical mechanics, Satya Prakash, Sultan chand and Sons, Fourth Revised and enlarged edition, 2002.

DETAILED REFERENCE:

1. Mathematical methods for Physicists, G.B. Arfken & H.J. Weber, VIth Edition, ELSEVIER, A division of Reed Elsevier India Pvt. Ltd, 2004

   UNIT I **:** Chapter 2: 2.2-2.5

   UNIT II **:** Chapter 6: 6.1-6.6.

   UNIT IV **:** Chapter 9: 9.1-9.5
2. Matrices and tensors in Physics, A.W. Joshi, Revised III Edition, New age International Publishers, 2002.

   UNIT III: Chapter 15: 15.1-15.5, Chapter 16: 16.1-16.7, Chapter 18: 18.1-18.3
3. Mathematical Physics with Classical mechanics, Satya Prakash, Sultan chand and Sons, Fourth Revised and enlarged edition, 2002

   UNIT V: Chapter 9.1-9.4, 9.9-9.11, 9.15, 9.17

BOOKS FOR REFERENCE:

1. The Mathematics of Physics and chemistry, Margenau & Murphy. Plurabella Books Ltd., United Kingdom, 1943.
2. Fourier Transforms in Physics, D.C. Champeney Wiley Eastern Ltd, 1988.
3. Applied Mathematics for engineers and Physicists, Louis. A. Pipes and Lawrence R. Harvill, III edn. McGraw - Hill International, 2014.

QUANTUM MECHANICS - I

Semester: II **Hours: 6**

Code : 23PPH2C04 **Credit: 5**

COURSE OUTCOMES:

CO NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO-1	Describe the historical aspects of development of quantum mechanics	PSO - 1	K1
CO-2	Understand and explain the difference between classical and quantum mechanics	PSO - 1, PSO - 2	K2
CO-3	Use the knowledge of quantum mechanics to different quantum mechanical systems encountered in different areas of physics	PSO - 2, PSO - 3	K3
CO-4	Analyze the fundamental quantum mechanical processes in nature	PSO - 3, PSO - 4	K4
CO-5	Construct approximate quantum mechanical models using mathematical tools	PSO - 4, PSO - 5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: II				**QUANTUM MECHANICS - I**							**Hours: 6**
Code : 23PPH2C04											**Credit: 5**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO-1	5	4	4	4	3	2	5	4	3	2	2	3.20
CO-2	5	4	4	5	4	3	5	5	3	2	2	3.40
CO-3	4	4	4	5	5	3	4	5	5	2	2	3.60
CO-4	5	3	4	5	3	4	4	3	5	5	2	3.80
CO-5	4	3	3	4	5	5	2	3	4	5	5	3.80
Overall Mean Score												**3.56**

Result: The score for this course is **3.56** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I: SCHRODINGER EQUATION AND STATIONARY STATES

Inadequacy of classical concepts - Black body radiation - Specific heats of solids - Photoelectric effect - Compton effect - Schrodinger equation - Free particle in 1D - Generalization to 3D - Particle subject to forces. Normalization and Probability Interpretation - Box Normalization - Conservation of Probability - Expectation Values: Ehrenfest's Theorem - Admissibility Conditions - Time Independent Schrödinger equation - Particle in a Square Well Potential - Bound states - non-localized states. **(18 Hours)**

UNIT II: WAVE MECHANICS

Schrödinger equation and Probability Interpretation for N Particle system - Fundamental Postulates of Wave Mechanics - Adjoint of an Operator - Degeneracy - Eigenvalue problem - Self Adjoint operators - Dirac Delta Function -Observables - Closure - Physical interpretation - Momentum Eigen functions - Uncertainty Principle - Minimum value for Uncertainty Product - Removal of degeneracy - Evolution of System with Time. **(18 Hours)**

UNIT III: EXACTLY SOLUBLE EIGENVALUE PROBLEMS

Simple harmonic oscillator -Schrodinger equation and Energy eigen values - Energy eigen functions - Properties of Stationary states - Abstract Operator method - Coherent States - Angular momentum operators - Eigen value equation for L_2 - Eigen values and Eigen functions - Spherical harmonics. Hydrogen Atom - Energy levels - Stationary State Wave functions - Discussion of Bound States. **(18 Hours)**

UNIT IV: SCATTERING THEORY

Differential and Total Cross-sections - Scattering Amplitude - Green's Functions - Born Approximation - Validity - Born Series - Eikonal approximation - Partial Wave Analysis - Phase Shifts - Optical theorem - Potentials of finite range - Low energy scattering - resonant and non resonant scattering. **(18 Hours)**

UNIT V: ANGULAR MOMENTUM

Eigenvalue spectrum - Matrix representation of J in the |jm> basis - Spin angular momentum - Diamagnetism - Addition of Angular momenta - Clebsch-Gordan Co-efficient - Spin wavefunctions for a system of two spin-1/2 particles - Addition of Spin and Orbital Angular momenta. **(18 Hours)**

BOOK FOR STUDY:

- A Textbook of Quantum Mechanics, P. M. Mathews & K. Venkatesan, Second Edition Seventh Reprint, McGraw Hill Education (India) Private Limited, New Delhi, 2014

DETAILED REFERENCE:

1. A Textbook of Quantum Mechanics, P. M. Mathews & K. Venkatesan, Second Edition Seventh Reprint, McGraw Hill Education (India) Private Limited, New Delhi, 2014

   UNIT I : Chapter 1: 1.3 to 1.6, Chapter 2: 2.1 to 2.12

   UNIT II : Chapter 3: 3.1 to 3.14

   UNIT III : Chapter 4: 4.1 to 4.9, 4.15 to 4.17

   UNIT IV : Chapter 6: 6.1 to 6.13

   UNIT V : Chapter 8: 8.1 to 8.9

BOOKS FOR REFERENCE:

1. Quantum Mechanics, L. I. Schiff, III edition, Tata McGraw Hill, New Delhi, 1968.
2. Relativistic Quantum Fields, Bjorken & Drell, Tata McGraw Hill, New Delhi, 1965.
3. Advanced Quantum Mechanics, J. J. Sakurai, Pearson Education Inc., New Delhi, 2008.
4. Quantum Mechanics,S. L. Kakani and H. M. Chandalia, Sultan & Sons, New Delhi, 2007.
5. Quantum Mechanics, Chatwal Anand, Himalaya Publishing House, Mumbai, 2007.

PRACTICAL - II

Semester: II **Hours: 6**

Code : 23PPH2P02 **Credit: 5**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Explain the functions of oscillators, shift registers, counters and other devices.	PSO - 1	K1
CO - 2	Determine the different parameters of the given materials using appropriate methods and equipments and write down the assembly language programs	PSO - 1, PSO - 2	K2
CO - 3	Compare the obtained results with the theoretical value.	PSO - 3	K3
CO - 4	Deduce the results from the required formulae/ program	PSO - 3, PSO - 4	K4
CO - 5	Assess the results.	PSO - 5	K5

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: II	PRACTICAL -II											Hours: 6
Code : 23PPH2P02												Credit: 5
Course Outcomes	Programme Outcomes (PO)						Programme Specific Outcomes (PSO)					Mean Score of CO's
	1	2	3	4	5	6	1	2	3	4	5	
CO - 1	4	4	3	5	4	3	5	4	4	3	3	3.90
CO - 2	4	3	3	5	4	3	5	5	4	3	3	3.81
CO - 3	3	3	3	5	4	3	4	4	5	3	3	3.72
CO - 4	4	3	3	5	4	3	4	4	5	5	3	3.81
CO - 5	3	3	3	5	4	3	3	3	4	4	5	3.82
Overall Mean Score												3.81

Result: The Score for this Course is **3.81** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

LIST OF PRACTICALS: (ANY NINE)

1. Construction of Mod-3,Mod-5,Mod-10Counters
2. To study of diode characteristics at different temperatures
3. Construction of Shift register & Ring counter using IC's
4. Program to find Largest & Smallest elements in array using 8085μp
5. Program to arrange the given set of numbers in the ascending & descending order
6. Construction of D/A Counter using IC 741
7. Construction of Wein's bridge & Phase shift Oscillator
8. Determination of e/m by Millikan's oil drop method.
9. Measurement of Hall co-efficient by Hall effect in Semi conductor.
10. To find the velocity of waves through different liquid media using Nan of luid Inter ferometer.
11. Construction of Decoder and Encoder circuits using IC's
12. Determination of refractive index of liquids using diode Laser.

NANO MATERIALS AND THEIR APPLICATIONS

Semester: II **Hours: 6**

Code : 23PPH2ID1 **Credit: 3**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Acquire the basic knowledge on nano science and nanotechnology.	PSO - 1	K1
CO - 2	Explain different types of nanomaterials based on their functions and structures.	PSO - 2, PSO - 3	K2
CO - 3	Apply the concept of nanoscale in various fields.	PSO - 3, PSO - 4	K3
CO - 4	Analyze the properties of nanostructured materials	PSO - 4	K4
CO - 5	Summarize the synthesis methods, Characterization, application of nanomaterials for knowing modern technology	PSO - 4, PSO - 5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: II				NANO MATERIALS AND THEIR APPLICATIONS								Hours: 6
Code : 23PPH2ID1												Credit: 3
Course Outcomes	Programme Outcomes (PO)						Programme Specific Outcomes (PSO)					Mean Score of CO's
	1	2	3	4	5	6	1	2	3	4	5	
CO - 1	5	4	3	3	2	2	5	4	5	4	4	3.72
CO - 2	5	5	4	3	3	2	3	5	5	4	2	3.72
CO - 3	3	3	4	5	3	5	2	3	5	5	3	3.72
CO - 4	2	3	5	4	3	2	2	3	4	5	4	3.36
CO - 5	2	3	3	4	5	3	3	3	3	5	5	3.54
Overall Mean Score												3.61

Result: The Score for this Course is **3.61** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

UNIT I: INTRODUCTION TO NANOSCIENCE

History - Definition of Nano meter, Nano meter and Nanotechnology-Classification of Nano materials - Nanotechnology from the Perspective of Medieval Period - Classification of Solid-state Materials- Bulk Properties of Materials-Effect of Size reduction on Bulk Properties-Optoelectronic Property of Bulk and Nanostructures.

(12 hours)

UNIT II: NANOSTRUCTURES ANDDIMENSIONS

Quantum confinement: Quantum wells, Quantum wires, Quantum Dots- Summary of the Confined states in Quantum Wells, Quantum Wires and Quantum Dots, Different Types of Nanostructures: Introduction- Shapes and Structures of Nano materials- Size Effect on Shape of Materials- Size Effect on Electronic Properties- Nanorods, Nanocones, Nanotetrapods, Nanoparticles- Nanocombs and Nano walls- Nanotubes, Nanowires and Nano islands- Semiconductor Nanoparticles.

(12 hours)

UNITIII: SYNTHESIS OFNANOMATERIALS

Synthesis Techniques for the Preparation of Nanoparticles: Bottom - Up Approach - Sol-Gel Synthesis - Hydrothermal growth- Thin film Growth: Physical Vapor Deposition- Chemical Vapor Deposition Top-Down Approach- Ball Milling - Micro fabrication - Lithography - Ion-Beam Lithography. **(12 hours)**

UNIT IV: CHARACTERIZATION OFNANOMATERIALS

Introduction - X- Ray Diffraction and Scherrer Method- Scanning electron microscope- Transmission electron microscope- Energy-Dispersive X-Ray Analysis-Scanning Probe Microscope (SPM) - Atomic Force Microscopy- Photoluminescence Spectra- Raman Spectroscopy. **(12 hours)**

UNIT V: APPLICATIONS OFNANOMATERIALS

Introduction - Applications in Biology and Medicine- Applications in surface Science- Applications in Energy and Environment- Applications of Nano structured Thin Films- Applications of Quantum Dots- Carbon Nanotechnology- Graphene- Applications of Carbon Nanotubes. **(12 hours)**

BOOKS FOR STUDY

- Nano science and Nano technology, M. S. Ramachandra Rao, Shubra Singh, Fundamental to Frontiers, Wiley India pvt. Ltd, 2013.

DETAILED REFERENCE

- Nano science and Nanotechnology, M. S. Ramachandra Rao, Shubra Singh, Fundamental to Frontiers, Wiley India pvt. Ltd, 2013.

UNIT I : Chapter 1- All Sections, Chapter 2: 2.4, 2.5, 2.7, 2.8

UNIT II : Chapter 3: 3.3-3.3.1, 3.3.2, 3.3.3, 3.3.4, Chapter 5: 5.1, 5.2-5.2.1 to 5.2.5, 5.4

UNIT III : Chapter 4 - 4.4.1,4.4.2

UNIT IV : Chapter 8- 8.1-8.7, 8.13, 8.14

UNIT V : Chapter 10- 10.1, 10.3-10.8

BOOKS FOR REFERENCES:

1. Introduction to Nano science and Nano technology, C.Binns, Vol. 14, John Wiley & Sons, 2010.
2. Introduction to Nano technology,P.C. Poole Jr, and F.J. Owens, John Wiley & Sons,2003.
3. Nano scale Science and Technology, R. Kelsall, I.W. Hamley, and M. Geoghegan, John Wiley & Sons, 2005.

MEDICAL PHYSICS

Semester: II **Hours: 4**

Code : 23PPH2SE2 **Credit: 2**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO-1	Define the basic concepts of modern biomedical instruments	PSO- 1	K1
CO-2	Explain the mechanism of transducer, bio amplifier, medical equipments and imaging systems	PSO- 1, PSO-2	K2
CO-3	Make use of the acquired knowledge in real life situation.	PSO-2, PSO-3	K3
CO-4	Analyze the special features of modern medical systems.	PSO- 3, PSO-4	K4
CO-5	Assess the importance of modern biomedical instruments in real life situation.	PSO-5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: II							**MEDICAL PHYSICS**					**Hours: 4**
Code : 23PPH2SE2												**Credit: 2**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO-1	5	3	3	3	3	3	5	3	3	3	2	3.27
CO-2	5	5	5	3	2	2	5	5	3	3	2	3.63
CO-3	3	3	2	5	2	5	3	5	5	3	2	3.45
CO-4	3	2	5	3	2	5	3	3	5	5	2	3.45
CO-5	3	3	3	3	5	4	4	3	2	2	5	3.36
Overall Mean Score												**3.43**

Result: The Score for this Course is **3.43** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

UNIT I: BIOPOTENTIAL ELECTRODES AND TRANSDUCERS

Transport of ions through cell membrane - Bio electric potential - Design of medical instruments - Electrodes - Micro & Surface - Transducers (active transducers only). **(12 Hours)**

UNIT II: BIO SIGNAL AMPLIFIERS AND RECORDERS

Isolation amplifier - Medical pre amplifier design - Chopper amplifier - Bio signal analysis - Characteristics of recording systems - Electrocardiography - Encephalography - Electromyography - Accuracy of recorders. **(12 Hours)**

UNIT III: PHYSIOLOGICAL ASSIST DEVICES

Pace makers - Artificial heart valves - Defibrillators - Nerve and muscle stimulators - Heart lung machine - Kidney machine**.** **(12 Hours)**

UNIT IV: SPECIALIZED MEDICAL EQUIPMENTS

Blood flow meters - Gas analyzers - Oximeters - Blood cell counters - Electron microscope - Radiation detectors - Photometers and calorimeters - Digital thermometers - Audio meters - X-ray tube - X-ray Machine. **(12 Hours)**

UNIT V: MODERN IMAGING SYSTEMS

Lasers in medicine - Endoscopes - Cryogenic Surgery - Nuclear imaging Techniques - Computer Tomography - Thermography - Ultrasonic imaging system - Magnetic resonance Imaging - Positron emission tomography - Digital subtraction angiography. **(12 Hours)**

BOOK FOR STUDY:

1. Bio medical Instrumentation, Dr. M. Arumugam, Anuradha Publication, 2006.

DETAILED REFERENCE:

- Bio medical Instrumentation, Dr. M. Arumugam, Anuradha Publication, 2006.

  UNIT I: Chapter 1: 1.4 to 1.6 Chapter 2: 2.2, 2.3, 2.4-2.4.1 to 2.4.5, 2.5

  UNIT II: Chapter 3: 3.3, 3.4, 3.8, 3.9.1 to 3.9.4, Chapter 4: 4.2 to 4.5, 4.7

  UNIT III: Chapter 5: 5.1, 5.2, 5.4 to 5.8

  UNIT IV: Chapter 6: 6.10, 6.13, 6.15, Chapter 7: 7.2 to 7.9

  UNIT V: Chapter 10: 10.3 to 10.12

BOOK FOR REFERENCE:

1. Physics of Diagnostic Radiology, Curry, Dowdey and Murry, Christensen's, Lippincot Williams and Wilkins, 1990.
2. Physics of Radiation Therapy, FM Khan, William and Wilkins, 3rd edition, 2003.
3. An Introduction to Biomedical Instrumentation, D. J. Dewhurst, 1st edition, Elsevier Science, 2014.

CYBER SECURITY

Semester: II **Hours: 2**

Code : 23PAE2SK2 **Credit: 2**

COURSE OUTCOMES

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO-1	State the need of Cyber Security and history of Internet	PSO-1, 2	K1
CO-2	Understand history and types of Cyber Crime	PSO-2,4	K2
CO-3	Apply critical thinking in Security Policies and Cyber Laws	PSO-3	K3
CO-4	Discuss and demonstrate the cyber security components and infrastructure security	PSO-3,4	K4
CO-5	Diagnose the ways and means of fighting Cyber Attacks	PSO-4,5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: II				**CYBER SECURITY**							**Hours: 2**
Code : 23PAE2SK2											**Credit: 2**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO-1	4	3	3	3	3	3	5	5	3	3	3	3.45
CO-2	3	3	3	3	3	3	4	5	3	5	3	3.45
CO-3	3	3	3	2	3	3	3	4	5	3	3	3.18
CO-4	3	3	3	3	3	3	3	4	5	5	3	3.45
CO-5	5	3	3	4	4	4	2	2	3	5	5	3.64
Overall Mean Score												**3.44**

Result: The score for this course is **3.44** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I

Introduction: Cyber Security – The need of the Hour - History of Internet – Impact of Internet – Internet in India **(6 Hours)**

UNIT II

Introduction to Cyber Security: Cyber Security – CIA Triad - Reasons for Cyber Crimes – Why we need Cyber Security – Damage to the Organizations – History of Cyber Crimes – Types of Cyber Crimes **(6 Hours)**

UNIT III

Cyber Security Components: OSI Layer – Zero Day Attacks – Types of Network Attacks – Application Security – Endpoint Security – Identify and Access Management (IAM) – Mobile Security – Data Security - Drive-By Download - Infrastructure Security - Disaster Recovery (DR) - End-user Education **(6 Hours)**

UNIT IV

Fighting Cyber Attacks: Defense in Depth – Authentication - Cryptography – Firewall - Data Loss Prevention - Antivirus Software - Virtual Private Network (VPN)- Web browsers - Data Backup – Conclusion **(6 Hours)**

UNIT V

Introduction to Security Policies and Cyber Laws: Need for an Information Security Policy - Information Security Standards – ISO - Introducing Various Security Policies and Their Review Process - Introduction to Indian Cyber Law - Objective and Scope of the IT Act, 2000 - Intellectual Property Issues - Overview of Intellectual-Property- Related Legislation in India - Patent - Copyright - Law Related to Semiconductor Layout and Design - Software License **(6 Hours)**

BOOKS FOR STUDY

1. **"Introduction to Cyber Security: Guide to the World of Cyber Security",** Anand Shinde, Notion Press, 2021

   Unit I : Chapter: 1

   Unit II : Chapter: 2.

   Unit III : Chapter: 3

   Unit IV : Chapter: 4.

2. "Introduction to information security and cyber laws", Dr. Surya Prakash Tripathi, Ritendra Goyal, Praveen Kumar Shukla, KLSI, Dreamtech Press, 2014

   Unit V : Chapter: 4

BOOKS FOR REFERENCE

1. **"Information and Cyber security: Principles and Practices",** S U, Aswathy; Faizal, Ajesh; V, Antony Asir Daniel, Noor Publishing, 2020
2. "**Security in the Digital Age: Social Media Security Threats and Vulnerabilities**", Henry A. Oliver, Create Space Independent Publishing Platform, 2015
3. "**Cybersecurity for Beginners**", Raef Meeuwisse, Second Edition, 2017
4. "**Auditing IT Infrastructures for Compliance**", Martin Weiss, Michael G. Solomon, 2nd Edition, Jones Bartlett Learning, 2017

WEB RESOURCES

1. https://www.coursera.org/professional-certificates/google-cybersecurity
2. https://www.coursera.org/learn/cybersecurity-for-everyone
3. https://www.coursera.org/specializations/intro-cyber-security
4. https://www.udemy.com/course/cybersecurity-from-beginner-to-expert/
5. https://www.udemy.com/course/it-law-cyber-crimes-and-data-protection-laws/

JACEP - EXTENSION

P.G. PROGRAMME OUTCOMES (2023 - 2026)

PO. NO.	UPON COMPLETION OF THIS PROGRAMME THE STUDENTS WILL BE ABLE TO
1.	Acquire comprehensive knowledge and evaluate analytically in their specific disciplines.
2.	Apply the acquired knowledge in professional and social life.
3.	Evolve new methodologies in the specific discipline leading to innovation and employability.
4.	Develop critical thinking required to pursue research.
5.	Apply the computational and life skills to the challenging problems in life.
6.	Design and develop independent projects.

PROGRAM SPECIFIC OUTCOMES (PSO)

PSO. NO.	UPON COMPLETION OF THIS PROGRAMME THE STUDENTS WILL BE ABLE TO	PO MAPPED
PSO - 1	Understand and identify the needs of the community and will be enabled to articulate viewpoints both practically and theoretically.	PO1, PO3
PSO - 2	Develop among themselves a sense of social and civic responsibility and will be enabled to be more culturally equipped.	PO2, PO3, PO4, PO6
PSO - 3	Apply their education to finding practical solutions to individual, community problems and will be enabled to exercise their rights properly.	PO1, PO3, PO4, PO6
PSO - 4	Acquire leadership qualities and a democratic attitude by carrying out their duties as effective citizens of the country.	PO2, PO3, PO5
PSO - 5	Develop the capacity to think clearly and cogently to meet emergencies and national disasters and practice national integration and social harmony	PO3, PO4, PO5

JACEP - EXTENSION

Semester: II **Hours: 30**
Code : 23PSL2EX1 **Credit: 1**
COURSE OUTCOMES

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Impart knowledge of the importance of education	PSO- 3, PSO-2	K1
CO - 2	Analyse the reasons for health problems and impart knowledge on a balanced diet.	PSO-1, PSO-5	K2
CO - 3	Develop a concern for the voiceless and faceless	PSO-1, PSO-2, PSO-5	K3
CO - 4	Get awareness of environmental issues	PSO-1, PSO-3	K4
CO - 5	Apply Knowledge to the society	PSO-3, PSO-4, PSO-5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: II				**JACEP - EXTENSION**							**Hours: 30**
Code : 23PSL2EX1											**Credit: 1**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	3	3	4	4	3	3	3	5	3	3	5	3.54
CO - 2	3	4	3	2	4	3	4	5	4	5	2	3.55
CO - 3	3	4	5	3	3	4	3	3	5	3	5	3.72
CO - 4	2	2	3	3	2	3	3	5	5	5	3	3.27
CO - 5	3	3	5	3	3	4	5	5	3	3	5	3.82
Overall Mean Score												**3.58**

Result: The score for this course is **3.58** (High relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

UNIT I: LITERACY GROUP:

Giving orientation to the students about JACEP - focusing on School dropouts and counseling the parents to re-admit the school dropouts - conducting awareness programs through kindling culturals - organizing games based on the disciplines - conducting competitions for school children – educating the school children about the positives and negatives of social media.

UNIT II: HEALTH AND HYGIENE GROUP:

Doing a survey on health problems - organizing medical camps and talks - organizing general check-ups by B.voc students of JAC to the adopted villages.

UNIT III: LIAISON GROUP AND PEOPLE ORGANIZATION GROUP:

Motivating NREGA workers to access government savings schemes - celebrating important days - organizing income generation skill training for self-help groups. organizing population education programmes - conducting awareness programmes on emerging social issues - fostering tie-ups with non-governmental organizations and local bodies to ensure the development of the villages - organizing youth, farmers and self-help group to function democratically.

UNIT IV: ENVIRONMENTAL GROUP:

Tree and sapling plantation - promotion of Herbal Gardens - organizing personal hygiene awareness talk – observing environmental-related days –awareness campaign to educate the villagers to protect the environment.

UNIT V: APPLICATION OF KNOWLEDGE:

Conducting Special Skill Training for self-employment based on discipline to the target group with the help of JAC SARWODEEP and government organizations – serving as intermediaries between unorganized sector workers and government welfare schemes.

SCHEME OF EVALUATION

Continuous Internal Assessment		
1.	Attendance (30 hours)	10 Marks
2.	Field Visit & Report	50 marks
3.	Assignment	40 Marks
Total		**100 marks**

QUANTUM MECHANICS - II

Semester: III **Hours: 6**

Code : 23PPH3C05 **Credit: 5**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO-1	Describe different approximation methods for stationary states	PSO - 1, PSO - 2	K1
CO-2	Discuss the time evolution of quantum mechanical systems and explain the concepts of propagators	PSO - 2, PSO - 3	K2
CO-3	Apply quantum mechanics principles to solve advanced problems involving multi-particle quantum systems.	PSO - 3, PSO - 4	K3
CO-4	Analyze the implications of various quantum phenomena on physical systems.	PSO - 4, PSO - 5	K4
CO-5	Evaluate the use of quantization formalism of electromagnetic field.	PSO - 5, PSO - 6	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: III				**QUANTUM MECHANICS - II**							**Hours: 6**
Code : 23PPH3C05											**Credit: 5**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO-1	5	4	4	5	3	2	5	4	4	3	4	3.90
CO-2	5	3	4	5	4	2	4	5	5	3	4	4.00
CO-3	5	2	4	4	4	2	5	5	5	2	4	3.81
CO-4	5	3	4	5	3	4	4	5	3	2	4	3.81
CO-5	5	3	5	5	3	4	5	5	4	2	3	4.00
Overall Mean Score												**3.90**

Result: The score for this course is **3.90** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I: APPROXIMATION METHODS FOR STATIONARY STATES

Perturbation theory for discrete levels: Non-degenerate - Degenerate - Applications. Variational method: Ground State energy - Application to excited states - Exchange interaction. WKB approximation: Bohr-Sommerfeld Quantum Condition - Applications. **(18 Hours)**

UNIT II: EVOLUTION WITH TIME

General Solution of Schrodinger equation - Propagators - Sudden Approximation - Perturbation theory - Transition Amplitude - Selection rules - First and Second Order transitions with Constant Perturbation - Scattering of a particle by a Potential - Inelastic Scattering - Double Scattering by two non-overlapping scatterers.

(18 Hours)

UNIT III: PERTURBATION THEORY AND ALTERNATIVE PICTURES

Harmonic perturbations - Interaction of an atom with EM radiation - Dipole Approximation - Einstein's Coefficients - Schrodinger picture - Heisenberg picture - Matrix mechanics - Electromagnetic wave as Harmonic Oscillator - Spontaneous emission - Interaction picture - Scattering operator. **(18 Hours)**

UNIT IV: RELATIVISTIC QUANTUM MECHANICS

Klein-Gordon equation - Limitations - Dirac equations - Dirac matrices - Plane wave solutions - Spin of the Dirac particle - Negative energy states - Dirac particle in EM fields - Dirac equation in Central field - Spin magnetic moment - Spin Orbit Energy.

(18 Hours)

UNIT V: QUANTUM FIELD THEORY

Lagrangian field theory - The Classical Field Equations - Hamiltonian Formulations- Quantization of the Field - Non-Relativistic Fields - System of Bosons and Fermions- Relativistic fields: Klein-Gordon field, Dirac field, Electromagnetic field - Interacting fields. **(18 Hours)**

COURSE BOOKS

1. P. M. Mathews & K. Venkatesan - A Textbook of Quantum Mechanics, Second Edition (Seventh Reprint 2014) - McGraw Hill Education (India) Private Limited, New Delhi.

   UNIT I: Chapter 5: 5.1 to 5.13
   UNIT II: Chapter 9: 9.1, 9.2, 9.4, 9.7 to 9.13
   UNIT III: Chapter 9: 9.14 to 9.22
   UNIT IV: Chapter 10: 10.1 to 10.11, 10.16, 10.17

2. V. K. Thankappan - Quantum Mechanics, Third edition - New Age International Publishers - 2012.

   UNIT V: Chapter 11: All sections.

BOOKS FOR REFERENCE:

1. L. I. Schiff, Quantum Mechanics, III edition, Tata McGraw Hill, New Delhi, 1968.
2. Bjorken & Drell, Relativistic Quantum Fields, Tata McGraw Hill, New Delhi, 1965.
3. J. J. Sakurai, Advanced Quantum Mechanics, Pearson Education Inc., New Delhi - 2008.
4. S. L. Kakani and H. M. Chandalia - Quantum Mechanics - Sultan & Sons, New Delhi - 2007.
5. Chatwal Anand - Quantum Mechanics - Himalaya Publishing House, Mumbai - 2007.

WEB SOURCES:

1. https://ocw.mit.edu/courses/physics/8-05-quantum-physics-ii-fall-2013/lecture notes/MIT8_05F13_Chap_09.pdf
2. http://www.thphys.nuim.ie/Notes/MP463/MP463_Ch1.pdf
3. http://hep.itp.tuwien.ac.at/~kreuzer/qt08.pdf
4. https://www.cmi.ac.in/~govind/teaching/rel-qm-rc13/rel-qm-notes-gk.pdf
5. https://web.mit.edu/dikaiser/www/FdsAmSci.pdf

NUMERICAL METHODS AND MATLAB

Semester: III **Hours: 6**

Code : 23PPH3C06 **Credit: 5**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO-1	Identify the methods of solving equations and describe the basics of MATLAB programming	PSO - 1, PSO - 2	K1
CO-2	Derive the formulae for various numerical methods and explain the special features of a MATLAB program	PSO - 2, PSO - 3	K2
CO-3	Apply the working rules of numerical methods for solving equations and illustrate the organization of a MATLAB program	PSO - 2, PSO - 3	K3
CO-4	Analyze the results of numerical methods and the respective MATLAB program	PSO - 3, PSO - 4	K4
CO-5	Formulate various steps of numerical methods and develop programs using MATLAB software for real life problems	PSO - 4, PSO - 5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: III				**NUMERICAL METHODS AND MATLAB**							**Hours: 6**
Code : 23PPH3C06											**Credit:5**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO-1	5	4	3	4	3	2	5	5	4	3	2	3.63
CO-2	5	4	3	4	3	2	4	5	5	3	3	3.73
CO-3	5	4	3	4	3	2	3	3	5	5	3	3.63
CO-4	5	4	3	4	3	2	3	2	3	5	5	3.55
CO-5	5	4	3	4	3	2	4	4	5	4	3	3.73
Overall Mean Score												**3.65**

Result: The score for this course is **3.65** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I: POLYNOMIAL AND TRANSCENDENTAL EQUATIONS

Basic properties of equations - Synthetic division - Bisection method - Regula Falsi method - Secant method - Iteration method - Aitken's method - Newton Raphson method.

INTERPOLATION

Equal intervals: Newton's forward and backward interpolation formula - Unequal intervals: Lagrange's formula. **(18 Hours)**

UNIT II: CURVE FITTING

Laws reducible to linear law - Method of least squares - Fitting a curve - Method of group averages - Method of moments.

SIMULTANEOUS ALGEBRAIC EQUATIONS

Direct methods of solution: Cramer's rule, Matrix inversion method, Gauss elimination method, Gauss-Jordan method, Factorization method - Iterative methods of solution: Jacobi's method, Gauss Siedel method, Relaxation method.

(18 Hours)

UNIT III: ORDINARY DIFFERENTIAL EQUATIONS

Picard's method - Taylor's Series method - Euler's method - Modified Euler's method - Runge's method - Runge Kutta method - Predictor Corrector methods.

NUMERICAL INTEGRATION AND DIFFERENTIATION

Trapezoidal rule - Simpson's 1/3 rule - Simpson's 3/8 rule - Boole's rule - Weddle's rule - Errors in quadrature formulae. **(18 Hours)**

UNIT IV: MATLAB FUNDAMENTALS

MATLAB environment - Types of files - Character set - Data types - Constants and variables - Operators - Hierarchy of operations - Built-in functions - Assignment statement - Data input - Interactive inputs - Reading/Storing File Data - Output commands - Low level input/output functions - Loops - Branches - Break and Continue statements - Editor - MATLAB programming - Function Subprograms - Passing function Arguments - Function Workspace. **(18 Hours)**

UNIT V: MATLAB PROGRAMS FOR NUMERICAL METHODS

MATLAB programs for: Bisection method - Regula-falsi method - Newton Raphson method - Gauss Elimination method - Factorization method - Gauss Siedal iteration method - Method of Least Squares - Method of Group Averages - Method of Moments - Newton's forward interpolation formula - Lagrange's interpolation formula - Trapezoidal rule - Simpson's rule - Euler's method - Modified Euler's method - Runge Kutta method. **(18 Hours)**

COURSE BOOKS:

1. B. S. Grewal and J. S. Grewal - Numerical methods in Engineering & Science, Eleventh Edition - Khanna Publishers, New Delhi - 2017.

   UNIT I: Chapter 2: 2.1 - 2.5, 2.8 - 2.12, Chapter 7: 7.1 - 7.3, 7.11, 7.12

   UNIT II: Chapter 5: 5.1 - 5.7, 5.9 - 5.11, Chapter 3: 3.3 - 3.5

   UNIT III: Chapter 10: 10.1 - 10.7, Chapter 8: 8.4 - 8.6

2. Raj Kumar Bansal, Ashok Kumar Goel and Manoj Kumar Sharma - MATLAB and its applications in Engineering, Second Edition - Pearson India Education Services Pvt. Ltd. Uttar Pradesh - 2017.

   UNIT IV: Chapter 1: 1.3, 1.5, Chapter 2: 2.2 - 2.8, Chapter 5: 5.2 - 5.6,
   Chapter 7: 7.2 - 7.5, Chapter 8: 8.2 - 8.6

   UNIT V: Chapter 16: 16.3 - 16.5, 16.8 - 16.11, 16.13 - 16.17, 16.20 - 16.24

BOOKS FOR REFERENCE:

1. H. K. Jain, S. R. K. Iyengar and R. K. Jain - Numerical methods for Scientific and Engineering Computation, IV edition - New Age International (P) Limited, Publishers, New Delhi - 2002.
2. J. N. Sharma - Numerical Methods for Engineers and Scientists - Narosa Publishing House, New Delhi - 2004.
3. P. Kandasamy, K. Thilagavathy and K. Gunavathy - Numerical Methods - S. Chand & Company Ltd, New Delhi - 2003.
4. E. Balagurusamy - Numerical Methods - Tata McGraw Hill Publishing Company Limited, New Delhi - 2005.

WEB SOURCES:

1. http://numericalmethods.eng.usf.edu/
2. http://www.mathworks.com/
3. https://matlab.en.softonic.com/
4. https://www.classcentral.com/tag/numerical-methods
5. https://onlinecourses.nptel.ac.in/noc19_ma21/preview

PRACTICAL - III

Semester: III **Hours: 6**

Code : 23PPH3P03 **Credit: 5**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO-1	Explain the working principle of Op-Amp and Program of microprocessor and MATLAB.	PSO - 1	K1
CO-2	Demonstrate the performance of IC 741, IC 7485 and MATLAB.	PSO - 1, PSO - 2	K2
CO-3	Build Circuits using ICs for Comparator and execute the Program in Microprocessor, MATLAB.	PSO - 3	K3
CO-4	Deduce the results from circuits and verify with theoretical values and Solving Problems	PSO - 3, PSO - 4	K4
CO-5	Assess the results with the standard values	PSO - 5	K5

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: III				**PRACTICAL - III**							**Hours: 6**
Code : 23PPH3P03											**Credit: 5**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO-1	4	3	4	4	2	2	5	4	3	3	2	3.27
CO-2	4	3	4	2	2	2	5	4	3	3	2	3.09
CO-3	3	3	4	4	2	2	4	4	5	3	2	3.27
CO-4	4	3	3	4	3	3	3	3	4	5	2	3.36
CO-5	4	3	3	3	4	3	4	3	3	4	4	3.45
Overall Mean Score												**3.28**

Result: The score for this course is **3.28** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

LIST OF PRACTICALS (any eight)

1. Determination of resistivity and band gap of a semiconductor using four probe method.
2. Construction of one bit, two bit and four-bit digital comparators.
3. Write various assembly language program using 8085 μP - Code conversion.
4. Construction of A/D Converter using ICs.
5. Construction of Phase Shift oscillator using Operational Amplifier.
6. Construction of Sinewave, Square wave and Triangular wave using Operational Amplifier.
7. Write the assembly language program for Ring Counter using 8085 microprocessors.
8. Write a MATLAB Program, to find the real root of $x \log_{10} x = 1.2$ correct to five decimals place using Newton's Raphson method.
9. Write a MATLAB Program, to find an approximate value of Y corresponding to x = 1, given that $\frac{dy}{dx} = x + y$ and y = 1 when x = 0 using Euler's method.
10. Write a MATLAB Program, to evaluate $\int_0^6 \frac{dx}{1+x2}$ using Simpson's rule.
11. Write a MATLAB Program, to evaluate $\int_0^6 \frac{dx}{1+x2}$ using Trapezoidal rule.
12. Write a MATLAB Program, to find a root of the equation $x^3 - 4x - 9 = 0$, using the bisection method correct to three decimal places.
13. Write a MATLAB Program, to evaluate f (9), using Lagrange interpolation method,

x	5	7	11	13	17
f (x)	150	392	1452	2366	5202

ADVANCED MATHEMATICAL PHYSICS

Semester: III **Hours: 6**

Code : 23PPH3E2A **Credit: 4**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO-1	Explain the importance of studying Group theory, Tensors and Special functions.	PSO - 1, PSO - 2	K1
CO-2	Demonstrate proficiency in mathematical concepts needed for a proper understanding of physics	PSO - 1, PSO - 2, PSO - 4	K2
CO-3	Apply mathematical problems and solutions in aspect of science and technology	PSO - 3, PSO - 4	K3
CO-4	Analyze mathematical problems using the relevant formulae and theorems.	PSO - 3, PSO - 5	K4
CO-5	Model and solve everyday problems extensively using the acquired knowledge	PSO - 4, PSO - 5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: III				**ADVANCED MATHEMATICAL PHYSICS**							**Hours: 6**
Code : 23PPH3E2A											**Credit: 4**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO-1	5	4	4	2	2	2	5	5	4	3	2	3.45
CO-2	5	5	3	2	2	2	5	5	4	5	3	3.71
CO-3	5	5	4	5	3	2	3	3	5	5	3	3.90
CO-4	5	5	4	2	3	2	3	3	5	4	3	3.54
CO-5	5	5	4	2	3	2	3	3	4	5	5	3.72
Overall Mean Score												**3.66**

Result: The score for this course is **3.66** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I: DISCRETE GROUPS

Group - The Multiplication Table - Conjugate elements and classes- Subgroups- direct product of group- isomorphism and homomorphism - invariant subspace and reducible representations- irreducible representations- Schur's Lemma and orthogonality theorem- Character Table of C4v, Symmetrized basis functions for irreducible representations **(18 Hours)**

UNIT II: CONTINUOUS GROUPS

Topological groups and Lie groups-the axial rotation group SO(2)- Generators of SO(2) - The three dimension rotation group SO(3) - irreducible representation SO(3)- connectedness of SO(3)- The group O(n)- special unitary group SU(2)- irreducible representations of SU(2)- Homomorphism of SU(2)on SO(2)- direct product representation of SU(2)- Lie algebra and representations of Lie group- Special unitary group SU(3)- Physical applications of SU(2) and SU(3) **(18 Hours)**

UNIT III: TENSORS

Occurrence of tensors in Physics- Notations and conventions- contravariant vector- covariant vector- tensors of second rank-general definition- Equality and null tensor- addition and subtraction- outer product of tensor- inner product of tensor- contraction of a tensor- symmetric and antisymmetric tensors- The Kronecker delta- metric tensor- associate tensors **(18 Hours)**

UNIT IV: SPECIAL FUNCTIONS I

Bessel function- Bessel functions of the first kind - Recurrence relation- Bessel's Differential equation- Integral representation- Bessel function of Nonintegral Order- Orthogonality- Normalization- Bessel Series- Continuum Form- Modified Bessel Functions- Recurrence Relations- Spherical Bessel function - definitions- Limiting Values- recurrence Relations - Orthogonality. **(18 Hours)**

UNIT V: SPECIAL FUNCTIONS II

Legendre Function- Legendre Polynomials- Linear Electric Multipoles- Vector Expansion- Extension to Ultraspherical Polynomials- Recurrence relations and special properties- Differential Equations- Special Values- Parity- Upper and Lower Bounds - Orthogonality- Expansion of Functions, Legendre Series- Spherical Harmonics- Azimuthal Dependence - Orthogonally- Polar Angle Dependance- Spherical Harmonics- Laplace Series, Expansion Theorem- Hermite function- recurrence Relations- Alternate Representations- Orthogonality- quantum Mechanical Simple Harmonic Oscillator- Laguerre functions- Associated Laguerre Polynomials. **(18 Hours)**

COURSE BOOKS:

1. AW Joshi, Elements of Group theory for Physicists, Fifth Edition, New Age International (P) Ltd, 2018

   UNIT I: Chapter 1: 1.1-1.6 Chapter 3: 3.2-3.3, 3.6, 3.8

   UNIT II: Chapter 4: 4.1- 4.3, 4.5, 4.7, 4.8
2. AW Joshi, Matrices and Tensors in Physics, Third Edition, New Age International (P) Ltd, 1995

   UNIT III: Chapter 5: 15.1-15.6, Chapter 16: 16.1-16.7, Chapter 18: 18.1, 18.3
3. G.B. Arfken & H . J . Weber, Mathematical methods for physicists, Elsevier, A division of Reed Elsevier India Pvt. Ltd, VI 2004

   UNIT IV: Chapter 11: 11.1-11.2, 11.5, 11.7.

   UNIT V: Chapter 12: 12.1-12.3, 12.6, Chapter: 13: 13.1-13.2

BOOKS FOR REFERENCE:

1. A. Pipes & R. Harvil, Applied Mathematics for Engineers and Physicists, III edition, McGraw Hill international Book Company, New Delhi, 2014.
2. Satya Prakash, Mathematical Physics with Classical mechanics, Sultan Chand and Sons, Fourth Revised and enlarged edition, 2002.

WEB SOURCES:

1. 1.https://vdoc.pub/documents/unitary-symmetry-and-elementary-particles-c4qsfejthkc0
2. https://physics.iith.ac.in/HEP_Physics/slides/poplawskitalk.pdf
3. https://www.hindawi.com/journals/amp/
4. https://projecteuclid.org/journals/advances-in-theoretical-and-mathematical-physics
5. https://www.springer.com/journal/11232

NONLINEAR DYNAMICS

Semester: III **Hours: 6**

Code : 23PPH3E2B **Credit: 4**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE, THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO-1	Define the parameters involved in nonlinear dynamics	PSO - 1	K1
CO-2	Find the difference between linear and nonlinear systems, equilibrium points, bifurcations and solitons	PSO - 1, PSO - 2	K2
CO-3	Apply the nonlinear principles to real life problems	PSO - 2, PSO - 3	K3
CO-4	Analyze the performance of nonlinear systems and the onset of new phenomena	PSO - 3, PSO - 4	K4
CO-5	Formulate the equations for various nonlinear systems and compute the solutions	PSO - 4, PSO - 5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: III				**NONLINEAR DYNAMICS**							**Hours: 6**
Code : 23PPH3E2B											**Credit: 4**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	4	3	2	4	4	5	4	4	3	3	3.73
CO - 2	5	4	3	4	2	3	5	5	4	3	2	3.64
CO - 3	4	3	3	5	4	2	4	5	5	2	3	3.64
CO - 4	5	4	3	2	4	3	3	4	5	5	4	3.82
CO - 5	5	4	3	4	3	2	3	3	4	5	5	3.73
Overall Mean Score												**3.71**

Result: The score for this course is **3.71** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

UNIT I: LINEAR AND NONLINEAR SYSTEMS

Linear and Nonlinear forces - Linear and Nonlinear systems - Linear Superposition Principle - Working definition and Effects of Nonlinearity - Linear and Nonlinear Oscillators: Free, Damped and Forced Oscillators - Primary and Secondary Resonances- Jump Phenomenon (Hysteresis). **(18 Hours)**

UNIT II: EQULIBRIUM POINTS: CLASSIFICATION AND STABILITY

Autonomous and Non-autonomous Systems - Coupled First order differential equations - Equilibrium points - Phase trajectories - Classification of equilibrium points - Criteria for Stability - Limit Cycle Motion: Periodic Attractor - Poincare - Bendix son theorem. **(18 Hours)**

UNIT III: BIFURCATIONS AND ONSET OF CHAOS

Simple Bifurcation: Saddle-Node, Pitchfork, Transcritical, Hopf - Discrete Dynamical Systems: Logistic Map - Equilibrium points and their stability - Periodic solutions - Periodic Doubling Phenomenon - Onset of chaos - Lyapunov exponent - Bifurcation diagram - Cobweb diagram. **(18 Hours)**

UNIT IV: LINEAR AND NONLINEAR DISPERSIVE WAVES

Linear and Nonlinear dispersive and non-dispersive wave propagation - Fourier transform and Solution of Initial Value Problem - Wave Packet and Dispersion - Wave of Permanence - John Scott Russel's Great Wave of Translation - Conodal and Solitary Waves - Cortege-de Vries (KdV) equation. **(18 Hours)**

UNIT V: KdV EQUATION AND SOLITONS

Scott Russel Phenomenon and KdV equation - Fermi-Pasta-Ulam (FPU) lattice - Recurrence Phenomenon - Asymptotic Analysis - Zabusky and Kruskal experiments - Birth of Solitons - Hirota's Direct or Bilinearization method for Soliton solutions of KdV equation. **(18 Hours)**

COURSE BOOKS:

- M. Lakshmanan and S. Rajasekar - Nonlinear Dynamics: Integrability, Chaos and Patterns, Springer (India) Private Limited, New Delhi, 2009.

  UNIT I: Chapter 1:1.1 to 1.4, Chapter 2: 2.1 (2.1.1 to 2.1.3), 2.2 (2.2.1 to 2.2.4)

  UNIT II: Chapter 3: 3.1 to 3.5

  UNIT III: Chapter 4: 4.1(4.1.1 to 4.1.4), 4.2 (4.2.1 to 4.2.10)

  UNIT IV: Chapter 11: 11.1 to 11.7

  UNIT V: Chapter 12: 12.1 to 12.5

BOOKS FOR REFERENCE:

1. G. Drazin and R. S. Johnson - Solitons: An Introduction - Cambridge University Press, 1989.
2. M. Lakshmanan and K. Murali - Chaos in Nonlinear Oscillators - World Scientific, 1989.
3. S. Strogatz - Nonlinear Dynamics and Chaos - Addison Wesley, 1995.
4. Hao Bai-Lin - Chaos - World Scientific, Singapore, 1984.
5. A. Hasegawa and Y. Kodama - Solitons in Optical Communications - Oxford Press, 1995.
6. P. G. Drazin - Nonlinear Systems - Cambridge University Press, 2012.
7. S. Wiggins - Introduction to Applied Nonlinear Dynamical Systems and Chaos - Springer, 2003.
8. H. Steven Strogatz - Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering - Westview Press, 2014.

WEB SOURCES:

1. https://www.digimat.in/nptel/courses/video/108106135/L06.html
2. http://digimat.in/nptel/courses/video/115105124/L01.html
3. https://www.digimat.in/nptel/courses/video/108106135/L01.html
4. http://complex.gmu.edu/neural/index.html
5. https://cnls.lanl.gov/External/Kac.php

BIOPHYSICS

Semester: III **Hours: 6**

Code : 23PPH3E2C **Credit: 4**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO-1	Describe the fundamental principles of biological dynamics.	PSO - 1	K1
CO-2	Explain the functioning of biological systems and techniques.	PSO - 1, 2	K2
CO-3	Apply biophysical principles and techniques to investigate biological phenomena.	PSO - 2,3	K3
CO-4	Analyze the impact of biophysical factors on the structure.	PSO - 3, 4	K4
CO-5	Assess the limitations and strengths of various biophysical methods for specific applications.	PSO - 4, 5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: III						**BIOPHYSICS**					**Hours: 6**
Code : 23PPH3E2C											**Credit: 4**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO-1	5	4	4	5	3	2	5	4	3	3	2	3.60
CO-2	5	3	4	5	4	2	5	5	3	3	2	3.71
CO-3	5	2	4	4	4	2	2	5	5	4	2	3.54
CO-4	5	3	4	5	3	4	2	2	5	5	3	3.72
CO-5	5	3	5	5	3	4	2	2	2	5	5	3.71
Overall Mean Score												**3.67**

Result: The score for this course is **3.67** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

UNIT I: CELL - ITS ORGANELLES AND MOLECULES

Prokaryotes and Eukaryotes - Molecular components of cell - Carbohydrates - Monosaccharides, Disaccharides, Polysaccharides - Lipids - Lipid monomers, Fatty acids, Multicomponent Lipids, Complex Lipids - Proteins - Nucleic Acids - Hetero macromolecules. **(18 Hours)**

UNIT II: PHYSICS OF BIOMOLECULES

Molecular forces - Strong force - Intermolecular weak forces - Structural organization of Proteins and Nucleic acids - Molecular mechanism of Genetic Information Transfer Genetic code - Transfer of genetic information - Molecular mechanism of Protein synthesis - Principle of molecular recognition. **(18 Hours)**

UNIT III: THERMODYNAMICS OF BIOMEMBRANES

Equilibrium thermodynamics - Near equilibrium thermodynamics - Isolated and Open systems - Gibbs free energy - Chemical potential - Thermodynamic analysis of membrane transport - Simple and Facilitated Diffusion - Phase Equilibrium - More on irreversible thermodynamics. **(18 Hours)**

UNIT IV: BIOENERGETICS

Bioenergetics and ATP molecules - Redox reactions - Electro-chemical Half cells, Redox couples - Cellular respiration - Mitochondria, Energetics, Respiration and Oxidative Phosphorylation - Chemiosmotic theory - Photosynthesis - Muscle contraction. **(18 Hours)**

UNIT V: NEUROBIOPHYSICS

Anatomy of neurons - Physico-chemical nature of membrane potential - Nernst potential, Hodgkin-Katz-Goldman potential, Donnan Potential - Electric analog of membrane - Nerve excitation - Action potential - Conduction of action potential - Synaptic transmission. **(18 Hours)**

COURSE BOOKS:

- P. K. Srivastava - Elementary Biophysics - Narosa Publishing House, New Delhi - 2005.

UNIT I: Chapter 6: 6.1 to6.7

UNIT II: Chapter 7: 7.1 to7.10

UNIT III: Chapter 9: 9.1 to9.7

UNIT IV: Chapter 10: 10.1 to10.6

UNIT V: Chapter 11: 11.1 to11.7

BOOKS FOR REFERENCE:

1. Vasantha Pattabhi - Biophysics - Prentice Hall of India Private Limited, New Delhi - 2003.
2. G. R. Chatwal - Biophysics - Himalaya Publishing House, Mumbai -2011.
3. Vatsala Piramal - Biophysics - Dominant Publishers and Distributors Private Limited, New Delhi -2014.
4. K. Sarn - Biophysics - Rajat Publications, New Delhi -2005.
5. Ismael Azad - Biophysics - Arise Publishers & Distributors, New Delhi -2008.

WEB SOURCES:

1. General Bio: http://www.biology.arizona.edu/DEFAULT.html
2. Electrophoresis: http://learn.genetics.utah.edu/content/labs/gel/
3. Online biophysics programs: http://mw.concord.org/modeler/
4. https://blanco.biomol.uci.edu/WWW Resources.html

SEWAGE AND WASTE WATER TREATMENT AND REUSE

Semester: III **Hours: 6**

Code : 23PPH3SE3 **Credit: 3**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Explain the importance of treating water effluents and reduce the sludge.	PSO- 1, PSO-2	K1
CO - 2	Classify various methodologies involved in the waste water treatment	PSO- 1, PSO-2	K2
CO - 3	Articulate various disinfection methods and its importance.	PSO- 2, PSO-3, PSO-4	K3
CO - 4	Illustrate 4 stages of water treatment and disinfection methods	PSO- 3, PSO-4	K4
CO - 5	Prioritize the waste water treatment and experience it through industrial visits	PSO- 4, PSO- 5	K5

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: III				**SEWAGE AND WASTE WATER TREATMENT AND REUSE**							**Hours: 6**
Code : 23PPH3SE3											**Credit: 3**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	4	3	2	3	3	5	5	4	3	2	3.55
CO - 2	5	4	3	3	2	2	5	5	3	2	2	3.27
CO - 3	5	4	3	2	3	2	3	5	5	5	2	3.55
CO - 4	5	4	4	3	3	2	3	2	5	5	2	3.45
CO - 5	5	4	4	2	2	2	2	3	4	5	5	3.45
Overall Mean Score												**3.45**

Result: The Score for this Course is **3.45** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

UNIT I: RECOVERY OF WASTE WATER AND TREATMENT

Water purification - Stage I Preliminary Treatment - stage II Primary Treatment - stage III Secondary Treatment - Stage IV Tertiary Treatment - Criteria for Water Purity - Dissolved Oxygen - Biochemical Oxygen demand - Chemical Oxygen Demand

WATER REUSE: Waste water reuse application - need for water reuse **(18 Hours)**

UNIT II: DISINFECTION

What Waterborne diseases are- Treatment options available- ozonisation - ultraviolet radiation - electron beam - biology of aquatic systems- disinfection by chlorination - Disinfection with Interhalogens and halogen mixtures- sterilization using ozone **(18 Hours)**

UNIT III: CHEMICAL DISINFECTION

Regulatory requirements for waste water disinfection - Disinfection theory: Characteristics of an ideal disinfection - disinfection methods and means- mechanism of disinfections - factors influencing the action of disinfection- Disinfection with Chlorine: Characteristics of Chloring compounds- Disinfection process- formation and control of disinfection byproducts - other chemical disinfection methods: Peracetic acid- peroxone- combined chemical disinfection process **(18 Hours)**

UNIT IV: PHYSICAL DISINFECTION

Disinfection with Ozone: Ozone properties, chemistry, disinfection - modelling ozone disinfection process- ozone dosage - by product formations- other benefits - UV Radiation disinfection: sources of UV-germicidal effectiveness- modelling- estimating UV Dose- Environmental impacts of UV **(18 Hours)**

UNIT V: TREATING THE SLUDGE

Sludge- stabilization and conditioning- pre stage basics-chemical stabilization- stabilization via aerobic digestion- stabilization via anaerobic digestion-role of mixing- sludge conditioning using chemicals- sludge conditioning by thermal methods- sludge pasteurization process- blending - wet air oxidation- sludge after volume reduction - overview of options **(18 Hours)**

COURSE BOOKS:

1. G.S. Sodhi, Fundamental concepts of environmental Chemistry, 3rd Edition, Narosa Publication, 2008
   UNIT I: Chapter 25: All sections
2. George Tchobanoglous, Franklin L. Burton, H. David Stensel, Waste water Engineering, Treatment and Reuse, 4th Edition, Metcalf & Eddy Inc, 2003
   UNIT I: Chapter 13: Pages 1350 - 1356
   UNIT III: Chapter 12: 2.1-12.3, 12.8
   UNIT IV: Chapter 12: 12.7, 12.9
3. Nicholas P. Cheremisinoff, Handbook of water and waste water treatment technologies, Butterworth-Heinemann publication, USA, 2002
   UNIT II: Chapter 11 all sections
   UNIT V: Chapter 12 pages 497 - 520, 560- 571

BOOKS FOR REFERNECE:

1. Frank. R Spellman, Handbook of Water and Wastewater Treatment Plant Operations, CRC Press, 2020
2. Mritunjay Chaubey, Wastewater Treatment Technologies, Wiley, 2021.
3. Metcalf and Eddy, Wastewater Engineering, 4th ed., McGraw Hill Higher Edu., 2002.
4. W. Wesley Eckenfelder, Jr., Industrial Water Pollution Control, 2nd Edn., McGraw Hill Inc., 1989
5. Lancaster, Green Chemistry: An Introductory Text, 2nd edition, RSC publishing, 2010

WEB SOURCES:

1. https://www.google.co.in/books/edition/Drinking_Water_DisinfectionTechniques/HVbNBQAAQBAJ?hl=en
2. https://www.meripustak.com/Integrated-Solid-Waste-Management-Engineering-Principles-And-Management-Issues-125648?
3. https://www.meripustak.com&gclid=Cj0KCQjwuuKXBhCRARIsAC-gM0iVpismAJN93CHA1sX6NuNeOKLXfQJjxHCOVH3QXjJ1iACq30KofoaAmFsEALw_wcB
4. https://www.meripustak.com&gclid=Cj0KCQjwuuKXBhCRARIsAC-gM0iVpismAJN93CHA1sX6NuNeOKLXfQJ jxHCOVH3QXjJ1iACq30KofoaAmFsEALw_wcB

INTERNSHIP

Semester: III

Code : 23PPH3IN1 **Credit: 2**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Recall and summarize the basic scientific concepts involved in concerned industry.	PSO-1	K1
CO - 2	Understand the principles and methodologies employed during the Internship.	PSO - 2	K2
CO - 3	Apply the subject knowledge and skills to conduct experiments, collection of data to be an entrepreneur.	PSO - 2, PSO - 3	K3
CO - 4	Analyze the steps involved in the training process.	PSO - 4	K4
CO - 5	Critically assess the effectiveness of experimental techniques.	PSO - 4, PSO - 5	K5

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: III				**INTERNSHIP**							**Credits: 2**
Code : 23PPH3IN1											
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO-1	4	3	4	4	2	2	5	4	3	3	3	3.45
CO-2	4	3	4	2	2	2	4	5	3	3	3	3.36
CO-3	3	3	4	4	2	2	4	5	5	2	2	3.45
CO-4	4	3	3	4	3	3	4	4	4	5	3	3.64
CO-5	4	3	3	3	4	3	4	4	4	5	5	3.64
Overall Mean Score												**3.51**

Result: The score for this course is **3.51** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

NUCLEAR AND PARTICLE PHYSICS

Semester: IV **Hours: 6**

Code : 23PPH4C07 **Credit: 5**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO-1	Explain the concepts of nuclear models, particles decay and elementary particles.	PSO - 1	K1
CO-2	Summarize the fundamentals of nuclear and particle physics.	PSO - 2, PSO - 3	K2
CO-3	Articulate different nuclear phenomena and the conservation laws of elementary particles.	PSO - 1, PSO - 2, PSO - 4	K3
CO-4	Analyze the outcome of nuclear scattering experiments.	PSO - 4, PSO - 5	K4
CO-5	Criticize the interactions of nuclear forces, nuclear models and symmetries of elementary particles.	PSO - 3, PSO - 5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: IV				**NUCLEAR AND PARTICLE PHYSICS**							**Hours: 6**
Code : 23PPH4C07											**Credit: 5**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO-1	5	4	5	5	3	2	5	4	3	4	2	3.81
CO-2	5	4	4	4	3	2	4	5	5	4	3	3.90
CO-3	5	3	4	5	4	2	5	5	3	5	2	3.90
CO-4	5	3	4	5	4	2	3	3	4	5	5	3.90
CO-5	5	3	4	5	3	2	3	3	5	3	5	3.72
Overall Mean Score												**3.84**

Result: The score for this course is **3.84** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I: ALPHA-PARTICLES

Determination of q/m for the α-particle - Range of α-particles - Energy of α-particles - Range - Velocity - Energy - Half Life Relations - Alpha Decay - Energy - Mass Number - Alpha particle spectra - Gamow's theory of α-decay - Advances in the theory of α-decay **(18 Hours)**

UNIT II: BETA - DECAY

Beta spectroscopy - Flat-type and Lens-type spectrometers - The Neutrino - Energy-Half-life relationships - Fermi theory of β-decay - Kurie plots - Mass of neutrino - Life-time of β-decay - Classification of Beta transitions - Selection rules for allowed and forbidden transitions - General theory of β-decay - Electron capture - Violation of parity conservation in β-decay - Helicity - Helicity of electron and of neutrino - Double Beta decay. **(18 Hours)**

UNIT III: NUCLEAR MODELS

Fermi gas model - Liquid drop model - Shell model - Magic numbers - Extreme Single Particle model - Square well of infinite depth - Harmonic Oscillator Potential, Spin-Orbit Potential - Single particle model - Individual Particle model - Predictions of shell model - Collective Nuclear model - Unified model - Deformed Shell model - Nilsson model - Superconductivity model. **(18 Hours)**

UNIT IV: NUCLEAR REACTIONS

Types of Nuclear reactions - Conservation laws - Nuclear reaction Kinematics - Nuclear Transmutations - Charged Particle reaction spectroscopy - Neutron spectroscopy - Nuclear cross-section - Classical analysis of cross section - Partial wave analysis of reaction cross section - Thick target yield - Requirements for a reaction - Reaction mechanism - General features of reaction cross-sections - Inverse reaction - Principle of detailed balance - Compound Nucleus - Compound nucleus reactions. **(18 Hours)**

UNIT V: ELEMENTARY PARTICLES

Classification of elementary particles - Fundamental interactions - Gravitational - Electromagnetic - Strong and Weak interactions - Conservation laws - Invariance under charge - Parity - C.P., time and CPT - Electron and Positron - Proton and antiproton - Neutron and Antineutron - Neutrino and antineutrino - Graviton - Phonon and Gluon - Mesons: Muons - Tauons - Pions - K-Mesons - η-Mesons - Hyperons: Λ-, Σ, Ξ, Ω-Hyperons - Hyper nuclei - Resonance states - Elementary particle symmetries - Quarks - Isospin of Quarks. **(18 Hours)**

COURSE BOOKS:

1. D. C. Tayal, Nuclear Physics, Himalaya Publishing House, 2014.

   UNIT I: Chapter 5: 5.1- 5.8

   UNIT II: Chapter 6: 6.1 - 6.11

   UNIT III: Chapter 9: 9.1 - 9.8

   UNIT IV: Chapter 10: 10.1 - 10.16

   UNIT V: Chapter 18: 18.1 - 18.20

BOOKS FOR REFERENCE:

1. Irving Kaplan, Nuclear Physics, Narosa Publishing House, New Delhi, 2002.
2. S. B. Patel, Nuclear Physics, New Age International Publishers, New Delhi, 2012.
3. Srivastava, Fundamentals of Nuclear Physics, Rastogi Publications, New Delhi, 2011.

WEB SOURCES:

1. http://bubl.ac.uk/link/n/nuclearphysics.html
2. http://www.phys.unsw.edu.au/PHYS3050/pdf/Nuclear_Models.pdf
3. http://www.scholarpedia.org/article/Nuclear_Forces
4. https://www.nuclear-powe.net/nuclear-power/nuclear-reactions/
5. https://www.nded.org/EducationResources/HighSchool/Radiography/radioactivedecay.html

CONDENSED MATTER PHYSICS

Semester: IV **Hours: 6**

Code : 23PPH4C08 **Credit: 5**

COURSE OUTCOMES:

CO. NO	UPON COMPLETION OF THE COURSE THE STUDENTS WILL BE ABLE TO	PSO addressed	Cognitive level
CO-1	Describe the basic theoretical concepts of crystal structure, lattice dynamics and other solid-state materials.	PSO - 1, PSO - 2	K1
CO-2	Explain the properties and significance of various materials from an experimental and solid-state theory view point	PSO - 2, PSO - 3	K2
CO-3	Apply needed analysis technique to typical problems encountered in different fields of condensed matter physics	PSO - 3	K3
CO-4	Analyze the microscopic/atomic processes between free electron gas/atoms and to differentiate the typical properties of different solid-state matter.	PSO - 3, PSO - 4	K4
CO-5	Imbibe the concepts and application of the different solid materials and to explore the knowledge towards real-time process.	PSO - 5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: IV				**CONDENSED MATTER PHYSICS**							**Hours: 6**
Code : 23PPH4C08											**Credit: 5**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	4	5	2	3	3	5	5	3	3	2	3.63
CO - 2	5	3	3	3	2	2	3	5	5	4	2	3.36
CO - 3	5	4	3	3	3	2	3	4	5	3	2	3.36
CO - 4	5	4	4	3	3	2	3	4	5	5	2	3.63
CO - 5	5	4	4	2	2	2	3	3	4	4	5	3.45
Overall Mean Score												**3.49**

Result: The score for this course is **3.49** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I: CRYSTAL PHYSICS

Periodic Arrays of atoms - Basis and crystal structure - Fundamental types of lattices (2D, 3D) - Index system for crystal plane - Simple crystal structures - Diffraction of waves by crystals- Bragg's law - Scattered Wave Amplitude - Fourier Analysis - Reciprocal Lattice vectors - Diffraction Conditions - Laue equations - Brillouin zone - Reciprocal lattice to sc, bcc, fcc lattice - Fourier analysis of the Basis - Structure factor - Atomic form factor - Crystals of Inert gas -Cohesive energy - Ionic crystals - Madelung energy - Evaluation of the Madelung Constant. **(18 Hours)**

UNIT II: LATTICE DYNAMICS

Vibrations of crystals with monoatomic basis - First Brillouin zone - Group velocity - Long Wavelength limit - Derivation of force constant from experiment - Two atoms per primitive cell - Quantization of lattice waves - Phonon momentum - Inelastic scattering by phonons - Debye model for density of states - Debye T^3 law - Einstein model of the density of states - General result for $D(\omega)$ - Anharmonic crystal interactions - Thermal Conductivity - Thermal resistivity of Phonon gas - Umklapp processes- Imperfections. **(18 Hours)**

UNIT III: THEORY OF FREE ELECTRON FERMI GAS AND METALS

Energy levels in one dimension - Effect of temperature on the Fermi- Dirac distribution - Free electron gas in three dimensions - Heat capacity of the electron gas - Experimental heat capacity of metals - Hall effect - Thermal conductivity of metals - Ratio of thermal to electrical conductivity - Energy bands - Nearly free electron model - Origin of the energy gap - Bloch functions - Kronig-Penney model - Wave equations of electron in a periodic potential- Restatement of the Bloch theorem - crystal momentum of an electron - Solution of the central equation - Kronig-Penney model in reciprocal space - Construction of Fermi surfaces - Experimental methods in Fermi surface studies - de Hass-van Alphen effect - Extremal orbits - Fermi surface of Copper and Gold. **(18 Hours)**

UNIT IV: SUPERCONDUCTIVITY

Experimental survey - Occurrence of superconductivity - Destruction of superconductivity by magnetic fields - Meissner effect - Heat capacity - Energy gap - Microwave and infrared properties - Isotope effect - Theoretical survey - Thermodynamics of super conducting transition - London equation - Coherence length - BCS theory of superconductivity - BCS Ground state - Flux quantization in a superconducting ring - Duration of Persistant currents - Type II superconductors - Vortex state - Estimation of H_{c1} and H_{c2} - Single particle tunneling - Josephson superconductor tunneling - DC and AC Josephson effects - High Temperature Superconductors. **(18 Hours)**

UNIT V: MAGNETISM

Diamagnetism - Langevin Diamagnetism equation - Quantum theory of diamagnetism of mononuclear systems - Paramagnetism - Quantum theory of Paramagnetism - Rare earth ion - Hund's rule - Tron group Ions - Crystal field splitting - Quenching of orbital angular momentum - Ferromagnetic order- Curie point and the Exchange integral - Magnons - Quantization of spin waves - Thermal excitation of magnons - Neutron magnetic scattering - Ferrimagnetic order - Curie temperature and susceptibility of ferrimagnets - Iron Garnets - Antiferromagnetic order - Susceptibility below the Neel temperature - Antiferromagnetic Magnons - Ferromagnetic domains - Anisotropy energy - Transition region between Domains - Origin of Domains. **(18 Hours)**

COURSE BOOK:

- C. Kittel, Introduction to Solid State Physics, 8th Edition, Wiley, New York, 2019.

UNIT I: Chapter 1: Pages: 3 -18, Chapter 2: Pages: 27- 45,
Chapter 3: Pages: 51-55, 61-68.

UNIT II: Chapter 4: Pages: 92-104, Chapter 5: Pages: 114-130

UNIT III: Chapter 6: Pages: 135-149, 155-159, Chapter 7: Pages: 165-178,
Chapter 9: Pages: 228- 230, 244 - 251.

UNIT IV: Chapter 10: Pages: 261-296.

UNIT V: Chapter 11: Pages: 300-313, Chapter 12: Pages: 324-328, 332-354.

BOOKS FOR REFERENCE:

1. Rita John, Solid State Physics,1st Edition, Tata Mc-Graw Hill Publication, 2014.
2. A. J. Dekker, Solid State Physics, 1st Edition, Macmillan India, New Delhi, 2000.
3. M. Ali Omar, Elementary Solid-State Physics - Principles and Applications, Addison - Wesley, 1974.
4. H. P. Myers, Introductory Solid-State Physics, 2nd Edition, Viva Book, New Delhi, 1998.
5. J. S. Blakemore, Solid state Physics, 2nd Edition, W.B. Saunder, Philadelphia, 1974.

WEB SOURCES:

1. http://www.physics.uiuc.edu/research/electronicstructure/389/389-cal.html
2. http://www.cmmp.ucl.ac.uk/%7Eaph/Teaching/3C25/index.html
3. https://www.britannica.com/science/crystal
4. https://www.nationalgeographic.org/encyclopedia/magnetism/
5. https://www.brainkart.com/article/Super-Conductors_6824/

SPECTROSCOPY

Semester: IV **Hours: 5**

Code : 23PPH4C09 **Credit: 4**

COURSE OUTCOMES:

CO NO	UPON COMPLETION OF THE COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO-1	Comprehend the theory behind different spectroscopic methods	PSO -1, PSO - 2	K1
CO-2	Explain the importance of different analytical tools and the working principles of different types of spectrometers	PSO -2, PSO - 3	K2
CO-3	Apply spectroscopic techniques for the qualitative and quantitative analysis of various chemical compounds.	PSO - 3, PSO -4	K3
CO-4	Analyze the spectral ranges and the corresponding properties of the materials	PSO - 2, PSO - 4	K4
CO-5	Explore various applications of spectroscopic techniques towards R & D.	PSO -1, PSO - 5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: IV				**SPECTROSCOPY**							**Hours: 5**
Code : 23PPH4C09											**Credit: 4**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	4	5	2	3	3	5	5	3	3	2	3.63
CO - 2	5	3	3	3	2	2	3	5	5	3	2	3.27
CO - 3	5	4	3	3	3	2	3	3	5	5	2	3.45
CO - 4	5	4	4	3	3	2	3	4	3	5	2	3.45
CO - 5	5	4	4	2	2	2	4	2	3	3	5	3.27
Overall Mean Score												**3.41**

Result: The score for this course is **3.41** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

UNIT I: MICROWAVE SPECTROSCOPY:

Rotational of molecules - Classification of Molecules - Interaction of Radiation with Rotating molecule - Rotational spectra of Rigid diatomic molecules - Effect of isotopic substitution - Intensity of Spectral Lines - Non rigid rotator - Vibrational excitation effect - Linear Polyatomic molecules - Symmetric top molecules - Asymmetric top molecules - Stark effect - Quadrupole Hyperfine Interaction - Instrumentation techniques: Microwave spectrometer - Information Derived from Rotational Spectra- Problems. **(15 Hours)**

UNIT II: INFRA-RED SPECTROSCOPY:

Vibrational energy of a diatomic molecule - Zero-point energy- Infrared spectra - Preliminaries - Selection rules - Vibrating diatomic molecule - Diatomic Vibrating Rotator- PR branch - PQR branch- Asymmetry of rotation, vibration band- Normal vibration of H_2O and CO_2 - Anharmonicity - Rotation, vibration spectra of polyatomic molecules - Interpretation of vibrational spectra - Group frequencies - Introduction to application of vibrational spectra: IR Spectrophotometer Instrumentation - Fourier Transform Infrared Spectroscopy - Advantages - Applications - Other applications, Problems. **(15 Hours)**

UNIT III: RAMAN SPECTROSCOPY:

Theory of Raman Scattering - Classical theory - Quantum theory of Raman effect - Rotational Raman spectra of linear molecule - Symmetric top molecule - Spherical and Asymmetric top molecules - Vibrational Raman Spectra - Mutual exclusion principle - Instrumentation technique and block diagram - Raman Spectrometer- Sample Handling techniques - FT Raman spectrometer - Single crystal Raman spectra - Structure determination using IR and Raman Spectroscopy - Industrial applications - Resonance Raman Scattering - SERS - applications, Problems.

(15 Hours)

UNIT IV: ELECTRONIC SPECTRA OF DIATOMIC MOLECULES:

Vibrational Coarse structure - Vibrational analysis of Band systems - Deslandres Table - Progressions and sequences - Information derived from vibrational analysis - Franck-Condon Principle - Intensity of vibrational electronic spectra- Rotational fine structure of electronic - vibration spectra - The Fortrat Parabolae - Dissociation - Predissociation - Electronic angular momentum in diatomic molecules - Photoelectron spectroscopy - Instrumentation - Information from Photoelectron Spectra, Problems. **(15 Hours)**

UNIT V: RESONANCE SPECTROSCOPY:

Magnetic Properties of nuclei- Resonance condition- NMR Instrumentation - Additional experimental techniques of NMR spectroscopy - Relaxation Processes - Bloch equation - Dipolar Interaction - Chemical shift and its measurement - Indirect Spin -Spin Interaction - NMR Imaging- Interpretation of certain NMR spectra

Electron Spin Resonance: Basic principle - ESR spectrometer - Total Hamiltonian - Hyperfine Structure (H_2 atom) - ESR Spectra of Free radicals in solution - Anisotropic systems - g - factors. **(15 Hours)**

COURSE BOOK:

- G Aruldhas, Molecular Structure and Molecular Spectroscopy, Second Edition, Prentice - Hall of India, New Delhi, 1994.

  UNIT I: Chapter 6: 6.1 -6.15

  UNIT II: Chapter 7: 7.1 - 7.8, 7.11, 7.14, 7.16 -7.19

  UNIT III: Chapter 8:8.1 -8.7, 8.9, 8.11, 8.12, 8.15, 8.16, Chapter 14: 14.6, 14.7

  UNIT IV: Chapter 9: 9.1 -9.12

  UNIT V: Chapter 10: 10.1-10.9, 10.19,10.20 Chapter 11:11.1 -11.5.1, 11.6, 11.7

BOOKS FOR REFERENCE:

1. C N Banwell and E M Mc Cash, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw-Hill, New Delhi,1994.
2. D.N. Satyanarayana, Vibrational Spectroscopy and Applications, 3rd Edition, New Age International Publication, 2001.
3. B.K. Sharma, Spectroscopy, 1st Edition, Goel Publishing House Meerut, 2015.
4. Kalsi. P.S, Spectroscopy of Organic Compounds, 7th Edition, New Age International Publishers, 2016.

WEB SOURCES:

1. https://www.youtube.com/watch?v=0iQhirTf2PI
2. https://www.coursera.org/lecture/spectroscopy/introduction-3N5D5
3. https://www.coursera.org/lecture/spectroscopy/infrared-spectroscopy-8jEee
4. https://onlinecourses.nptel.ac.in/noc20_cy08/preview
5. https://www.coursera.org/lecture/spectroscopy/nmr-spectroscopy-introduction-XCWRu

ELECTROMAGNETIC THEORY

Semester: IV **Hours: 5**

Code : 23PPH4E3A **Credit: 3**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Recognize the fundamental laws of electromagnetic theory and the basic concepts of plasma.	PSO-1	K1
CO - 2	Outline the electromagnetic wave theory and Debye theory	PSO-1, PSO-2	K2
CO - 3	Determine Poynting vector for E and H in various media and plasma parameters.	PSO-3	K3
CO - 4	Examine the basic principles of electrical and electronic circuits over the entire electromagnetic spectrum	PSO-4	K4
CO - 5	Deduct the applications of electromagnetic theory and plasma.	PSO-4, PSO-5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: IV				**ELECTROMAGNETIC THEORY**								**Hours: 5**
Code : 23PPH4E3A												**Credit: 3**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	5	4	5	3	3	2	5	4	3	3	2	3.55
CO - 2	4	4	5	3	2	2	5	4	3	4	2	3.45
CO - 3	3	4	5	3	3	2	4	3	5	3	2	3.36
CO - 4	5	4	4	2	2	2	4	3	3	5	2	3.27
CO - 5	4	4	5	2	2	2	4	3	3	4	5	3.45
Overall Mean Score												**3.41**

Result: The score for this course is **3.41** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

UNIT I: BASICS OF ELECTROMAGNETISM

Coulomb's law, Gauss law, Poisson's law - The equations of Poison's and Laplace - conductors - Potential energy - charge distribution - Conservation of electric charge - electric charge - Biot savart law - vector potential - Ampere's circuital law.

(15 Hours)

UNIT II: MAXWELL'S EQUATIONS

The potentials V and A - Lorenz condition - the divergence of E and the non - homogeneous wave equation for V and A - the curl of B - Maxwell's equations Duality - Lorentz Lemma - The nonhomogeneous equations for E and B propagation of EM waves in free space, non-conducting and conducting medium- good conductors. **(15 Hours)**

UNIT III: PROPAGATION OF EM WAVES

The Laws of Reflection and Snell's Law of Refraction - Fresnel's equations - Reflection and Refraction at the Interface between two nonmagnetic non-conductors - Total Reflection at an Interface between two non-conductors- Reflection and Refraction at the surface of a good conductor - Propagation through different interfaces - propagation through Coaxial line -through rectangular wave guides. **(15 Hours)**

UNIT IV: RADIATION OF EM WAVES

Retarded potentials- Oscillating electric dipole- magnetic dipole and quadruple field radiation - half wave antenna - point charge radiation - relativistic electrodynamics - Reciprocity theorem. (**15 Hours)**

UNIT V: INTRODUCTORY PLASMA PHYSICS

Basic concepts of plasma, concepts of temperature-Debye shielding-the plasma parameter-criteria for plasmas applications in plasma.

PLASMA APPLICATIONS

Motion of charged particle in electromagnetic fields - E and B uniform and non-uniform fields, time varying fields -Adiabatic invariants. **(15 Hours)**

COURSE BOOKS:

1. Dale Corson & Paul Lorrain, Electromagnetic Fields &Waves, CBS Publishers, New Delhi, Reprint 2001.

   UNIT I: Chapter 2:2.1, 2.5, 2.6, 2.7, 2.8, 2.14, Chapter 7: 7.2, 7.7, Chapter 10: 10.1, 10.3 - 10.10 (all sections)

   UNIT II: Chapter 11: 11.1 - 11.5.

   UNIT III: Chapter 12: Chapter 12: 12. 1 - 12.5, Chapter 13:13.2, 13.3

   UNIT IV: Chapter: 10.2, 10.2.1. Chapter: 14.2 -14.2.1, 14.2.2, 14.2.3, 14.5.14.6. 14.8.

2. S. N. Goswami, Elements of Plasma Physics, New Central Book Agency (P) Ltd., Calcutta, 1995.

   UNIT V: Chapter 1: 1.1 -1.8, Chapter 4:4.5, Chapter 3:3.7, 3.2, Chapter 7: 7.1, 7.2 (Book 2) Chapter 2: 2.1 - 2.3 - 2.3.1 - 2.3.3, 2.6, 2.1 (Book 2)

BOOKS FOR REFERENCE:

1. David Griffiths, Electrodynamics, Pearson Education, III Edition, 1998.
2. F. Francis, Introduction to Plasma Physics & Controlled Fusion (Volume I), Chen, Plenum Press, New York, Edition II, 1995.

WEB SOURCES:

1. http://www.plasma.uu.se/CED/Book/index.html
2. http://www.thphys.nuim.ie/Notes/electromag/frame-notes.html
3. http://www.thphys.nuim.ie/Notes/em-topics/em-topics.html
4. http://dmoz.org/Science/Physics/Electromagnetism/Courses_and_Tutorials/
5. https://www.cliffsnotes.com/study-guides/physics/electricity-and-magnetism/electrostatics

CRYSTAL GROWTH AND THIN FILMS

Semester: IV **Hours: 5**

Code : 23PPH4E3B **Credit: 3**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO-1	Define the basic concepts of crystal growth and thin film formation.	PSO-1	K1
CO-2	Explain the crystal Growth techniques and thin film deposition methods	PSO-1, PSO-2	K2
CO-3	Apply acquired knowledge in various crystal growth and thin film techniques	PSO-2, PSO-3	K3
CO-4	Analyze the crystal structure and the quality of thin films.	PSO-3, PSO-4	K4
CO-5	Assess the merits of crystal growth techniques and evaluate the performance of thin films.	PSO - 4, PSO-5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: IV			**CRYSTAL GROWTH AND THIN FILMS**						**Hours: 5**			
Code : 23PPH4E3B												**Credit: 3**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO-1	5	4	4	5	3	2	5	4	3	3	2	3.60
CO-2	5	3	4	5	4	2	5	5	3	3	2	3.71
CO-3	5	2	4	4	4	2	2	5	5	4	2	3.54
CO-4	5	3	4	5	3	4	2	2	5	5	3	3.72
CO-5	5	3	5	5	3	4	2	2	2	5	5	3.71
Overall Mean Score												**3.60**

Result: The score for this course is **3.60** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I: CRYSTAL GROWTH PHENOMENA

Crystal growth techniques - Chemical physics of crystal growth - Nucleation - Theories of nucleation - Classical theory of nucleation - Gibbs Thomson equation for vapor - Modified Thomson's equation for melt - Gibb's Thomson's equation for solution - Energy of formation of a nucleus - Spherical nucleus -Cylindrical nucleus - Heterogeneous nucleation - Cap-shaped nucleus - Disc-shaped nucleus.

(15 Hours)

UNIT II: MELT GROWTH AND SOLUTION GROWTH

Growth from the melt - The Bridgman and related techniques - Container selection - Crystal pulling - Equilibrium - Advantages - Versatility and adaptability - Visibility and speed of growth -Unconstrained growth - Doping - Dislocation control - Disadvantages - Growth stride - Facets - The crystal pulling technique - Practice of crystal pulling - Description of the controlling parameters - Low temperature solution growth - High temperature solution growth. **(15 Hours)**

UNIT III: CRYSTAL GROWTH TECHNIQUES

Vapor Growth - Physical Vapour Deposition - Chemical Vapor Deposition - Advantages and Disadvantages of CVD - Chemical Vapor Transport - Hydrothermal growth - Gel Growth - Materials selection. **(15 Hours)**

UNIT IV: THIN FILM DEPOSITION TECHNIQUES

Deposition technology - Thermal Deposition in Vacuum -Kinetic Theory of Gas and Emission Condition - Distribution of Deposit - Resistance Heating - Thermal Evaporation - Flash Evaporation - Multi Evaporation process - F. or Induction Heating -Electron Beam Method - Sputtering - Chemical Vapour Deposition & vapor Plating - Thermal Decomposition - Vapor Phase Reaction - Vapor Transportation Method - Disproportionation Method - Chemical Deposition - Electrodeposition - Anodic Oxidation - Electroless Plating - Deposition by Chemical Reaction - Chemical Displacement. **(15 Hours)**

UNIT V: THIN FILM APPLICATIONS

Discrete Resistive Components - Resistors - Carbon Films - Oxide and Nitride films - Cermet films - Metal films - Thermistor - Varistor - Strain gauge element - Capacitor - Hall Probe Element - Active Devices - Micro-Electronics, Integrated circuits and other applications - Applications of Thin Film Dielectrics - Applications of Superconducting and magnetic films. **(15 Hours)**

COURSE BOOKS:

1. P. Santhana Raghavan and P. Ramasamy, Crystal Growth: Processes and Methods, Kru Publications, 2000.

   UNIT I: Chapter 1: 1.4, 1.5

   Chapter 2: 2.2.1, 2.2.2, 2.2.2-1, 2, 3, 4, 5, 6, 2.2.3-1, 2.

   UNIT II: Chapter 3: 3.2, 3.3, 3.3.1, 3.4, 3.4.1, 3.4.2, 3.4.2-1, 2, 3, 4, 5, 3.4.3-1, 2, 3.4.4-1, 2

   Chapter 4: 4.1, 4.1-1, 2, 3, 4.1.3-1, 2, 3, 4.2, 4.2-1, 2, 3, 4.3, 4.4, 4.5, 4.6-1, 2, 4.7-1, 2, 4.8, 4.8.1

   UNIT III: Chapter 6: 6.1, 6.1-1, 2, 3, 4, 6.2-1, 2, 3, 4, 5, 6, 7

2. A. Goswami, Thin film Fundamentals, New Age International Publishers, New Delhi, 2014.

   UNIT IV: Chapter 1: 3-3.1, 3.2, 3.3, 4-4.1, 4.2, 4.3, 4.4, 5, 6-6.1, 6.2, 6.3, 6.4, 7-7.1, 7.2, 7.3, 7.4, 8-8.1, 8.2, 8.3, 8.4, 8.5.

   UNIT V: Chapter 14: 1, 2, 2.1, 2.1.1, 2.1.2, 2.1.3, 2.1.4, 3, 3.1, 3.2, 3.3, 4, 5, 6, 7

   Chapter 10: 21

   Chapter 11: 10

BOOKS FOR REFERENCE:

1. B. R. Pamplin, Crystal Growth, II edition, Pergamon Press, Oxford, 1980.
2. H. K. Heinsch, Crystals in Gels and Liesegang Rings, Cambridge University Press, 1938.
3. D. L. Smith, Thin Film deposition, Principles and Practice, McGraw Hill Inc, 1995.
4. O. S. Heavens, Thin film Physics, Methuen & Co, London, 1970.
5. K. L. Chopra, Thin film phenomenon, McGraw Hill, New York, 1990.

WEB SOURCES:

1. https://www.youtube.com/playlist?list=PLbMVogVj5nJRjLrXp3kMtrIO8kZl1D1Jp
2. https://www.youtube.com/playlist?list=PLFW6lRTa1g83HGEihgwcy7KeTLUuBu3WF
3. https://www.youtube.com/playlist?list=PLADLRin7kNjG1Dlna9MDA53CMKFHPSi9m
4. https://www.youtube.com/playlist?list=PLXHedI-xbyr8xIl_KQFs_R_oky3Yd1Emw
5. https://www.electrical4u.com/thermal-conductivity-of-metals/

SOLAR ENERGY UTILIZATION

Semester: IV **Hours: 5**

Code : 23PPH4E3C **Credit: 3**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO-1	Define the fundamental aspects of solar energy and basic principles of photovoltaics.	PSO - 1	K1
CO-2	Explain various solar technologies and their applications.	PSO - 1, PSO-2	K2
CO-3	Demonstrate a solar energy system for a given scenario	PSO - 2, PSO-3	K3
CO-4	Analyze factors influencing solar energy production.	PSO - 3, PSO-4	K4
CO-5	Evaluate the environmental impact of solar energy compared to other energy resources.	PSO - 4, PSO-5	K5

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: IV				**SOLAR ENERGY UTILIZATION**							**Hours: 5**
Code : 23PPH4E3C											**Credit: 3**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO-1	5	4	4	5	3	2	5	4	3	3	2	3.61
CO-2	5	3	4	5	4	2	5	5	3	3	2	3.70
CO-3	5	2	4	4	4	2	2	5	5	4	2	3.53
CO-4	5	3	4	5	3	4	2	2	5	5	3	3.62
CO-5	5	3	5	5	3	4	2	2	2	5	5	3.72
Overall Mean Score												**3.63**

Result: The score for this course is **3.63** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

UNIT I: RADIATION GEOMETRY

Basis earth sun angles - Determination of Solar time -Derived Solar angles - Day length - Solar Radiation measurements - Selective surfaces - Heat balance energy lost by radiation, convection and conduction - Physical characteristics of selective surface - Anti reflection coatings - Solar reflector materials - Production methods of coatings. **(15 Hours)**

UNIT II: FUNDAMENTALS OF HEAT TRANSFER

Transfer of Heat by Conduction: Study heat flow in a slab - Steady heat flow in a cylindrical shell - Heat transfer through fins - Transient heat conduction- Thermal Radiation: Basic laws of radiation - Radiant heat transfer between two black bodies- Radiant heat transfer between grey bodies.

Convention heat loss Evaluation of convective heat transfer co-efficient -Free convection from vertical planes and cylinders - Forced convection - Heat transfer for fully established flow in tubes. **(15 Hours)**

UNIT III: SOLAR THERMAL SYSTEMS

General description of plate collector - Thermal losses and efficiency of FPC - Energy balance equation- Evaluation of overall loss coefficient - Thermal analysis of flat plate collector and useful heat gained by the fluid performance of solar air heaters - Heating and drying of agricultural products Types of drier in use.

Solar concentrators and Receiver geometries - General characteristics of focusing collector systems Evaluation of optical losses - Thermal performance of focusing collectors. **(15 Hours)**

UNIT IV: PHOTOVOLTAICS

Description of the photovoltaic effect - Electrical characteristics calibration and efficiency measurement - Silicon solar energy converters - Thermal generation of recombination centers silicon.

Role of thin films in solar cells Properties of thin films for solar cells CdSe, Cete, In P, Ga As, Cd Cu_2, Cu In SnO_2, Cd_2SnO_4ZnO - Transport properties of metal films - Poly crystalline film silicon solar cells Amorphous silicon solar cells **(15 Hours)**

UNIT V: ENERGY STORAGE AND SOLAR APPLICATIONS

Types of energy storage - Thermal storage Latent heat storage - Electrical storage - Principle of solar ponds - Non convective solar ponds - Theoretical analysis of solar pond - solar distillation- solar cooking - solar pumping. **(15 Hours)**

COURSE BOOKS:

1. Maheshwar Sharon, Madhuri Sharon, Carbon ''Nano forms and Applications'', Mc Graw-Hill, 2010.

   UNIT I: Chapter 6: 6.1 to 6.7

   UNIT II: Chapter 7: 7.1 to 7.10

   UNIT III: Chapter 9: 9.1 to 9.7

2. A. Soteris Kalogirou, Solar Energy Engineering: Processes and Systems", Academic Press, London, 2009

   UNIT IV: Chapter 10: 10.1 to10.6

   UNIT V: Chapter 11: 11.1 to11.7

BOOKS FOR REFERENCE:

1. J. A. Duffie, W. A. Beckman, Solar Energy: Thermal Processes, 4th Edition, John Wiley and Sons, 2013
2. John W. Twidell & Anthony D. Weir, Renewable Energy Resources, Second Edition, Taylor and Francis, 2005
3. John A. Duffie, William A. Beckman, Solar Energy: Thermal Processes, 4th Edition, john Wiley and Sons, 2013

WEB SOURCES:

1. https://pdfs.semanticscholar.org/63a5/a69421b69d2ce9f359bbfc86c63556f9a4f
2. www.nptel.ac.in/courses/112105051
3. www.freevideolectures.com

PROJECT WITH VIVA VOCE

Semester: IV **Hours: 6**

Code : 23PPH4R01 **Credit: 3**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO - 1	Do literature survey in their respective field and identify a problem.	PSO-1	K1
CO - 2	Understand the various methods involved in solving the problem.	PSO-1, PSO-2	K2
CO - 3	Adopt suitable analytical techniques to complete the research.	PSO-2, PSO-3	K3
CO - 4	Improve their presentation skills through reviews.	PSO - 4	K4
CO - 5	Compile their research findings.	PSO-4, PSO-5	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: IV						**PROJECT WITH VIVA VOCE**					**Hours: 6**
Code : 23PPH4R01											**Credit: 3**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO - 1	4	3	4	4	2	2	5	4	4	3	3	3.45
CO - 2	4	3	4	2	2	2	5	5	4	3	3	3.36
CO - 3	3	3	4	4	2	2	4	5	5	3	3	3.45
CO - 4	4	3	3	4	3	3	4	4	4	5	3	3.64
CO - 5	4	3	3	3	4	3	4	3	3	5	5	3.64
Overall Mean Score												**3.50**

Result: The score for this course is **3.50** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = Total of Values / Total No. of POs & PSOs	Mean Overall Score for COs= Total of Mean Scores / Total No. of COs

TRAINING FOR COMPETITIVE EXAMINATIONS

Semester: IV **Hours: 2**

Code : 23PPH4SE4 **Credit: 1**

COURSE OUTCOMES:

CO. NO.	UPON COMPLETION OF THIS COURSE THE STUDENTS WILL BE ABLE TO	PSO ADDRESSED	COGNITIVE LEVEL
CO-1	Acquire knowledge on various topics involved in the preparation for competitive examinations.	PSO - 1, PSO - 2	K1
CO -2	Describe the importance of basic science, current events, geography and history of India	PSO - 2, PSO - 3	K2
CO-3	Apply the knowledge gained to sort out the correct answer.	PSO - 3, PSO - 4	K3
CO-4	Analyze the societal proceedings for further improvement.	PSO - 4, PSO - 5	K4
CO-5	Assess the results of mock examinations.	PSO - 5, PSO - 6	K5, K6

RELATIONSHIP MATRIX FOR COURSE OUTCOMES, PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

Semester: IV						**TRAINING FOR COMPETITIVE EXAMINATIONS**					**Hours: 2**
Code : 23PPH4SE4											**Credit: 1**
Course Outcomes	**Programme Outcomes (PO)**						**Programme Specific Outcomes (PSO)**					**Mean Score of CO's**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	
CO-1	4	3	4	4	2	2	5	4	3	3	2	3.27
CO-2	4	3	4	2	2	2	5	4	3	3	2	3.09
CO-3	3	3	4	4	2	2	4	4	5	3	2	3.27
CO-4	4	3	3	4	3	3	3	3	4	5	2	3.36
CO-5	4	3	3	3	4	3	4	3	3	4	4	3.45
Overall Mean Score												**3.28**

Result: The score for this course is **3.28** (High Relationship)

Note:

Mapping	1-20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Scale	1	2	3	4	5
Relation	0.0 - 1.0	1.1 - 2.0	2.1 - 3.0	3.1 - 4.0	4.1 - 5.0
Quality	Very Poor	Poor	Moderate	High	Very High

Values Scaling:

Mean Score of COs = $\frac{\text{Total of Values}}{\text{Total No. of POs \& PSOs}}$	Mean Overall Score for COs= $\frac{\text{Total of Mean Scores}}{\text{Total No. of COs}}$

UNIT I: GENERAL SCIENCE

Scientific Knowledge and Scientific Temper - Power of Reasoning - Rote Learning Vs Conceptual Learning - Science as a tool to understand the past, present and future -Nature of Universe - General Scientific Laws - Mechanics - Properties of Matter, Force, Motion and Energy - Everyday application of the Basic Principles of Mechanics, Electricity and Magnetism, Light, Sound, Heat, Nuclear Physics, Laser, Electronics and Communications - Elements and Compounds, Acids, Bases, Salts, Petroleum Products, Fertilisers, Pesticides - Main concepts of Life Science, Classification of Living Organisms, Evolution, Genetics, Physiology, Nutrition, Health and Hygiene, Human Diseases -Environment and Ecology. **(6 Hours)**

UNIT II: CURRENT EVENTS

History - Latest diary of events - National symbols - Profile of States - Eminent personalities and places in news - Sports - Books and authors - Polity - Political parties and political system in India - Public awareness and General administration - Welfare oriented Government schemes and their utility, Problems in Public Delivery Systems - Geography - Geographical landmarks - Economics - Current socio - economic issues - Science - Latest inventions in Science and Technology - Prominent Personalities in various spheres - Arts, Science, Literature and Philosophy. **(6 Hours)**

UNIT III: GEOGRAPHY OF INDIA

Location - Physical features - Monsoon, Rainfall, Weather and Climate - Water Resources - Rivers in India - Soil, Minerals and Natural Resources - Forest and Wildlife - Agricultural pattern- Transport - Communication - Social Geography - Population density and distribution - Racial, Linguistic Groups and Major Tribes - Natural calamity - Disaster Management - Environmental pollution: Reasons and preventive measures - Climate change - Green energy. **(6 Hours)**

UNIT IV: HISTORY AND CULTURE OF INDIA

Indus Valley Civilization - Guptas, Delhi Sultans, Mughals and Marathas - Age of Vijayanagaram and Bahmani Kingdoms - South Indian History - Change and Continuity in the Socio - Cultural History of India - Characteristics of Indian Culture, Unity in Diversity - Race, Language, Custom - India as a Secular State, Social Harmony. **(6 Hours)**

UNIT V: APTITUDE AND MENTAL ABILITY

Simplification - Percentage - Highest Common Factor (HCF) - Lowest Common Multiple (LCM) - Ratio and Proportion - Simple interest - Compound interest - Area - Volume - Time and Work - Logical Reasoning - Puzzles-Dice - Visual Reasoning - Alpha numeric Reasoning - Number Series. **(6 Hours)**

COURSE BOOKS

1. Murugan, M.A. Selavanayagam, V.V.K. Subburaj, updated Edition, SURA`S TNPSC Group II & II A Main Exam Paper I & II Book, 2024.
2. TNPSC Group II- A combined civil services II General studies and general English based on Samacheer Kalvi, Basheer Ahamed, S. Sambasivan, Sakthi Publication, 2019.