Government Polytechnic, Pune

'180 OB' – Scheme

Programme	**Diploma in Metallurgical Engineering**
Programme Code	01/02/03/04/**05**/06/07/08/15/16/17/18/**19**/21/22/23/24/26
Name of Course	**Advanced Physics**
Course Code	**SC2106**
Prerequisite course code and name	**NA**
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
L	T	P	C		ESE	PA	ESE	PA	
02	00	02	04	Marks	80	20	--	25	125
				Exam Duration	03 Hrs	01 Hr	--	--	

Legends : L - Lecture, P- Practical, T- Tutorial, C- Credits, ESE- End Semester Examination, PA- Progressive Assessment (Test I, II/TermWork), *- Practical Exam, $- Oral Exam, #- Online Examination. Each Lecture/Practical period is of one clock hour

2. RATIONALE

Metallurgical diploma engineers have to deal with various materials and machines. The study of concepts and principles of lens aberrations, microscopy, laser, temperature measurement, interference, superconductivity and nanotechnology will help them in understanding the technology courses where emphasis is laid on the applications. This course is designed in the way by which fundamental information will help the diploma engineers to apply the concepts and principles of advanced physics in various applications.

3. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Apply principles of physics to solve broad-based engineering problems.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency**:**

1. Identify the different type of lens aberrations and minimization of aberrations.
2. Use different measuring instrument like spectrometer, thermometer, travelling microscope.
3. Apply the principles of laser, magnetism and superconductivity to solve engineering problems.
4. Use the basic principles of thermoelectricity, interference, nanotechnology in related engineering problems.

5. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency**:**

Sr. No.	Unit No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. required
1	1	Study of new Cartesian sign conventions and image formation by lenses.	1	04*
2	2	Draw ray diagrams of simple microscope, compound microscope and metallurgical microscope.	2	04*
3	2	Use travelling microscope to calculate surface tension of water.	2	04*
4	4	Determination of angle of divergence of laser beam using He-Ne Laser.	3	02*
5	5	Use spectrometer to calculate refractive index of prism.	2	04*
6	5	Measurement of wavelength using spectrometer.	2	04*
7	6	Determine radius of curvature of convex surface using Newton's ring apparatus.	4	04*
8	7	Determine the temperature coefficient of resistance using platinum resistance thermometer.	4	02
9	7	Measurement of unknown temperature using thermocouple.	4	02
10	8	Measurement of pole strength of given magnet.	3	02
11	8	Use of magnetic compass to determine the neutral points.	3	02
12	9	Study of properties and applications of nano materials in different field	4	02
13	ALL	Complete a Micro- project based on guidelines provided in Sr.No 11	1 to 4	04*
		Total		**32**

Note: A suggestive list of Experiments is given in the above table. Minimum 09 practical need to be performed out of which practicals marked as * are compulsory. Any one practical out of Sr. No. 8 to 12 need to be performed.

SCHEME OF PRACTICAL EVALUATION

Sr.No.	Performance Indicators	Weightage in %
a.	Arrangement of available equipment / test kit or model	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned**.**

Sr. No.	Equipment Name with Broad Specifications	Experiment Sr. No.
1	Convex lens.	1
2	Travelling Microscope. Range: 0.001 cm to 22 cm Resolution 0.001 cm.	3
3	He-Ne Laser Kit.	4
4	Spectrophotometer, Prism. Range: 0 to 360^0 Least count 1’	5,6
5	Newton’s ring apparatus. Range: 0.001 cm to 15 cm Resolution 0.001 cm	7
6	Platinum resistance.	8
7	Thermocouple, Multimeter.	9
8	Bar magnet, Magnetic compass.	10,11

7. THEORY COMPONENTS

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit I Lens and lens aberration (3 hrs, 8 marks)	
1a. Draw different image using lens. 1b. Calculate- magnification and power of lens. 1c. Identify different types of lens aberrations and minimization of aberration.	1.1 Revision: types of lenses and image formation by lenses. 1.2 Numerical aperture, aperture of lens, magnification and power of lens - Definition, formula, unit, analytical treatment. 1.3 Lens aberrations – chromatic, spherical, coma, astigmatism (no derivations), minimization of aberrations.
Unit II Optical Microscopy (3 hrs, 8 marks)	
2a. Differentiate between simple and compound microscope 2b. Draw ray diagram of metallurgical microscope and explain construction and working of metallurgical microscope. 2c. Distinguish between Huygens and Rams den eyepieces. 2d. State advantages of oil immersion objective	2.1 Simple and compound microscope. 2.2 Metallurgical microscope – construction ray diagrams and applications. 2.3 Eyepieces- Huygens's and Ramsden's eyepiece, comparison. 2.4 Objective- Oil immersion objective, properties, numerical aperture, resolving power.
Unit III Electron Microscopy (4 hrs, 8 marks)	
3a. State Debroglie hypothesis 3b. Distinguish between optical microscope and electron microscope. 3c. Describe working and application of Scanning electron microscope and transmission electron microscope.	3.1 Terminology- De Broglie's hypothesis. 3.2 Electron microscope - Principle, construction, working and applications, comparison with optical microscope. 3.3 Types of Electron Microscopes- Working and application of Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM).
Unit IV Laser (2 hrs, 8 marks)	
4 a. Differentiate between spontaneous and stimulated emission. 4b. Define atomic excitation, excitation potential, optical pumping, population inversion. 4c. Describe working of laser system with energy level diagram. 4d. Explain construction and working of He -Ne Laser. 4e. Explain construction and working of Ruby Laser.	4.1 Terminology- atomic excitation, spontaneous absorption, spontaneous and stimulated emission, parts of laser system, optical pumping, active medium, population inversion, metastable state, life time . 4.2 Working - of laser using energy level diagram. 4.3 Production and working of He-Ne (Gas) laser. 4.4 Production and working of Ruby (solid) laser.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
4f. State applications of laser in different field.	4.5 Applications- laser coating and industrial applications.
Unit V Spectroscopy (3 hrs, 8 marks)	
5a. Define line spectra, band spectra, continuous spectra. 5b. Explain different types of spectra. 5c. State applications of spectra.	5.1 Revision on different types of spectrum. 5.2 Terminology- spectral analysis, types of spectra- line, band, continuous & its origin. 5.3 Application of spectra.
Unit VI Interference (4 hrs, 10 marks)	
6a. State Newton's corpuscular and Huygens wave theory with its advantages and disadvantages. 6b. Define- interference, constructive and destructive interference. 6c. Sate conditions for steady interference pattern. 6d. Describe flatness testing and wedge shape thin film. 6e. Calculate diameter, radius, refractive index and wavelength of light.	6.1 Newton's corpuscular and Huygens wave theory with its advantages and disadvantages. 6.2 Superposition of waves, phenomena of interference, constructive and destructive interference, conditions for stationary interference pattern. 6.3 Applications of interference- wedge shape film, flatness testing, measurement of diameter of microscopic objects. 6.4 Newton's rings- measurement of radius, refractive index and wavelength.
Unit VII Temperature Measuring Devices (6 hrs, 12 marks)	
7a. State Seeback effect, Peltier effect. 7b. State applications of thermocouple. 7c. Describe construction, working and applications of thermometric and platinum resistance thermometer. 7d. Describe bimetallic thermometer with its principle, construction, working and application. 7e. State Stefan's Boltzmann's law, Newton's law, Kirchhoff's law, Wien's law.	7.1 Change of properties, thermoelectricity, See beck effect, Peltier effect. 7.2 Thermocouple, Variation of emf with temperature, inversion temperature, neutral temperature, applications of thermocouple. 7.3 Thermometers: - Thermometric thermometer: - principle, construction, working and applications. Platinum resistance thermometer: principle, construction, working and applications. 7.4 Bimetallic thermometer: principle, construction, working and applications. 7.5 Introduction of radiation, Black body radiation, Stefan's Boltzmann's law, Newton's law, Kirchhoff's law, Wien's law.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
7f. Differentiate between thermometry and pyrometer.	7.6 Difference between the thermometer and pyrometer.
7g. Describe disappearing filament optical pyrometer with its principle, construction, working and application.	7.7 Pyrometer: Disappearing filament optical pyrometer- principle, construction, working and applications.
7h. Describe total radiation pyrometer with its principle, working and application.	7.8 Total radiation pyrometer- principle, construction, working and applications.
Unit VIII Magnetism and Superconductivity (5 hrs, 12 marks)	
8a. Define - susceptibility, permeability, hysteresis, retentively, coactivity, area under hysteresis loop and work done.	8.1 Susceptibility, permeability, magnetization, magnetic materials-diamagnetic, paramagnetic and ferromagnetic materials, hysteresis, hysteresis loop, retentivity, coercivity.
8b. Difference between hard and soft magnetic materials and its applications.	8.2 Hard and soft magnetic materials - its relation using hysteresis loop, properties and uses of magnets.
8c. Define superconductivity, critical temperature.	8.3 Superconductivity phenomena, superconducting materials, critical temperature, destruction of superconductivity.
8d. Describe Messenger's effect and type1 and type 2 superconducting materials.	8.4 Messenger's effect, type1 and type 2 superconductors.
Unit IX Nanotechnology (2 hrs, 6 marks)	
9a. Define nonmaterial, nanaoscale. 9b. Describe Properties of nanomaterial.	9.1 Definition of nanoparticles, size dependent properties of nonmaterial's, tools and techniques to study nano materials.
9c. State applications of nanotechnology in different engineering field.	9.2 Applications of nanotechnology in different engineering field.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Lens and lens aberration	03	02	04	02	08
II	Optical Microscopy	03	02	04	02	08
III	Electron Microscopy	04	04	02	02	08
IV	LASER	02	02	04	02	08
V	Spectroscopy	03	02	04	02	08
VI	Interference	04	04	02	04	10
VII	Temperature Measuring Devices	06	04	04	04	12
VIII	Magnetism and Superconductivity	05	04	04	04	12
IX	Nanotechnology	02	02	02	02	06
Total		**32**	**26**	**30**	**24**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Prepare journal based on practical performed in physics laboratory. Journal consists of drawing, observations, required equipment's, date of performance with teacher signature.
b. Demonstration
c. Presentation

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
c. With respect to item No.9, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with power plant system and equipments.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components, operation and
h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. It should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that she/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty.

a) **Lens :**Prepare chart showing different Types of Lens .
b) **Optics** :Prepare chart showing properties of Lasers / Nanoparticles.
c) Prepare report on Stefan's Boltzmann's law, Newton's law, Kirchhoff's law, Wien's law.
d) Prepare report to distinguish Simple Pendulum and Compound Pendulum.
e) Prepare chart showing different types of Spectrum.

12. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publisher, Edition Year of publication and ISBN Number
1	Engineering Physics	R.K. Gaur S. L. Gupta	Dhanpat Rai Publications, Delhi. ISBN: 9788189928223,1981
2	Principles of Metallographic Laboratory Practice	George L. Khel	McGraw-Hill ISBN: 007033479X
3	Modern Engineering Physics	A. S. Vasudeva	S. Chand Publishing ISBN: 9788121917575
4	Perspective of Modern Physics	Arthur Beiser	Mc Graw Hills Text ISBN: 978-0070043503
5	Elements of Physical Metallurgy	Albert G. Guy	Addison-Wesley Press
6	Text Book of Optics	N. Subrahmanyam Brijlal M.N. Avadhanulu	S. Chand ISBN: 9788121926119
7	Introduction to Nanoscience and Nanotechnology	K K Chattopadhyay A N Banerjee	Prentice Hall India Learning Private Limited ISBN:978-8120336087
8	Engineering Physics	D K Bhattacharya Poonam Tandon	Oxford University Press ISBN: 978-0199452811

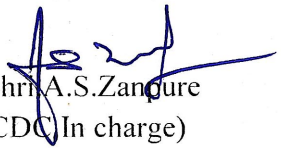
13. SOFTWARE/LEARNING WEBSITES

1. http://onlinelibrary.wiley.com/book
2. https://en.wikipedia.org/wiki/Electron_microscope
3. www.colorado.edu/physics
4. http://teachingbd24.com
5. https://www.smartzworld.com
6. http://www.faadooengineers.com
7. www.freebookcentre.net/Physics
8. www.kopykitab.com/Engineering-Physics
9. https://nptel.ac.in

14. PO - COMPETENCY- CO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	2	1	1	2
CO2	3	2	2	2	1	1	2
CO3	3	2	2	2	1	1	2
CO4	3	3	2	1	1	1	2

CO	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	1
CO2	3	2	2	1
CO3	2	1	1	1
CO4	1	1	1	1

Sign:  Name: Smt. D. V. Saurkar Dr. R. B. Birajadar (Course Experts)	Sign:  Name : Smt.N.S.Kadam (Head of Department)
Sign:  Name: Smt.N.S.Kadam (Program Head) (Metallurgical Engineering Department)	Sign:  Name : Shri A.S.Zangure (CDC In charge)