A. Course Handout

Institute/School Name	Chitkara University Institute of Engineering and Technology		
Department Name	Computer Sciences and Engineering		
Programme Name	Bachelor of Engineering, Computer Science & Engineering		
Course Name	Modern and Computational Physics	Session	2022-2023
Course Code	AS22015	Semester/Batch	1st/2022
L-T-P (Per Week)	4-0-2	Course Credits	05
Course Coordinators	Dr. Chinky Jaggi & Ms Monika Dhiman		

1. Objectives of the Course

The course provides a wide scope of learning & understanding of the subject and the main objectives of the course are:

- Understand different types of magnetic materials, role of superconducting magnets in engineering, the need of quantum mechanics and related phenomenon and electronic behaviour of solids
- Understand engineering problems for its physical interpretation and viability.
- Develop sufficient depth in both engineering and physics and will be able to co-relate fundamental key concept of physics to engineering problems.
- Study the physical problems related to real life and find their solutions.
- Compute gradient, divergence & curl and apply these to solve problems related to vector calculus.

2. Course Learning Outcomes

Student should be able to:

	Course Outcome	POs	CL	KC	Sessions
CLO01	Analyze and solve mathematical problems relating to Gradient, Divergence and Curl of scalar and vector fields and establish their relationship with propagation of Electromagnetic waves in free space using Maxwell's equation.	PO1,PO3,PO6	K2	Factual Conceptual	**5**
CLO02	Differentiate between different types of LASERs and optical fibres their operation, advantages, and disadvantages and solve related problems and their application in engineering domain.	PO1,PO3	K3	Fundamental Conceptual	**10**
CLO03	Differentiate between characteristics and properties of various magnetic and superconducting materials and establish their applications in engineering disciplines.	PO1,PO3,PO12	K3	Conceptual Procedural	**8**
CLO04	Describe the dual nature of waves and particles in context of Quantum Mechanics and to apply the Schrodinger Wave Equation in solving different physical systems and processes.	PO1,PO2, PO12	K3	Conceptual Procedural	**5**
Total Contact Hours					**48**

Revised Bloom's Taxonomy Terminology

*Cognitive Level =CL
*Knowledge Categories = KC

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CLO01	H	H				H						
CLO02	H		H									
CLO03	H		M									H
CLO04	H	H										M

H=High, M=Medium, L=Low

3. ERISE Grid Mapping

Feature Enablement	Level(1-5, 5 being highest)
Entrepreneurship	2
Research	4
Innovation	2
Skills	5
Employability	3

4. Recommended Books:

B01: Engineering Physics by H. K. Malik and A. K. Singh, McGraw Hill Education.
B02: Engineering Physics by Chitkara Publication 2nd Edition.
B03: Engineering Physics by Dr. M. N. Avadhanulu and Dr P.G. Kshirsagar, S. Chand & Company PVT. LTD.
B04: Engineering Physics by Dr S Mani Naidu, Pearson
B04: Engineering Physics by Dattu R Joshi, McGraw Hill Education
B05: Concepts of Modern Physics by Arthur Beiser
B06: Engineering Physics by R.K Guar, & S. L. Gupta
B07: Engineering Physics by Vanchna Singh and Sheetal Kumar
B08: Interactive Engineering Physics by Randhir Singh

5. Other readings and relevant websites:

S.No.	Link of Journals, Magazines, websites and Research Papers
1.	www.apniphysics.com [Engineering Physics Video Lectures], https://goo.gl/P1AqJM
2.	https://onlinecourses.nptel.ac.in/noc19_ph16/preview
3.	https://onlinecourses.nptel.ac.in/noc21_ph02/preview
4.	http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
5.	http://ocw.mit.edu/resources/res-6-005-understanding-lasers-and-fiberoptics-spring-

	2008/fiberoptics-fundamentals [Laser+Optical Fibre]
6.	http://www.irm.umn.edu/hg2m/hg2m_b/hg2m_b.html [Magnetic Material]
7.	http://www.phys.ufl.edu/~pjh/teaching/phz7427/7427notes/ch5.pdf [Superconductivity]
8.	https://onlinecourses.nptel.ac.in/noc17_ph03/preview [Quantum Mechanics]

6. Recommended Tools and Platforms

Google classroom

7. Course Plan:

Session Number	Topics	Recommended Book / Other reading	Page numbers of Text
1-2	**Electrodynamics:** Vector and scalar fields, Gradient, divergence, curl and their physical interpretation Determination of planck's constant.	**B02** **B01**	**1** **10.2-10.5**
3	Gauss's theorem and Stoke's theorem (Statement only), Equation of continuity, Green's theorm	**B01**	**10.6, 10.7, 10.14**
4-5	Maxwell's equations (differential and integral form), Maxwell's equations in free space, Propagation of electromagnetic waves in free space and its applications in daily life.	**B01**	**10.15-10.22**
6-8	**Laser:** Introduction, Laser characteristics such as coherence, monochromaticity, collimated and directionality, laser action, stimulated absorption, spontaneous emission, stimulated emission, Population inversion and pumping. Derivation of Einstein's coefficient relation To find out the wavelength of laser light using diffraction grating.	**B01**	**4.1-4.5**
9	Various level lasers, two level, three level, four level, Ruby laser, Helium-Neon laser	**B01**	**4.6, 4.7**
10	Semiconductor laser, concepts of Holography, LASER Applications in engineering	**B01**	**4.13-4.21**
	ST1		
11	**Fibre Optics:** Basic principle of optical fibre, step index and graded index fibres	**B01**	**5.3**
12-13	Parameters of optical fibres, acceptance angle, numerical aperture, normalized frequency, No. of modes, normalized frequency Determination of angular divergence using laser.	**B01**	**5.5**
14-15	Attenuation in optical fibres, intermodal and intramodal dispersion (no derivation), optical fibres in communication, Applications of optical fibre in engineering	**B01**	**5.8, 5.13**
	Lab Evaluation 1		
16-17	**Magnetic Materials:** Types of Magnetic Materials, the domain structure, super paramagnetic materials, Ferrites, Anti ferromagnetic, ferrimagnetic materials Determination of susceptibility using quinke's method.	**B01**	**18.1-18.12**
18	Ferromagnetism and related phenomena, The hysteresis loop	**B01**	**18.13,18.14**

19	Types of magnetic materials, soft magnetic materials, hard magnetic materials , applications of magnetic materials in engineering Superparamagnetism	**B02** **B01**	**7.15** **18.18**
20	**Superconductivity:** Introduction, Meissner effect, critical field, critical current	**B01**	**19.1, 19.2**
21-22	Isotope effect , Types of superconductors: type I superconductors, type II superconductors, Isotope Effect, London equations To find the hall coefficient and carrier concentration using hall effect.	**B01**	**19.3 - 19.5**
23	Penetration depth, Cooper pair and BCS theory (Qualitative only), high temperature superconductors, applications	**B01**	**19.5-19.10**
ST2			
24-25	**Quantum Mechanics:** Heisenberg Uncertainty Principle, Introduction to Quantum Mechanics, Group velocity and phase velocity (No relation)	**B01** **B02**	**15.1** **5.4-5.8**
26	Wave function and its significance, Normalized wave function, Time Dependent and Independent Schrodinger wave equations	**B01**	**15.7-15.10**
27-28	Particle in a one dimensional box To find out the , charge by mass ration using Thomson method.	**B01**	**15.11**
Lab Evaluation 2			
End Term			

8. Delivery/Instructional Resources

Session No.	Topics	Web References	Audio-Video
1-5	Vector and scalar fields, Gradient, divergence, curl and their physical interpretation Gauss's theorem and Stoke's theorem (Statement only), Equation of continuity, Green's theorm, Maxwell's equations (differential and integral form), Maxwell's equations in free space, Propagation of electromagnetic waves in free space and its applications in daily life.	www.apniphysics.com [Engineering Physics Video Lectures], https://goo.gl/P1AqJM	www.apniphysics.com [Engineering Physics Video Lectures], https://goo.gl/P1AqJM
6-10	Introduction, Laser characteristics such as coherence, monochromaticity, collimated and directionality, laser action, stimulated absorption, spontaneous emission, stimulated emission, Population inversion and pumping. Derivation of Einstein's coefficient relation, Various level lasers, two level, three level, four level, Ruby laser, Helium-Neon laser Semiconductor laser, concepts of Holography, LASER Applications in engineering	http://ocw.mit.edu/resources/res-6-005-understanding-lasers-and-fiberoptics-spring-2008/fiberoptics-fundamentals [Laser+Optical Fibre]	http://ocw.mit.edu/resources/res-6-005-understanding-lasers-and-fiberoptics-spring-2008/fiberoptics-fundamentals [Laser+Optical Fibre]

11-15	Basic principle of optical fibre, step index and graded index fibres Parameters of optical fibres, acceptance angle, numerical aperture, normalized frequency, No. of modes, normalized frequency, Attenuation in optical fibres, intermodal and intramodal dispersion (no derivation), optical fibres in communication, Applications of optical fibre in engineering	https://classroom.codingninjas.com/app/classroom/me/20926/content/430931/offering/6231280	https://nptel.ac.in/courses/106106182
16-19	Types of Magnetic Materials, the domain structure, super paramagnetic materials, Ferrites, Anti ferromagnetic, ferrimagnetic materials, Ferromagnetism and related phenomena, The hysteresis loop Types of magnetic materials, soft magnetic materials, hard magnetic materials , applications of magnetic materials in engineering Superparamagnetism	http://www.irm.umn.edu/hg2m/hg2m_b/hg2m_b.html [Magnetic Material]	http://www.irm.umn.edu/hg2m/hg2m_b/hg2m_b.html [Magnetic Material]
20-23	Introduction, Meissner effect, critical field, critical current, Isotope effect , Types of superconductors: type I superconductors, type II superconductors, Isotope Effect, London equations, Penetration depth, Cooper pair and BCS theory (Qualitative only), high temperature superconductors, applications	http://www.phys.ufl.edu/~pjh/teaching/phz7427/7427notes/ch5.pdf [Superconductivity]	http://www.phys.ufl.edu/~pjh/teaching/phz7427/7427notes/ch5.pdf [Superconductivity]
24-28	Heisenberg Uncertainty Principle, Introduction to Quantum Mechanics, Group velocity and phase velocity, Wave function and its significance, Normalized wave function, Time Dependent and Independent Schrodinger wave equations, Particle in a one dimensional box, concept of quantum computing.	https://onlinecourses.nptel.ac.in/noc17_ph03/preview [Quantum Mechanics], https://www.digimat.in/nptel/courses/video/115101092/L45.html	https://onlinecourses.nptel.ac.in/noc17_ph03/preview [Quantum Mechanics], https://www.digimat.in/nptel/courses/video/115101092/L45.html

9. Action plan for different types of learners

Slow Learners	Average Learners	Fast Learners
Remedial Classes, Doubt Sessions, Guided Tutorials	Doubt Session	Students will be motivated/offered to participate in competitions and research.

10. Evaluation Scheme & Components:

Evaluation Component	Type of Component	No. of Assessments	Weightage of Component	Mode of Assessment
Component 1	Lab Evaluations	02*	30%	Offline
Component 2	Sessional Tests (STs)	02**	20%	Offline
Component 3	End Term Examination	01***	50%	Offline

Total	100%

* Lab Evaluation is mandatory evaluation taken twice in a semester, one will be considered as mid term evaluation and another one will be final evaluation.

**Out of 02 STs, the ERP system automatically picks the best 01 ST.

*** Further, as per Academic Guidelines minimum 75% attendance is required to become eligible for appearing in the End Semester Examination.

11. Syllabus of the Course:

Subject: Modern and Computational Physics			
S.No.	**Topics**	**No. of Sessions**	**Weightage %**
1	Vector and scalar fields, Gradient, divergence, curl and their physical interpretation Gauss's theorem and Stoke's theorem (Statement only), Equation of continuity, Green's theorm, Maxwell's equations (differential and integral form), Maxwell's equations in free space, Propagation of electromagnetic waves in free space and its applications in daily life.	5	18
2	Introduction, Laser characteristics such as coherence, monochromaticity, collimated and directionality, laser action, stimulated absorption, spontaneous emission, stimulated emission, Population inversion and pumping. Derivation of Einstein's coefficient relation, Various level lasers, two level, three level, four level, Ruby laser, Helium-Neon laser Semiconductor laser, concepts of Holography, LASER Applications in engineering	5	18
3	Basic principle of optical fibre, step index and graded index fibres Parameters of optical fibres, acceptance angle, numerical aperture, normalized frequency, No. of modes, normalized frequency, Attenuation in optical fibres, intermodal and intramodal dispersion (no derivation), optical fibres in communication, Applications of optical fibre in engineering	5	18
4	Types of Magnetic Materials, the domain structure, super paramagnetic materials, Ferrites, Anti ferromagnetic, ferrimagnetic materials, Ferromagnetism and related phenomena, The hysteresis loop Types of magnetic materials, soft magnetic materials, hard magnetic materials , applications of magnetic materials in engineering Superparamagnetism	4	14

5	Introduction, Meissner effect, critical field, critical current, Isotope effect , Types of superconductors: type I superconductors, type II superconductors, Isotope Effect, London equations, Penetration depth, Cooper pair and BCS theory (Qualitative only), high temperature superconductors, applications	4	14
6	Heisenberg Uncertainty Principle, Introduction to Quantum Mechanics, Group velocity and phase velocity, Wave function and its significance, Normalized wave function, Time Dependent and Independent Schrodinger wave equations, Particle in a one dimensional box, concept of quantum computing.	5	18

This Document is approved by:

Designation	**Name**	**Signature**
Course Coordinators	Dr. Chinky Jaggi & Ms Monika Dhiman	
Head-Academic Delivery	Dr Reetu Malhotra	
Dean	Dr. Mohit Kumar Kakkar	
Date (DD/MM/YYYY)	11/10/2022	