COMPETENCY BASED CURRICULUM

DIPLOMA IN
CERAMIC ENGINEERING

(Duration 3 Years)
NSQF Level – 5

Under
Haryana State Board of Technical Education

Developed By

Curriculum Development Center
National Institute of Technical Teachers Training & Research
(Ministry of Education, Government of India)
Sector - 26, Chandigarh, UT, India.

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PREFACE

Learning and learning experience are the foundation of any education system. Appropriateness of education and its useful implications stand on the platform of knowledge and skill. But the knowledge and skill cannot be quantified qualitatively without ensuring learning experience. Curriculum is the pathway to select and organise learning experience. It helps the teachers to provide tangible resources, goals and objectives to learners. Curriculum acts as a catalyst to stimulate creativity, innovation, ethics, values, responsibility and many human factors. Curriculum embodies rigour and high standards and creates coherence to empower learner to meet the industrial and societal needs. Curriculum is a central guide for a teacher to plan a standard based sequence for the instructional delivery.

The industrial revolution 4.0 has forced the technical education system to reinvent the curriculum to meet the human resource requirement of the industry. The data driven systems relying on the subjects like machine-learning, Artificial Intelligence, Data Science etc are literally forcing the technical education system to offer different subjects differently to address the emerging challenges. The non-linear way of learning now facilitates students to choose path of knowledge to skill or vice-versa. The bi-directional process requires innovative curriculum design and revision. Diploma programme is now more challenging than ever. The level of skill and knowledge demanded by industry from diploma holders are highly interdisciplinary at the same time address special need. Hence, there is a need to align the curriculum to National Skill Qualification Framework (NSQF).

National Education Policy, NEP-2020 has now opened up diversities for the education system to explore and exploit to make the education relevant. The policy emphasises to inculcate value, ethics, respect to culture and society etc along with industry ready knowledge and skill among the students. The interdisciplinary nature of curriculum, academic bank of credits and integration of technology in teaching-learning envisaged in NEP-2020 make it more challenging for curriculum development. NITTTR, Chandigarh has developed the art of curriculum development over 54 years of its existence. The expertise and experience available in the institute follow time-tested and acclaimed scientific methods to design/revise curriculum. The experienced faculty members entrusted with the curriculum development or revision activities are well-versed with NSQF, NEP and Outcome based education. I am happy to note that **Haryana State Board of Technical Education, Panchkula, Haryana** reposed their confidence on this expertise to develop **AICTE/NSQF/NEP 2020** aligned curriculum for the state. This documented curriculum is an outcome of meticulous planning and discussions among renowned experts of the subject through series of workshops. The effective implementation of this curriculum supported with quality instructional resources will go a long way in infusing the learning experience among learners to make them industry ready.

Director

National Institute of Technical Teachers Training & Research, Chandigarh

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Professor & Head
Project Coordinator & Head Curriculum Development Center
National Institute of Technical Teachers Training & Research, Chandigarh

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1. SALIENT FEATURES

1.	Name	:	**Diploma in Ceramic Engineering**
2.	Duration	:	**03 Years**
3.	Hours per week	:	**35 - 40**
4.	Entry Qualification	:	**10th Pass**
5.	Student Intake	:	**As per sanctioned strength**
6.	Pattern	:	**Semester**
7.	Scheme	**:**	**Multi Point Entry and Exit**
8.	NSQF Level	:	**5**
9.	Theory Practical Ratio	:	**36 : 64**
10.	Project Work	:	**Minor and Major Project**
11.	In-house/Industrial Training	:	**Mandatory after First and Second Year**

2. NSQF COMPLIANCE

National Skill Qualification Framework has defined total Ten Levels. Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Fig.1: NSQF Domains

NSQF LEVEL - 3 COMPLIANCE

The NSQF level - 3 descriptor is as follows:

Process	• Person may carry out a job which may require limited range of activities routine and predictable.
Professional Knowledge	• Basic facts, process and principle applied in trade of employment.
Professional Skill	• Recall and demonstrate practical skill, routine and repetitive in narrow range of application.
Core Skill	• Communication written and oral, with minimum required clarity, skill of basic arithmetic and algebraic principles, personal banking, basic understanding of social and natural environment.
Responsibility	• Under close supervision. Some responsibility for own work within defined limit.

Fig 2: NSQF Level – 3 Descriptor

Work requiring knowledge, skills and aptitudes at level 3 will be routine and predictable. Job holders will be responsible for carrying out a limited range of jobs under close supervision. Their work may require the completion of a number of related tasks. People carrying out these job roles may be described as "Semi skilled workers". Individuals in jobs which require level 3 qualifications will normally be expected to be able to communicate clearly in speech and writing and may be required to use arithmetic and algebraic processes. They will be expected to have previous knowledge and skills in the occupation and should know the basic facts, processes and principles applied in the trade for which they are qualified and be able to apply the basic skills of the trade to a limited range of straightforward jobs in the occupation.

They will be expected to understand what constitutes quality in their job role and more widely in the sector or sub-sector and to distinguish between good and bad quality in the context of the jobs they are given. Job holders at this level will be expected to carry out the jobs they are given safely and securely. They will work hygienically and in ways which show an understanding of environmental issues. This means that they will be expected to take responsibility for their own health and safety and that of fellow workers and, where appropriate, customers and/or clients. In working with others, they will be expected to conduct themselves in ways which show a basic understanding of the social environment. They should be able to make a good contribution to team work.

NSQF LEVEL - 4 COMPLIANCE

The NSQF level-4 descriptor is given below:

Process	• Work in familiar, predictable, routine, situation of clear choice
Professional Knowledge	• Factual knowledge of field of knowledge or study.
Professional Skill	• Recall and demonstrate practical skill, routine and repetitive in narrow range of application, using appropriate rule and tool, using quality concepts.
Core Skill	• Communication written and oral, with required clarity, skill of basic arithmetic and algebraic principles, personal banking, basic understanding of social and natural environment.
Responsibility	• Responsibility for own work and learning.

Fig 3: NSQF Level – 4 Descriptor

Work requiring knowledge, skills and aptitudes at level 4 will be carried out in familiar, predictable and routine situations. Job holders will be responsible for carrying out a range of jobs, some of which will require them to make choices about the approaches they adopt. They will be expected to learn and improve their practice on the job. People carrying out these jobs may be described as "skilled workers". Individuals in jobs which require level 4 qualifications should be able to communicate clearly in speech and writing and may be required to use arithmetic and algebraic processes. They will be expected to have previous knowledge and skills in the occupation in which they are employed, to appreciate the nature of the occupation and to understand and apply the rules which govern good practice. They will be able to make choices about the best way to carry out routine jobs where the choices are clear.

They will be expected to understand what constitutes quality in the occupation and will distinguish between good and bad quality in the context of their job roles. Job holders at this level will be expected to carry out their work safely and securely and take full account of the health and safety on colleagues and customers. They will work hygienically and in ways which show an understanding of environmental issues. In working with others, they will be expected to conduct themselves in ways which show a basic understanding of the social and political environment. They should be able to guide or lead teams on work within their capability.

NSQF LEVEL - 5 COMPLIANCE

The NSQF level-5 description is given below:

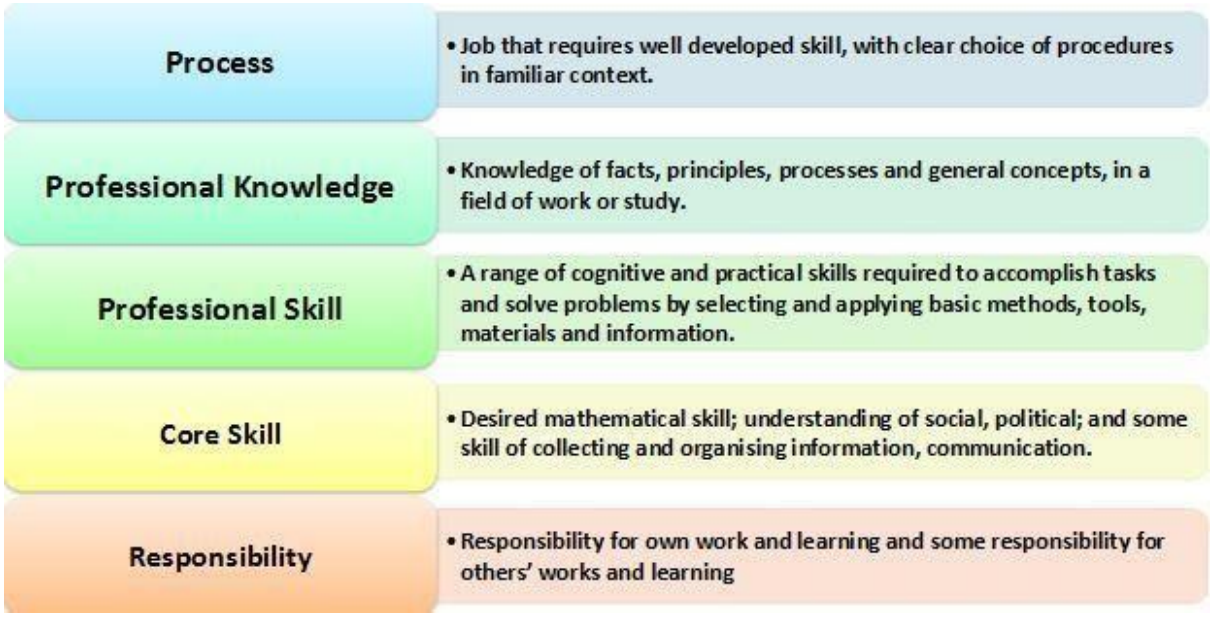

Fig 4: NSQF Level – 5 Descriptor

Work requiring knowledge, skills and aptitudes at level 5 will also be carried out in familiar situations, but also ones where problems may arise. Job holders will be able to make choices about the best procedures to adopt to address problems where the choices are clear. Individuals in jobs which require level 5 qualifications will normally be responsible for the completion of their own work and expected to learn and improve their performance on the job. They will require well developed practical and cognitive skills to complete their work. They may also have some responsibility for others' work and learning. People carrying out these jobs may be described as "fully skilled workers" or "supervisors".

Individuals employed to carry out these jobs will be expected to be able to communicate clearly in speech and writing and may be required to apply mathematical processes. They should also be able to collect and organise information to communicate about the work. They will solve problems by selecting and applying methods, tools, materials and information. They will be expected to have previous knowledge and skills in the occupation, and to know and apply facts, principles, processes and general concepts in the occupation. They will be expected to understand what constitutes quality in the occupation and will distinguish between good and bad quality in the

context of their work. They will be expected to operate hygienically and in ways which show an understanding of environmental issues. They will take account of health and safety issues as they affect the work they carry out or supervise.

In working with others, they will be expected to conduct themselves in ways which show an understanding of the social and political environment.

3. NATIONAL EDUCATION POLICY (NEP) - 2020

NEP 2020 aims at a comprehensive holistic education to develop all capacities of human beings - intellectual, aesthetic, social, physical, emotional, and moral - in an integrated manner. A holistic arts education will help develop well-rounded individuals that possess: critical 21st century capacities in fields across the arts, humanities, languages, sciences, social sciences, and professional, technical, and vocational fields; an ethic of social engagement; soft skills, such as communication, discussion and debate; and rigorous specialization in a chosen field or fields. Such a holistic education shall be, in the long term, the approach of all undergraduate programmes, including those in professional, technical, and vocational disciplines.

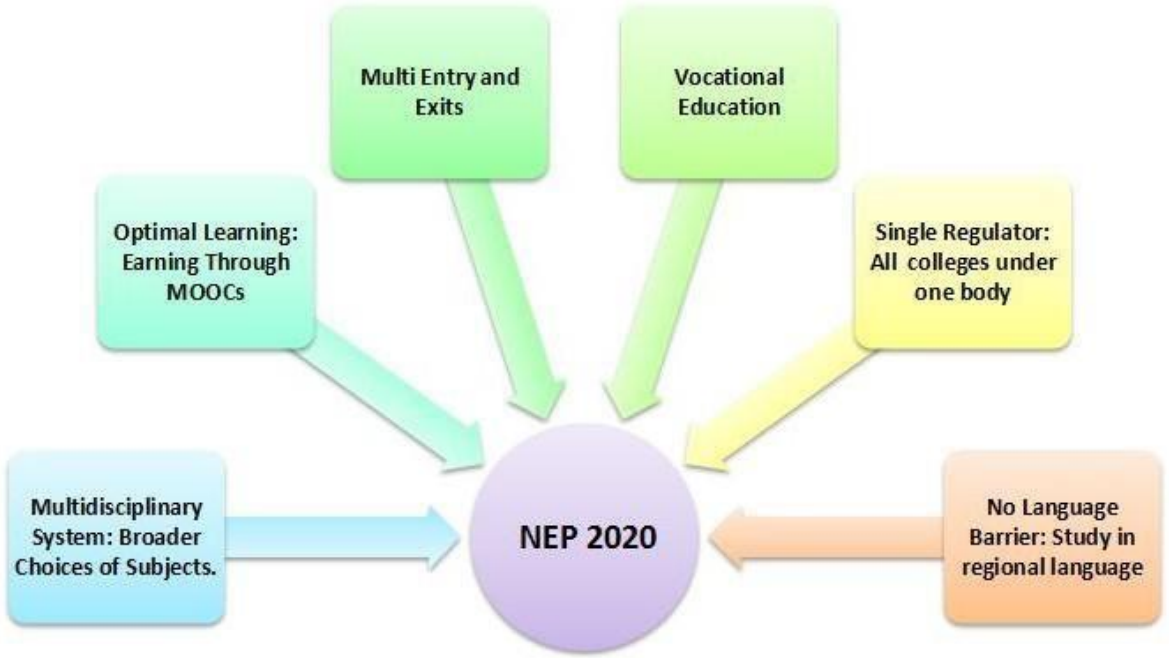

Fig 5: NEP 2020

Flexibility in curriculum and novel and engaging course options will be on offer to students, in addition to rigorous specialisation in a subject or subjects. Pedagogy for courses will strive for significantly less rote learning and an increased emphasis on communication, discussion, debate, research, and opportunities for cross-disciplinary and interdisciplinary thinking. The flexible and innovative curriculum shall emphasize on offering credit-based courses and projects in the areas of community engagement and service, environmental education and value-based education. as part of a holistic education, students will be provided with opportunities for internships with local industry, businesses, artists, crafts persons, villages and local communities, etc., as well as

research internships with faculty and researchers at their own or other HEIs or research institutions, so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability.

Effective learning requires relevant curriculum, engaging pedagogy, continuous formative assessment and adequate student support. The curriculum must be updated regularly aligning with the latest knowledge requirements and shall meet specified learning outcomes. High-quality pedagogy is then necessary to successfully impart the curricular material to students; pedagogical practices determine the learning experiences that are provided to students - thus directly influencing learning outcomes. The assessment methods have to be scientific and test the application of knowledge. Higher Education Institutes should move to a criterion-based grading system that assesses student achievement based on the learning goals for each programme, making the system fairer and outcomes more comparable. HEIs should also move away from high-stakes examinations towards more continuous and comprehensive evaluation.

4. DIPLOMA PROGRAMME OUTCOMES

The programme outcomes are derived from five domains of NSQF Level namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this programme, the student will be able to:

PO1: Perform tasks in limited range of activities, familiar situation with clear choice of procedures.

PO2: Acquire knowledge of principles and processes in the field of Ceramic Engineering.

PO3: Develop skills to accomplish quality tasks and solve problems using methods, tools, materials and information**.**

PO4: Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.

PO5: Take the responsibility of own works and supervise others work.

PO6: Select multidisciplinary subjects of own interest from broader choices.

PO7: Perform Self Learning through Massive Open Online Courses (MOOCs).

5. DERIVING CURRICULUM SUBJECT AREAS FROM DIPLOMA PROGRAMME OUTCOMES

The following curriculum subject areas have been derived from Programme outcomes:

Sr. No.	Programme Outcomes	Curriculum Subject Areas
1.	Perform tasks in limited range of activities, familiar situation with clear choice of procedures.	• Basics of Ceramic Engineering • Introduction to Ceramic Products • Ceramic Fabrication • Ceramic Raw Materials • Engineering Graphics • General Workshop Practice • Applied Physics • Applied Chemistry • Chemistry Applications • Industrial Operations • Professional Practices
2.	Acquire knowledge of principles and processes in the field of Ceramic Engineering.	• Applied Physics • Ceramic Fabrication • Basics of Ceramic Engineering • Ceramic Raw Materials • Fuels and Furnaces • Ceramic Machinery • Cement Technology • Industrial Operations • Ceramic Moulding Lab • Glass Technology – I • Glass Technology –II • Whiteware Technology • Whiteware and Glazes • Refractory Technology • Slip Testing Lab • Refractory Applications • Professional Practices • Ceramic Testing Lab

3.	Develop skills to accomplish quality tasks and solve problems using methods, tools, materials and information**.**	• Introduction to Ceramic Products • Basics of Ceramic Engineering • Ceramic Fabrication • General Workshop Practice • Engineering Graphics • Industrial / In-HouseTraining. • Fuels and Furnaces • Ceramic Machinery • Cement Technology • Ceramic Moulding Lab • Slip Testing Lab • Ceramic Testing Lab
4.	Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.	• English and Communication Skills – I • English and Communication Skills - II • Applied Mathematics • Fundamentals of IT • Environmental Studies & Disaster Management
5.	Take the responsibility of own works and supervise others work.	• General Workshop Practice • Industrial / In-House Training
6.	Select multidisciplinary subjects of own interest from broader choices.	• Programme Elective • Programme Elective II • Project Oriented Professional Training
7.	Perform Self Learning through Massive Open Online Courses (MOOCs).	• Open Elective (MOOCs^{+}/Offline)

FIRST YEAR
NSQF LEVEL - 3

7. DIPLOMA PROGRAMME STUDY AND EVALUATION SCHEME
FIRST YEAR

FIRST SEMESTER:

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P = C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
1.1	*English and Communication Skills - I	2	2	2+1=3	40	40	80	60	60	120	200
1.2	**Applied Mathematics	4	-	4+0=4	40	-	40	60	-	60	100
1.3	***Applied Physics	2	2	2+1=3	40	40	80	60	60	120	200
1.4	*Applied Chemistry	3	2	3+1=4	40	40	80	60	60	120	200
1.5	*Engineering Graphics	-	6	0+3=3	-	40	40	60	-	60	100
1.6	*General Workshop Practice	-	6	0+3 = 3	-	40	40	-	60	60	100
#Student Centred Activities (SCA)		-	6	-							
Total		**11**	**24**	**20**	**160**	**200**	**360**	**300**	**240**	**540**	**900**

* Common with other diploma programmes

** Same as Applied Mathematics I and Common with other diploma programmes.

*** Same as Applied Physics I Common with other diploma programmes.

Student Centred Activities will comprise of co-curricular activities like extension lectures on Constitution of India, etc, Games, Yoga, Human Values & Ethics, Knowledge of Indian System, Hobby clubs e.g. Photography etc., Seminars, Declamation Contests, Educational field visits, NCC, NSS, Cultural Activities and Self-study etc.

SECOND SEMESTER:

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P = C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
2.1	Ceramic Fabrication	4	4	4+2=6	40	40	80	60	60	120	200
2.2	Basics of Ceramic Engineering	3	4	3+2=5	40	40	80	60	60	120	200
2.3	Chemistry Applications	3	2	3+1=4	40	40	80	60	60	120	200
2.4	*Environment Studies and Disaster Management	2	-	2+0=2	40	-	40	60	-	60	100
2.5	*Fundamentals of IT	2	4	2+2=4	40	40	80	60	60	120	200
2.6	Introduction to Ceramic Products	-	4	0+2=2	-	40	40	-	60	60	100
#Student Centred Activities (SCA)		-	3	-							
Total		**14**	**21**	**23**	**200**	**200**	**400**	**300**	**300**	**600**	**1000**

* Common with other diploma programmes

Student Centred Activities will comprise of co-curricular activities like extension lectures on Constitution of India, etc, Games, Yoga, Human Values & Ethics, Knowledge of Indian System, Hobby clubs e.g. Photography etc., Seminars, Declamation Contests, Educational field visits, NCC, NSS, Cultural Activities and Self-study etc.

Summer Industrial/In-house Training : After 2nd semester, students shall undergo Summer Training **of 4 Weeks.**

7. HORIZONTAL AND VERTICAL ORGANISATION OF SUBJECTS

Sr. No.	Subjects	Hours Per Week	
		First Semester	Second Semester
1.	English and Communication Skills - I	4	-
2.	Applied Mathematics	4	
3.	Applied Physics	4	
4.	Applied Chemistry	5	-
5.	Engineering Graphics	6	-
6.	General Workshop Practice	6	-
7.	Ceramic Fabrication	-	8
8.	Basics of Ceramic Engineering	-	7
9.	Chemistry Applications	-	5
10.	Environmental Studies & Disaster Management	-	2
11.	Fundamentals of IT	-	6
12.	Introduction to Ceramic Products	-	4
13.	Student Centered Activities	6	3
	Total	**35**	**35**

8. COMPETENCY PROFILE AND EMPLOYMENT OPPORTUNITIES

In government and private sectors related to Ceramic Engineering, “Semi Skilled workers” are required to carry out a limited range of predictable tasks under close supervision. They are normally expected to communicate clearly in speech and along with knowledge of arithmetic and algebraic processes. They should know basic facts, processes and principles applied in limited area of Ceramic Engineering.

The NSQF Level – 3 pass out students are expected to recall and demonstrate practical routine and repetitive skills, in narrow range of Ceramic Engineering applications. They are expected to understand what constitutes quality in their job role. They are also expected to carry out the jobs given to them safely and securely. The pass outs have numerous avenues in medicine, aerospace, food and chemical industry, electronics, aerospace, refinery and mining industries. They have wide opportunities to work as semi-skilled employee on wage basis in following industries:

i) Ceramic ware manufacturing
ii) Glass bulbs
iii) Enamels
iv) Kitchen ware
v) Decorative ware
vi) Engine components manufacturing

They have wide scope in establishing small startups in the area of Marketing and Sales, and Manufacturing Units.

9. PROGRAMME OUTCOMES

The programme outcomes are derived from five domains of NSQF Level – 3 namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this programme, the student will be able to:

PO1: Carry out a task which may require limited range of predictable activities.

PO2: Acquire knowledge of basic facts, process and principles related to Ceramic Engineering for employment.

PO3: Demonstrate practical skill in narrow range of Ceramic Engineering applications.

PO4: Communicate in written and oral, with minimum required clarity along with skill of basic arithmetic and algebraic principles, personal banking and basic understanding of social and natural environment.

PO5: Perform task under close supervision with some responsibility for own work within defined limit.

10. ASSESSMENT OF PROGRAMME AND COURSE OUTCOMES

Programme Outcomes to be Assessed	Assessment Criteria for the Course Outcomes
PO1: Carry out a task which may require limited range of predictable activities.	• Identify physical quantities, select their units for use in engineering solutions, and make measurements with accuracy. • Represent physical quantities as scalar and vector and identify type of motions, various forms of energy, their conversion and applications. • Classify the elements into metals, non-metals and metalloids. • Explain the extraction of metals from ores, their mechanical properties and modification of properties by alloy formation. • Classify fuels and lubricants and apply them indifferent engineering applications. • Identify the polymeric materials, assess their properties and design suitable polymeric materials for current and future applications. • Apply effective methods for corrosion prevention. • Explain the properties and uses of various raw materials of ceramics. • Demonstrate methods of body preparation by dry and wet method. • Explain the constructional features of variousshaping processes. • Explain the mechanism of drying in ceramics. • Prepare flow diagrams of various processes • Comprehend the scope of ceramic engineering. • Explain the properties of refractories.

	• Explain the properties of cement. • Classify various types of glass. • Comprehend the geological work of river, sea and glacier. • Classify various types of rocks. • Specify various ceramic products. • List the characteristics of various ceramic products. • Carry out various tests on ceramic products. • Explain various terms atomic and molecular masses, empirical and molecular formula. • Understand testing of fuels. • Use phase rule and phase diagram and its applications. • Explain concept of adsorption and absorption. • Explain the concept of colloid. • Explain composition and applications of engineering materials.
PO2: Acquire knowledge of basic facts, process and principles related to Ceramic Engineering for employment.	• Identify physical quantities, select their units for use in engineering solutions, and make measurements with accuracy. • Represent physical quantities as scalar and vector and identify type of motions, various forms of energy, their conversion and applications. • Explain the properties and uses of various raw materials of ceramics. • Demonstrate methods of body preparation by dry and wet method. • Explain the constructional features of various shaping processes. • Explain the mechanism of drying in ceramics. • Prepare flow diagrams of various processes.

	• Comprehend the scope of ceramic engineering. • Explain the properties of refractories. • Explain the properties of cement. • Classify various types of glass. • Comprehend the geological work of river, sea and glacier. • Classify various types of rocks.
PO3: Demonstrate Practical skill in narrow range of Ceramic Engineering applications.	• Elaborate scientific work, energy and power, forms of friction and solve problems related to them. • Comprehend properties of matter and effect of temperature on various matter and phenomenon. • Identify tools, equipment and materials used inpreparing jobs. • Take measurements with the help of basic measuring tools/equipment. • Select materials, tools, and sequence of operations to make a job as per given specifications/drawing. • Prepare simple jobs independently and inspectthe same. • Use safety equipment and Personal Protection Equipment (PPE). • Maintain good housekeeping practices. • Draw Orthographic views of different objects viewed from different angles. • Draw and interpret sectional views of an object which are otherwise not visible in normal view. • Draw Isometric views of different solids and develop their surfaces. • Identify conventions for different engineering materials, symbols, sections of regular objects and general fittings used in Civil and Electrical household appliances.

	• Draw orthographic views of different objects by using basic commands of AutoCAD. • Demonstrate the use of physical principles and analysis in various fields of engineering. • Explain the properties and uses of various raw materials of ceramics. • Demonstrate methods of body preparation by dry and wet method. • Explain the constructional features of various shaping processes. • Explain the mechanism of drying in ceramics. • Prepare flow diagrams of various processes • Comprehend the scope of ceramic engineering. • Explain the properties of refractories. • Explain the properties of cement. • Classify various types of glass. • Comprehend the geological work of river, sea and glacier. • Classify various types of rocks. • Specify various ceramic products. • List the characteristics of various ceramic products. • Carry out various tests on ceramic products.
PO4: Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.	• Identify the nuances of Communication, both Oral and Written. • Acquire knowledge of the meaning c • Acquire enhanced vocabulary and in-depth understanding of Grammatical Structures and their usage in the communication. • Communicate effectively with an increased confidence to read, write and speak in English language fluently. • Comprehend the importance of sustainable ecosystem.

	• Clarify interdisciplinary nature of environmental issues. • Describe corrective measures for the abatement of pollution. • Identify the role of non-conventional energy resources in environmental protection. • Recognize various types of disasters. • Explain the basic components of Computers, Internet and issues of abuses/ attacks on information and computers • Handle the computer/laptop/ mobiles/Internet Utilities and Install/Configure OS. • Assemble a PC and connect it to external devices • Manage and Use Office practiced Automation Tools • Develop worksheets and Prepare presentations • Understand the geometric shapes used in engineering problems by Co-ordinate Geometry and Trigonometry. • Formulate engineering problems into mathematical formats with the use matrices, co-ordinate geometry and trigonometry • Calculate the approximate value of roots of certain expressions in engineering problems byapplication of binomial theorem. • Explore the idea of location, graph, and linear relationships between two variables. • Learn about basic fundamentals about MATLAB/ SciLab and mathematical calculation with MATLAB/ SciLab software.

PO5: Perform task under close supervision with some responsibility for own work within defined limit.	• Take measurements with the help of basic measuring tools/equipment. • Select materials, tools, and sequence of operations to make a job as per given specifications/drawing. • Prepare simple jobs independently and inspectthe same. • Use safety equipment and Personal Protection Equipment (PPE). • Maintain good housekeeping practices.

11. SUBJECTS & DETAILED CONTENTS

FIRST SEMESTER

1.1 ENGLISH & COMMUNICATION SKILLS – I

L	P
2	2

RATIONALE

Language as the most commonly used medium of self-expression remains indispensable in all spheres of human life –personal, social and professional. This course is intended to break fresh ground in teaching of Communicative English as per the requirements of National Skill Quality Framework. This course is designed to help students to acquire the concept of communication and develop an ability or skills to use them effectively to communicate with the individuals and community.

COURSE OUTCOMES

After undergoing this subject, the students will be able to:

CO1: Identify the nuances of Communication, both Oral and Written.

CO2: Acquire knowledge of the meaning of communication, communication process and speaking skills.

CO3: Acquire enhanced vocabulary and in-depth understanding of Grammatical Structures and their usage in the communication.

CO4: Communicate effectively with an increased confidence to read, write and speak in English language fluently.

DETAILED CONTENTS

UNIT I

Reading

1.1 Techniques of reading: Skimming and Scanning

1.2 Extensive and Intensive Reading: Textual Study

1.3 Homecoming – R.N. Tagore

1.4 Life Sketch of Sir Mokshagundam Visvesvarayya

1.5 Life Sketch of Dr. Abdul Kalam

1.6 Narayan Murthy’s speech at LBSNA, Dehradun

UNIT II

Fundamentals of Communication

2.1 Concept and Process of Communication

2.2 Types of Communication (Verbal Communication)

2.3 Barriers to Communication
2.4 Speaking Skill: Significance and essentials of Spoken Communication
2.5 Listening Skill: Significance and essentials of Listening

UNIT III

Grammar and Usage

3.1 Nouns
3.2 Pronouns
3.3 Articles
3.4 Verbs(Main and Auxiliary)
3.5 Tenses

UNIT IV

Writing Skills

4.1 Significance, essentials and effectiveness of Written Communication
4.2 Notice Writing
4.3 Official Letters and E-mails.
4.4 Frequently-used Abbreviations used in Letter-Writing
4.5 Paragraph Writing
4.6 Netiquettes

PRACTICAL EXERCISES

1. Reading

Reading Practice of lessons in the Lab Activity classes.

i. Comprehension exercises of unseen passages along with the lessons prescribed.
ii. Vocabulary enrichment and grammar exercises based on the selected readings.
iii. Reading aloud Newspaper headlines and important articles.

2. Fundamentals of Communication

i. Introducing oneself, others and leave- taking(talking about yourself)
ii. Just a minute (JAM) sessions: Speaking extempore for one minute on given topics
iii. Situational Conversation: Offering-Responding to offers; Congratulating; Apologizing and Forgiving; Complaining; Talking about likes and dislikes, Self-introduction Mock Interviews

3. Grammar and Usage

i. Written and Oral Drills will be undertaken in the class to facilitate holistic linguistic competency among learners.
ii. Exercises on the prescribed grammar topics.

4. Writing Skills

i. Students should be given Written Practice in groups so as to inculcate team-spirit and collaborative learning .

ii. Group exercises on writing paragraphs on given topics.

iii. Opening an e-mail account, receiving and sending emails

RECOMMENDED BOOKS

1) Alvinder Dhillon and Parmod Kumar Singla, "Text Book of English and Communication Skills Vol – 2", M/S Abhishek Publications, Chandigarh.
2) V Sasikumar & PV Dhamija, "Spoken English", Tata MC Graw Hills, New Delhi, Second Edition.
3) JK Gangal, "A Practical Course in Spoken English", PHI Learning Pvt. Ltd., New Delhi.
4) NK Aggarwal and FT Wood, "English Grammar, Composition and Usage", Macmillan Publishers India Ltd., New Delhi.
5) RC Sharma and Krishna Mohan, "Business Correspondence & Report writing", Tata MC Graw Hills, New Delhi, Fourth Edition.
6) Kavita Tyagi & Padma Misra, "Professional Communication", PHI Learning Pvt. Ltd., New Delhi.
7) Nira Konar, "Communication Skills for professionals", PHI Learning Pvt. Ltd., New Delhi.
8) Krishna Mohan & Meera Banerji, "Developing Communication Skills", Macmillan Publishers India Ltd., New Delhi, Second Edition
9) M. Ashraf Rizwi, "Effective Technical Communication", Tata MC Graw Hills, New Delhi.
10) Andrea J Rutherfoord, "Basic Communication Skills for Technology", Pearson Education, New Delhi.

INSTRUCTIONAL STRATEGY

This is practice based subject and topics taught in the class should be practiced as exercises in the Lab regularly for development of communication skills in the students. The students should be involved in activities to enhance their personality skills. This subject contains four units of equal weightage.

1.2 APPLIED MATHEMATICS

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RATIONALE

Contents of this course provide fundamental base for understanding engineering problems and their solution algorithms. Contents of this course will enable students to use basic tools like logarithm, binomial theorem, matrices, t-ratios and co-ordinates for solving complex engineering problems with exact solutions in a way which involve less computational task. By understanding the logarithm, they will be able to make long calculations in short time and it is also a pre-requisite for understanding Calculus.

COURSE OUTCOMES

After undergoing this subject, the students will be able to:

CO1: Illustrate the geometric shapes used in engineering problems by Co-ordinate Geometry and Trigonometry.

CO2: Formulate engineering problems into mathematical formats with the use matrices, co-ordinate geometry and trigonometry

CO3: Calculate the approximate value of roots of certain expressions in engineering problems by application of binomial theorem.

CO4: Explore the idea of location, graph, and linear relationships between two variables.

CO5: Learn about basic fundamentals about MATLAB/ SciLab and mathematical calculation with MATLAB/ SciLab software.

DETAILED CONTENTS

UNIT I

Algebra

1.1 Complex Numbers: definition of complex number, real and imaginary parts of a complex number, Polar and Cartesian Form and their inter conversion, Conjugate of a complex number, modulus and amplitude, addition subtraction, multiplication and division of complex numb

1.2 Logarithms and its basic properties

UNIT II

Binomial Theorem, Determinants and Matrices

2.1 Meaning of ${}^{n}P_{r}$ & ${}^{n}C_{r}$ (mathematical expression). Binomial theorem (without proof) for positive integral index (expansion and general form); binomial theorem for any index (expansion up to 3 terms - without proof), first binomial approximation with application to engineering problems.

2.2 Determinants and Matrices – Evaluation of determinants (upto 2nd order), solution of equations (upto 2 unknowns) by Crammer's rule, definition of Matrices and its types, addition, subtraction and multiplication of matrices (upto 2nd order).

UNIT III

Trigonometry

3.1 Concept of angle, measurement of angle in degrees, grades, radians and their conversions.

3.2 T-Ratios of Allied angles (without proof), Sum, Difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versa

3.3 Applications of Trigonometric terms in engineering problems such as to find an angle of elevation, height, distance etc.

UNIT-IV

Co-ordinate Geometry

4.1 Cartesian and Polar co-ordinates (two dimensional), Distance between two points, mid-point, centroid of vertices of a triangle.

4.2 Slope of a line, equation of straight line in various standards forms (without proof); (slope intercept form, intercept form, one-point form, two-point form, symmetric form, normal form, general form), intersection of two straight lines, concurrency of lines, angle between straight lines, parallel and perpendicular lines, perpendicular distance formula, conversion of general form of equation to the various forms.

UNIT V

Geometry of Circle and Software

Circle

5.1 General equation of a circle and its characteristics. To find the equation of a circle, given:

i. Centre and radius
ii. Three points lying on it
iii. Coordinates of end points of a diameter

Software

5.2 **MATLAB Or SciLab software –** Theoretical Introduction, MATLAB or Scilab as Simple Calculator (Addition and subtraction of values –Trigonometric and Inverse Trigonometric functions) – General Practice

RECOMMENDED BOOKS

1. R. D. Sharma, "Applied Mathematics – I & II for Diploma Courses", Dhanpat Rai Publications.
2. "Mathematics for Class XI", NCERT Publication, New Delhi.
3. "Mathematics for Class XII", NCERT Publication, New Delhi.
4. H. K Dass, "Applied Mathematics for Polytechnics", CBS Publishers & Distributers.
5. A Ganesh and G Balasubramanian, "Textbook of Engineering Mathematics – I", CBS Publisher, New Delhi.
6. A Ganesh and G Balasubramanian, "Textbook of Engineering Mathematics –II", CBS Publisher, New Delhi.
7. G. B. Thomas, R. L. Finney, "Calculus and Analytic Geometry", Addison Wesley, Ninth Edition.
8. B S Grewal, "Elementary Engineering Mathematics", Khanna Publishers, Delhi, Thirty-fifth Edition.
9. R.K. Jain and S.R.K. Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, New Delhi, Second Edition, 2003.
10. SS Sabharwal & Dr Sunita Jain, "Applied Mathematics Vol. I & II", Eagle Parkashan, Jalandhar.
11. S Kohli, "Engineering Mathematics Vol. I & II", IPH, Jalandhar.
12. Reena Garg & Chandrika Prasad, "Advanced Engineering Mathematics", Khanna Publishing House, New Delhi
13. R. Pratap, "Getting Started with MATLAB 7", Oxford University Press, Seventh Edition.
14. E-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. https://www.scilab.org

INSTRUCTIONAL STATREGY

This is theoretical subject and contains five units of equal weight age.
Basic elements of algebra, trigonometry and co-ordinate geometry can be taught in the light of their applications in the field of engineering and technology. By laying more emphasis on applied part, teacher can also help in providing a good continuing education base to the students. Students need to be taught the skills needed to use software tools built by experts through multiple problem solving based on the topics related to Algebra, Trigonometry and Coordinate Geometry that the industry requires. Examples to be used should be related to engineering.

Useful software MATLAB or open source software SciLab can be taught theoretically by books/online literatures and basic operations can be shown practically with practical software laboratory or small mobile apps of these software or authentic Trial version of MATLAB/ SciLab software. Students should be able to relate to the actual use of these examples and the way mathematical calculations will help them in doing their job.

1.3 APPLIED PHYSICS

L	P
2	2

RATIONALE

Applied physics includes the study of a large number of diverse topics all related to things that go on in the world around us. It aims to give an understanding of this world both by observation and by prediction of the way in which objects will behave. Concrete use of physical principles and analysis in various fields of technical are given prominence in the course content.

COURSE OUTCOMES

After completing this subject, student should be able to:

CO1: Identify physical quantities, select their units for use in engineering solutions, and make measurements with accuracy.

CO2: Represent physical quantities as scalar and vector and identify type of motions, various forms of energy, their conversion and applications.

CO3: Elaborate scientific work, energy and power, forms of friction and solve problems related to them.

CO4: Comprehend properties of matter and effect of temperature on various matter and phenomenon.

CO5: Demonstrate the use of physical principles and analysis in various fields of technology.

DETAILED CONTENTS

UNIT I

Unit and Dimensions

1.1 Definition of Physics, physical quantities- fundamental and derived

1.2 Units: fundamental and derived

1.3 System of units: CGS, FPS, MKS, SI

1.4 Dimension, dimensional formulae and SI units of physical quantities-distance, displacement, area, volume, density, velocity, acceleration, linear momentum, force, impulse, work, power, energy, pressure, surface tension, stress, strain)

1.5 Dimensional equations, principle of homogeneity of dimensional equation

1.6 Application of dimensional analysis: checking the correctness of physical equation, conversion of system of unit (force, work, acceleration)

UNIT II

Force and Motion

2.1 Scalar and vector quantities– definition and examples, representation of vector, types of vector (unit vector, position vector, co-initial vector, collinear vector, co-planar vector)

2.2 Vector algebra- addition of vectors, Triangle & Parallelogram law (statement and formula only),

2.3 Scalar and vector product (statement and formula only)

2.4 Force and its units, resolution of force (statement and formula only)

2.5 Newton's laws of motion (statement and examples)

2.6 Linear momentum, Law of conservation of linear momentum (statement and examples), Impulse

2.7 Circular motion: definition of angular displacement, angular velocity, angular acceleration, frequency, time period; Relation between linear and angular velocity, centripetal and centrifugal forces (definition and formula only), application of centripetal force in banking of road

2.8 Rotational motion: definition with examples

2.9 Definition of torque, angular momentum, moment of inertia and its physical significance

UNIT III

Work, Power and Energy

3.1 Work- definition, symbol, formula and SI unit, types of work (zero work, positive work and negative work) with example

3.2 Friction– definition and its simple daily life applications

3.3 Power- definition, formula and units

3.4 Energy- definition and its SI unit, examples of transformation of energy.

3.5 Kinetic energy- definition, examples, formula and its derivation

3.6 Potential energy- definition, examples, formula and its derivation

3.7 Law of conservation of mechanical energy for freely falling bodies (with derivation)

3.8 Simple numerical problems based on formula of Power and Energy

UNIT IV

Properties of Matter

4.1 Elasticity and plasticity- definition, deforming force, restoring force, example of elastic and plastic body

4.2 Definition of stress and strain, Hooke's law, modulus of elasticity

4.3 Pressure- definition, atmospheric pressure, gauge pressure, absolute pressure, Pascal's law

4.4 Surface tension- definition, SI unit, applications of surface tension, effect of temperature on surface tension

4.5 Viscosity: definition, unit, examples, effect of temperature on viscosity

UNIT V

Heat and Temperature

5.1 Definition of heat and temperature (on the basis of kinetic theory)

5.2 Difference between heat and temperature

5.3 Principle and working of mercury thermometer

5.4 Modes of transfer of heat- conduction, convection and radiation with examples.

5.5 Properties of heat radiation

5.6 Different scales of temperature and their relationship

PRACTICAL EXERCISES

1. Familiarization of measurement instruments and their parts (for example - vernier calliper, screw gauge, spherometer, travelling microscope etc.), and taking a reading. (compulsory to all students)
2. To find diameter of solid cylinder using a vernier calliper
3. To find internal diameter and depth of a beaker using a vernier calliper and hence find its volume.
4. To find the diameter of wire using screw gauge
5. To find thickness of paper using screw gauge.
6. To determine the thickness of glass strip using a spherometer
7. To determine radius of curvature of a given spherical surface by a spherometer.
8. To verify parallelogram law of force
9. To determine the atmospheric pressure at a place using Fortin's Barometer
10. To determine force constant of spring using Hooke's law
11. Measuring room temperature with the help of thermometer and its conversion in different scale.

RECOMMENDED BOOKS

1. "Text Book of Physics for Class XI (Part-I, Part-II)", N.C.E.R.T., Delhi.
2. Dr. HH Lal, "Applied Physics, Vol. I and Vol. II", TTTI Publications, Tata McGraw Hill, Delhi.
3. AS Vasudeva, "Applied Physics – I", Modern Publishers, Jalandhar.
4. R A Banwait, "Applied Physics – I", Eagle Prakashan, Jalandhar.
5. E-books/e-tools/relevant software to be used as recommended by AICTE/ HSBTE/ NITTTR.

6. C. L. Arora, “Practical Physics”, S Chand Publication.

SUGGESTED WEBSITES

1. http://swayam.gov.in
2. The Physics Classroom
3. https://www.khanacademy.org/science/physics

INSTRUCTIONAL STATREGY

This is hands-on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weightage.

Teacher may use various teaching aids like models, charts, graphs and experimental kits etc. for imparting effective instructions in the subject. Students need to be exposed to use of different sets of units and conversion from one unit type to another. Software may be used to solve problems involving conversion of units. The teacher should explain about field applications before teaching the basics of mechanics, work, power and energy, rotational motion, properties of matter etc. to develop proper understanding of the physical phenomenon. Use of demonstration can make the subject interesting and develop scientific temper in the students. Teachers should give examples of engineering/technology applications of various concepts and principles in each topic so that students are able to appreciate learning of these concepts and principles. In all contents, SI units should be followed. Working in different sets of units can be taught through relevant software.

1.4 APPLIED CHEMISTRY

L	P
3	2

RATIONALE

The regular use of a variety of chemistry based materials and processes in diverse technical and engineering fields have repeatedly proven the importance of Applied Chemistry and its role in current and future technological advancements. Ever increasing use of chemical materials in the emerging engineering applications demands engineers and technocrats to acquire an in-depth knowledge of Applied Chemistry to be able to choose the best suited materials to meet their needs while maintaining the environment sustainability. An understanding of the principles of Applied Chemistry will develop scientific attitude in the budding engineers to understand the physical and chemical properties of the available materials for engineering applications as well as an ability to design new and effective materials.

COURSE OUTCOMES

After studying this subject, students will be able to:

CO1: Classify the elements into metals, non-metals and metalloids.

CO2: Explain the extraction of metals from ores, their mechanical properties and modification of properties by alloy formation.

CO3: Classify fuels and lubricants and apply them in different engineering applications.

CO4: Identify the polymeric materials, assess their properties and design suitable polymeric materials for current and future applications.

CO5: Apply effective methods for corrosion prevention,

DETAILED CONTENTS

UNIT 1

Atomic Structure, Periodic Table and Chemical Bonding.

1.1 Bohr's model of atom (qualitative treatment only), dual character of matter: derivation of de-Broglie's equation, Heisenberg's Principle of Uncertainty, modern concept of atomic structure: definition of orbitals, shapes of s, p and d-orbitals, quantum numbers and their significance. Electronic configuration: Aufbau and Pauli's exclusion principles and Hund's rule, electronic configuration of elements up to atomic number 30.

1.2 Modern Periodic law and Periodic table, classification of elements into s, p, d and f-blocks, metals, non-metals and metalloids (periodicity in properties excluded).

1.3 Chemical bonding: cause of bonding, ionic bond, covalent bond, and metallic bond (electron sea or gas model), Physical properties of ionic, covalent and metallic substances.

UNIT II

Metals and Alloys

2.1 Metals: mechanical properties of metals such as conductivity, elasticity, strength and stiffness,luster, hardness, toughness, ductility, malleability, brittleness, and impact resistance and their uses.

2.2 Definition of a mineral, ore, gangue, flux and slag. Metallurgy of iron from haematite using a blast furnace. Commercial varieties of iron.

2.3 Alloys: definition, necessity of making alloys, composition, properties and uses of duralumin and steel. Heat treatment of steel- normalizing, annealing, quenching, tempering.

UNIT III

Water, Solutions, Acids and Bases

3.1 Solutions: definition, expression of the concentration of a solution in percentage (w/w, w/v and v/v), normality, molarity and molality and ppm. Simple problems on solution preparation.

3.2 Arrhenius concept of acids and bases, strong and weak acids and bases, pH value of a solution and its significance, pH scale. Simple numerical problems on pH of acids and bases.

3.3 Hard and soft water, causes of hardness of water, types of hardness – temporary and permanent hardness, expression of hardness of water, ppm unit of hardness; disadvantages of hard water; removal of hardness: removal of temporary hardness by boiling and Clark's method; removal of permanent hardness of water by Ion-Exchange method; boiler problems caused by hard water: scale and sludge formation, priming and foaming, caustic embrittlement; water sterilization by chlorine, UV radiation and RO.

UNIT IV

Fuels and Lubricants

4.1 Fuels: definition and classification of higher and lower calorific values, units of calorific value, characteristics of an ideal fuel. Petroleum: composition and refining of petroleum; gaseous fuels: composition, properties and uses of CNG, PNG, LNG, LPG; relative advantages of liquid and gaseous fuels over solid fuels. Scope of hydrogen as future fuel.

4.2 Lubricants- Functions and qualities of a good lubricant, classification of lubricants with

examples; lubrication mechanism (brief idea only); physical properties (brief idea only) of a lubricant: oiliness, viscosity, viscosity index, flash and fire point, ignition temperature, pour point.

UNIT V

Polymers and Electrochemistry

5.1 Polymers and Plastics: definition of polymer, classification, addition and condensation polymerization; preparation properties and uses of polythene, PVC, Nylon-66, Bakelite; definition of plastic, thermoplastics and thermosetting polymers; natural rubber and neoprene, other synthetic rubbers (names only).

5.2 Corrosion: definition, dry and wet corrosion, factors affecting rate of corrosion, methods of prevention of corrosion—hot dipping, metal cladding, cementation, quenching, cathodic protection methods

5.3 Introduction and application of nanotechnology: nano-materials and their classification, applications of nanotechnology in various engineering applications (brief).

PRACTICAL EXERCISES

1. To prepare standard solution of oxalic acid.
2. To dilute the given $KMnO_4$ solution
3. To find out the strength in grams per litre of an unknown solution of sodium hydroxide using a standard (N/10) oxalic acid solution.
4. To find out the total alkalinity in parts per million (ppm) of a water sample with the help of a standard sulphuric acid solution.
5. To determine the total hardness of given water sample by EDTA method
6. To determine the amount of total dissolved solids(TDS) in ppm in a given sample of water gravimetrically
7. To determine the pH of different solutions using a digital pH meter.
8. To determine the calorific value of a solid/liquid fuel using a Bomb calorimeter.
9. To determine the viscosity of a lubricating oil using a Redwood viscometer
10. To prepare a sample of Phenol-formaldehyde resin (Bakelite)/Nylon-66 in the lab.

RECOMMENDED BOOKS

1. "Textbook of Chemistry for class XI and XII (part I & II) NCERT", Delhi, 2017-18.
2. C.N. R. Rao, "Understanding Chemistry", Universities Press (India) Pvt. Ltd, 2011.
3. Jain & Jain, "Engineering Chemistry", Dhanpat Rai and Sons; New Delhi, 2015.
4. Dr. G. H. Hugar & Prof A. N. Pathak, "Applied Chemistry Laboratory Practices, Vol. I and Vol. II", NITTTR, Chandigarh, Publications, 2013-14.
5. Rajesh Agnihotri, "Chemistry for Engineers", Wiley India Pvt. Ltd, 2014.
6. "Applied Chemistry" by Usha Raju.

SUGGESTED WEBSITES

1. www.chemguide.co.uk/atommenu.html (Atomic structure and chemical bonding)
2. www.visionlearning.com (Atomic structure and chemical bonding)
3. www.cheml.com (Atomic structure and chemical bonding)
4. https://www.wastewaterelearning.com/elearning/ (Water treatment)
5. www.capital-refractories.com (Metals, Alloys, Cement, and Refractory Materials)
6. www.em-ea.org/guide%20books/book-2/2.1%20fuels%20and%20combustion.pdf (Fuel and Combustion)

INSTRUCTIONAL STRATEGY

Teachers may take help of various models and charts while imparting instructions to make the concept clear. More emphasis should be laid on discussing and explaining practical applications of various chemical process and reactions. In addition, students should be encouraged or motivated to study those processes in more details, which may find practical application in their future professional career. This subject contains five units of equal weightage.

1.5 ENGINEERING GRAPHICS

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RATIONALE

Drawing is the language of engineers and technicians. Reading and interpreting engineering drawings is their day to day responsibility. The subject is aimed at developing basic graphic skills in the students so as to enable them to use these skills in preparation of engineering drawings, their reading and interpretation. The emphasis, while imparting instructions, should be to develop conceptual skills in the students following BIS SP 46 – 1988.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:

CO1: Draw Orthographic views of different objects viewed from different angles.

CO2: Draw and interpret sectional views of an object which are otherwise not visible in normal view.

CO3: Draw Isometric views of different solids and develop their surfaces.

CO4: Identify conventions for different engineering materials, symbols, sections of regular objects and general fittings used in Civil and Electrical household appliances /fittings.

CO5: Draw orthographic views of different objects by using basic commands of AutoCAD.

DETAILED CONTENTS

UNIT I

1. Introduction to Engineering Drawing and Graphics

1.1 Introduction to use and care of drawing instruments, drawing materials, layout and sizes of drawing sheets and drawing boards.

1.2 Symbols and conventions-

a) Conventions of Engineering Materials, Sectional Breaks and Conventional lines.

b) Civil Engineering Sanitary fitting symbols

c) Electrical fitting symbols for domestic interior installations.

1.3 Geometrical construction-geometrical figures such as triangles, rectangles, circles, ellipses and curves, hexagons, pentagons bisecting a line and arc , division of line and circle with the help of drawing instruments.

2. Technical Lettering of Alphabet and Numerals

Definition and classification of lettering, Free hand (of height of 5,8,12 mm) and instrumental lettering (of height 20 to 35 mm) : upper case and lower case, single and double stroke, vertical and inclined (Gothic lettering) at 75 degree to horizontal and with suitable height to width ratio 7:4.

3. Dimensioning

3.1 Necessity of dimensioning, method and principles of dimensioning (mainly theoretical instructions).

3.2 Dimensioning of overall sizes, circles, threaded holes, chamfered surfaces, angles, tapered surfaces, holes, equally spaced on P.C.D., countersunk holes, counter bored holes, cylindrical parts, narrow spaces and gaps, radii, curves and arches.

4. Scales

4.1 Scales –Needs and importance (theoretical instructions), Type of scales, Definition of Representative Fraction (R.F.) and Length of Scale.

4.2 To draw/construct plain and diagonal scales.

UNIT II

1. Orthographic Projections

1.1 Theory of orthographic projections (Elaborate theoretical instructions).

1.2 Three views of orthographic projections of different objects of given pictorial view of a block in 1st and 3rd angle.

1.3 Projection of Points in different quadrant

1.4 Projection of Straight Line (1^{st} angle)

i. Line parallel to both the planes.

ii. Line perpendicular to any one of the reference plane and parallel to others

iii. Line inclined to any one of the references and parallel to another plane.

1.5 Projection of Plane – Different lamina like square rectangular, triangular, circle and Hexagonal pentagon. Trace of planes (HT and VT).

1.6 Identification of surfaces.

2. Sectioning

2.1 Importance and salient features

2.2 Drawing of full section, half section, partial or broken out sections, Offset sections, revolved sections and removed sections (theoretical only).

2.3 Orthographic sectional views of different objects.

UNIT III

1. Introduction of projection of right solids such as prism & pyramid (square, Pentagon, Hexagonal) cube, cone & cylinder (Axes perpendicular to H.P and parallel to V.P.)
2. Introduction of sections of right solids - Section planes, Sections of Hexagonal prism, pentagon pyramid, cylinder and cone (Section plane parallel to anyone reference planes and perpendicular to V.P. and inclined to H.P.)
3. Development of Surfaces – Development of lateral surfaces of right solids like cone, cylinder, pentagonal prism, pyramid and hexagonal pyramid (Simple problems)

UNIT IV

Isometric Views

1. Fundamentals of isometric projections and isometric scale.
2. Isometric views of different laminas like circle, pentagon and hexagon.
3. Isometric views of different regular solids like cylinder, cone, cube, cuboid, pyramid and prism.
4. Isometric views from given different orthographic projections(front, side and top view)

UNIT V

Introduction to AutoCAD

Basic introduction and operational instructions of various commands in AutoCAD. At least two sheets of different objects on AutoCAD (given pictorial/isometric view of a block). AutoCAD skill of student is evaluated in internal assessment only not in external exam.

RECOMMENDED BOOKS

1. Surjit Singh, “A Text Book of Engineering Drawing”, Dhanpat Rai & Co., Delhi.
2. PS Gill, “Engineering Drawing”, SK Kataria & Sons, New Delhi.
3. ND Bhatt, “Elementary Engineering Drawing in First Angle Projection”, Charotar Publishing House Pvt. Ltd., Anands.
4. T. Jeyapoovan, “Engineering Drawing and Graphics using AutoCAD”,Vikas Publishing House Pvt, Ltd Noida.
5. S.R.Singhal and O.P.Saxena, “A Text Book of Engineering Drawing”, Asian Publisher, Delhi.
6. RB Gupta, “Engineering Drawing”, Satya Prakashan, New Delhi.

INSTRUCTIONAL STRATEGY

Teacher should show model of realia of the component/part whose drawing is to be made. Emphasis should be given on cleanliness, dimensioning and layout of sheet. Focus should be on proper selection of drawing instruments and their proper use. First angle projection is to be

followed. Minimum of 20 sheets to be prepared and at least 2 sheets on AutoCAD**.** Instructions relevant to various drawings may be given along with appropriate demonstrations, before assigning drawing practice to students. This subject contains five units of equal weight age.

1.6 GENERAL WORKSHOP PRACTICE

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RATIONALE

In order to have a balanced overall development of diploma engineers, it is necessary to integrate theory with practice. General Workshop Practice is included in the curriculum in order to provide hands-on experience about use of different tools and basic manufacturing practices. This subject aims at developing general manual and machining skills in the students. In addition, the development of dignity of labour, safety at work place, team working and development of right attitude are the other objectives.

COURSE OUTCOMES

After undergoing this subject, the students will be able to:

CO1: Identify tools, equipment and materials used in preparing jobs.

CO2: Take measurements with the help of basic measuring tools/equipment.

CO3: Select materials, tools, and sequence of operations to make a job as per given specifications/drawing.

CO4: Prepare simple jobs independently and inspect the same.

CO5: Use safety equipment and Personal Protection Equipment (PPE).

CO6: Maintain good housekeeping practices.

DETAILED CONTENTS CUM PRACTICAL EXERCISES

Note: The students are supposed to come in proper workshop dress prescribed by the institute. Wearing shoes in the workshop(s) is compulsory. Importance of safety and cleanliness, safety measures and upkeep of tools, equipment and environment in each of the following shops should be explained and practiced. The students should prepare sketches of various tools/jobs in their practical Notebook.

The following shops are included in the syllabus:

1. Welding Shop I
2. Fitting and Plumbing Shop I
3. Sheet Metal Shop
4. Carpentry Shop I
5. Painting Shop
6. Electric and Electronics Shop I

1. WELDING SHOP – I

1.1 Safety Precautions of concerned shop and use of personal protective equipment (PPE), demonstration of tools, equipment, sample jobs, Best practices in the concerned shop.

1.2 Introduction and importance of welding process as compared to other material joining processes. Specifications and type of ARC welding machines, parts identification, classification, selection and coding of electrodes, welding parameters, welding joints and welding positions. Common weldable materials, safety precautions in welding shop, use of Personal Protective Equipment, Use of welding screens, Hazards and remedies during welding, Elementary symbolic representations, demo of tools, equipment, sample jobs prepared, set up of Gas welding apparatus, and welding defects.

1.3 Jobs to be prepared

- Job I Practice of striking arc and depositing uniform and straight beads onflat at different current levels. (Minimum 4 beads on M.S. flat at four setting of current level using shielded metal arc welding and differentiating their characteristics).
- Job II Edge Preparation and welding lap joint using shielded metal arcwelding (SMAW) process.
- Job III Edge Preparation and welding butt joint using shielded metal arcwelding process.
- Job IV Edge Preparation and welding T Joint using shielded metal arcwelding (100mm x 6 mm M.S. Flat).
- Job V To make a simple job using oxy acetylene gas welding.

2. FITTING AND PLUMBING SHOP – I

2.1 Safety Precautions of concerned shop and use of personal protective equipment (PPE), demonstration of tools, equipment, sample jobs, Best practices in the concerned shop.

2.2 Introduction and Function of holding/ clamping devices, hand tools and cutting tools,

2.3 Practical applications of fitting and plumbing

2.4 Introduction, function and types of marking and measuring tools and instruments (surface plate, try square, caliper, steel rule, scriber and Vernier caliper)

2.5 Identification of materials. (Iron, Copper, Stainless Steel, Aluminum etc.) and identification of various steel sections (flat, angle, channel, bar etc.).

2.6 Introduction to various types of pipes (eg water, steam, gas etc) and functions of various pipe fitting items (GI pipe fittings, CPVC pipe fittings), Methods of pipe joints

2.7 Introduction to various types of threads (internal and external)

2.8 Description and demonstration of various types of drills, taps and dies.

2.9 Jobs to be prepared:

- Job I To fit hacksaw blade in its frame and perform hacksawing operation byusing marking media and marking tool and straight sawing practice.
- Job II To perform filing on MS workpiece (75 * 50 * 6 mm) for giving it aperfect rectangular shape and drilling, tapping operation.

Job III To perform step filing operation at right angle on MS workpiece.

Job IV Making external threads on a pipe by using die and to make a PVC/GI pipe connection using nipple and socket.

Job V Fitting of all components of wash basin and ball valve in a tank.

3. SHEET METAL SHOP

3.1. Safety Precautions of concerned shop and use of personal protective equipment (PPE), demonstration of tools, equipment, sample jobs, best practices in the concerned shop.

3.2 Demonstration of various power tools, apparatus, equipment, hand tools used in sheet metal shop.

3.3 Jobs to be prepared

Job I Prepare a seam joint by using hand tools on GI sheet.

Job II To prepare riveted lap joint (single/double) on GI sheet.

Job III To fabricate a funnel of GI sheet using operations of shearing, flatteningand bending.

Job IV To fabricate a conduit joint using various sheet metal operations.

Job V To fabricate a utility job (eg soap case/file tray/canister box) of thin GIsheet.

4. CARPENTRY SHOP - I

4.1 Safety Precautions of concerned shop and use of personal protective equipment (PPE), demonstration of tools, equipment, sample jobs, Best practices in the concerned shop.

4.2 Introduction and industrial applications of carpentry jobs.

4.2.1 Name and use of raw materials used in carpentry shop : wood & alternative materials(board, plywood)

4.2.2 Introduction to wood, timber and their identification, shapes and specifications, their properties, applications & defects. Study of the joints in roofs, doors, windows and furniture, seasoning of wood

4.2.3 Names, uses, and types of hand tools such as Saws, C-Clamp, Chisels, Mallets, Carpenter's vices, Marking gauges, Try-squares, Rulers and other commonly used tools and materials used in carpentry shop by segregating as cutting tools, supporting tools, holding tools, measuring tools etc.

4.2.4 Specification of iron jack plane used in carpentry shop.

4.3 Practice

4.3.1 Practices for Basic Carpentry Work

4.3.2 Sawing practice using different types of saws

4.3.3 Assembling jack plane — planning practice including sharpening and bladeadjustment of jack plane cutter

4.3.4 Chiselling practice using different types of chisels including sharpening ofchisel

4.3.5 Making of different types of wooden pin and fixing methods. Markingmeasuring and inspection of jobs.

4.3.6 Housekeeping practices and instructions.

4.4 Jobs to be Prepared

Job 1 Prepare a rectangular wooden block involving operations likeMarking, sawing, planning to size, chiseling.

Job II Prepare a Half Lap Joint (cross, L or T – any one).

Job III Prepare a Mortise and Tenon joint (T-Joint).

Job IV Prepare a Dove tail Joint (Half lap dovetail joint.

Job V Prepare a Bridle Joint.

5. PAINTING SHOP

5.1 Safety Precautions of concerned shop and use of personal protective equipment (PPE), demonstration of tools, equipment, sample jobs, Best practices in the concerned shop.

5.2 Introduction to paints, varnishes, primers and their types, General properties of paints, Constituents of paints, polishes, their advantages and applications.

5.3 Introduction of powder coating and spray painting with their uses. Different types of tools and equipment used in polishing and painting.

5.4 Preparation of different colours of the paints by using prime colours, Practical demonstration of powder coating and spray painting on a utility object

5.5 Jobs to be Prepared

Job I Prepare wooden surface for painting such as cleaning, sanding, applying putty, filling procedure and application of primer coat andbrush paint the same.

Job II Painting on wooden and metallic surfaces by spray gun.

Job III Practice of lettering: name plates / sign board.

Job IV Practice of dip painting/powder coating.

Job V Prepare wooden surface for polishing, apply French polish on woodensurface.

6. ELECTRICAL AND ELECTRONICS SHOP - I

6.1 Safety Precautions of concerned shop and use of personal protective equipment (PPE), demonstration of tools, equipment, sample jobs, best practices in the concerned shop.

6.2 Demonstration and identification of common electrical materials with standard ratings and specifications such as wires, cables, switches, MCB & ELCB, fuses, cleats, clamps and allied items, tools and accessories.

6.3 Identification of phase, Neutral and Earth wires for connection to domestic electrical appliances and their connections to three pin plugs. Difference between series and parallel wiring.

6.4 Jobs to be performed

Job I Carrying out house wiring circuits using fuse, switches, sockets,ceiling rose etc. in batten or P.V.C. casing-caping. Demo of conduit wiring through junctions.

Job II To prepare a three level Godown wiring circuit with PVC conduitwiring system.

Job III Installation of Solar Panel, inverter and batteries.

6.5 Identification and familiarization with the following tools used in electronic shop such as Tweezers, Screw drivers (different sizes), Insulated Pliers, Cutter, Sniper, Philips Screw Driver (Star Screw Driver), L- Keys, Soldering Iron, soldering wire, flux and their demonstration and uses. Identification and familiarization with multimeter (analog and digital). Various types of protective devices such as wire fuse, cartridge fuse etc. Identification and familiarization with ear phone speaker connector, telephone jacks and similar male and female connectors (audio, video).

6.6 Jobs to be performed

Job IV Practice in the use of tools and instruments used in electronicshop. For this a small experimental set up may be done.

Job V Cut, strip, join an insulated wire with the help of soldering iron (repeat with different types of wires).

RECOMMENDED BOOKS

1. SK Hajra Choudhary and AK Choudhary, "Workshop Technology I, II, III", Media Promoters and Publishers Pvt. Ltd., Mumbai, Fifteenth Edition, 2016.
2. RK Jain, "Workshop Technology Vol I& II'', Khanna Publishers, New Delhi, First Edition,2021.
3. Manchanda, "Workshop Technology Vol. I, II, III", India Publishing House, Jalandhar.
4. S.S. Ubhi, "Workshop Training Manual Vol. I, II'', Katson Publishers, Ludhiana.
5. K Venkata Reddy, "Manual on Workshop Practice", MacMillan India Ltd., New Delhi,Sixth Edition, 2020.
6. "General Workshop Manual (Diploma Jobs)", Khanna Publishers, First Edition, 2021.
7. T Jeyapoovan, "Basic Workshop Practice Manual", Vikas Publishing House (P) Ltd., NewDelhi.
8. B. S. Raghuvanshi, "Workshop Technology, Vol. I", Dhanpat Rai and Sons, Delhi, EleventhEdition, 2017.
9. Kannaiah K L, Narayana, "Workshop Manual", Scitech Publications, Chennai, Second Edition 1998.
10. H S Bawa, "Workshop Practice", Tata McGraw Hill Publication, First Edition, 2004

INSTRUCTIONAL STRATEGY

This is hands-on practice based workshop for development of required skills in the students.

SECOND SEMESTER

SECOND SEMESTER

2.1 CERAMIC FABRICATION

L	P
4	4

RATIONALE

Ceramic fabrication plays an important role in the production and manufacturing of Ceramic wares. It helps to solve problems of material selection and application. So an diploma engineering student must be conversant with properties, composition and behavior of materials from reliability, sustainability and performance of the product point of view. It will also help the students in understanding basic concepts of materials and fabrication of engineering subjects where the emphasis is laid on the production.

COURSE OUTCOMES

After undergoing this course, the students will be able to:

C01: Explain the properties and uses of various raw materials of ceramics.
C02: Demonstrate methods of body preparation by dry and wet method.
CO3: Explain the constructional features of various shaping processes.
C04: Explain the mechanism of drying in ceramics.
CO5: Prepare flow diagrams of various processes

DETAILED CONTENTS

UNIT-1

Introduction to Ceramic Fabrication

1.1 Definition of Fabrication Processes.
1.2 Classification of Ceramic Fabrication Processes with example.

2. Basic Raw Materials & Additves

2.1 Clay – its role & Classification
2.2 Properties and uses of clay.
2.3 Quartz – its role, properties and uses.
2.4 Feldspar – its role, properties and uses.

2.5 Additives – its type and role.
2.5.1 Water, Plasticizer, Binder
2.5.2 Deflocculants
2.5.3 Lubricants

UNIT- II

3. Batch Preparation

3.1 Definition of batch preparation, typical whiteware body composition.
3.2 Dry mix, plastic and slip mix (flow diagram of body preparation).
3.3 Demonstrate methods of body preparation by dry and wet method.
3.4 Enumerate the advantages and disadvantages of dry and wet method.
3.5 Explain Weathering & Ageing
3.6 Blungers.
3.7 Pugging /Explanation of pug mill (ordinary & de-airing).

UNIT- III

4. Shaping

Illustrate the shaping process with sketches & constructional features of machinery for following processes :

4.1 Plastic Shaping – Hand moulding with potter's wheel, Jiggering & Jolleying,
4.2 Semi-plastic Shaping – pressing
4.3 Extrusion & turning
4.5 Dry Pressing - study the Particle packing characteristics.
4.6 Outline the important parameters of pressing (powder, die & pressurecharacteristics),
4.7 Stages of pressing.
4.8 Types of presses: Toggle press, Fly press/screw press, Friction press, Hydraulic press, Pneumatic Press
4.9 Casting - Slip casting (solid, hollow)
4.10 Explain Surface finishing methods - Trimming, Smoothening

UNIT- IV

5 Drying & Firing

5.1 Definition and importance of drying in ceramics & its mechanism.
5.2 Classification of driers – batch & continuous, for materials and products withexamples.
5.3 General sketch of drier and its working.

5.4 Common drying defects with remedies. (warping, cracking, lamination)
5.5 Definition of firing, types of firing (biscuit and glost)
5.6 Types of furnaces
5.7 Stages in firing.
5.8 General sketch of furnace with working

UNIT V

6. Process FLOW CHARTS

Illustrate and explain general manufacturing process (dry & wet) of ceramic products with flow chart. Describe the following processes with flow diagram –

6.1 Bone china plates by jiggering
6.2 Ceramic cups by jolleying,
6.3 Refractories by semi-dry pressing,
6.4 Floor tiles by dry pressing.

PRACTICAL EXERCISES (Minimum 10 to be conducted)

1. Identification of ceramic raw materials and additives.
2. Demonstration of Machinery used in the shaping& identification of tools according to use.
3. Prepare terracotta wall plates
4. Prepare terracotta jewelry articles
5. Clay models having attachments/ projections.
6. Preparing a bowl
7. Shaping flower vase
8. Fabricating pot
9. Prepare a triaxial batch composition for plastic pressing and fabricate an article.
10. Prepare a triaxial batch composition for semi plastic pressing and fabricate an article.
11. Prepare single piece POP mould.
12. Prepare double, triple piece POP mould
13. Prepare slip and leave for ageing
14. Preparation of article by slip casting
15. Preparation of glaze
16. Application of glaze
17. Drying of slip casted wares.
18. Firing of wares

RECOMMENDED BOOKS

1 Sudhir Sen, "White Wares", Oxford & IBH Publishing Co., New Delhi.
2 S.K. Mirmira, "Indian Pottery", Gramodaya Sangh, Bhadrawati.
3 Singer & Singer, "Industrial Ceramics", Chemical Publishing Co, Boston, USA.
4. W D Kingery, "Introduction to Ceramics", Elsevier Scientific Publishing Company,New York.
5. S K Jain, "Mineral Processing", CBS Publishers & Distributors, New Delhi.
6. James Reed, "Principles of Ceramic Processing", Wiley Publishers.

WEBSITE RESOURCES

1. www.britannica.com/art/whiteware
2. www.ceramicindustry.com/Topics
3. http://www.minerals.net/
4. http://www.mineralminers.com/
5. http://www.webmineral.com
6. http://www.geology.com/
7. http://www.ceramicartsdaily.org
8. Porcelain Insulator: www.youtube.com/watch?v=rpKHxt9o-M0
9. Sanitary Wares: www.youtube.com/watch?v=CAthI2Rigys
10. Glazed Tiles: www.youtube.com/watch?v=EIjE_F026EQ
11. Spray Drier: www.youtube.com/watch?v=0o4ZCjHnaRw
12. Industrial Ceramics Singer & Singer e-Resources
13. http://digitalfire.com/4sight/education/index.html
14. http://ceramicartsdaily.org/
15. http://ceramicart.com.au/
16. https://www.youtube.com/user/CeramicArtsDaily

INSTRUCTIONAL STRATEGY

This is hands-on practice based subject and topics taught in the class should be practiced in the lab regularly for development of required skills in the students. This subject contains five units of equal weightage.

2.2 BASICS OF CERAMIC ENGINEERING

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RATIONALE

It is an introductory subject to be given to students opting for ceramic engineering. It will expose the students to various areas to be covered in this course and various field jobs where they will find employment. The students will also be exposed to various categories of ceramics and geology. The contents of geology combined with other subjects helps the students to know about physical, chemical and thermal properties of raw materials, additives and finished products which help them to select appropriate materials and process for producing finished goods.

COURSE OUTCOMES

After undergoing this subject, the students will be able to:

C01: Comprehend the scope of ceramic engineering.
C02: Explain the properties of refractories.
CO3: Explain the properties of cement.
C04: Classify various types of glass.
CO5: Comprehend the geological work of river, sea and glacier.
CO6: Classify various types of rocks.

DETAILED CONTENTS

UNIT I

1. Introduction of Ceramics

1.1 Definition, Brief history and development of ceramics.
1.2 Scope of Ceramic Engineering, opportunities in ceramic engineering for diploma holders.
1.3 Traditional Ceramics – White wares (Terracotta, Earthenware, Stoneware and Porcelains).

1.4 Cements, Glass.
1.5 Refractories, Abrasives.
1.6 Advanced Ceramic products – Electrical, Electronic &Magnetic, Automobile Ceramics
1.7 Mechanical, Electronics, Chemical, Bio-Ceramics & Nuclear Ceramic Products.

2. White Ware

2.1 Definition, Classification of Wares: white wares, heavy clay wares.
2.2 Raw materials,
2.3 Properties and application.

UNIT II

3. Refractory

3.1 Definition of refractory, Classification of refractories (Acidic, Basic, Neutral)
3.2 Raw material, properties of refractories, general application of refractories. General manufacturing method.

4. Cement

4.1 Definition of cement, Classification ,
4.2 Types of cement,
4.3 Raw material, General method of making cement,
4.4 Properties of cement & uses.

UNIT III

5. Glass

5.1 Definition, Types of glass:- container glass, sheet glass, plate glass, bulb glass,laboratory glass, glass wool etc.
5.2 Raw material of glass.

6. Composites

Introduction, classification, Properties and applications. Cermets and applications

UNIT IV

7. Introduction to Earth

7.1 The earth as a planet
7.2 Important parts of earth
7.3 Internal structure of earth.

8. Work of Atmosphere

8.1 Weathering of rocks.

8.2 Work of wind erosion, transport of materials, deposition.

8.3 Geological work of rivers, erosion, transport and deposition.

8.4 Geological work of sea, wave erosion and deposition.

8.5 Geological work of glaciers, formation of glaciers.

UNIT V

9. Rocks

9.1 Igneous Rocks: Formation, composition, structures, texture., Classification and brief study of important igneous rocks (Granite, Diorite, Basalt, Hornblende, Obsidian, Pegmatite, Syenite, Gabor, Dolerite).

9.2 Sedimentary Rocks Formation, compositions, structures, texture of sedimentary rocks, Classification and brief study of important sedimentary rocks(Dolomite, Limestone, Sandstone, Shale).

9.3 Metamorphic Rocks: Metamorphism, types, Metamorphic rocks: formation, structures and texture, Classification and brief study of important metamorphic rocks (Marble, Slate, Soapstone, Quartzite, Gneiss, Phyllite, Schist, Amphibolite).

PRACTICAL EXERCISES (Minimum 8 Practicals to be completed)

1. Observe and record physical properties of minerals: Colour, lusture, streak.
2. Observe and record physical properties of minerals hardness, cleavage, fracture.
3. Observe and record physical properties of minerals tenacity, structure, and specific gravity.
4. Microscopic identification of minerals.
5 Studyof crystal system.
6. Identification of minerals in hand specimen.
7. Identification of igneous rocks in hand specimen.
8. Identification of Sedimentary rocks in hand specimen.
9 Identification of Metamorphic rocks in hand specimen.
10. Determination of specific gravity of minerals.
11. Determination of Hardness of minerals.

RECOMMENDED BOOKS

1. WD Kingery, “Introduction to Ceramics”, Elsevier Scientific Publishing Company,New York.
2. Sudhir Sen, “Ceramic White Wares”, Oxford & IBH Publishing Co., New Delhi.
3. M.I. Mishra, “Refractories”, Oxford & IBH Publishing Co., New Delhi.
4. S.G. Schlose, “Modern glass practice”, McGraw Hill Publishing Co. New Delhi..
5. Edward J Tarbuck, “Earth Science”, Amazon Publication.
6. Edward A Keller, “Introduction to Environmental Geology”, Second Edition, Amazon Publication.
7. John Erickson, “Rock Formation and Universal Geological Structure: Exploring the Earth Surface”, Powell Publication.
8. Parbin Singh, “Engineering Geology”, Katson Publishers.

INSTRUCTIONAL STRATEGY

Teacher should give emphasis on give emphasis on concepts and understanding of various terms related to Ceramics and understanding the various processes involved in formation of rocks. Samples of different rocks must be shown to the students for better understanding of various properties. This subject contains five units of equal weightage.

2.3 CHEMISTRY APPLICATIONS

L	P
3	2

RATIONALE

The role of chemistry in every branch of engineering and technology is expanding greatly. Chemistry is considered as one of the core subjects for diploma students in engineering and technology for developing in them scientific temper and appreciation of chemical properties of materials, which they have to handle in their professional career. Effort should be made to teach this subject through demonstration/minor projects and with the active involvement of students.

COURSE OUTCOMES

After undergoing this subject, student will be able to:
CO1: Explain various terms atomic and molecular masses, empirical and molecular formula.
CO2: Understand testing of fuels.
CO3: Use phase rule and phase diagram and its applications.
CO4: Explain concept of adsorption and absorption
CO5: Explain the concept of colloid.
CO6: Explain composition and applications of engineering materials

DETAILED CONTENTS

UNIT 1

Language of Chemistry.

1.1 General Introduction. Definition of symbol, formula, valency and chemical equation. Atomic and molecular masses, mole concept and molar mass.

1.2 Writing of the chemical formula of a simple chemical compound, empirical and molecular formula,Calculation of percentage composition of a chemical compound.

1.3 Essentials of a chemical equation, balancing of a chemical equation by Hit and Trial method. Exothermic and endothermic equations

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UNIT II

Fuels Testing and manufacture of gaseous fuels

2.1 Calorific value, determination of calorific value by bomb calorimeter.

2.2 Combustible and non combustible constituents of coal,

2.3 Proximate and ultimate analysis of coal.

2.4 Manufacture, properties and uses of Producer gas

2.5 Manufacture, properties and uses of Water gas

2.6 Manufacture, properties and uses of Bio Gas.

UNIT III

Introduction to Phase Rule and Phase Diagrams

3.1 Phase rule, terminology related to phase rule, Gibb's phase rule, applications of phase rule.

3.2 General phase diagram only, Concept of Fusion/ freezing curve, Vaporization/condensation curve, Sublimation/ deposition curve, Concept of Triple point.

3.3 Classification of phase diagrams (Uniary, Binary and ternary) with examples without explanations.

UNIT IV

Surface Chemistry

4.1 Adsorption - Physisorption and chemisorption, factors affecting adsorption of gases on solids. Distinction between absorption and adsorption.

4.2 Colloidal state: Distinction between true solutions, colloids and suspension; lyophilic, lyophobic, properties of colloids; Tyndall effect, Brownian movement.

4.3 Concept of flocculation, deflocculation of colloids, coagulation.

UNIT V

Engineering Materials

5.1 Definition and types with suitable examples and applications of- Ceramics, Refractory and Composite materials.

5.2 Glass-chemical composition and application of Soda, Borosilicate and lead glasses only.

5.3 Paint, varnish and enamels- definition, constituents and advantages of these organic coatings.

PRACTICAL EXERCISES

1. Crystallization of a sample of alum.
2. Separation of constituents of an inorganic mixture by paper chromatography .
3. Separation of components of ink.
4. To prepare colloidal solution of starch.
5. To prepare colloidal solution of ferric hydroxide.
6. Detection of iron metal in the given solution of rust.
7. Preparation of crystals of Mohr's salt (NH4)2Fe(SO4)2.6H2O
8. Gravimetric estimation of ash content in the given coal sample.
9. Determination of percentage composition of volatile/non volatile matter in the given mixture.
10. Gravimetric estimation of moisture in the given coal sample.

RECOMMENDED BOOKS

1. J.C Kuriacone, J Rajaram, "Chemistry in Engineering and Technology", McGraw Hill Education India private Ltd.
2. S.S Dua, "A Text book of engineering Chemistry", S. Chand and Company limited.
3. Atkin, "Physical Chemistry", Oxford Publication.
4. Puri Sharma Pathania, "Principles of Physical Chemistry", Vishal Publications.
5. Chemistry for class XI Part I, NCERT,2020
6. P.C. Jain & Monika Jain, "Engineering Chemistry", Dhanapat Rai Publishing Company, New Delhi.

INSTRUCTIONAL STRATEGY

While teaching, teacher should lay emphasis on discussing and explaining practical applications of various chemical process and materials. In addition, students should be encouraged or motivated to study those processes in more details, which may find practical application in their future professional career. This subject contains five units of equal weightage.

2.4 ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT

L	P
2	-

RATIONALE

A diploma holder must have knowledge of different types of pollution caused due to industrial and construction activities so that he/she may help in balancing the ecosystem and controlling pollution by various control measures. The course is intended to provide a general concept in the dimensions of environmental pollution and disasters caused by nature beyond the human control as well as the disasters and environmental hazards induced by human activities with emphasis on disaster preparedness, response and recovery.

COURSE OUTCOMES

After undergoing the subject, the student will be able to:

CO1: Comprehend the importance of sustainable ecosystem.
CO2: Clarify interdisciplinary nature of environmental issues.
CO3: Describe corrective measures for the abatement of pollution.
CO4: Identify the role of non-conventional energy resources in environmental protection.
CO5: Recognize various types of disasters.

DETAILED CONTENTS

UNIT I
Introduction

1.1 Basics of ecology, eco system- concept, and sustainable development, Sources, advantages, disadvantages of renewable and nonrenewable energy.
1.2 Rain water harvesting
1.3 Deforestation – its effects & control measures

UNIT II
Air and Noise Pollution

2.1 Air Pollution: Source of air pollution. Effect of air pollution on human health, economy, Air pollution control methods.
2.2 Noise Pollution: Source of noise pollution, Unit of noise, Effect of noise pollution, Acceptable noise level, Different method of minimizing noise pollution.

UNIT III

Water and Soil Pollution

3.1 Water Pollution: Impurities in water, Cause of water pollution, Source of water pollution. Effect of water pollution on human health, Concept of DO, BOD, COD. Prevention of water pollution- Water treatment processes, Sewage treatment. Water quality standard.

3.2 Soil Pollution :Sources of soil pollution, Effects and Control of soil pollution, Types of Solid waste- House hold, Industrial, Agricultural, Biomedical, Disposal of solid waste, Solid waste management E-waste, E – waste management

UNIT IV

Impact of Energy Usage on Environment

Global Warming, Green House Effect, Depletion of Ozone Layer, Acid Rain. Eco-friendly Material, Recycling of Material, Concept of Green Buildings, Concept of Carbon Credit & Carbon footprint.

UNIT V

Disaster Management

A. Different Types of Disaster:

Natural Disaster: such as Flood, Cyclone, Earthquakes and Landslides etc.

Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea Rail & Road), Structural failures(Building and Bridge), War & Terrorism etc.

B.Disaster Preparedness:

Disaster Preparedness Plan

Prediction, Early Warnings and Safety Measures of Disaster

Psychological response and Management (Trauma, Stress, Rumour and Panic)

RECOMMENDED BOOKS

1. S.C. Sharma & M.P. Poonia, “Environmental Studies”, Khanna Publishing House, New Delhi.
2. BR Sharma, “Environmental and Pollution Awareness”, Satya Prakashan, New Delhi.
3. Dr. RK Khitoliya, “Environmental Pollution”, S Chand Publishing, New Delhi.
4. Erach Bharucha, “Environmental Studies”, University Press (India) Private Ltd., Hyderabad.
5. Suresh K Dhamija, “Environmental Engineering and Management”, S K Kataria and Sons, New Delhi.
6. E-books/e-tools/relevant software to be used as recommended by AICTE/BTE/NITTTR, Chandigarh.
7. Dr. Mrinalini Pandey, “Disaster Management”, Wiley India Pvt. Ltd.

8. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill Education (India) Pvt. Ltd.

INSTRUCTIONAL STRATEGY

In addition to theoretical instructions, different activities pertaining to Environmental Studies and Disaster Management like expert lectures, seminars, visits etc. may also be organized This subject contains five units of equal weightage.

2.5 FUNDAMENTALS OF IT

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2	4

RATIONALE

Information technology has great influence on all aspects of life. Almost all work places and living environment are being computerized. In order to prepare diploma holders to work in these environments, it is essential that they are exposed to various aspects of information technology such as understanding the concepts of information technology and its scope, operating a computer: use of various office management tools, using internet and mobile applications etc. This course is intended to make new students comfortable with computing environment - Learning basic computer skills, learning basic application software tools, Understanding Computer Hardware, Cyber security awareness.

COURSE OUTCOMES

At the end of the subject student will be able to

CO1: Explain the basic components of Computers, Internet and issues of abuses/ attacks on information and computers
CO2: Handle the computer/laptop/mobiles/Internet Utilities and Install/Configure OS
CO3: Assemble a PC and connect it to external devices
CO4: Manage and Use Office practiced Automation Tools
CO5: Develop worksheets and Prepare presentations

DETAILED CONTENTS

UNIT I

Basics of Computer

Brief history of development of computers, Definition of Computer, Block diagram of a Computer, Hardware, Software, Booting: Cold and Hot Booting, Interaction between the CPU and Memory with Input/Output devices, Function of CPU and major functional parts of CPU. Memory, Bit, Nibble, Byte, KB, MB, GB, TB, PB, Functions of memory, Use of storage devices in a Computer, List types of memory used in a Computer, Importance of cache memory, CPU speed and CPU word length

UNIT II

Basic Internet Skills

Understanding browser, Introduction to WWW, efficient use of search engines, awareness about Digital India portals (state and national portals) and college portals. Advantages of Email, Various email service providers, Creation of email id, sending and receiving emails, attaching documents with email and drive.

Effective use of Gmail, G-Drive, Google Calendar, Google Sites, Google Sheets, Online mode of communication using Google Meet & WebEx.

UNIT III

Basic Logic building

Introduction to Programming, Steps involved in problem solving, Definition of Algorithm, Definition of Flowchart, Steps involved in algorithm development, differentiate algorithm and flowchart, symbols used in flowcharts, algorithms for simple problems, flowcharts for simple problems, Practice logic building using flowchart/algorithms

UNIT IV

Office Tools

Office Tools like LibreOffice/OpenOffice/MSOffice.

OpenOffice Writer – Typesetting Text and Basic Formatting, Inserting Images, Hyperlinks, Bookmarks, Tables and Table Properties in Writer

Introducing LibreOffice/OpenOffice *Calc*, Working with Cells, Sheets, data, tables, using formulae and functions, using charts and graphics.

OpenOffice Impress – Creating and Viewing Presentations, Inserting Pictures and Tables, Slide Master and Slide Design, Custom Animation.

UNIT V

Use of Social Media

Introduction to Digital Marketing – Why Digital Marketing, Characteristics of Digital Marketing, Tools for Digital Marketing, , Effective use of Social Media like LinkedIn, Google+, Facebook, Twitter, etc.: Features of Social media, Advantages and Disadvantages of Social Media.

PRACTICAL EXERCISES

1. Browser features, browsing, using various search engines, writing search queries
2. Visit various e-governance/Digital India portals, understand their features, services offered
3. Read Wikipedia pages on computer hardware components, look at those components in lab, identify them, recognize various ports/interfaces and related cables, etc.
4. Using Administrative Tools/Control Panel Settings of Operating Systems

5. Connect various peripherals (printer, scanner, etc.) to computer, explore various features of peripheral and their device driver software.
6. Explore features of Open Office tools and MS-Office, create documents, create presentation, create spread sheet, using these features, do it multiple times
7. Working with Conversion Software like pdfToWord, WordToPPT, etc.
8. Working with Mobile Applications – Searching for Authentic Mobile app, Installation and Settings, Govt. of India Mobile Applications
9. Creating email id, sending and receiving mails with attachments.
10. Using Google drive, Google calendar
11. Create Flow chart and Algorithm for the following

i. Addition of n numbers and display result
ii. To convert temperature from Celsius to Fahrenheit
iii. To find Area and Perimeter of Square
iv. Swap Two Numbers
v. find the smallest of two numbers
vi. Find whether given number is Even or Odd
vii. To print first n even Numbers
viii. find sum of series 1+2+3+…..+N
ix. print multiplication Table of a number
x. generate first n Fibonacci terms 0,1,1,2,3,5…n (n>2)
xi. sum and average of given series of numbers
xii. Factorial of number n (n!=1x2x3x…n)
xiii. Armstrong Number
xiv. Find whether given number is Prime or not

RECOMMENDED BOOKS

1. R.S. Salaria, “Computer Fundamentals”, Khanna Publishing House.
2. Ramesh Bangia, “PC Software Made Easy – The PC Course Kit”, Khanna Publishing House.
3. Online Resources, Linux man pages, Wikipedia
4. Mokhtar Ebrahim and Andrew Mallett, “Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming”.
5. Vikas Gupta, “Comdex Hardware and Networking Course Kit”, Dream Tech press, New Delhi, 2008.
6. Sumitabha Das, “UNIX concepts and applications” Tata McGraw Hill, New Delhi, 2008, Fourth Edition.

SUGGESTED WEBSITES

1. https://nptel.ac.in/courses/106/106/106106222/ - NPTEL Course on Modern Application Development
2. https://onlinecourses.swayam2.ac.in/aic19_de01/preview -
3. https://spoken-tutorial.org/ - Tutorials on Introduction to Computers, HTML, LibreOffice Tools, etc.
4. NOTEPAD++
5. https://tms-outsource.com/blog/posts/web-development-ide/

INSTRUCTIONAL STRATEGY

This is a skill based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weight age.

2.6 INTRODUCTION TO CERAMIC PRODUCTS

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RATIONALE

Ceramic product specifications and testing play an important role in the understanding of ceramic products and gaining an insight of Ceramics Engineering. This will help the students to focus on key knowledge and skills areas in coming year of study and help them to find their area of interest. It will also help in understanding specifications of end product and their control during manufacturing, Thus, the students will be able to understand criticality of different manufacturing steps.

COURSE OUTCOMES

At the end of the subject student will be able to
CO1: Specify various ceramic products
CO2: List the characteristics of various ceramic products
CO3: Carry out various tests on ceramic products.

PRACTICAL EXERCISES

1. Familiarization and uses of different Ceramic Products:
   Whiteware - Wall tile, Floor Tile, Insulator, Sanitary ware, Dinner ware, Pottery ware.
   Refractory - Different Shapes of refractory.
   Glass - Different Glass Products: Plate Glass, Container Glass, Laboratory ware.
   Cement - Grades of ordinary Portland cement and its uses.
2. Specification / Physical characteristics of Whiteware products preferably with the help of industrial product catalogue.
3. Specification / Physical characteristics of Refractory products preferably with the help of industrial product catalogue
4. Specification / Physical characteristics of Glass products preferably with the help of industrialproduct catalogue.
5. Dimensional measurements of Tiles/Bricks

5.1 Deviation in length and breadth
5.2 Deviation in thickness
5.3 Rectangularity of tile
5.4 Straightness of tile side.

6. Hardness of Ceramic products

7. Density measurement of different Products
8. Flexural strength of Ceramic products
9. Stain resistance of floor tile.
10. Surface flatness of floor tiles
11. Water absorption of Ceramic products.

INSTRUCTIONAL STRATEGY

This is hands-on practice based subject and topics taught in the class should be practiced in the labregularly for development of required skills in the students

SECOND YEAR

NSQF LEVEL - 4

12. STUDY AND EVALUATION SCHEME

THIRD SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P = C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
3.1	Industrial Training/In house Training-1	-	2	0+1=1	-	40	40	-	60	60	100
3.2	Ceramic Raw Materials	4	-	4+0=4	40	-	40	60	-	60	100
3.3	Fuels and Furnaces	4	2	4+1=5	40	40	80	60	60	120	200
3.4	Ceramic Machinery	3	2	3+1=4	40	40	80	60	60	120	200
3.5	Cement Technology	3	4	3+2=5	40	40	80	60	60	120	200
3.6	Industrial Operations	-	4	0+2=2	-	40	40	-	60	60	100
3.7	Ceramic Moulding Lab	-	4	0+2=2	-	40	40	-	60	60	100
3.8	Open Elective (MOOCs^{+}/Offline)	2	-	2+0=2	40	-	40	60	-	60	100
# Student Centered Activities(SCA)		-	1	-	-	-	-	-	-	-	-
	Total	16	19	25	200	240	440	300	360	660	1100

\+ Assessment of Open Elective through MOOCs shall be based on assignments out of 100 marks.

Student Centered Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Electoral Literacy, Motor Vehicles (Driving) Regulations 2017 etc., games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

FOURTH SEMESTER :

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P = C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
4.1	*English and Communication Skills - II	2	2	2+1=3	40	40	80	60	60	120	200
4.2	Glass Technology - I	3	4	3+2=5	40	40	80	60	60	120	200
4.3	Whiteware Technology	3	4	4+2=6	40	40	80	60	60	120	200
4.4	Refractory Technology	3	4	3+2=5	40	40	80	60	60	120	200
4.5	**Programme Elective	3	-	3+0=3	40	-	40	60	-	60	100
4.6	Slip Testing Lab	-	4	0+2=2	-	40	40	-	60	60	100
# Student Centered Activities(SCA)		-	3	-	-	-	-	-	-	-	-
	Total	14	21	24	200	200	400	300	300	600	1000

* Common with other Diploma Courses

** Any one out of the following : 4.5.1 Ceramic Process Calculations 4.5.2 Ceramic Processing Technology 4.5.3 Tile Technology

\# Student Centered Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Electoral Literacy, Motor Vehicles (Driving) Regulations 2017 etc., games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

Industrial Training: After 4th Semester, students shall undergo Industrial Training of 4 Weeks.

13. HORIZONTAL AND VERTICAL SUBJECTS ORGANISATION

Sr. No.	Subjects	Hours Per Week	
		Third Semester	Fourth Semester
1.	Industrial Training/In house Training-1	2	-
2.	Ceramic Raw Materials	4	-
3.	Fuels and Furnaces	6	-
4.	Ceramic Machinery	5	-
5.	Cement Technology	7	-
6.	Industrial Operations	4	-
7.	Ceramic Moulding Lab	4	-
8.	Open Elective (MOOCs/Offline)	2	-
9.	English and Communication Skills - II	-	4
10.	Glass Technology - I	-	7
11.	Whiteware Technology	-	7
12.	Refractory Technology	-	7
13.	Programme Elective	-	3
14.	Slip Testing Lab	-	4
15.	Student Centered Activities(SCA)	1	3
	Total	**35**	**35**

14. COMPETENCY PROFILE & EMPLOYMENT OPPORTUNITIES

Government and private sectors related to Ceramic Engineering require **skilled workers** to work in familiar, predictable, routine situations of clear choice. They are expected to have factual knowledge of Ceramic Engineering field. They will be able to write and speak with required clarity. Students after passing level 4 shall have understanding of basic arithmetic, algebraic principles along with basic understanding of social and natural environment. They are expected to recall and demonstrate quality skill in narrow range of applications using appropriate rules and tools.

Skilled workers will be responsible for carrying out a range of jobs, some of which will require them to make choices about the approaches they adopt. They will be expected to learn and improve their practice on the job. They should know what constitutes quality in the occupation and should distinguish between good and bad quality in the context of their job roles. Skilled worker at this level will be expected to carry out their work safely and securely and take full account of the health and safety on colleagues and customers. They should work hygienically and in ways which show an understanding of environmental issues. In working with others, they will be expected to conduct themselves in ways which show a basic understanding of the social and political environment.

Ceramic Engineering NSQF Level – 4 pass out students are expected have the knowledge of ceramic raw materials and ceramic machinery. They are expected to have good knowledge of various industrial operations. They are also expected to have good knowledge and skills in glass technology, whiteware technology, refractory technology and cement technology.

Ceramic Engineering students have a wide scope in industries such as ceramic ware manufacturing, glass bulbs, enamels, kitchen ware, decorative ware and engine components manufacturing units. They have numerous avenues in medicine, aerospace, food and chemical, electronics, aerospace, refinery and mining industry. They also have wide scope in establishing small startups in the area of marketing and sales, and manufacturing units.

15. PROGRAMME OUTCOMES

The program outcomes are derived from five domains of NSQF Level – 4 namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this level, the student will be able to:

PO1: Carry out a task which may require limited range of predictable activities.

PO2: Acquire knowledge of basic facts, process and principles related to Ceramic Engineering for employment.

PO3: Demonstrate Practical skill in narrow range of Ceramic Engineering applications.

PO4: Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.

PO5: Perform task under close supervision with some responsibility for own work within defined limit.

PO6: Select open elective of own interest to develop self-learning through MOOCs.

16. ASSESSMENT OF PROGRAMME AND COURSE OUTCOMES

Programme Outcomes to be Assessed	Assessment Criteria for the Course Outcomes
PO1: Carry out a task which may require limited range of predictable activities.	• Take necessary safety precautions and measures. • Work in team for solving industrial problems. • Develop competencies and skills required by relevant industries.
PO2: Acquire knowledge of basic facts, process and principles related to Ceramic Engineering for employment.	• Understand the working environment of industries. • Learn about present and future requirement of industries. • Classify plastic clays. • Understand properties and uses of plastic raw materials. • Understand properties and uses of non plastic raw materials. • Explain properties and uses of alumina and silica containing raw materials. • Describe frit making process • Describe properties and uses of fluxes and fluxing action. • Explain properties and uses of synthetic raw materials. • Describe the role of processing additives. • Comprehend use of Industrial waste as raw materials. • Describe the process of combustion. • Understand fuels, its types, characteristics and their testing. • Classify furnaces and kilns, their construction, working and applications. • Explain working of burners for liquid and gaseous fuels.

	• Explain various methods of temperature measurement • Follow norms and safety guidelines in fuel and furnace handling. • Explain construction and working of crushers and grinding equipment. • Classify size reduction machinery. • Understand the size separation of material. • Explain construction and working of filtration machines. • Explain construction and working of body mixers. • Explain construction and working of plastic shaping machines. • Explain construction and working of presses. • Explain construction and working of dryers. • Explain working of various material handling equipment. • Explain testing equipment. • Explain classification and properties of cement. • Understand raw materials and uses of cement. • Carry out calculations of raw mix. • Explain reactions of Portland cement. • Describe manufacturing process of cement. • Describe properties and uses of lime, gypsum and plaster of paris. • Undertake testing of cement. • Understand fundamental concept of glass.

	• Explain chemical composition of different types of glasses. • Explain features of various furnaces used for glass melting. • Explain glass shaping methods. • Explain various properties of glass. • List various glass defects and their remedies. • Identify the suitability of raw materials for glass manufacture. • Understand functions of glass making oxides. • Classify whiteware. • Describe the properties and uses of whitewater bodies. • Explain properties and uses of various raw materials used for preparing whiteware. • Explain various ways of processing ceramic raw material. • Describe various methods used for fabricating or shaping. • Explain features of various types of driers. • Explain the effect of heat on ceramic bodies. • Classify various types of refractories. • Describe manufacturing process, properties and uses of various types of refractories. • Test different types of refractories. • Identify causes of failure of refractories. • Describe manufacturing process, properties and uses of monolithic refractories. • Determine the moisture content in ceramics.

	• Evaluate the dimensional changes of ceramic product. • Calculate density, porosity and absorption characteristics of porous bodies. • Calculate the density of ceramic suspensions. • Compose glaze compositions from their formulae. • Compute the strength of ceramic bodies. • Classify various ceramic fabrication methods. • Comprehend effect of temperature, pressure and microstructure on ceramic properties. • Explain properties of various processing additives. • Explain the modeling and mould making process. • Take appropriate action for production control. • Comprehend impact of environment on ceramic industry. • Ensure safety in ceramic industry. • Explain various types of raw materials used, properties and applications of tiles. • Explain the unit operations in tile ceramics. • Describe the function and working of tunnel kiln and roller kiln • Classify various fuels used in tile industry • Explain various types of tile tests. • Explain defects in tiles.

PO3: Demonstrate Practical skill in narrow range of Ceramic Engineering applications.	• Understand the working environment of industries. • Take necessary safety precautions and measures. • Work in team for solving industrial problems. • Develop competencies and skills required by relevant industries. • Solve simple problems related to combustion. • Undertake testing of cement. • Carry out various industrial operations. • Use various instruments and equipment for ceramic moulding. • Test different types of refractories. • Identify causes of failure of refractories. • Find the effect of casting body by addition of solutions. • Carry out fluidity ratio test.
PO4: Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.	• Develop writing, speaking and presentations skills. • Comprehend use of Industrial waste as raw materials. • Solve simple problems related to combustion. • Carry out calculations of raw mix. • Communicate effectively with an increased confidence; read, write and speak in English language fluently. • Comprehend special features of format and style of formal communication through various modes. • Write a Report, Resume, make a Presentation, Participate in GDs and Face Interviews

	• Illustrate use of communication to build a positive self-image through self-expression and develop more productive interpersonal relationships.
PO5: Perform task under close supervision with some responsibility for own work within defined limit.	• Take necessary safety precautions and measures. • Work in team for solving industrial problems. • Develop competencies and skills required by relevant industries. • Follow norms and safety guidelines in fuel and furnace handling.
PO6: Select open elective of own interest to develop self-learning through MOOCs.	• State the basic concepts and principles about the subject of interest. • Perform in a better way in the professional world. • Select and learn the subject related to own interest. • Explore latest developments in the field of interest. • Develop the habit of self-learning through online courses.

17. SUBJECTS & CONTENTS

(SECOND YEAR)

THIRD SEMESTER

3.1 INDUSTRIAL/IN-HOUSE TRAINING- I

L	P
-	2

RATIONALE

Industrial training / In – house training will help the students to understand the working environment of relevant industries. The student will learn to work in team to solve theindustrial problems. It will also give exposure about the present and future requirements of the relevant industries. This training is very important for development of required competencies and skills for employment and start– ups.

COURSE OUTCOMES

After undergoing the training, the students will be able to:

CO1: Understand the working environment of industries

CO2: Take necessary safety precautions and measures.

CO3: Learn about present and future requirement of industries.

CO4: Work in team for solving industrial problems

CO5: Develop competencies and skills required by relevant industries.

CO6: Develop writing, speaking and presentations skills.

PRACTICAL EXERCISES

1. Report writing based on industrial training.
2. Preparation of Power Point Slides based on industrial training and presentation by the candidate.
3. Internal Evaluation based on quality of Report, PPT preparation, PPT presentation and answer to queries.
4. External Evaluation based on quality of Report, PPT preparation, PPT presentation and answer to queries.

GUIDELINES

Students will be evaluated based on Industrial training / In – house training report and their presentation using Power Point about the knowledge and skills gained during the training. The Head of the Department will depute faculty coordinators by assigning a group of students to each. The coordinators will mentor and guide the students in preparing the PPTs for final presentation. The following performance parameters are to be considered for assessment of the students out of 100 marks:

	Parameter	**Weightage**
i	Industrial / In-house assessment of the candidate by the trainer	40%
ii	Report Writing	20%
iii	Power Point Presentation	20%
iv	Viva-voce	20%

3.2 CERAMIC RAW MATERIALS

L	P
4	-

RATIONALE

This subject has been designed to introduce the diploma students to the properties related to the structure and the characteristics of various types of specialized materials used in the ceramic industries. The usage of these materials in various industries is also covered in this subject.

COURSE OUTCOMES

After going through this course, the students will be able to:
CO1: Classify plastic clays.
CO2: Understand properties and uses of plastic raw materials.
CO3: Understand properties and uses of non plastic raw materials.
CO4: Explain properties and uses of alumina and silica containing raw materials.
CO5: Describe frit making process
CO6: Describe properties and uses of fluxes and fluxing action.
CO7: Explain properties and uses of synthetic raw materials.
CO8: Describe the role of processing additives.
CO9: Comprehend use of Industrial waste as raw materials.

DETAILED CONTENTS

UNIT -1

Introduction of Clays

Geology and mineralogy of clays.

Clay: Definition, classification of clays with examples. Primary clays or residual clay, Secondary clays or transported clays.

Plastic Raw Materials (Clay)

Kaolin clay, Ball Clays, fire clay, Alumina clays. Bentonite clay, their properties & usesin ceramic industries.

Impurities in clay like silica, alumina, calcium, magnesium, titanium alkalis, andcarbonaceous material.

Benefication and Purification of clay – mechanical and chemical methods – sorting, sifting, air separation, washing methods of clays. Winning and mining of clays. magnetic separation.
Properties: Specific gravity, Moisture content, Plasticity. Plasticity –
theories of plasticity and measurement of plasticity.
Bulk Density (green and dry) Shrinkage and its effects on final product.Effect
of heat on clays.

UNIT- II

Plastic Raw Materials (Non-Clay)

Talc, steatite, pyrophyllite and sericite pyrophyllite. Properties and uses.

Non-Plastic Raw Materials

Silica – Various forms of silica raw materials like quartz, sand, sand stone,quartzite, Flint - Properties and Uses.
Role of silica in Ceramic bodiesEffect
of heat on silica.

Phosphate Containing Raw Materials

Bone ash, Apatite - Properties & uses.

UNIT III

Alumina

Sources of various alumina: Gibbsite, Diaspore, bauxite, corundum, fused alumina andsintered alumina - Properties and uses.
Preparation of fused alumina and sintered alumina.

Other Alumina & Silica Containing R w Materials

Silimanite, Kyanite, Andalusite & mullite - Properties & uses.

UNIT -IV

Fluxes

Definition and Types of feldspars (Potash Feldspar, Soda feldspar) and other fluxing materials (Cornish stone, nepheline syenite)
Properties and uses of feldspars (Potash Feldspar, Soda feldspar) and other fluxingmaterials (Cornish stone, nepheline syenite)
Role of feldspar in triaxial body.

Frit

Definition of frit, Use of frit in glaze preparation.

Purpose of fritting, Manufacturing of Frit: Smelting, Quenching, Drying & milling.

UNIT - V

Synthetic Materials

- Carbides: Definition and Types (silicon carbide(SiC), boron carbide(B_4C), tungsten carbide(WC) and calcium carbide(Ca_2C)) - Properties and uses.
- Nitrides: Definition and Types (Silicon Nitride (Si_3N_4), Boron nitride (BN)) - Properties and uses.
- Silicides: Definition and Types, General Properties anduses.

Processing Additives

- De-flocculants: Role and types
- Binders : Role of binder, Types of Binders (Clay Binders, Molecular Binders, Vinyl Binders, Cellulose Binders, Polyethylene Glycol Binders, Waxes.)
- Lubricants, Types and role.
- Colouring Oxides

Industrial Wastes as Raw Materials:

- Sources & utilization of industrial wastes like Cullets, Grog, Fly Ash, Blast Furnace Slag.

RECOMMENDED BOOKS

1. Sudhir Sen, "White Wares", Oxford & IBH Publishing Co., New Delhi
2. S K Jain, "Mineral Processing", CBS Publishers & Distributors, New Delhi
3. Singer and Singer, "Industrial Ceramics" , Oxford & IBH Publishing Co., New Delhi
4. S.K. Mirmira, "Indian Pottery", Gramodaya Sangh, Bhadrawati.
5. W.E. Worrel, " Ceramics Raw Materials" , Pergamon Press
6. W D Kingery, "Introduction to Ceramics", Elsevier Scientific Publishing Company,New York
7. W.Ryan, " Properties of Ceramics Raw Materials" , Pergamon Press.

INSTRUCTIONAL STRATEGY

The teacher should give emphasis on understanding of various terms and concepts used in the subject. This is a theoretical subject and contains five units of equal weight age.

3.3 FUELS AND FURNACES

L	P
4	2

RATIONALE

Ceramic materials are manufactured at high temperature so the knowledge of fuels and furnaces is necessary for proper processing and quality products. Moreover ceramic materials are also used for high temperature applications therefore, for their characterization knowledge of fuels and furnaces are required.

COURSE OUTCOMES

After undergoing this course, the students will be able to:
CO1: Describe the process of combustion.
CO2: Solve simple problems related to combustion.
CO3: Understand fuels, its types, characteristics and their testing.
CO4: Classify furnaces and kilns, their construction, working and applications.
CO5: Explain working of burners for liquid and gaseous fuels.
CO6: Explain various methods of temperature measurement
CO7: Follow norms and safety guidelines in fuel and furnace handling.

DETAILED CONTENTS

UNIT -1

Introduction of Fuel

Classification of fuels - Solid, Liquid and Gaseous fuels with examples.

Theory of Combustion

Actual air required for combustion, theoretical and excess air. Simple problemsrelated to combustion.

UNIT-II

Solid Fuel

General properties, varieties of solid fuel (wood, coal, saw dust, charcoal)
Coal and Coke, Classification of coal, Properties of coal and coke.

Spontaneous combustion, its causes and remedy.Combustible and Non-combustible constituents, Ignition temperature.

Pulverised coal and its utilisation.

Testing of fuels - Proximate analysis (like moisture, ash, volatile matter, fixed carbon content)

Ultimate analysis (Carbon, Hydrogen, Nitrogen, sulphur, Oxygen)

Orsat analysis and determination of calorific value by Bomb Calorimeter.

UNIT-III

Liquid Fuels

Indian resources of crude oil, liquid petroleum products - petrol, kerosene, fuel oil andcoke, properties of various petroleum products.

Testing of liquid fuels, octane and cetane number,

Calorific value, flash point and fire point, viscosity determination,

Burner for liquid fuels (atomizer, cup & cone burner, squirrel gauge.

Storage and handling practices in industry.

Gaseous Fuels

Types of Gaseous fuels (Natural, producer, water, carburretted water gas, coke oven gas, blast furnace gas, Refinery gas). Composition, calorific value and uses of natural gas, producer gas, water gas and LPG. Burners for gaseous fuels. Suppliers of fuels.

UNIT IV

Furnaces

Definition of furnace. Classification of furnaces based on Heat Source, Mode of operation, Method of Handling

Material, types of Fuel used, types of firing & Type of Heat Recovery.

Furnace atmosphere.

Regenerators and Recuperators.

Description of muffle furnace, tank furnace, blast furnace, electrical furnace and annealing furnace.

Kilns

Definition of kiln, Classification of kilns.

Batch Kilns: Description of Updraught, Downdraught (Round and rectangular), Shuttle kiln.

Continuous Kilns: Fundamentals of continuous kilns - construction, working and firing circuits of tunnel kiln, roller kiln,
Muffle kilns: Muffle tunnel kiln, principle of working, advantages of muffle type tunnel kiln.
Factors affecting furnace efficiency.
Safety measures to be taken while working with furnace environments and maintenance.

UNIT V

Furnace and Kiln Accessories

Brief explanation about fire box, chimney, crown, damper and stack.
Definition, type and mechanism of draught and dampers.
Kiln furniture and accessories.

Pyrometery and Pyroscope

Need for temperature measurement in kiln.
Introduction to pyroscopes, such as seger cones, Behaviour of cones, holdcrafts bar, bullers ring. Their working and uses.
Introduction to Pyrometers and various types of pyrometers. Optical, Radiation, Infrared, Resistance.
Thermocouple pyrometer (thermo electric pyrometers) General principle, Types of thermocouple :chromel - Alumel, Platinum - Rhodium etc., Indicators, recorders, Advantage of thermo electric method of measuring temperature.

PRACTICAL EXERCISES

1. To determine the moisture content of a solid fuel.
2. To determine the calorific value of coal by bomb calorimeter.
3. To determine the flash point and fire point of liquid fuel.
4. Determination of viscosity of oil by Redwood viscometer or Torsion viscometer.
5. Demonstration of working of furnace and kiln.
6. Proximate analysis of solid fuel.
7. High temperature measurement by infrared gun or optical pyrometer.
8. Draw the wiring diagram of typical temperature controller used for lab furnace
9. Illustrate working of the temperature controller (as a switch) used in your lab model furnace/drier
10. Identify the inside temperature of furnace by observing the inside color.

RECOMMENDED BOOKS

1. O.P. Gupta,"Elements of Fuels, Furnaces and Refractories", Khanna Publishers.
2. Jain and Jain,"Industrial Chemistry",
3. AVK Suryanarayana, "Fuels Furnaces Refractories &Pyrometry", BS Publications
4. J. Griswold, "Fuels, Combustion and Furnaces", McGraw Hill Book Co., New York
5. R.C. Gupta, "Fuels, Furnaces and Refractories" , PHI Learning Pvt Limited, New Delhi.

INSTRUCTIONAL STRATEGY

The teacher should provide focus on understanding of concept and various terms related to fuels and furnaces. The subject contains five units of equal weight age.

3.4 CERAMIC MACHINERY

L	P
3	2

RATIONALE

A thorough knowledge of the important machineries used in the ceramic industries enable the students to carry out various processes efficiently; hence this subject is very essential.

COURSE OUTCOMES

After undergoing this course, the students will be able to:
CO1: Explain construction and working of crushers and grinding equipment.
CO2: Classify size reduction machinery.
CO3: Understand the size separation of material.
CO4: Explain construction and working of filtration machines.
CO5: Explain construction and working of body mixers.
CO6: Explain construction and working of plastic shaping machines.
CO7: Explain construction and working of presses.
CO8: Explain construction and working of dryers.
CO9: Explain working of various material handling equipment.
CO10: Explain testing equipment.

DETAILED CONTENTS

UNIT-I

Crushing and Grinding Equipment

Size Reduction: Selection of crushing & grinding equipment. Description of closed and open circuit operations. Classification of size reduction machinery.

Crushers: Introduction, single and double toggle jaw crushers, Gyratory crushers, Crushing rolls and hammer mills, edge runner etc.

Grinding: Introduction, pan grinding, ring roll mills, ball mills, pot mills, pebble mill, rod and tube mills, cylindrical ball mill, conical mills, ball tube mills and their parts, quantity of balls, size of balls. Factors affecting grinding efficiency.

UNIT-II

Size Separation

Wet classifiers, Air, Electromagnetic / magnet separators, vibrating sieve, slip lifting & Diaphragm pump, Filter press, Vacuum filter, Centrifugal De- watering.

Mixing and Body Making

De-airing single and double arc pug mills and plugging equipment. Extruders, kneading equipment, wet pan mill, muller mixer, ribbon mixer, blunger, agitator etc.

UNIT-III

Shaping Machine

Potters wheel, Jigger & Jolly, Batting machine, Semi & fully automatic jiggers, Roller machines, Extrusion wire cutting machines,

Pressing Machines

Important parameters of pressing (Die, Powder & Pressure), Screw press, friction press, Hydraulic press, vibratory compaction machine Isostatic press, Hot isostatic press (HIP), Injection moulding, Tape casting,

UNIT-IV

Dryers

Unheated Dryers, Heated Dryers, Batch Dryers, Chamber and Corridor dryers.
Humidity dryers, Continuous dryers, Tunnel dryers.

Kilns and Material Handling Equipment

Tunnel kiln (Roller hearth Kiln, Slab Kiln), Shuttle Kiln
Material Handling Equipment: Portable power driven machines, permanent installations, flight, belt & screw conveyors, conveying through pipes, slurry pumps, bucket elevator.

UNIT -V

Testing Equipment

Vicat apparatus, Le-Chatlier apparatus, Fired MOR testing machine, Autoclave machine, abrasion testing machine, Infrared moisture balance, Impact testing machine (Izod and Ball type) Maintenance of Machineries: Concept of Preventive, Predictive and Break down maintenance. Schedule of maintenance.

PRACTICAL EXERCISES

1. To grind a given sample in ball mill.
2. To study the operation of crushers.
3. To study the operation of magnetic separator.
4. To filter the flow of slip through filter press.
5. Demonstration of operation of jigger and jollying machine.
6. Demo of operation of pressing machine with pressing parameters.
7. Demo of operation of vibrating machine.
8. Demo of operation of Blunger machine.
9. Demo of operation of Agitator machine.
10. Study of natural and artificial drying.
11. Demo of autoclave machine.
12. Practice maintaining firing schedule in lab furnace

RECOMMENDED BOOKS

1. Singer & Singer, “Industrial Ceramic”, IBH Publisher.
2. George C. Phillips,” Concise Introduction to Ceramics”, Amazon Publication
3. Richard Zakin,”Ceramics, Mastering the Craft”, American Ceramic Society Publication,
4. Rashid Chesti, “Refractories
5. R.C. Gupta, “Fuels, Furnaces and Refractories” , PHI Learning Pvt Limited, New Delhi
6. O.P. Gupta,”Elements of Fuels, Furnaces and Refractories”, Khanna Publishers.
7. Himadri Panda, “ Handbook of Ceramics and Ceramics Processing”, Engineers India Research Institute.

INSTRUCTIONAL STRATEGY

The teacher should lay emphasis on explaining the concept, construction and working of ceramic machinery. The subject contains five units of equal weight age.

3.5 CEMENT TECHNOLOGY

L	P
3	4

RATIONALE

This specialized subject is taught to the diploma holders of ceramic engineering in order to widen their scope of employment cement manufacturing units also.

COURSE OUTCOMES

After undergoing this course, the students will be able to:
CO1: Explain classification and properties of cement.
CO2: Undertake raw materials and uses of cement.
CO3: Carry out calculations of raw mix.
CO4: Explain reactions of Portland cement.
CO5: Describe manufacturing process of cement.
CO6: Describe properties and uses of lime, gypsum and plaster of paris.
CO7: Undertake testing of cement.

DETAILED CONTENTS

UNIT 1

Introduction to Cement

Definition and Classification of cements, Types of Portland cements: Ordinary Portland cement, Pozzolona cement, slag cement, Quick setting cement, Rapid hardening cement, Low heat cement, High alumina cement, White & coloured cement, Oil well cement, Iron ore cement, Water proof cement, Sulphate resisting cement, Acid proof cement, Hydrophobic cement.
Ordinary Portland cement of different grades (33,43,& 53)

UNIT II

Raw Materials and Additives

Raw materials, and their selection
Calcareous Raw materials: Limestone, Chalk, Marl.
Argillaceous Raw materials: Silica and its Sources, Alumina, Iron oxide, Shale.

Other raw materials: Fly ash, blast furnace slag, lime sludge.
Additives: Definition, Types and purposes. Effect of gypsum on cement properties

UNIT III

Effect of Constitutions on Properties of Cement and Raw Mix Calculations

Effect of raw materials and constituents on the properties of cement, General composition of cement. Phases of cement and their effect on the properties of Cement
Calculations of raw mix:- Estimation of silica modulus, alumina modulus, Hydraulic modulus, Lime saturation factor, Liquid content. Impact of modulus on cement manufacturing process and clinker.

UNIT IV

Reactions of Portland Cement

Hydration of portland cement, Hydration and heat of hydration of cement, mechanism of hydration, hydration of C2S, C3S and C3A setting and hardening of Portland cement.
Physical and mechanical properties of portland cement.

Manufacture of Cement

Wet and dry process, advantages and disadvantages of each process, Types of kilns used in Kiln used in cement manufacture. Raw mill Grinding, Mixing and homogenization,
Burning, Refractories used in Kiln and Coating Formation, Thermo chemistry of clinker formation, sequence of reaction.
Cooling - Importance of cooling.
Grinding of clinker - in tube mill, ball mills, Role of gypsum. Effect of temperature on gypsum during grinding of clinkers

UNIT V

Lime

Lime and other building materials, different classes of lime, their properties and uses.

Pollutants

Pollutants from cement industry and pollution control measures. Electro Static Precipitators, Cyclone dust collector, Scrubbers and wet collectors.

Testing of Cement

Water consistency, initial setting time, final setting time, fineness, soundness and compressive strength

Health and Safety Measures taken in cement industries. Precautions for environmental pollution.

PRACTICAL EXERCISES (Minimum 10 Practicals to perform)

1. Physical identification of cement: Colour and Specific gravity.
2. Physical identification of limestone: Colour and Specific gravity
3. Study of ball mill for clinker grinding (online demonstration may be given).
4. Determination of fineness of cement.
5. Determination of water cement ratio.
6. Determination of initial & final setting time of cement.
7. Determination of soundness of cement by Le Chatteliers apparatus.
8. Determination of compressive strength of cement mortar cubes.
9. Chemical analysis of cement.
10. Determination of liter weight of clinker.
11. Prepare a sequential flow Diagram for Dry process and wet process
12. Prepare a cement plant Layout
13. Slide show of a Cement plant
14. Video demonstration on safety measures taken in cement plant.

RECOMMENDED BOOKS

1. F.M. Lee, " The Chemistry of Cement and Concrete", Chemical Publishing Co Inc.,U.S.
2. S.M. Ghose,"Advances in Cement Technology", CRC Press
3. Dudda,"Hand book on Cement Technology", Bauverlag GmBH
4. H.N. Banerjee, "Technology of Portland Cement and Blended Cements", Wheeler Publishing, Allahabad
5. Rangwala, " Engineering Materials" , BSC Publishers and Distributors.

INSTRUCTIONAL STRATEGY

The teacher should give emphasis on explaining the concept and processes used in cement technology. The subject contains five units of equal weight age.

3.6 INDUSTRIAL OPERATIONS

L	P
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RATIONALE

A thorough knowledge of industrial operations is essential for the study of ceramic engineering. This course acquaints the students with the basic principles of fluid mechanics, mechanical operations, handling of solids, basics of heat and thermodynamics

COURSE OUTCOMES

After undergoing this course, the students will be able to:
CO1: Carry out various industrial operations.

PRACTICAL EXERCISES

1. To prove Bernoulli's theorem on hydraulic bench.
2. To observe the pattern of laminar and turbulent flow.
3. To carry out the sieve analysis of different raw material.
4. To determine the size of materials with the help of screens.
5. To determine the drying characteristics of ceramic ware and draw the drying curve.
6. To determine the specific gravity of ceramic raw materials.
7. To carry out chemical analysis of ball clay.
8. Demonstration of sedimentation behavior of slurry.
9. Determination of critical speed of ball mill.
10. Demonstration of pressing operations with pressing parameters.
11. To study kiln firing schedule.

INSTRUCTIONAL STRATEGY

This is hands-on practice based subject for development of required skills in the students.

3.7 CERAMIC MOULDING LAB

L	P
-	4

RATIONALE

In diploma engineering education, skill development plays a vital role. The skill development can be achieved by on- hand experience in handling various instruments, apparatus and equipment. This is accomplished by doing engineering related experiments in practical classesin various laboratories. The objective of this course is to develop such skills.

COURSE OUTCOMES

After undergoing this course, the students will be able to:

CO1: Use various instruments and equipment for ceramic moulding.

PRACTICAL EXERCISES (Minimum 10 practicals to be conducted)

1. Determine the moisture content of plaster of Paris.
2. Determine the particle size analysis of plaster of Paris by sieve method.
3. Determine the setting time of plaster of Paris
4. Determine the rise of temperature for plaster of Paris
5. Determine the Water absorption of plaster of Paris after setting.
6. Determine the Strength for plaster of Paris.
7. Determine the expansion and contraction of plaster of Paris
8. Prepare the pattern for the given article by using clay material.
9. Prepare POP mould/Master mould with the help of given sample.

10. Prepare working case mould.

11. Prepare one piece, two piece POP mould.

INSTRUCTIONAL STRATEGY

This is hands-on practice based subject for development of required skills in the students.

3.8 OPEN ELECTIVE

L	P
2	-

RATIONALE

Open electives are very important and play major role in implementation of National Education Policy. These subjects provide greater autonomy to the students in the curriculum, giving them the opportunity to customize it to reflect their passions and interests. The system of open electives also encourages cross learning, as students pick and choose subjects from the different streams.

COURSE OUTCOMES

At the end of the open elective, the students will be able to:

CO1: State the basic concepts and principles about the subject of interest.

CO2: Perform in a better way in the professional world.

CO3: Select and learn the subject related to own interest.

CO4: Explore latest developments in the field of interest.

CO5: Develop the habit of self-learning through online courses.

LIST OF OPEN ELECTIVES
(The list is indicative and not exhaustive)

1. Computer Application in Business
2. Introduction to NGO Management
3. Basics of Event Management
4. Event Planning
5. Administrative Law
6. Introduction to Advertising
7. Moodle Learning Management System
8. Linux Operating System
9. E-Commerce Technologies
10. NCC
11. Marketing and Sales
12. Graphics and Animations

13. Digital Marketing
14. Human Resource Management
15. Supply Chain Management
16. TQM

GUIDELINES

Open Elective shall be offered preferably in online mode. Online mode open elective shall preferably be through Massive Open Online Courses (MOOCs) from Swayam, NPTEL, Upgrad, Udemy, KhanAcademy or any other online portal to promote self-learning. A flexible basket of large number of open electives is suggested which can be modified depending upon the availability of courses at suggested portals and requirements. For online open electives, department coordinators shall be assigned to monitor and guide the group of students forselection of minimum 20 hours duration online course of their choice. For offline open electives,a suitable relevant subject shall be offered by the respective department to the students with minimum 40% of the total class strength as per present and future requirements.

Assessment of MOOCs open elective shall be based on continuous evaluation by the respective coordinator. The coordinator shall consider the submitted assignments by the students from time to time during the conduct of MOOCs. The MOOCs assessment shall be conducted by the coordinator along with one external expert by considering submitted assignments out of 100 marks.

In case, no suitable open elective is available online, only then the course may be conducted in offline mode. The assessment of offline open elective shall be internal and external. The offline open elective internal assessment of 40 marks shall be based on internal sessional tests; assignments etc. and external assessment of 60 marks shall be based on external examination at institute level.

NOTE

The students enrolled under NCC will compulsorily undertake NCC as an open elective subject.

SUGGESTED WEBSITES

1. https://swayam.gov.in/
2. https://www.udemy.com/
3. https://www.upgrad.com/
4. https://www.khanacademy.org/

FOURTH SEMESTER

4.1 ENGLISH AND COMMUNICATION SKILL - II

L	P
2	2

RATIONALE

Communication II moves a step further from Communication Skills I and is aimed at enhancing the linguistic competency of the students. Language as the most commonly used medium of self-expression remains indispensable in all spheres of human life – personal, social and professional. This course is intended to make fresh ground in teaching of Communicative English as per the requirements of National Skill Quality Framework.

COURSE OUTCOMES

After undergoing this course, the learners will be able to:

CO1: Communicate effectively with an increased confidence; read, write and speak in English language fluently.

CO2: Comprehend special features of format and style of formal communication through various modes.

CO3: Write a Report, Resume, make a Presentation, Participate in GDs and Face Interviews

CO4: Illustrate use of communication to build a positive self-image through self-expression and develop more productive interpersonal relationships.

DETAILED CONTENTS

UNIT I

Reading

1.1 Portrait of a Lady - Khushwant Singh

1.2 The Doctor's Word by R K Narayan

1.3 Speech by Dr Kiran Bedi at IIM Indore2007 Leadership Concepts

1.4 The Bet - by Anton Chekov

UNIT II

Effective Communication Skills

2.1 Modern means of Communication (Video Conferencing, e- mail, Teleconferencing)

2.2 Effective Communication Skills: 7 C's of Communication

2.3 Non-verbal Communication – Significance, Types and Techniques for Effective Communication

2.4 Barriers and Effectiveness in Listening Skills
2.5 Barriers and Effectiveness in Speaking Skills

Unit III

Professional Writing

3.1 Correspondence: Enquiry letters, placing orders, complaint letters
3.2 Report Writing
3.3 Memos
3.4 Circulars
3.5 Press Release
3.6 Inspection Notes and tips for Note-taking
3.7 Corrigendum writing
3.8 Cover Letter

UNIT IV

Grammar and Vocabulary

4.1 Prepositions
4.2 Conjunctions
4.3 Punctuation
4.4 Idioms and Phrases: A bird of ill omen, A bird's eye view, A burning question, A child's play, A cat and dog life, A feather in one's cap, A fish out of water, A shark, A snail's pace, A snake in the grass, A wild goose chase, As busy as a bee, As faithful as dog, Apple of One's eye, Behind one's back, Breath one's last, Below the belt, Beat about the bush, Birds of a feather flock together, Black Sheep, Blue blood, By hook or crook, Chicken hearted, Cut a sorry figure ,Hand in glove, In black and white, In the twinkling, In full swing ,Is blind as a bat, No rose without a thorn, Once in a blue moon, Out of the frying pan in to the fire, know no bounds ,To back out, To bell the cat, To blow one's trumpet, To call a spade a spade, To cut one's coat according to one's cloth, To eat humble pie, To give ear to, To have a thing on one's finger tips, To have one's foot in the grave, To hold one's tongue, To kill two birds with one stone, To make an ass of oneself, To put two and two together, To the back bone, Turn coat, ups and downs.
4.5 Pairs of words commonly misused and confused: Accept-except, Access-excess, Affect-effect, Artificial- artful, Aspire-expire, Bail-bale, Bare-bear, Berth-birth, Beside-besides, Break-brake, Canvas-canvass, Course- coarse, Casual-causal, Council-counsel, Continual-continuous, Coma-comma, Cue- queue, Corpse- corps-core, Dairy-diary, Desert-dessert, Dual-duel, Dew- due, Die-dye, Draft- draught-drought, Device-devise, Doze-dose, Eligible-illegible, Emigrant- immigrant, Envelop-envelope, Farther-further, Gate-gait, Goal-goal, Human-humane, Honorable-honorary, Hail-hale, Hair-heir-hare, Industrial-industrious, Impossible- impassable, Idle-idol-ideal, Lose-

loose, Later-latter, Lesson-lessen, Main-Mane, Mental-mantle, Metal-mettle, Meter-metre, Oar-ore, Pray- prey, Plain-plan, Principal - principle, Personal- personnel, Roll- role, Route-rout-roote, Stationary-stationery, Union- unity, Urban- urbane, Vocation- vacation, Vain- vein-vane, Vary- very.

4.6 Translation of Administrative and Technical Terms in Hindi or Mother tongue: Academy, Abandon, Acting in official capacity, Administrator, Admission, Aforesaid, Affidavit, Agenda, Alma Master, Ambiguous, Appointing Authority, Apprentice, Additional, Advertisement, Assistant, Assumption of charge, Assurance, Attested copy, Bonafide, Bond, Cashier, Chief Minister, Chief Justice Clerical error, Commanding ,Officer, Consent, Contractor, corruption, Craftsman, Compensation, Code, Compensatory allowance, Compile, Confidential letter, Daily Wager, Data, Dearness allowance, Death - Cum Retirement, Dispatch, Dispatch Register, Disciplinary, Disciplinary Action, Disparity Department, Dictionary, Director, Director of Technical Education, Earned Leave, Efficiency Bar, Estate, Exemption, Executive Engineer, Extraordinary, Employment Exchange, Flying Squad, General Body, Head Clerk, Head Office, High Commission, Inconvenience, Income Tax, Indian Assembly Service, Justify, Legislative Assembly, Negligence, Officiating ,Office Record, Office Discipline, On Probation, Part Time, Performance, Polytechnic, Proof Reader Precautionary, Provisional, Qualified, Regret, Responsibility, Self-Sufficient, Senior, Simultaneous ,Staff, Stenography ,Superior, Slate, Takeover, Target Data Technical Approval, Tenure, Temporary, Timely Compliance, Under Investigation, Under Consideration, Verification, Viva-voce, Write off, Working Committee, Warning, Yours Faithfully , Zero Hour.

UNIT V

Employability Skills

5.1 Presentation Skills: How to prepare and deliver a good presentation

5.2 Telephone Etiquettes

5.3 Importance of developing employable and soft skills

5.4 Resume Writing: Definition, Kinds of Resume, Difference between Bio-data and Curriculum Vitae and Preparing a Resume for Job/ Internship

5.5 Group discussions: Concept and fundamentals of GD, and learning Group Dynamics.

5.6 Case Studies and Role Plays

PRACTICAL EXERCISES

1. Reading Practice of the above lessons in the Lab Activity classes.
2. Comprehension exercises of unseen passages along with the given lessons.
3. Vocabulary enrichment and grammar exercises based on the above selective readings.

4. Situational Conversation: Requesting and responding to requests; Expressing sympathy and condolence.
5. Warning; Asking and giving information.
6. Getting and giving permission.
7. Asking for and giving opinions.
8. A small formal and informal speech.
9. Seminar.
10. Debate.
11. Interview Skills: Preparing for the Interview and guidelines for success in the Interview and significance of acceptable body-language during the Interview.
12. Written Drills will be undertaken in the class to facilitate a holistic linguistic competency among learners.
13. Participation in a GD, Functional and Non-functional roles in GD, Case Studies and Role Plays
14. Presentations, using audio-visual aids (including power-point).
15. Telephonic interviews, face to face interviews.
16. Presentations as Mode of Communication: Persuasive Presentations using multi-media aids.
17. Practice of idioms and phrases on: Above board , Apple of One's eye , At sea, At random, At large, A burning question, A child's play, A wolf in sheep's clothing, A deal, Breath one's last, Bid fair to, Beat about the bush, Blue Blood, Big Gun, Bring to Book, Cut a sorry figure, Call names, Carry weight, Dark Horse, Eat Humble pie, Feel small, French leave, Grease the palm, Go against the grains, Get One's nerves, Hard and Fast, Hue and Cry, Head and ears, In full swing, Jack of all trades, know no bounds, kiss the dust, Keep an eye on, Lion's share, learn by rote, Null and void, on the cards, Pull a long face, Run amuck, Right and Left, Rain on Shine, Small talk, Take to one's heels, Tooth and nail, to take by storm, , Wet blanket, Yearn for.

RECOMMENDED BOOKS

1. Alvinder Dhillon and Parmod Kumar Singla, "Text Book of English and Communication Skills Vol – 1, 2", M/s Abhishek Publications, Chandigarh.
2. J Sethi, Kamlesh Sadanand & DV Jindal, "Course in English Pronunciation", PHI Learning Pvt. Ltd., New Delhi.
3. Wren and Martin, "High School English Grammar and Composition" .
4. NK Aggarwal and FT Wood, "English Grammar, Composition and Usage", Macmillan Publishers India Ltd., New Delhi.
5. RC Sharma, and Krishna Mohan, "Business Correspondence & Report Writing", (4th Edition), by Tata MC Graw Hills, New Delhi.

6. Varinder Kumar, Bodh Raj & NP Manocha, “Business Communication Skills”, Kalyani Publisher, New Delhi.
7. Kavita Tyagi & Padma Misra, “Professional Communication”, PHI Learning Pvt. Ltd., New Delhi.
8. Nira Konar, “Communication Skills for Professionals”, PHI Learning Pvt. Ltd., New Delhi.
9. Krishna Mohan & Meera Banerji, “Developing Communication Skills”, (2nd Edition), Macmillan Publishers India Ltd., New Delhi.
10. M. Ashraf Rizwi, “Effective Technical Communication”, Tata MC Graw Hills, New Delhi.
11. Andrea J Rutherford, “Basic Communication Skills for Technology”, Pearson Education, New Delhi.

INSTRUCTIONAL STRATEGY

This is practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required communication skills in the students. Emphasis should be given on practicing of communication skills. This subject contains five unit of equal weight age.

4.2 GLASS TECHNOLOGY - I

L	P
3	4

RATIONALE

In this specialized subject on glass technology, starting from fundamental concepts, characteristics, composition and properties, furnaces for glass making are also discussed in detailfor making the students competent in this technology area.

COURSE OUTCOMES

After going through this course, the students will be able to:

CO1: Understand fundamental concept of glass.

CO2: Explain chemical composition of different types of glasses.

CO3: Explain features of various furnaces used for glass melting.

CO4: Explain glass shaping methods.

CO4: Explain various properties of glass.

CO5: List various glass defects and their remedies.

CO6: Identify the suitability of raw materials for glass manufacture.

CO7: Understand functions of glass making oxides.

DETAILED CONTENTS

UNIT I

Introduction and Raw materials

Introduction to Glass : Origin of glass, fundamental concept of glassy state, definition of glass,General properties and uses.

Classification of Glasses: Based on chemical nature: Soda lime, Lead Glass, Borosilicate glass Based on field of applications: Sheet glass, plate glass, Tempered Glass or toughened glass, LaminatedGlass, Solar panel glass, bullet proof glass etc

Properties & uses of Soda lime, Potash lime, Potash lead & Borosilicate glasses.

Raw materials for Glass Making Oxides: Classification of glass making oxides: Based on structure (Glassformers, modifiers and amphoteric), Based on chemical nature (Acidic, Basic, Nutral), Functions of glass making oxides.
Raw (Batch) materials of different oxides, colorant and decolorants, refining agents, Oxidising andreducing agents, Cullet and its importance.

UNIT II

Batching and Mixing

Chemical composition of different types of glasses (Sodalime, potash lime, lead glass, Borosilicateglass, float glass, bottle, Window glass etc.),

Calculation of batch from glass composition and vice-versa. Empirical formula.

Batch material, factors influencing choice of batch materials, their storage (silos, hopper), Weighingand mixing, importance of batch mixing and batch homogeneity.

UNIT III

Furnace

Furnaces: Batch (Pot and Day tank) and continuous type, glass tank furnace (Cross fired furnace, End - fired furnace) , regenerators and recuperators, Parts of furnace: Crown, Throat ,Port, Fore hearth, flue system, chimney, draft, damper, batch charging, control of furnace temperature floaters. Advantages & disadvantages of pot furnace, tank furnace, comparison between pot furnace & tank furnace.
Different types of refractories used in glass industry. Fuels used for firing: NG, LPG, Furnace Oil, Diesel.

UNIT IV

Glass Melting Process

Batch charging, Glass melting process, Tank temperature, Mechanism of melting, convection current,coloring & decolorization, refining & homogenizing, fining process. Use of electric boosters

Glass Fabrication Process: hollow wares, sheet glass by drawing process & float process, colburn process, fourcault process, pitsburg process,

Plate glass manufacturing by continuous horizontal and vertical rolling

process, Annealing (Removal of strain), factors affecting annealing process,

stress of glass,Strain in Glass: Types such as temporary & permanent strains

and their sources.

UNIT V

Properties, Defects and Decorations

Physical properties of glass: Density, Porosity, Water absorption, Specific gravity and theirdetermination process.

Mechanical Properties of glass: MOR test for sheet glass, crushing strength test of bottle glass,Impact strength test of sheet glass, elastic module, poisson ratio, hardness, bending test,

Thermal properties of glass: Glass transition temperature, thermal expansion, thermal conductivity,softening point of glass, Temperature vs viscosity, surface tension, annealing point
Optical properties of glass: Transparency, absorption of light, Reflection, Refraction, Refractive

index)Chemical Properties: Durability attack of acid, water & alkalis on glass

Causes and remedies of defects in glass- forming defects, visual defects stones, cords, blister, seeds,bad colours etc), bad workman ship.

PRACTICAL EXERCISES (Minimum 10 Practicals to be performed)

1. Determination of refractive index of glass.
2. Purification of sand.
3. Sieve analysis of sand.
4. Moisture estimation in raw materials.
5. Removal of iron from sand
6. Batch formulation of soda lime glass.
7. Mixing & melting of batch ingredients
8. Drawing rods from molten glass
9. Determination of density of glasses.
10. Examination of strain in glass.
11. Determine the impact strength of glass
12. Examination of Common defects in glass, their sources and remedies.
13. Determination of hardness of glass.
14. Determination of durability of glass.

INSTRUCTIONAL STRATEGY

Different glass industries like sheet glass industry, hollow ware glass industry, float glass industry must be shown to students for better understanding of raw materials, processes and products etc. The subject contains five units of equal weight age.

RECOMMENDED BOOKS

1. S.G. Scholse, “Modern Glass Practice”, Publisher McGraw Hill.
2. F.V. Tooley, “Handbook of Glass Manufacturing”, Publisher Prentice Hall of India.
3. Norton, “Hand book of Glass Engineering”
4. Subrata Banerjee,”Glass and its Application”
5. Singer,”Industrial Ceramics”, Springer.

4.3 WHITEWARE TECHNOLOGY

L	P
3	4

RATIONALE

In this specialized subject, whiteware technology inputs are provided to the students about rawmaterials, processes, fabrication, drying and firing techniques.

COURSE OUTCOMES

After going through this course, the students will be able to:
CO1: Classify whiteware.
CO2: Describe the properties and uses of whitewater bodies.
CO3: Explain properties and uses of various raw materials used for preparing whiteware.
CO4: Explain various ways of processing ceramic raw material.
CO5: Describe various methods used for fabricating or shaping.
CO6: Explain features of various types of driers.
CO7: Explain the effect of heat on ceramic bodies.

DETAILED

CONTENTSUNIT I

Whiteware: Introduction and classification: Definition, brief history, Classification of whiteware, Division of pottery: Terracotta, Earthen ware, Stone ware, Porcelain ware Brief explanation of tiles and its types, crockery, sanitary ware, art ware, electrical porcelain andchemical porcelain ware.

Introduction to raw materials: Naturally occuring raw materials-Clay (China, ball and fireclay), Quartz, Napelene syenite, Talc, Sillimanite, sandstone, wollastonite, Zircon, Bone-ash, Synthetically prepared materials-Alumina, Zirconia, Beryllia.
Additives: Organic liquids, water, flocculants, de flocculants, Binders, Lubricants.

UNIT II

Body Preparation Processes:- Methods of Batch calculation (Batch Recipe, chemical composition),

Unloading and storage, Crushing and grinding, batch mixing, blunging, ball milling, mixing, agitating, magnetising, sieving(screening), pumping, filtration (dewatering), pugging and batting.

Process of Body Preparation(for shaping):

a) Dry and semidry powder

b) Plastic mass

c) slip

UNIT III

Shaping Methods

a) Pressing (pressure fabrication)
   i) Dry pressing ii) Semidry Pressing iii) hot pressing iv) isostatic pressing
b) Plastic forming: Jiggering & jollying, extrusion, Hand Moulding, injection moulding, throwing.
c) Slip casting: Detailed study of slip casting, Theoretical concept about slip casting, zetapotential, double layer formation, role of electrolytes, deflocculants.
   Different types of casting-
   i) Ordinary or Natch casting ii) Bench casting iii) Battery casting iv) Capillary casting
d) Finishing operation; sponging, smoothing, fettling, jointing or stickup.

Mould Materials:

Mould materials and their properties. (Different Types of dies and mould), Process of mouldmaking using POP.

UNIT IV

Drying: Definition, Process of Removal of water, Importance of drying, factors affecting dryingrate/time, Drying shrinkage, Drying efficiency, Rate of drying.

Methods of drying, stages of drying, Critical moisture content, Types of driers-batch & continuous, hot floor (through steams pipes), chamber driers & tunnel driers etc., defects indrying.

Glaze preparation, storing and applications of glaze.

UNIT V

Precautions and Methods of setting wares in kilns.

Firing: Definition, stages of firing and firing schedules., Different types of firing: Biscuitfiring, glost firing, decoration firing.
Different types of kilns- Batch and Continuous.Kiln Furniture, placing of wares in kiln.

Defects in whiteware bodies and glazes: - Crawling, pinholes, peeling, crazing, spit-outdunting, blistering, sulphering, rolling, chipping and their records

PRACTICAL EXERCISES (Minimum 10 Practicals to be performed)

1. Moisture content in china clay/given sample.
2. Determination of Water of Plasticity of clay.
3. Determination of loss on Ignition.
4. Determination of fineness of various raw materials used for whiteware bodies.
5. Particle size distribution of powder granuels.
6. Flow and rolling limit of clay bodies.
7. Identify different formimg methods.
8. Preparation of different bodies and their glazes.
9. Fabrication of test specimen by different process by casting and jiggering.
10. Study of defects in drying process in dry oven.
11. Determination of linear drying shrinkage (LDS) of clay body.
12. Biscuit and glost firing of test pieces.
13. Study of heating & cooling schedule.
14. Determination of firing shrinkage of clay body.
15. Determination of water absorption of fired Ceramic products.
16. MOR (Strength) of fired characteristics of test specimens.
17. Examine the Crazing of the given sample by using Autoclave machine.

RECOMMENDED BOOKS

1. Sudhir Sen, “Ceramic Whitewares”.
2. Singer & Singer, “Industrial Ceramics”, Khanna Publishers, New Delhi.

3. "Handbook of Ceramics", Prentice Hall of India.
4. W. Ryan and C. Radford, "Whitewares: Production, Testing and Quality Control",Pergamon Press

INSTRUCTIONAL STRATEGY

Students must get industrial exposure of various whiteware industries to know more aboutprocess and products. The subject contains five units of equal weight age.

4.4 REFRACTORY TECHNOLOGY

L	P
3	4

RATIONALE

In this specialised subject on refractory technology, a thorough knowledge of classification and testing of refractories is provided along with manufacturing techniques of important refractories. Phase diagrams are also dealt in this subject.

COURSE OUTCOMES

After going through this course, the students will be able to:
CO1: Classify various types of refractories.
CO2: Describe manufacturing process, properties and uses of various types of refractories.CO3: Test different types of refractories.
CO4: Identify causes of failure of refractories.
CO5: Describe manufacturing process, properties and uses of monolithic refractories.

DETAILED

CONTENTSUNIT I

Introduction to refractories:

Definition of refractory - Classification of refractories based on chemical nature (acidic, basic, neutral), based on method of manufacture (shaped and unshaped), based on refractoriness (Super, High, medium and low heat duty) .Special refractories with examples. Raw materials such as Fire clay, Sillimanite, Kyanite, Andalusite, Bauxite, Quartzite, Magnesite, Chromite, Dolomite, Zircon, Forsterite. Properties of materials, factors affecting the selection of raw material, occurrence of raw material and manufacturing units in India

UNIT II

Properties and their Measurement:

Physical properties: Porosity, bulk density, permeability, water absorption, specific gravity,

Chemical properties: Slag resistance and acid resistance
Mechanical properties: Compressive strength, bending strength, tensile strength, cold crushingstrength, fracture toughness and abrasion resistance
Thermal properties**:** Thermal expansion, Permanent linear change, thermal conductivity, thermalexpansion and spalling, Refractoriness and Refractoriness under load

UNIT III

Manufacturing of Alumina, Silica, Magnesite, Fire Clay, Carbon and Graphite refractories, Chromite, Chrome- Magnesium, Magnesium-Chrome refractories, Dolomite refractories, and Mullite, Sillimanite, Fused cast refractory - their properties and uses.

UNIT IV

Phase rule, Phase equilibrium in a single component system, Phase equilibrium diagrams forSilica.
Two Component systems: phase compositions for important ceramic systems Al_2O_3-SiO_2 andMgO-SiO_2.
The application of phase diagrams in refractories,

UNIT V

Monolithic Refractories : Definition, Explanation of types: Castables, Patching and ramming mixes, Gunning mixes, Refractory mortar, Ceramic fibre, Glass wool – manufacturing, properties and uses, Advantages of monolithic refractories over shaped refractories.
Application of refractories in steel Indutsry.

PRACTICAL EXERCISES

1. Determination of specific gravity of refractory materials.
2. Determine porosity of refractory materials.
3. Refractoriness determination (pyrometric cone equivalent) of different bricks. (VideoDemonstration/Online/lab performance)
4. Green & sinter density determination of ceramic sample.
5. Particle size determination of refractory raw materials by sieve analysis.
6. Preparation of refractory sample by dry press or moulding

7. Firing of sample at appropriate temperature.
8. Determination of permanent linear change of different bricks.
   (VideoDemonstration/Online/Lab performance)
9. Determination of cold crushing strength of different bricks.
10. Determination of cold modules of rupture of different bricks.
11. Determination of single refractory piece by water absorption test:
    i. Apparent porosity ii. Bulk density
    iii. Apparent specific gravity iv. Percentage of water absorption.

Note :- Those practical's which are not possible at institute level, can be demonstrated/performed in Industrial Training/field exposure/Online.

INSTRUCTIONAL STRATEGY

Industrial visits of students may be organized for better understanding of various manufacturingprocess and products of refractories. The subject contains five units of equal weight age.

RECOMMENDED BOOKS

1. Nandi D. N. , "Refractory", New Age Publication.
2. Mishra, "Refractory", Tata McGraw Hill Publishers, New Delhi.
3. W.D. Kingery, "Introduction to Ceramics", Prentice Hall of India Publication.
4. F.H.Norton,"Refractories", McGraw Hill, New York
5. Chester J. H. "Refractories - Production and Properties", Iron and Steel Institute, London

4.5.1 CERAMIC PROCESS CALCULATIONS

L	P
3	-

RATIONALE

This course includes various calculations done in ceramic industries required for process control. This course provides knowledge to students regarding calculations used in the manufacturing and to provide foundation for diploma ceramic engineers who want to further specialise in the field of ceramics. In this course the students are trained to find moisture and loss on ignition of raw materials, understand shrinkage in wares, manage dimensional changes in the product, control the density of slurry for wet processing, understanding pore structure and its effect and method to find porosity, water absorption and density. The course also coversthe formulating of glaze recipe from the glaze formula

COURSE OUTCOMES

After going through this course, the students will be able to:

CO1: Determine the moisture content in ceramics.

CO2: Evaluate the dimensional changes of ceramic product.

C03 : Calculate density, porosity and absorption characteristics of porous bodies.

C04: Calculate the density of ceramic suspensions.

C05: Compose glaze compositions from their formulae.

C06: Compute the strength of ceramic bodies.

DETAILED CONTENTS

UNIT I

Moisture Content

Types of moisture content in Ceramic Bodies (mechanical, hygroscopic & chemically combined water)

Significance of moisture content and its measurement.

Understand practical problems arise while composing a body batch in industries with moisture content.

Loss on Ignition.

Formulating batch composition in consideration with moisture content.

Critical moisture content, drying of ceramic products

Factors affecting efficiency of drying.

Dimensional Changes

Dimensional changes in ceramic body on drying and firing

Definition of shrinkage (drying & firing), linear shrinkage & volume shrinkage,

Factor affecting shrinkage.

Problems on linear drying &firing shrinkage

Predict dry and fired size based on shrinkage factors

Calculate volume drying shrinkage

Relation between linear and volume shrinkage. Conversion formula from LDS to VDS and VDS to LDS.

Calculations on conversion.

Estimate the green size and final size of the product with known shrinkage factors

UNIT II

Porous Solids

Understanding the pore structures in ceramic bodies (Open pores, closed pores) and their volume (apparent, open pore, apparent solid volume).

Archimedes principle, its use in finding Porosity, Water Absorption and density.

Effect of porosity on density of ceramic products

Derive the expression for true porosity Influence of porosity on thermal Insulation.

Solve problems based on all parameters

Definition of Bulk density & true density. Calculation of Bulk Density, apparent solid density, Specific Gravity, Apparent porosity & Water absorption

UNIT III

Ceramic Suspensions (Rheological Properties)

Definition of slip, density of slip,

Rheological properties, need for maintaining density of slurry in white ware industry.
Density of the batch.
Reducing the slurry density to lower value.
preparing slip of known density
Increasing the density of casting slip.
Understand and use the Brongniart's formula, finding dry content in slurry
Simple methods and formulas to dilute slurry

UNIT IV

Glaze Calculations

Definition of Molecular weights, calculation of molecular weights of ceramic raw materials and glaze/glass compositions, percentage composition and Empirical formula,
Basic concepts of chemical calculations-gram atom, gram mole, mole concepts
Molecular formula, Molecular mass, molecular parts
Mole Percentage chemical composition
Theoretical loss on ignition
Calculation of glaze recipe to formula incorporating various ceramic raw materials, frits (Raw glaze & Fritted Glaze).
Seger formula, unity percentage
Conversion of glaze recipe to formula.
Making glaze recipe from Seger formula.
Formulating fritted glazes with substitute raw materials
Illustration on composing fritted glazes.

UNIT V

Mechanical Strength of Ceramic Products

Definition of strength, cold crushing strength, abrasion resistance, tensile strength, Modulus of Rupture.
Mechanical Strength of ceramic product. & the Factors effecting it
Cold Crushing Strength(CCS), Abrasion resistance, Tensile Strength

Instruments for measuring CCS and tensile strength, Modulus of Rupture (MOR), arrangement of the instruments
Need for measuring MOR instead of CCS
Measuring MOR and Effective Modulus
Finding Standard Surface Factor & Standard Sieve Fraction.

RECOMMENDED BOOKS

1. R. Griffiths and Radfard,"Calculations in Ceramic", J. G. Fen Ltd.
2. Richard L. Lehman,"Lead Glazes for Ceramic Food ware", International Lead Management Centre Research Triangle Park, NC USA
3. A I Andrews,"Ceramic Test and Calculation", John Wiley and Sons Inc
4. Tooley F. V.,"Handbook of Glass Manufacture", Vol I and II, Ogden Publishing Company, New York.

INSTRUCTIONAL STRATEGY

The teacher should give emphasis on calculations used in the manufacturing. This is a theoreticalsubject and contains five units of equal weight age.

4.5.2 CERAMIC PROCESSING TECHNOLOGY

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RATIONALE

Diploma Ceramic Engineer as to details with different types of forming methods. Preparation of body, different machineries and equipment used for preparation of ceramic ware. They should also know the role of particle size, compaction behaviour and there importance in ceramic processing. The course has been design to develop these skills and its associated cognitive, practical and effective domain learning outcomes.

COURSE OUTCOMES

After going through this course, the students will be able to:
CO1: Classify various ceramic fabrication methods.
CO2: Comprehend effect of temperature, pressure and microstructure on ceramic properties.
CO3: Explain properties of various processing additives.
CO4: Explain the modeling and mould making process.
CO5: Take appropriate action for production control.
CO6: Comprehend impact of environment on ceramic industry.
CO7: Ensure safety in ceramic industry.

DETAILED CONTENTS

UNIT I

Introduction :

Ceramic fabrication process, classification of ceramics fabrication methods.

(i) Pressing (a) Dry Pressing (b) Iso-static Pressing
(ii) Plastic shaping (a) Extrusion (b) Jiggering & Jollying (c) Injection Moulding.
(iii) Slip Casting (a) Hollow Casting (b) Solid Casting (c) Tape Casting.

Effects of processing on properties

Introduction, Selection of materials (Physical properties of phases, chemical properties ofphases, Microstructure).

Effects of temperature on properties Strength, Fracture, Toughness, Grain Size.

Effect of pressure on properties Green density , Compaction, Shrinkage, Fired

D

ensityEffect of microstructure on properties Strength, Elastic Modulus, Hardness.

UNIT II

Processing Additives

De-flocculants (Particle Charging in liquid suspension, Double Layer formation)Coagulation and flocculation.

Binders Types of Binders (Clay Binders, Molecular Binders, Vinyl Binders, Cellulose Binders, Polyethylene Glycol Binders, Waxes.)

Plasticizer, Foaming and antifoaming agents, Lubricants, Preservatives

UNIT III

Modeling and Mould Making

Plaster of Paris, Types of POP, mixing of plaster, Model making , Mould making process

Production Controls in Tile Industry - I

(i) Controls of raw material or bodies
Post pressing expansion, Pressed tile bending strength (MOR), Drying shrinkage, Driedtile Bending Strength, Loss on ignition, firing shrinkage, water absorption

(ii) Body Preparation Department Controls
Residue, Slip density, Slip water Content, Viscosity

(iii) Spray Dried powder controls
Moister content, Bulk density, Particle size distribute

(iv) Press department controls
Compression ratio, penetration measurements

UNIT IV

Production Controls in Tile Industry -II

(i) Dried ware controls
Moisture content at inlet, Average weight of dry ware, Moisture content of outlet

(ii) Biscuit ware controls
Average weight, Water absorption, Bending Strength (MOR), Firing shrinkage, Biscuitthermal expansion coefficient

(iii) Controls in glazing departments
Glaze Density, Glaze Viscosity, Glaze Applied weights

(iv) Finished products controls
Average weights, water absorption, Size variation, Bending strength, Crazing resistance,Resistance to acids, Abrasion resistance

UNIT V

Environmental Impact of Ceramic Industry

Introduction, Pollutants in raw materials for bodies, Pollutants in glazes , Pollutants in gaseousemission , Atmospheric pollutions , Bag filters

Safety in Ceramic Industry

Ceramic laboratory Hazards, Ways to avoid accidents Safety check list.

RECOMMENDED BOOKS

5. "Applied Ceramic Technology Vol- I &II", Sacmi Imola Via Selice Provinciale ImolaBO, Italy.
6. Alan .G. King, "Ceramic Technology & Processing", Standard Publishers DistributersDelhi.
7. James S. Reed, "Principles of Ceramic Processing", John Wiley & Sons Inc.
8. Dora M. Billington, "The Technique of Pottery", BT Batsford Ltd. London.

INSTRUCTIONAL STRATEGY

The teacher should give emphasis on understanding of ceramic processing methods. This is a theoretical subject and contains five units of equal weight age.

4.5.3 TILE TECHNOLOGY

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RATIONALE

Diploma holders in ceramic engineering are required to have knowledge about various tiles and related unit operations. The students should have knowledge of the working of various kiln, various tests and defects in tiles. Hence, this subject.

COURSE OUTCOMES

After going through this course, the students will be able to:

CO1: Explain various types of raw materials used, properties and applications of tiles.

CO2: Explain the unit operations in tile ceramics.

CO3: Describe the function and working of tunnel kiln and roller kiln

CO4: Classify various fuels used in tile industry

CO5: Explain various types of tile tests.

CO6: Explain defects in tiles.

DETAILED CONTENTS

UNIT I

Introduction of Tiles

History of floor and wall tiles, Types of tile like glazed, vitrified , glazed vitrified, doublecharged etc.

Porcelain Tiles

Composition of raw materials in the manufacture of porcelain tiles: Quartz sand; Clay kaolin;Mica; Feldspar; Pigment.

Glazed Tiles

Definition of Glazed tiles, raw materials, composition (for body & glaze), Properties, Types ofglazed tiles (wall and floor), Manufacturing process and flow chart of glazed tiles.

Vitrified Tiles

Definition of Vitrified tile, raw materials, composition, Properties. Types of Vitrified Tiles - Glazed vitrified tiles (GVT / Polished GVT), Double charge (DC), Full body tiles. Color body tiles, Soluble salt.

Manufacturing process and flow chart of vitrified tiles.

Comparison between glazed floor tiles vs glazed wall tiles vs vitrified tiles. Recent advancement in tile technology.

UNIT II

Body Making: Batch composition

Crushing, Grinding, Blunging,

Ball milling (wet milling), parameters of ball mill, agitator, screening, magnetic separation

Spray drying, operating parameters of spray drier,

Pressing

Drying

Firing

Sorting

Flow charts of single firing and double fired ceramic tiles.

Preparation of Slip:

Introduction of slip, flocculants, deflocculates, properties of slip.

UNIT III

Engobe

Definition of engobe, importance, raw materials, composition and application.

Shaping (Die Pressing and Roller Pressing)

Die Pressing: Define pressing, Classification (Single, double, isostatic) and Types of presses,Single cavity and multi cavity.

Stages in die pressing, pressing variables, capacity of pressing machine, die size. Discusspossible defects and their remedies occurring during pressing. (laminations)

Roller Pressing: Mechanism of roller Pressing, sizing of tiles.

UNIT IV

Drying

The drying of ceramic tiles, intermittent and continuous driers.

Describe drying, its need, drying time, drying temperature, driers used with respect to tileindustry. Explain pressing & drying defects (warping & cracks) with causes and remedies

Glaze Line Operations: Glazes and glazing: General principles of glazing process. Control of glazing lines.

Illustrate water spraying, application of top and bottom engobe, glazing-spraying (mechanical / disc, pneumatic), curtain coating (bell method/water fall), typical operating parameters (density, viscosity, glaze thickness). Describe decoration methods (direct & indirect) screen printing, roller printing, digital printing and other decoration methods.

Firing :

Introduction of kiln, types of kilns and various applications. Explanation on tunnel and rollerkiln, Comparison between roller kiln and tunnel kiln. Describe fuels (natural gas, LPG) & furnace (roller hearth kiln) used in tile industry, different zones with temperature and pressure, maintaining draught, illustrate typical firing schedule, control parameters in firing.

UNIT V

Operations for Vitrified Tiles

Polishing, edge trimming, different polishing materials with grades.

Inprocess Testing and Final Testing

In-process Testing: Moisture content of raw materials, particle size analysis , viscosity of slip,density of slip, Strength like green and fired, green body density distribution (penetrometer), Final Testing : Dimensional Testing, Water absorption test, porosity test, density test, shrinkage,thickness test, glossiness, MOR test, warpage test,& abrasion resistance.

Specification of Tiles/ Standard Used to manufacture tiles:

Introduction of Tiles Standard EN ISO 10545, ISO 13006, IS 13630, IS 15622 and other ISstandards

Study following Standards: Water absorption, Length and width, Thickness,

Rectangularity,Surface flatness, abrasion resistance etc

Defects

Describe firing defects such as pin holes, blisters, over glazing, under glazing, discoloration, over firing, peeling, crazing, crawling, fish scaling, stuck ware, black core etc with their causes & remedies.

RECOMMENDED BOOKS

1. "Applied Ceramic Technology Vol- I & II", Sacmi Imola Via Selice Provincial 17/A -400026, Italy.
2. Singer and Singer, "Industrial Ceramics", Springer.
3. K. Mariswamy, "Notes on Manufacture of Ceramic Tiles".

INSTRUCTIONAL STRATEGY

The teacher should give emphasis on providing knowledge about various tiles and understandingof various unit operations. This is a theoretical subject and contains five units of equal weight age.

4.6 SLIP TESTING LABORATORY

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RATIONALE

The objective of this subject is to enable the students to handle various instruments, apparatusand equipment. This will help the students to develop desired skills.

COURSE OUTCOMES

After going through this course, the students will be able to:

CO1: Find the effect of casting body by addition of solutions.

CO2: Carry out fluidity ratio test.

PRACTICAL EXERCISES (Minimum 10 practical's to be performed in lab)

1 Prepare the good casting slip for the given raw material

2. Find the effect on casting body by adding sodium carbonate.

3. Find the effect on casting body by adding sodium silicate

4. Find the effect in casting body by adding sodium carbonate solution

5. Find the effect in casting body by adding sodium silicate solution

6. Find out the fluidity ratio with 1:1 (Na2CO3: Na2SiO3) of sodium carbonate and sodiumsilicate.

7. Find out the fluidity ratio with 1:2 (Na2CO3: Na2SiO3) of sodium carbonate and sodiumsilicate.

8. Find out the fluidity ratio with 2:1 (Na2CO3: Na2SiO3) of sodium carbonate and sodiumsilicate.

9. Find out the amount of dry material or powdered substance present in a given slip - drycontent for 1 cc and 1000 cc

10. Find out the dry content of the given slip or liquid using the brongniart formula and alsoverify the weight of the slip.

11. Determination of density of casting slip.

12. Determination of Engler's viscosity of casting slip by ford cup.
13. Determination of dry content of slip by drying.
14. Determination of residue of given slip.
15. Determination of Specific gravity of suitable solution/slip.
16. Determination of rate of casting.
17. Control of density and viscosity of slip.

INSTRUCTIONAL STRATEGY

The teacher should lay stress on providing hands-on practice for development of required skillsin the students.

THIRD YEAR

NSQF LEVEL - 5

18. STUDY AND EVALUATION SCHEME

FIFTH SEMESTER :

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
5.1	Industrial Training -II	-	2	0+1=1	-	40	40	-	60	60	100
5.2	Refractory Applications	3	-	3+0=3	40	-	40	60	-	60	100
5.3	Whiteware and Glazes	3	4	3+2=5	40	40	80	60	60	120	200
5.4	Programme Elective II	3	-	3+0=3	40	-	40	60	-	60	100
5.5	Open Elective (MOOCs/Offline)	2	-	2+0=2	40	-	40	60	-	60	100
5.6	Glass Technology –II	3	-	3+0=3	40	-	40	60	-	60	100
5.7	Professional Practices	-	6	0+3=3	-	40	40	-	60	60	100
5.8	Ceramic Testing Lab	-	6	0+3=3	-	40	40	-	60	60	100
# Student Centered Activities(SCA)		-	3	-	-	-	-	-	-	-	
Total		**14**	**21**	**23**	**200**	**160**	**360**	**300**	**240**	**540**	**900**

Programme Elective II : 5.4.1. Bio and Dental Ceramics **5.4.2**. .Modern Ceramics

Student Centered Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Electoral Literacy, Motor Vehicles (Driving) Regulations 2017 etc., games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

SIXTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) (L+P=C)	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
6.1	Project Oriented Professional Training	-	35	**0+16=16**	-	200	200	-	300	300	500
	Total	-	**35**	**16**	-	**200**	**200**	-	**300**	**300**	**500**

19. HORIZONTAL AND VERTICAL SUBJECTS ORGANISATION

Sr. No.	Subjects/Areas	Hours Per Week	
		Fifth Semester	Sixth Semester
1.	Industrial training - II	2	-
2.	Refractory Applications	3	-
3.	Whiteware and Glazes	7	-
4.	Programme Elective II	3	-
5.	Open Elective	2	-
6.	Glass Technology –II	3	-
7.	Professional Practices	6	-
8.	Ceramic Testing Lab	6	-
9.	Project Oriented Professional Training	-	35
10.	#Student Centered Activities(SCA)	3	-
	Total	**35**	**35**

20. COMPETENCY PROFILE AND EMPLOYMENT OPPORTUNITIES

Government and private sectors related to **Ceramic Engineering** require **supervisors and technician engineers,** having well developed skills with clear choice of procedures. They are expected to have complete knowledge and practical skills related to ceramic engineering. They shall be able to communicate clearly with others. Diploma holders after passing level 5 shall have understanding of desired mathematical skills and understanding of social and natural environment. They are expected to collect, organize and communicate information effectively.

Work requiring knowledge, skills and aptitudes at level 5 will also be carried out in familiar situations, but also ones where problems may arise. Job holders will be able to make choices about the best procedures to adopt to address problems where the choices are clear. Individuals in jobs which require level 5 qualifications will normally be responsible for the completion of their own work and expected to learn and improve their performance on the job. They will require well developed practical and cognitive skills to complete their work. They may also have some responsibility for others' work and learning.

Individuals employed to carry out these jobs will be expected to be able to communicate clearly in speech and writing and may be required to apply mathematical processes. They should also be able to collect and organise information to communicate about the work. They will solve problems by selecting and applying methods, tools, materials and information. They will be expected to have previous knowledge and skills in the occupation, and to know and apply facts, principles, processes and general concepts in the occupation. They will be expected to understand what constitutes quality in the occupation and will distinguish between good and bad quality in the context of their work. They will be expected to operate hygienically and in ways which show an understanding of environmental issues. They will take account of health and safety issues as they affect the work they carry out or supervise. In working with others, they will be expected to conduct themselves in ways which show an understanding of the social and political environment.

They are expected have the knowledge of White Wares and Glazes, Ceramic Testing, Bio and Dental Ceramics, Modern Ceramics, Refractory Applications, Glass Technology and Professional practices being followed in the ceramic engineering. They might find work with a manufacturing company and spend time maintaining, or even designing, the machines that perform much of the automations. They might also work in relevant laboratories for any institute, university or even a private companies. They are expected to have good exposure of humanities, life skills, entrepreneur

development and management to establish small start-ups in the area of Marketing, Sales, Repair and Maintenance etc**.**

They have wide scope to work as supervisory technical employee on wage basis in following organizations: In manufacturing industries primarily in private sector and to some extent in public sector such as: Iron and Steel Industry, DRDO, ISRO, NNFL (National Nuclear Fuel Limited), NALCO (National- Aluminium Cooperation Limited. Ordinance factory, other public/private sector undertakings scuh as White Ware Industry: Sanitary ware, Tiles, Crockery, Pottery ware, Handicraft; Refractories; Glass Industry; Cement Industry; Modern Ceramic industries-metallurgical cosmoferrites; modern insulators, Maintenance department Instructor in Technical Institutions

They have wide scope in establishing small start-ups in the area of Marketing and Sales, Manufacturing Units and Repair and Maintenance Units etc.

21. PROGRAMME OUTCOMES

The program outcomes are derived from five domains of NSQF Level – 5 namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this level, the student will be able to:

PO1: Perform task that require well developed skills with clear choice of procedures.

PO2: Acquire knowledge of facts, principles and processes related to Ceramic Engineering

PO3: Demonstrate cognitive and practical skills to complete tasks and solve problems.

PO4: Develop skills to collect, organize and communicate information.

PO5: Accomplish own work and supervise others work.

PO6: Select online multidisciplinary electives of own interest to promote self-learning.

22. ASSESSMENT OF PROGRAM AND COURSE OUTCOMES

Programme Outcomes to be assessed	Assessment criteria for the Course Outcomes
PO1: Perform task that require well developed skills with clear choice of procedures.	• Describe about present and future requirement of industries. • Explain the working environment of industries • Explain the term superconductivity. • Explain terms like lot size and importance of sampling. • Collect the desired information on a given topic
PO2: Acquire knowledge of facts, principles and processes related to Ceramic Engineering	• Choose refractory materials and products, for the construction of furnace/kilns. • Enlist and explain different refractory products. • Explain refractories used in glass tank furnace and rotary kiln. • Explain the furnaces used and the process for iron and steel making. • Explain body formation, characteristics and manufacturing of various ceramic products. • Describe the properties and their uses of fine ceramics. • Describe bio ceramics and its applications. • Explain manufacture and use of ceramics in bio and dental applications. Describe applications of ceramics materials in electronics, electrical, mechanical and other engineering. Explain manufacturing of hard and soft ferrites, ceramic sensors and capacitors • Explain the concept of glassy state. • Describe manufacturing of fiber, safety and solar panel glass. • Explain concept of thermal stresses, annealing, toughening and tempering. • Explain properties of glass.

PO3: Demonstrate cognitive and practical skills to complete tasks and solve problems.	• Demonstrate competencies and skills required by relevant industries. • Use the refractories, coke oven. • Work in refractory lining. • Carry out Sampling and testing of ceramics. • Examine defects, causes and undertake remedies of ceramics wares. • Use ceramic colours and their manufacture. • Identify Ceramic applications in bio and dental science. • Select bio and dental materials for implants in human beings. • Execute glass decorations. • Undertake in process testing. • Carry out tests related to Ceramics. • Interpret the findings and draw conclusions • Explain trouble-shooting processes being followed in ceramic industries. • Demonstrate the competence to apply knowledge and skills learnt earlier in the context of the project.
PO4: Develop skills to collect, organize and communicate information.	• Demonstrate writing, speaking and presentations skills. • Participate in group discussion. • Apply the communication skills in writing and presenting the technical report.
PO5: Accomplish own work and supervise others work.	• Take necessary safety precautions and measures. • Work in team for solving industrial problems. • Acquire interpersonal skills and work as a team member.
PO6: Select online open elective of own interest to promote self-learning.	• State the basic concepts and principles about the subject of interest. • Perform in a better way in the professional world.

	• Select and learn the subject related to own interest. • Explore latest developments in the field of interest. • Develop the habit of self-learning through online courses. • Develop the problem-solving skills in finding solutions to the problems in the world of work.

23. SUBJECTS & CONTENTS

(THIRD YEAR)

FIFTH SEMESTER

5.1 INDUSTRIAL TRAINING-II

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RATIONALE

Industrial training / In – house training will help the students to understand the working environmentof relevant industries. The student will learn to work in team to solve the industrial problems. It willalso give exposure about the present and future requirements of the relevant industries. This trainingis very important for development of required competencies and skills for employment and start– ups.

COURSE OUTCOMES

After undergoing the training, the students will be able to:

CO1: Explain the working environment of industries
CO2: Take necessary safety precautions and measures.
CO3: Describe about present and future requirement of industries.
CO4: Work in team for solving industrial problems
CO5: Demonstrate competencies and skills required by relevant industries.
CO6: Demonstrate writing, speaking and presentations skills.

PRACTICAL EXERCISES

1. Report writing based on industrial training.
2. Preparation of Power Point Slides based on industrial training and presentation by the candidate.
3. Internal Evaluation based on quality of Report, PPT preparation, PPT presentation and answer to queries.
4. External Evaluation based on quality of Report, PPT preparation, PPT presentation and answer to queries.

GUIDELINES

Students will be evaluated based on Industrial training / In – house training report and their presentation using Power Point about the knowledge and skills gained during the training. The Head of the Department will depute faculty coordinators by assigning a group of students to each. The coordinators will mentor and guide the students in preparing the PPTs for final presentation. The following performance parameters are to be considered for assessment of the students out of 100 marks:

	Parameter	**Weightage**
i	Industrial / In-house assessment of the candidate by the trainer	40%
ii	Report Writing	20%
iii	Power Point Presentation	20%
iv	Viva-voce	20%

5.2 REFRACTORY APPLICATIONS

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RATIONALE

Refractory is the backbone of ferrous and non-ferrous metal extraction industries. Metals cannot be extracted without refractories. Also, other high temperature operations need refractories. So, the students of ceramic engineering should know the applications of refractories in high temperature operations.

COURSE OUTCOMES

At the end of the Course, the student will be able to:
CO1: Choose refractory materials and products, for the construction of furnace/kilns.
CO2: Enlist and explain different refractory products.
CO3: Explain refractories used in glass tank furnace and rotary kiln.
CO4: Explain the furnaces used and the process for iron and steel making**.**
CO5: Use the refractories, coke oven.
CO6: Work in refractory lining.

DETAILED CONTENTS

UNIT-I

Refractory Products

Bricks and other shapes, Crucibles, Saggers, Cordierite Kiln furniture, Furnace Blocks Muffles, Segar Cones, Burner Blocks and Silcon Crabide Troughs.

Special Refractories: Silicon Carbide, and insulation Refractory - manufacturing process, properties & applications.

Cermets – Special Characteristics, Types, Composition and properties. Manufacturing method and applications.

Monolithic Refractories: Definition, Types: Castables (conventional castables, low cement castables, ultralow cement castables, flow cement castables) and Advantages of monolithic /castables refractories. Classification of unshaped refractories: Pre-cast Pre-fired Refractories (PCPF), preparation of castables.

Refractory mortars:
Raw materials required, additives required, preparation of refractory mortar.

UNIT-II
Refractories in iron making process:
Coke Oven: Role of coke in iron making process, Importance of silica, fireclay refractory in wall and doors of coke oven battery, Desirable properties of coke oven refractory.
Role of calcined limestone and dolomite in steel making process, Types of refractory in lime and dolomite kilns.
Elementary idea of preparation of cast Iron.

Blast Furnace: Application of refractory in different zones of blast furnace, stove and cast house area. Role of carbon block in the hearth of blast furnace, Concept of grouting for periodic repair of tap hole, Refractories used in DC Arc Furnace, Torpedo Ladle/Transfer Ladle.

UNIT III
Refractories used in steel making process

Basic Oxygen Furnace: BOF steel making process and slag formation. Concept of requirement of different types of refractory in impact zone, metal zone, slag zone and tap hole area.

Electric Arc Furnace: Lining pattern and type of refractory used in EAF steel making.
Role of gunning and patching mass for hot repair.
Refractories in basic and open hearth furnace, Soaking pits, Reheating furnace.
Continuous casting tundish refractory, Slide gate refractory, Explain mono block shroud, sub entry Nozzle, Stopper, well block and purging.

UNIT IV
Application of refractories in other industries:

Glass tank Furnaces: (Understand structure of tank furnace, Refractory selection for Crown, Super Structure, Side walls, Bottom paving, Safety layer, Insulation)

Refractories used in glass tank furnace , Mechanism of refractories corrosion, Wear of glass contact area, Damage of refractories at upper structure

Cement and Lime industries: Cement Rotary kiln ,Lime Calcining kiln
Pottery Industries Types of kiln: I) Tunnel Kiln ii) Shuttle Kiln

UNIT V
Total Refractory Management: Concept, importance, Understand the general
Safety precautions to be taken during refractory erection.
Common factors affecting refractory life – improper heating, excess holding, lancing and other process parameters.

Phase Diagram Studies and Thermal Properties of Refractories: Hot MOR, Permanent linear change, Thermal Conductivity, Spalling Resistance, Creep Test.

Utilization of industrial wastes – grog, blast furnace slag, fly ash in making refractories.

RECOMMENDED BOOKS

1. Industrial Ceramics – Singer & Singer
2. Refractories -J.H. Chesters
3. Refractory Technology –Ritwik Sarkar, CRC Press
4. Refractories Handbook - Charles A Schascht
5. Fuels Furnace and Refractories – R C Gupta, PHI Publication
6. Industrial Furnaces – W Trinks- John Wiley & Sons, Inc
7. Industrial and Process Furnaces - Peter Mullinger & Barrie Jenkins, Elsevier
8. Refractory Material Selection for Steel Making – Thomas Vert, The American Ceramic Society Wiley
9. Fuels Furnace and Pyrometry-OP Gupta, Khanna Publishers
10. Refractories- Rashid Chesti
11. Refractories -F.H.Norton

RECOMMENDED WEBSITES

1. Ceramics Reference Library https://digitalfire.com/

2. Refractories and Insulation https://www.youtube.com/watch?v=EcPpoWNklz8&list=PLn0kAEsp1o6IZCKRsBMXqMeRBaF8KyW0g
3. Furnace https://www.youtube.com/watch?v=cmf-2B3H_zA
4. Steel Manufacturing https://www.youtube.com/watch?v=otVFDo9YSM8
5. History of Steel Making https://www.youtube.com/watch?v=mAsn1urqF8M
6. Blast Furnace3d Animation https://www.youtube.com/watch?v=6FUkhXboyXY
7. 3d Virtual Reality Blast Furnace https://www.youtube.com/watch?v=wqh2AQvs9D4
8. Blast furnace Tap Hole drilling https://www.youtube.com/watch?v=hcbQd6o_SfE
9. Making iron in blast furnace https://www.youtube.com/watch?v=Xn7D8GsQS4E 10. Steel from start to finish https://www.youtube.com/watch?v=wUOUjogRpRc 11. Cupola Furnace https://www.youtube.com/watch?v=bUbNVzOuJvA
10. Steel Making https://www.youtube.com/watch?v=8nbsPXqr_4A
11. Friction Press a. https://www.youtube.com/watch?v=a6YsrGHb2O4 b. https://www.youtube.com/watch?v=gRw3VzLKluk
12. Hydraulic Press https://www.youtube.com/watch?v=JxJUPD-Ajnc
13. Pan Mill https://www.youtube.com/watch?v=j9gWVsa0D_M
14. NPTEL :: Metallurgy and Material Science - Fuels Refractory and Furnaces

INSTRUCTIONAL STRATEGY

This subject contains five units of equal weightage. Teaches should take the students to industry and explain the details of various systems and their components. While imparting instructions, focus should be on conceptual understanding. Training slides and videos should be used to supplement the classroom teaching. Teachers should invite experts from the industries, research and higher level organizations/institutions to engage some sessions on the latest developments taking place on the subject. Some industrial and field visit may also be arranged. Students should visit steel plant/cement industry/glass industry or watch videos on refractory applications for more clarity.

5.3 WHITEWARE AND GLAZES

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RATIONALE

This specialized subject enables the students to handle heavy clay wares and fine ceramics. The students of ceramic engineering should be able to understand body formation, characteristics and manufacturing of various ceramic products. They should be able to take samples, test, diagnose problems and do trouble shooting in ceramic. Students need to be made aware of health and safety guidelines and defects in ceramic body.

COURSE OUTCOMES

After undergoing the training, the students will be able to:

CO1: Explain body formation, characteristics and manufacturing of various ceramic products.
CO2: Describe the properties and their uses of fine ceramics.
CO3: Carry out Sampling and testing of ceramics.
CO4: Examine defects, causes and undertake remedies of ceramics wares.
CO5: Use ceramic colours and their manufacture.

DETAILED CONTENTS

UNIT-I

Body Formation, Characteristics and Manufacturing

1.1 Earthen Ware a) Fine earthen ware b) Common earthen ware glaze tile (floor & wall) c) Earthenware sanitary ware

1.2 Stone Ware a) Fine stoneware. b) Coarse stoneware c) Sanitary wares d) Vitreous china sanitary wares e) Chemical stone ware f) Acid-resistant bricks and tile.

1.3 Porcelain Ware: a) Hard Porcelain b) Soft Porcelain c) Chemical Porcelain d) Electrical Porcelain e) Bone Chine and fritted China f) dental porcelain

1.4 **Heavy Clay Wares:-** a) Terracotta body b) Common Building bricks. c) Paving brick. d) Face brick e) Common Building tiles f) Salt glaze stone ware pipes.

UNIT-II

Manufacturing, Properties & Applications of Floor tiles, Wall tiles and Insulators -Low tension and High tension.

Factors affecting strength of porcelain insulators

Factors affecting breakdown of electric insulators

Low alkali porcelain as a resistor carrier

Demonstrate Insulation test, Hammer test, Tensile strength (is.731.1971) for high tension and low tension insulators.

UNIT III

Concept of quality control and quality assurance, Inspection and its significance, Concept of process and final inspection.

Properties and Tests:- Loss on ignition, water of plasticity, thermal shock resistance, corrosion resistance, abrasion resistance, lead solubility test, porosity, impact and chipping resistance, acid resistance, water absorption, MOR, Tensile and compressive strength, Crazing and Delayed crazing Test, Determination of drying and firing shrinkage, Practical control of slip properties. (IS &ASTM)

UNIT IV

Ceramics glaze:

Define glaze & classification of glaze, various types of glaze, Raw materials and their influence on glaze, Preparation of glaze, Glaze frit & its preparation.

Glaze application & decoration:

Different Glaze Application methods, Classification of Decoration's, Decorations methods.

Glaze calculation: Definition of Molecular weights, calculation of molecular weights of ceramic raw materials.

Glaze/glass compositions: Segar Unity formula, percentage composition and Empirical formula.

Testing of glaze: Various Tests of glaze and their procedures.

Method of controlling gloss.

UNIT V

Ceramic Colour and Decoration:

Introduction, Raw materials used for manufacture of ceramic colours, Properties and function of raw materials, Method of manufacture, Factors affecting the properties of ceramic colours. Preparation of ceramic colors for decoration on ceramic articles. Factors affecting decoration.

Defects: Cause and Remedy of Crawling, pinholes, peeling, crazing, spit-out, dunting, blistering, sulphering, rolling, chipping, Crack, Fish Scaling, Blistering, Hair Lining, Jumping Off, Reboiling, Rusting, Tearing, Warping etc.

Health & safety with glazes & ceramic materials:-labeling of hazardous material, ceramic material hazards, recommended health & safety procedures and disposal of waste materials.

PRACTICAL EXERCISES

1. Prepare porcelain ware body.
2. Prepare different types of ceramic stains.
3. Prepare of colored glaze and its application.
4. List out and study various defects like pinholes, chipping, dunting etc in ceramic products and their remedies.
5. Determination of thermal shock resistance of a given sample.
6. Determination of abrasion resistance of a given sample.
7. Determination of impact & chipping resistance of a given sample.
8. Determination of acid resistance of a given sample.
9. Application and firing of transfer prints.
10. Study the milling of enamel & glaze in pot mill.
11. Application of glaze frit by dipping & spraying.
12. To determine residue of glaze/body slip.
13. To determine viscosity of slip.

RECOMMENDED BOOKS

1. Sudhir Sen, “Ceramic Whitewares”.
2. Singer & Singer, “Industrial Ceramics”, Khanna Publishers, New Delhi.
3. “Handbook of Ceramics”, Prentice Hall of India.
4. W. Ryan and C. Radford, “Whitewares: Production, Testing and Quality Control”, Pergamon Press
5. Ceramic whitewares Rexford New course
6. Fine ceramics F.H.Norton
7. A hand book of modern H.N.Bose pottery manufacture
8. Tests and Calculation A.I.Andrew
9. Ceramic glazes Keneath Shaw

RECOMMENDED WEBSITES

1. www.xaar.com/media/colpzzdn/xaar-ceramic-guide.pdf
2. Ceramic Glaze Defects (digitalfire.com)
3. https://digitalfire.com/test
4. www.digitalfire.com

INSTRUCTIONAL STRATEGY

This is hands on practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills among the students. This subject contains five units of equal weightage. Teaches should take the students to industry and explain the details of various systems and their components. While imparting instructions, focus should be on conceptual understanding. Training slides and videos should be used to supplement the classroom teaching. Teachers should invite experts from the industries, research and higher level organizations/institutions to engage some sessions on the latest developments taking place on the subject. Some industrial and field visit may also be arranged so that the students get industrial exposure of various whiteware industries and understand various processes and products.

5.4 PROGRAMME ELECTIVE
5.4.1. BIO AND DENTAL CERAMICS

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RATIONALE

This course is designed to make students understand ceramic applications in Bio and dental applications. The students of ceramic engineering must understand manufacture and use of ceramic in bio and dental applications. They should also be able to identify ceramic applications in bio and dental science.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:

CO1: Describe bio ceramics and its applications.

CO2: Explain manufacture and use of ceramics in bio and dental applications.

CO3: Identify Ceramic applications in bio and dental science.

DETAILED CONTENTS

UNIT-I

Introduction to Bio Ceramics: Definition of bio ceramics and biological requirements, scope of bio-ceramics.

Classification of bio-ceramic based on composition and application. Illustrate ceramic Implants used in human body with specific parts and shapes with sketches.

Raw material and general manufacturing method.

UNIT-II

Dental Ceramics and Properties: Definition, classification, applications of dental ceramics. Define various physical properties: stress, strain, modulus of elasticity, permanent deformation, strength, brittleness, toughness, hardness, ductility, malleability, resilience, flexibility, impact, fatigue, creep etc. of dental materials.

Illustrate the tooth structure & explain parts: Enamel, Dentine, Cementum & Pulp. Primary and secondary teeth, chronology of teeth.
Definition of dentures, types: direct and indirect restorative dental material, with examples.

Illustrate all ceramic and metal ceramics restorations. Outline different compositions of ceramic and metal ceramic restorations.

UNIT III
Dental Materials:

A. **Impression materials –** definition, properties, classification based on different parameters. Properties, uses, applications and comparison between different impression materials like zinc oxide eugenol, agar and alginate.
B. **Gypsum products -** dental plaster, dental stone, improved stone each manufacturing process, chemical reactions, properties, applications, water-powder ratios. Difference between dental plaster and dental stone. Measurement of setting time, factors affecting setting time. Definition of modifier – accelerators, retarders.
C. **Waxes in dentistry -** Definition, classification and types of dental wax, applications. Ideal requirement of inlay wax, difference between direct and indirect pattern wax.
D. Investment materials – definition, requirements, types and general properties. E**. Metals and Alloys**: Noble metals: gold, platinum, palladium, Base Metals: silver, copper, zinc, tin, indium.
F. Dental porcelain raw materials, composition, castable, glass-ceramic.

UNIT IV
Fabrication: Illustrate with flow diagram casting procedure of all ceramic restoration, ceramic-metal restoration and ceramic jacket crowns, defects in cast restorations. Understand technical aspects of metal-ceramic restorations, benefits and draw backs of metal-ceramics over others.

UNIT V
Dental Cements: Definition and classifications of dental cement, Silicate cement, Zinc phosphate cement, Zinc oxide eugenol cement, Glass ionomer cement, zinc silico phosphate cement, Zinc poly carboxylate cement, Calcium hydroxide cement all with definition, applications, composition, properties and manipulations. Definition and applications of Cavity liner, cavity varnish and cavity bases.
Surface Finishing: Definition of abrasive, types of abrasives with examples and uses. Definition of grinding & polishing, objectives of polishing, stages of polishing, types of polishing tools, difference between grinding and polishing

RECOMMENDED BOOKS

1. Dental Materials 5th Ed. - V.K. Subbarao
2. Basic Dental Materials 2nd Ed. - Jhon J Manappallil
3. Dental Technicial 2nd Ed. - Dr. Syed Sadatullah.
4. Advances in Bio ceramic and porous ceramics - Roger Narayan, Paolo Colombo 5. Advanced ceramic – vol-1 Bioceramic - James F Shackelford
5. Basics of Dental Technology – Tony Johnson, David G Patrick, Wiley Blackwel

RECOMMENDED WEBSITES

1. Bioceramics in endodontics – a review - PMC (nih.gov)
2. How bioceramics is made - material, manufacture, used, processing, parts, components, composition, structure (madehow.com).

INSTRUCTIONAL STRATEGY

This subject contains five units of equal weightage. Teaches should take the students to industry and explain the details of various systems and their components. While imparting instructions, focus should be on conceptual understanding. Training slides and videos should be used to supplement the classroom teaching. Teachers should invite experts from the industries, research and higher level organizations/institutions to engage some sessions on the latest developments taking place on the subject. Some industrial and field visit may also be arranged.

5.4.2 MODERN CERAMICS

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RATIONALE

Development of new materials which have better performance and reliability in service are in demand in the various industries. This course has been designed to give the diploma holders of ceramic engineering a thorough knowledge of the new ceramics, their properties and applications in the specialized areas like nuclear ceramics, electronic devices and bio ceramics etc.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:

CO1: Explain the term superconductivity.

CO2: Describe applications of ceramics materials in electronics, electrical, mechanical and other engineering.

CO3: Explain manufacturing of hard and soft ferrites, ceramic sensors and capacitors

CO4: Select bio and dental materials for implants in human beings.

DETAILED CONTENTS

UNIT-1
INTRODUCTION

Introduction to new ceramics, scope & classification.

Superconductivity:- Phenomenon & properties of superconductors, Meissner effect. Examples of high temperature ceramic super conductors, application of super conductors.

Nuclear Ceramics:- Nuclear energy, Ceramics materials used in nuclear reactors: fuel elements, moderators, control rods, structural parts, irradiation effect, disposal of nuclear waste.

UNIT-II

Ferrites: Definition of ferrites, Classification: Hard and soft ferrites with examples, Definition of hard and soft ferrites, Comparison between hard and soft ferrites. Manufacture of soft & hard ferrite with a flow chart.

Difference between hard isotropic and hard anisotropic ferrite.
Properties and application of soft and hard ferrites.
Ceramic capacitors: - Definition, properties and uses of Ceramic substrates and capacitor dielectrics in electronics.
Manufacturing of ceramic capacitors: Multilayer capacitors.

UNIT-III

Ceramic sensors: Properties, manufacturing and applications of Resistors, Varistors and Thermistors.
Definition and application of oxygen sensor, NOx sensor and knock sensors..

Bio and Dental Ceramics:

Bio-Ceramics:- Definition of Bio-ceramics, Types of Bio Ceramics – Bioinert, Biodegradable & Bioactive ceramics with examples.
Elementary idea about preparation, properties and applications.

Dental Ceramics: Definition of dental ceramics, manufacturing of artificial teeth, their properties and application.

UNIT-IV

Definition and mechanism of membrane for filtration, classification of separation process, comparison between organic and inorganic membranes. General preparation of ceramic membrane with their applications

Working principle of Piezoelecticity, Ferroelectric and pyroelectric ceramics, its properties and field of application.
PZT and PLZT based materials.

UNIT-V

Wear Resistant Materials

Definition of abrasive (grain) grinding wheel, raw materials (Bauxite, corundum & carborundum), manufacturing, properties and Uses of grinding wheels.

Types of ceramic cutting tools.
Grinding media for tumbling (ball or tube) mills, Types of grinding media (Al_2O_3, SiAlON, TiC, WC), uses.
Properties and applications of Ball bearing based on TiC, WC, Si_3N_4

Introduction to honeycomb catalytic convertor and its applications, 3D printing technology for shaping of advanced technical ceramics.

RECOMMENDED BOOKS

1. Ceramic materials for electronics by R.C. Buchahan, McGraw Hill
2. Introduction to Ceramics by W.D. Kingery, Prentice Hall of India

RECOMMENDED WEBSITES

1. Ceramics for nuclear reactors|INIS (iaea.org)
2. Ceramic Superconductors - an overview | ScienceDirect Topics
3. Soft Ferrites VS Hard Ferrites | Stanford Magnets
4. Frontiers | Ceramic Sensors: A mini-review of their applications (frontiersin.org)

INSTRUCTIONAL STRATEGY

This subject contains five units of equal weightage. Teaches should take the students to industry and explain the details of various systems and their components. While imparting instructions, focus should be on conceptual understanding. Training slides and videos should be used to supplement the classroom teaching. Teachers should invite experts from the industries, research and higher level organizations/institutions to engage some sessions on the latest developments taking place on the subject. Some industrial and field visit may also be arranged. Students must get exposure of various industries like ferrite industry, semi-conductor industry and capacitor industry to know more about products and processes.

5.5 OPEN ELECTIVE

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RATIONALE

Open electives are very important and play major role in implementation of National Education Policy. These subjects provide greater autonomy to the students in the curriculum, giving them the opportunity to customize it to reflect their passions and interests. The system of open electives also encourages cross learning, as students pick and choose subjects from the different streams.

COURSE OUTCOMES

At the end of the open elective, the students will be able to:

CO1: State the basic concepts and principles about the subject of interest.

CO2: Perform in a better way in the professional world.

CO3: Select and learn the subject related to own interest.

CO4: Explore latest developments in the field of interest.

CO5: Develop the habit of self-learning through online courses.

LIST OF OPEN ELECTIVES (The list is indicative and not exhaustive)

1. Computer Application in Business
2. Introduction to NGO Management
3. Basics of Event Management
4. Event Planning
5. Administrative Law
6. Introduction to Advertising
7. Moodle Learning Management System

8. Linux Operating System
9. E-Commerce Technologies
10. NCC
11. Marketing and Sales
12. Graphics and Animations
13. Digital Marketing
14. Human Resource Management
15. Supply Chain Management
16. TQM

GUIDELINES

Open Elective shall be offered preferably in online mode. Online mode open elective shall preferably be through Massive Open Online Courses (MOOCs) from Swayam, NPTEL, Upgrad, Udemy, KhanAcademy or any other online portal to promote self-learning. A flexible basket of large number of open electives is suggested which can be modified depending upon the availability of courses at suggested portals and requirements. For online open electives, department coordinators shall be assigned to monitor and guide the group of students for selection of minimum 20 hours duration online course of their choice. For offline open electives, a suitable relevant subject shall be offered by the respective department to the students with minimum 40% of the total class strength as per present and future requirements.

Assessment of MOOCs open elective shall be based on continuous evaluation by the respective coordinator. The coordinator shall consider the submitted assignments by the students from time to time during the conduct of MOOCs. The MOOCs assessment shall be conducted by the coordinator along with one external expert by considering submitted assignments out of 100 marks.

In case, no suitable open elective is available online, only then the course may be conducted in offline mode. The assessment of offline open elective shall be internal and external. The offline open elective internal assessment of 40 marks shall be based on internal sessional tests; assignments etc. and external assessment of 60 marks shall be based on external examination at institute level.

NOTE The students enrolled under NCC will compulsorily undertake NCC as an open elective subject.

SUGGESTED WEBSITES

1. https://swayam.gov.in/
2. https://www.udemy.com/
3. https://www.upgrad.com/
4. https://www.khanacademy.org/

5.6 GLASS TECHNOLOGY-II

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RATIONALE

The glass colorization, annealing and toughening are important processes in glass manufacturing. Apart from this glass properties and testing are also important. This subject will help the students to understand manufacturing process of glass. The students of ceramic engineering should have knowledge of properties of glass. They shall also get an exposure and able to execute glass decorations.

COURSE OUTCOMES

After undergoing the subject, the students will be able to:
CO1: Explain the concept of glassy state.
CO2: Describe manufacturing of fiber, safety and solar panel glass.
CO3: Explain concept of thermal stresses, annealing, toughening and tempering.
CO4: Explain properties of glass.
CO5: Execute glass decorations.

DETAILED CONTENTS

UNIT I

Concept of glassy state, effect of composition on manufacturing of glass. Controlling devitrification of glass.
Importance of Solar Energy.
Composition, Manufacturing and applications of fibre glass, glass wool, solar glass and safety glass.

UNIT II

Strain and Annealing:
Development of thermal stresses, Temporary and Permanent strain, Detection and measurement of strain.
Concept of annealing and its purpose, Process of annealing.
Concept of Tempering and its purpose, Process of tempering.

Concept of toughening of glass by various methods: Chemical and Mechanical Toughening.

Colorization and Decolorization: Theory of colorization and decolorization of glass, coloring and decoloring agents of glass.

UNIT III

Refractories used in Glass Furnaces: Refractories used in various parts of glass tank furnace, Bridge wall, crown, side wall, checkers, chimney, super structure, dog house, throat, refining zone etc.
Refractories used in recuperators and regenerators.

Properties of Glass

Viscosity: Importance of viscosity during glass melting, Viscosity variation with temperature and composition, characteristics points on viscosity curves, relation between viscosity and crystallization, viscosity and plaining, viscosity and strain, viscosity and working processes, measurement of viscosity of glass.
Density of glass, Surface tension of glass, thermal expansion of glass.

UNIT IV

Testing of Glass:

Testing of glass by visual inspection: blisters and seeds, cords, straie, knots, stones in glass.
Detection and observation of strain in glass.
Measurement of Thermal Shock Resistance.
Testing of Viscosity, Density, Strength and durability, measurement of refractive index, tests for resistance to chemical attack.

Glass Decorations:

Cutting, Etching, Polishing, Grinding, Engraving: Needle, Sand blasting.
Glass mirrors.

UNIT V

Special Glasses:

Characteristics and Applications

- Borosilicate Glass
- Pyrex Glass
- Heat Resisting Glass
- Coloured Glass

- Ruby Glass
- Laminated Glass
- Heat absorbing glasses

Pollution control in glass industry: Sources of pollutions: water, noise and air pollution, their controlling measure, precautions required during manufacturing and processing of glass.

RECOMMENDED BOOKS

1. S.G. Scholse, “Modern Glass Practice”, Publisher McGraw Hill.
2. F.V. Tooley, “Handbook of Glass Manufacturing”, Publisher Prentice Hall of India.
3. Norton, “Hand book of Glass Engineering”
4. Subrata Banerjee,”Glass and its Application”

RECOMMENDED WEBSITES

1. https://www.lehigh.edu/imi/teched/GlassProcess/Lectures/Lecture03_Hubert_ industglassmeltfurnaces.pdf
2. Significance of Solar Glass in Solar Panels (vishakharenewables.com)
3. https://in.saint-gobain-glass.com/knowledge-center/glass-manufacturing-process
4. https://www.toughglass.com.au/product/processing/#:~:text=Toughened%20or%20tempered%20glass%20is,where%20it%20is%20rapidly%20cooled.

INSTRUCTIONAL STRATEGY

This subject contains five units of equal weightage. Teaches should take the students to industry and explain the details of various systems and their components. While imparting instructions, focus should be on conceptual understanding. Training slides and videos should be used to supplement the classroom teaching. Teachers should invite experts from the industries, research and higher level organizations/institutions to engage some sessions on the latest developments taking place on the subject. Some industrial and field visit may also be arranged. Students should understand different glass processes, defects and testing, which can be shown in industry or videos for better understanding.

5.7 PROFESSIONAL PRACTICES

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RATIONALE

Professional development of diploma engineering students is to be done by exposing them to various simulative situations in the industries. This is achieved by involving students in activities similar to industrial environment through this subject.

COURSE OUTCOMES

After undergoing the training, the students will be able to:
CO1: Explain terms like lot size and importance of sampling.
CO2: Collect the desired information on a given topic
CO3: Participate in group discussion.

PRACTICAL EXERCISES

1. Sampling, Lot size. Importance of sampling. Different Sampling Techniques and Their demonstration (online/offline) for tile industry. For this IS standards can be used.

2. **Information Search and Data collection:**
Search the information about any one topic suggested below or any other topic and make hand written report of 2 to 5 pages. This can be done through manufacturer's catalogue, websites, magazines; books etc.

Following topics are suggested:

1. Advanced Refractories 2. Cermets 3. Whisker Ceramics 4. Piezo electric sensors 5. Catalytic convertors 6. Bio-implants 7. Dental implants. 8. Composite materials 9. Nano materials 10. Ceramic coatings in aeronautics, turbine blades. 11. Ceramic applications in nuclear reactors. 12. Advanced applications of Glass-Ceramics. 13. Photo chromatic Glasses 14. Powder Coatings 15. Advances in Slip Casting. 16. Ceramic Injection Moulding 17. Impact of ceramic industry on environmental pollution. 18. Importance

of waste disposal in ceramic industries 19. Utilisation of Alternative energy sources in ceramics. 20. Ceramic Filters 21. Ceramics applications in Aeronautics/ Automobiles/ Electrical/ Electronics etc. 22. Ceramics applications in temperature sensing. 23. Advances in ceramic insulations. 24. Manufacturing of wash basins. 25. Ceramic Abrasives. 26. Maintenance procedure for laboratory model furnace. 27. Ceramic Cutting tools 28. Plant maintenance. 29. Industrial safety 30. Fire fighting 31. Industrial Effluent treatment 32. Low cost automation.

3. **Group Discussion:** Group discussions: Meaning and Importance of Group Discussion, Types of Group Discussions, Format of a Group Discussion, tips to crack Group discussion.

Methodology for conducting Group discussion

1. The teacher will allot a topic for a group of six students.

2. The teacher or any student should give an introductory talk on ways and rules to carry out group discussion

3. Teacher and other students will act as observing members and try to evaluate as per guidelines and will provide feedback at the end of GD.

4. The teacher should fix up the time duration for initiating and conducting the activity.

Some of the suggested topics are – i) Sports ii) Current news items iii) Discipline and House Keeping iv) Current topics related to ceramic engineering v) Polythene bags must be banned! vi) Do we really need smart cities? vii) . E–Books or Printed books – what's your choice? viii) Globalization and its impact on Indian Culture. ix) Global warming is caused more by developed countries x) Reservation for women would help the society. xi) Online vs off line education

4. **Student Activities (Team Work):** The students in a group of 3 to 4 will perform any one of the following activities (others similar activities may be considered Activity):

i) Make list of IS Testing standards for whiteware /refractories/Glass

ii) Collecting information from Market: Compare Nomenclatures and specifications of any ceramic products.

iii) Specifications of Lubricants.

5. Lecture on any one topic on concept of Brain storming, quality circles, ISO, SPC, 5S, kaizen etc.

General problem solving process (Identify and clarify the problem, information gathering related to problem, Evaluate the evidence, Consider alternative solution and their implications, Choose and implement best alternative, Review)

Problem solving techniques: Trial and error, Brainstorming, Lateral (Out of Box) Thinking.

6. **Self-Management Skills**: Lecture on any one topic like stress management, Time management, Developing Self-Awareness with JOHARI Window, Self-examination.

7. **Mock Interview:** Preparation for interviews, Types of Interviews, Approach for Facing an Interview, tips to crack Interview. After that conduct mock interview.
8. **Career Skills:** Introduction and significance of Résumé and Related Terms, Difference between a CV, Résumé, and Biodata, Essential Components and format of a Good Résumé.

RECOMMENDED BOOKS

1. https://miro.com/brainstorming/
2. www.simplilearn.com/quality-circle-article
3. Create a presentation in PowerPoint - Microsoft Support
4. Stress Management: How to Reduce and Relieve Stress (helpguide.org)

INSTRUCTIONAL STRATEGY

This is hands on practice based subject and topics taught in the class should be practiced during practical sessions regularly for development of required skills among the students. This subject contains five units of equal weightage. During practice work, it should be ensured that students get opportunity to individually and in groups perform practical tasks. The course will be delivered through discussions, activities and teacher has liberty to choose a combination or any of the modes.

5.8 CERAMIC TESTING LABORTARY

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RATIONALE

This subject will help students to understand importance of ceramic testing methods. They will be able to execute various tests in ceramics and draw conclusions. They will be exposed to industrial practices being followed in diagnosing the defects and trouble shooting in ceramics.

COURSE OUTCOMES

At the end of the open elective, the students will be able to:
CO1: Undertake in process testing.
CO2**:** Carry out tests related to Ceramics.
CO3. Interpret the findings and draw conclusions
CO4: Explain trouble-shooting processes being followed in ceramic industries.

PRACTICAL EXERCISES (Minimum 10 practical's needs to be performed)

1. Determine the Specific gravity of the given sample (Insoluble method).
2. Dried strength using MOR machine.
3. Determine shrinkage water and pore water.
4. Detect cracks in green articles.
5. Study various types of sieves used in ceramic lab.
6. Study rate of heating and cooling of electrical furnace.
7. Determine pH value of clay slip.
8. Decoration of Glass using methods of Etching and sand blasting.
9. Thermal Endurance / Shock resistance of glass.
10. Boil test of safety glass.
11. Resistance to shock test of safety glass.
12. Study glass test tube specifications and Acceptance criteria as per IS 2618
13. Determine impact resistance of glass.

14. Study the alkali resistance of glass.
15. Identify various defects of glass.
16. Determine density of glass.
17. Determine viscosity of slip.
18. Determine applied weight of glaze
19. Study visits to industries for studying the fault-diagnosis and trouble-shooting

INSTRUCTIONAL STRATEGY

This is hands on practice based subject and students should be given opportunities to conduct experiments lab regularly for development of required skills among them. During practice work, it should be ensured that students get opportunity to individually perform practical tasks. Field and industrial visits should be arranged at intervals to enable the students understand fault-diagnosis and trouble-shooting techniques being followed in the world of work.

SIXTH SEMESTER

6.1 PROJECT ORIENTED PROFESSIONAL TRAINING

L	P
-	35

RATIONALE

Project Oriented Professional Training is aimed at the application of knowledge and competencies gained in the previous semesters in an integrated manner towards addressing an issue in the industry/field, as per the interest and choice of both the industry and student. It also provide opportunities to the students to work relatively independently over extended and comprehensive periods of time. It is expected from the students to get acquainted with desired attributes for industrial/field environment. For this purpose, students are required to work in different establishments of world of work, and develop competencies.

COURSE OUTCOMES

After undergoing this course, the students will be able to:

CO1: Define the problem statement of the Industrial training as per industry need.
CO2: Develop the problem-solving skills in finding solutions to the problems in the world of work.
CO3: Acquire interpersonal skills and work as a team member.
CO4: Demonstrate the competence to apply knowledge and skills learnt earlier in the context of the project.
CO5: Apply the communication skills in writing and presenting the technical report.

GUIDELINES

The purpose of this project oriented professional training is to expose the students to the world of work and provide professional experience in real life situation. It is suggested that during the training, the student should remain attached with the various sections of industry/field for 3-4 weeks. The student will have to maintain a daily/weekly/monthly diary/work book and submit detailed reports of their activities periodically to their supervisor/teacher. These reports will be certified by the concerned/ authorized officer of the organization where the student is undergoing professional training and doing his/her project.

Each student is required to undergo one Professional Oriented Project according to his/her area of interest and the project report is to be submitted at the end of project. The concerned teacher will guide and supervise the students on work stations (as far as possible) at regular intervals. A systematic plan of action is required to be prepared, well in advance, by the polytechnic in consultation with the organizations where professional training and project is going to be executed. The teacher should clearly specify the expected learning outcomes and schedule on periodic basis, preferably weekly or fortnightly basis, for the whole of the professional project/training period of students. Performa may be developed by the polytechnic Training and Placement Officer in consultation with the teachers and personnel from industry to monitor the progress of the students. The performa should be filled by the students on daily, weekly and monthly basis, and should be duly countersigned by the personnel from industry and concerned teacher/supervisor attached to the particular student. Each teacher is supposed to guide and supervise about 5 – 8 students, depending upon the strength of the students and teachers in the department.

A criteria for assessing student performance by the internal examiner (personnel from industry and supervisor) and external examiner (teachers and experts) are given in table below:

S. No.	Performance criteria for Internal Assessment	Weightage of marks (in %age)
1.	Punctuality and regularity	10%
2.	Initiatives taken by the student in learning at training workplace	10%
3.	Defining problem statement, approach and schedule (Planning)	20%
4.	Level /proficiency of new practical skills acquired	20%
5.	Preliminary Action Plan and Report	40%
TOTAL		**100**

S. No.	Performance criteria for External Assessment	Weightage of marks (in %age)
1.	Project Report	60%
2.	Presentation & Viva voce	40%
Total marks		**100**

Important Notes:

1. This criteria must be followed by the faculty and they may see the daily, weekly and monthly progress/reports, while awarding awards as per the above criteria.
2. Students may visit websites as their learning tool during industrial training, Search videos, animations, text material on internet for preparation of training report during the training period.
3. The external examiner, preferably, may be the person from different industry/organization/institution, who is well versed with the discipline/branch of project-oriented -professional training of the students, so that she/he can properly evaluate the students on the above criteria.

24. ASSESMENT TOOLS & CRITERION

The assessment is carried out by conducting:

1. Formative assessments
2. Summative assessments

1. FORMATIVE ASSESSEMENT

The **formative assessment** will be evaluated on the basis of the internal assessments for theory subjects and practical by the concerned teachers for evaluating the knowledge and skill acquired by students and the behavioral transformation of the students. This **internal assessment** is primarily carried out by collecting evidence of competence gained by the students by evaluating them at work based on assessment criteria, asking questions and initiating formative discussions to assess understanding and by evaluating records and reports, and sessional marks are awarded to them.

2. SUMMATIVE ASSESSMENT

The **summative assessment** will include end semester examination for theory part for each candidate and practical examination with viva voice. Each Performance Criteria will be assigned marks proportional to its importance and proportion of marks for Theory and Skills Practical for each subject should be laid down.

The following assessment tools are used for effective student evaluation:

1. Theory Examinations
2. Practical Work
3. Internships
4. Professional Industrial Training
5. Project Work (Minor & Major)
6. Massive Open Online Courses (MOOCs)
7. Viva Voce
8. Case Studies

1. Theory

Evaluation in theory aims at assessing students' understanding of concepts, principles and procedures related to a course/subject, and their ability to apply learnt principles and solve problems.

The **formative evaluation** for theory subjects may be caused through

i. Sessional /class-tests,
ii. Quizzes,
iii. Assignments,
iv. Seminars/ Presentations
v. Attendance
vi. Case Studies

For **Summative evaluation** of theory, the question paper may comprise of three sections.

i. It should contain objective type question and multiple choice questions. The objective type items should be used to evaluate students' performance in knowledge, comprehension and at the most application domains only.
ii. It should contain short answer questions.
iii. Descriptive type questions , with some internal choice of the questions set may be given in this section

2. Practical Assessment

Evaluation of students performance in practical work (Laboratory experiments, Workshop practical /field exercises) aims at assessing students ability to apply or practice the concepts, principles and procedures, manipulative skills, ability to observe and record, ability to interpret and draw conclusions and work related attitudes. This will comprise of a creation of mock environment, wherever applicable in the skill lab which is equipped with all required equipment for development of desired skills. Candidate's soft skills, communication, aptitude, safety consciousness, quality consciousness etc. will be ascertained by observation and will be marked in observation checklist along with the assessment of Job carried out in labs and maintenance of Lab Record files.

Formative and summative evaluation may comprise of weightages to performance on task, quality of product, general behavior and it should be followed by viva-voce of the relevant subject. The end product will be measured against the specified dimensions and standards to gauge the level of his skill achievements

3. Internship

The two mandatory internships after I Year and II Year of the programme are to be assessed in 3rd and 5th semester subsequently. The internships should be preferably done in the field/ in the industry, can be in house depending upon the stream and availability of resources in and around the institute.

Every faculty should be assigned the students and made responsible for the evaluation and assessment of the internship. Formative assessment should be taken from the industry/institute/ department on the basis of performance, behavior and learning capabilities. Summative evaluation may comprise of weightages on the basis of report submission/ presentation followed by viva-voce of the relevant subject.

4. Professional Industrial Training

Evaluation of professional industrial training report and viva-voce/ presentation aims at assessing students' understanding of industrial processes, practices in the industry/field and their ability to engage in activities related to problem-solving in industrial setting as well as understanding of application of learnt knowledge and skills in real life situation. Formative and summative evaluation may comprise of weightages to performance on task, quality of product, general behavior and it should be followed by viva-voce of the relevant subject.

The formative assessment should include the evaluation from the employer where the student is doing his training or Project work in the ratio of 40:60. The final assessment will be the combination of the employer assessment and evaluation by the faculty of the institute which shall include report submission/ presentation/ seminar followed by viva-voce of the relevant subject.

5. Project Work Assessment

The purpose of evaluation of project work is to assess student's ability to apply, in an integrated manner, knowledge and skills in solving real life problems, manipulative skills, ability to observe, record, creativity and communication skills. The project work assigned should be of

relevance to the core skill, state of the art topics and the project areas that are pertaining to enhance job skill and enhance occupational opportunities. For both, minor and major project, Formative and summative evaluation may comprise of weightages to performance on task, quality of product, nature and relevance of project and general behavior.
The formative assessment should include the continuous assessment based on the work allocated and mid semester viva voice or presentation. The final assessment will be the combination of the project undertaken, report submission and should be followed by viva-voce of the relevant subject.

In case of the assessment of this component, the team of examiners should be constituted on 50 – 50 % basis. i.e. half of the examiners in the team should be invited from outside the institute conducting examination.

6. MOOC COURSES (Open Elective and Multi-Disciplinary Elective)

Massive Open Online Courses (MOOCs) platforms promise open, online courses to massive numbers of students as they are free to join, they provide a wide range of courses, they allow for space and time flexibility and their participants can benefit from various online communication tools and access to quality content.

The coordinating Department/Centre/Office shall monitor every student to adopt the courses online of their choice and preference on Swayam portal. The duration of courses will vary depending on the level and credit points. Courses offered in the duration of 4-10 weeks for 2 to 3 credits at diploma level are to be opted. Students, after they have registered, can get a certificate after attending the classes and submitting the assignments/quizzes and qualifying nationwide exam conducted written exam at the institute close to the one where the student is enrolled.

On successful completion of each course, the institution offering the MOOCs course would issue the certificate, along with the number of credits and grades, through which the student can get credits transferred into his marks certificate issued by his parent institution. Guidelines for credit sharing will be issued by concerned Regulators such as UGC, AICTE, etc. for consideration by various Institutes. There may be standard norms for the host Institution to conduct the course that may include continuous evaluation through assignments, online quizzes, case studies, online writing exercises, term examinations, student feedback, online forum management, etc.

The coordinating Department/Centre/Office of the respective department shall monitor every student and submit to the Office of Examinations, a score sheet (marks card) during the last 10 days prior to the close of the even semester.

7. Viva Voce

This tool will be used to assess the conceptual understanding and the behavioral aspects as regards the job role and the specific task at hand. It will also include questions on safety, quality, environment and equipment's etc. Ask questions on non-prescribed tasks to ensure that the learners have complete knowledge on the assessment

Computation of SGPA and CGPA

The UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

i. The SGPA is the ratio of sum of the product of the number of credits with the marks scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

$$SGPA\ (Si) = \sum(Ci \times Gi) / \sum Ci$$

where Ci is the number of credits of the ith course and Gi is the marks scored by the student in the ith course.

ii. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$CGPA = \sum(Ci \times Si) / \sum Ci$$

where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

iii. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

25. TEACHING LEARNING TOOLS FOR EFFECTIVE IMPLEMENTATION

For effective implementation of curriculum, the faculty and staff of institutions have to play a vital role in planning instructional experiences for the courses in four different environments viz. class-room, laboratory, library and field and execute them in right perspective. It is emphasized that only a proper mix of different teaching methods in all these places of instruction can bring the changes in students behavior as stipulated in the curriculum document. It is important to understand curriculum document holistically and further be aware of intricacies of Teaching-Learning Tools for achieving curriculum objectives. Given below are certain recommendations which may help in carrying out teaching-learning effectively:

PROGRAMME LEVEL RECOMMENDATIONS

1. Curriculum implementation takes place at programme, course and class-room level respectively and synchronization among them is required for its success. The first step towards achieving synchronization is to read curriculum document holistically and understand its rationale and philosophy.

2. An academic plan needs to be prepared at institute level. The Head of the institute have a great role to play in its dissemination and percolation up to grass-root level.

3. Head of Department are required to prepare academic plan at department level referring to institutional academic plan.

COURSE LEVEL RECOMMENDATIONS

Teachers are educational managers at class room level and their success in achieving course level objectives lies in using course plan and their judicious execution which is very important for the success of programme by achieving its objectives. Teachers are required to plan various instructional experiences viz. theory lecture, expert lectures, lab/workshop practicals, guided library exercises, field visits, study tours, camps etc. In addition, they have to carry out progressive assessment of theory, assignments, library, practicals and field experiences. Teachers are also required to do all these activities within a stipulated period which is made available to them in the academic plan at Board level. With the amount of time to their credit, it is essential for them to use it judiciously by planning all above activities properly and ensure execution of

the plan effectively. Following is the gist of suggestions for subject teachers for effective utilization of Teaching Learning Tools to achieve the course objectives:

1. Teachers need to ensure attainment of course outcomes so as to help the students achieve program outcomes and also meet the desired learning outcomes in five domains of NSQF i.e. Process, Professional knowledge, Professional skills, Core skills and Responsibility.

2. Teachers are required to prepare a course plan, taking into account number of weeks available and courses to be taught.

3. Teachers are required to prepare lesson plan for every theory class. This plan may comprise of contents to be covered, learning material for execution of a lesson plan.

4. Teachers are required to plan for expert lectures from field/industry. For this, necessary steps need to be taken such as planning in advance, identifying field experts, making correspondence to invite them, taking necessary budgetary approval etc.

5. Teachers are required to plan for guided library exercises by identification of course specific experience requirement, setting time, assessment, etc. The assignments and seminars can be thought of as terminal outcome of library experiences.

6. Concept based industrial/field visits may be planned and executed for such contents of course which are abstract in nature and no other requisite resources are readily available in institute to impart them effectively.

7. Lot of focus needs to be laid on skill development. There is need for planning practical experiences in right perspective. These slots in a course are the avenues to use problem based learning and experiential learning effectively. The development and use of lab manuals will enable the institutes to provide lab experiences effectively.

8. Emphasis should to lay on developing soft skills like communication skills, personality Development, self-learning, inter personal skills, problem solving, and creativity etc.

9. Where ever possible, it is essential to use activity based learning rather than relying on delivery based conventional teaching all the time. While teaching, the teacher should make

extensive use of audio visual aids such as video films, power point presentations and IT tools.

10. Teachers may take initiative in establishing liaison with industries and field organizations for imparting field experiences to their students.

11. Students be made aware about issues related to ecology and environment, safety, concern f for wastage of energy and other resources etc.

12. To enhance digital learning, open electives and multi-disciplinary electives have been provided in the curriculum to be taken up in the form of MOOCs. For Open electives, some courses may be identified out of the prescribed list given in the curriculum keeping in mind the interest of students. Similarly, for multi-disciplinary electives, courses to be o offered may be identified by considering their relevance and utility. Every year SWAYAM is notifying the list of courses which are going to be offered in forthcoming even and odd semester. The institute needs to select the courses that are offered on SWAYAM platform or any other online platform.

13. For effective implementation of Massive Open Online Courses (MOOCs), a faculty member in the department may be identified and given the responsibility to coordinate various activities related to MOOCs. The concerned faculty member will facilitate in registration of students for MOOCs. The faculty member will also be responsible for compiling the result of students on the completion of MOOCs and pass on the information to the concerned authority.

14. Flexibility has been provided in the curriculum for the students to choose a course related to the discipline as per their interest. For effective implementation of discipline-specific electives, the institute should identify some courses from the list of courses prescribed in the curriculum. The courses should be selected and offered keeping in mind the interest of students, infrastructure and expertise available in and around the institute related to the courses. Option for discipline-specific elective may be taken from students through a form and a course, with more than 10 students opting for it, may be run.

15. Where ever possible, it is essential to use activity based learning rather than relying on delivery based conventional teaching all the time. While teaching, the teacher should make extensive use of audio visual aids such as video films, power point presentations and IT tools.

16. Teachers may take initiative in establishing liaison with industries and field organizations for imparting field experiences to their students.

17. Students be made aware about issues related to ecology and environment, safety, concern for wastage of energy and other resources etc.

18. To enhance digital learning, open electives and multi-disciplinary electives have been provided in the curriculum to be taken up in the form of MOOCs. For Open electives, some courses may be identified out of the prescribed list given in the curriculum keeping in mind the interest of students. Similarly, for multi-disciplinary electives, courses to be offered may be identified by considering their relevance and utility. Every year SWAYAM is notifying the list of courses which are going to be offered in forthcoming even and odd semester. The institute needs to select the courses that are offered on SWAYAM platform or any other online platform.

26. LIST OF EXPERTS & REVIEWERS

1. Controller of Examination, Haryana State Board of Technical Education, Panchkula.
2. Controller of Administration and Finance, Haryana State Board of Technical Education, Panchkula.
3. Joint Secretary, Haryana State Board of Technical Education, Panchkula.
4. Deputy Secretary, Training and Placement, Haryana State Board of Technical Education, Panchkula.
5. Deputy Secretary, Examination, Haryana State Board of Technical Education, Panchkula.
6. Deputy Secretary, Academic, Haryana State Board of Technical Education, Panchkula.
7. Assistant Secretary, Academic, Haryana State Board of Technical Education, Panchkula.
8. Sh. Harsh Joshi, Assistant General Manager, Refractory Dept., JSW Steel Ltd., Karnataka.
9. Sh. Goutam Dhar, Head of Department, Hot End (Float Division). Asahi India Glass Ltd., Roorkee, Uttarakhand.
10. Sh. Rahul Sharma, Deputy Manager-Operations, Calderys India Refractories Ltd., Katni, Madhya Pradesh.
11. Sh. Sangeetha S.A., Head of Department, Ceramics Technology, Sri Jayachamarajendra (Govt.) Polytechnic, Bangalore, Karnataka.
12. Dr. Nidhi Aggarwal, Deputy Secretary (Acd), Haryana State Board of Technical Education, Panchkula, Haryana.
13. Sh. Bobinder Singh, Head of Department, Ceramic Engineering Department, Government Polytechnic, Jhajjar, Haryana.
14. Sh. Ashiwini Kumar, Senior Lecturer, Ceramic Engineering Department, Government Polytechnic, Jhajjar, Haryana.
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18. Sh. Jagjit Singh Narang, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Ambala, Haryana.
19. Sh. Subhash Chandra Bhoria, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Hisar, Haryana.
20. Sh. Rajiv Verma, Senior Lecturer, Mechanical Engineering Department, Government Polytechnic, Adampur, Haryana.
21. Sh. Parveen Saini, Lecturer, Mechanical Engineering Department, Government Polytechnic, Nilokheri, Haryana.
22. Sh. Baljeet Siwach, Lecturer, Mechanical Engineering Department, Government Polytechnic, Sonepat, Haryana.
23. Sh. Kapil Sharma, Lecturer, Mechanical Engineering Department, Seth Jai Parkash Polytechnic, Damla, Haryana.
24. Sh, Baltar Singh, Workshop Superintendent, Mechanical Engineering Department, Government Polytechnic, Ambala, Haryana.
25. Sh. Dinesh Mor, Workshop Superintendent, Workshop Department, Government Polytechnic, Sonipat, Haryana.
26. Sh. Manmohan Singh, Workshop Superintendent, Mechanical Engineering Department, Government Polytechnic, Damla, Haryana.
27. Sh. Balwan Singh, Workshop In-charge, Mechanical Engineering Department, Aryabhatt Institute of Technology, Delhi.
28. Sh. Gulab Singh, Workshop Instructor, Mechanical Engineering Department, Seth Jai Parkash Polytechnic, Damla, Haryana.
29. Sh. Ashwani Kumar, Workshop Instructor, Electrical Engineering Department, Government Polytechnic, Damla, Haryana
30. Sh. Rajneesh Rana, Workshop Instructor, Electronics Engineering Department, Government Polytechnic, Damla, Haryana.
31. Sh. Ankush Aggarwal, Lecturer, Mechanical Engineering Department, Seth Jai Parkash Polytechnic, Damla, Haryana.
32. Ms. Amita, Deputy Director (Acd), Directorate of Technical Education.

33. Dr. Bhajan Lal, Lecturer, Applied Science Department, Government Polytechnic forWomen, Sirsa, Haryana.
34. Sh. Anil Nain, Lecturer, Applied Science Department, Government Polytechnic, Hisar, Haryana.
35. Dr. Sarita Mann, Lecturer, Applied Science Department, Government Polytechnic,Ambala, Haryana.
36. Smt. Bindu Verma, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla, Haryana.
37. Dr. Pankaj Sharma, Professor, Applied Science Department, NITTTR, Chandigarh.
38. Dr. Ashok Kumar, Associate Professor, Applied Science Department, NITTTR, Chandigarh.
39. Smt. Pushpa Rani, SeniorLecturer, Applied Science Department, Government Polytechnic, Sonipat, Haryana.
40. Smt. Krishna Bhoria, Lecturer, Applied Science Department, Government Polytechnic, Ambala, Haryana.
41. Smt. Preetpal Kaur, Guest Faculty, Applied Science Department, Government Polytechnic, Ambala, Haryana.
42. Ms. Monika, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic,Damla, Haryana.
43. Dr. Neena Sharma, English Department, MCM College, Chandigarh.
44. Sh. Satyawan Dhaka, Senior Lecturer, Applied Science Department, Government Polytechnic, Nilokheri, Haryana.
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49. Sh. KG Srinivasa, Professor CSE, IIIT Naya Raipur.
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53. Dr. Rajesh Mehra, Professor and Head, Curriculum Development Centre, NITTTR, Chandigarh.
54. Dr. AB Gupta, Professor and Head, Education & Educational Management Department, NITTTR, Chandigarh.
55. Er. P.K. Singla, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.
56. Dr. SK Gupta, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.
57. Dr. Meenakshi Sood, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.

27. APPENDIX

Sr. No.	LIST OF EQUIPMENTS
1.	Ball Mill
2.	Mixer
3.	Triple roll mill
4.	Air Compressor
5.	Jaw Crusher
6.	Cyclone Separator
7.	Plate and frame filter press
8.	Sieve shaker
9.	High vacuum pumps
10.	Packed column
11.	Agitating equipment
12.	Ball falling in liquids apparatus
13.	Particle setting in fluids
14.	Sedimentation apparatus
15.	Filter press
16.	Friction pipe
17.	Weirs, channels, v-notch
18.	Centrifugal pumps
19.	Viscometer
20.	Rotameter, manometer
21.	Globe valve
22.	Gatevalve
23.	Reynolds measuring apparatus
24.	Moisture Measuring Equipement. (Moisture Meter)
25.	Bomb Calorimeter
26.	Orsat Apparatus
27.	Electric Heater
28.	Electronic Weighing Balance
29.	Physical Balance (1kg capacity)
30.	Dry Oven
31.	Flash Point Apparatus
32.	Red wood or Torsion Viscometer

33.	Chemical Balance
34.	Glass Ware (Lumpsum)
35.	Silica Dishes
36.	Tongs (Stainless Steel)
37.	Alumina & Chrome thermocouple
38.	Laboratory Tables
39.	Steel Almirahs
40.	Thermometer
41.	Muffle furnace (up to 1000□ C)
42.	Ball Mill
43.	Jaw Crusher
44.	Magnetic Separator
45.	Fitter press
46.	Jiggering & Jolleying Apparatus
47.	Hydraulic Press
48.	Toggle press
49.	Muffle furnace (up to 1200□ C
50.	Trays of different size
51.	Troughs, bargins, Mugs, Measuring Jars
52.	Casting mould for cup, flower pot etc
53.	Pot Mill
54.	Sieve Shaker and Standard Sieves set
55.	Spray gun
56.	Auto clave
57.	Tile cutting machine
58.	Drying oven
59.	Electronic Balance
60.	Electric Furnace (1450□C)
61.	Silica Crucible
62.	Platinum Tipped Tong (20 cm long)
63.	Platinum Crucibles (50 ml cup each)
64.	Platinum dishes (150ml cup each)
65.	Blowing machine
66.	Strain viewer
67.	Cold crushing strength testing machine

68.	Modulus of rupture apparatus
69.	P.C.E. furnace
70.	R.U.L. Furnace
71.	Spalling test equipment
72.	Hard operated press
73.	Vernier calipers and scales
74.	Andreson and pippet Apparatus
75.	Flame photometer
76.	Spectroscopy
77.	X-ray diffractometer


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