NEP-2020 Aligned Curriculum for

Three Year (Six Semester) Diploma Programme in

GLASS AND CERAMIC ENGINEERING

(3rd and 4th semester)

For the State of Uttar Pradesh

Prepared by:

Curriculum Development Centre

Institute of Research Development & Training

U. P. Kanpur

CONTENTS

THIRD SEMESTER

FOURTH SEMESTER

PREFACE

An important issue generally debated amongst the planners and educator's world over is how technical education can contribute to sustainable development of the societies struggling hard to come in the same bracket as that of the developed nations. The rapid industrialization and globalization have created an environment for free flow of information and technology through fast and efficient means. This has led to the shrinking of the world, bringing people from different culture and environments together and giving rise to the concept of world turning into a global village. In India, a shift has taken place from the forgettable years of closed economy to knowledge based and open economy in the last few decades. To cope with the challenges of handling new technologies, materials and methods, we have to develop human resources having appropriate professional knowledge, skills and attitude. Technical education system is one of the significant components of the human resource development and has grown phenomenally during all these years. Now it is time to consolidate and infuse quality aspect through developing human resources in the delivery system. Polytechnics play an important role in meeting the requirements of trained technical manpower for industries and field organizations. The initiatives being taken by Technical Education, UP to revise the existing curricula of diploma programmes as per the needs of the industry and making them NEP-2020 compliant, are laudable.

In order to meet the requirements of future technical manpower, we will have to revamp our existing technical education system and one of the most important requirements is to develop outcome-based curricula of diploma programmes. The curricula for diploma programmes have been revised by adopting time-tested and nationally acclaimed scientific method, laying emphasis on the identification of learning outcomes of diploma programme.

The real success of the diploma programme depends upon its effective implementation. However best the curriculum document is designed, if that is not implemented properly, the output will not be as expected. In addition to acquisition of appropriate physical resources, the availability of motivated, competent and qualified faculty is essential for effective implementation of the curricula.

It is expected of the polytechnics to carry out job market research on a continuous basis to identify the new skill requirements, reduce or remove outdated and redundant courses, develop innovative methods of course offering and thereby infuse the much-needed dynamism in the system

Director

Institute of Research Development &Training.

Kanpur

ACKNOWLEDGEMENTS

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1. Sh. Narendra Bhooshan, IAS, Additional Chief Secretary, Department of Technical Education, Govt. of UP, for his exemplary vision & approach.

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4. All the participants from industries, Polytechnics and other technical institutions for their professional inputs during curriculum workshops.

5. CDC Officer and other concerning staff of IRDT for their support and assistance in conducting curriculum workshops.

6. In the last but not least would like to thanks management of the industries who spare not only their precious time but also allowed the visit of their industries to the team making the curriculum.

Coordinator

Institute of Research Development & Training,

Kanpur, U.P.

1 . SALIENT FEATURES

1)	Name of the Programme	:	Diploma in Glass and Ceramic Engineering
2)	Duration of the Programme	:	Three years (Six Semesters)
3)	Entry Qualification	:	Matriculation or equivalent NEP-2020/NSQF Level-4 as Prescribed by State Board of Technical Education, U.P.
4)	Pattern of the Programme	:	Semester Pattern
5)	NSQF Level	:	Level - 5
6)	Ratio between Theory and Practical	:	40: 60 (Approx.)

1) Industrial Training

Four and six weeks of industrial training is made mandatory after the II and IV semesters during summer vacation.Total marks allotted to industrial training will be respectively 50 & 100.

In the last (6^{th} Semester) we have made the one semester Industrial training/Internship as optional along with usual classroom training.

2) Ecology and Environment

As per Govt. of India directives a subject on Environmental Science has been incorporated in the curriculum.

3) Entrepreneurship and Start-ups

A full subject Entrepreneurship & Start-ups has been incorporated in the curriculum.

4) Student Centred Activities

A provision of Minimum 4 hrs per week has been made for organizing Student Centered Activities for overall personality development of students. Such activities will comprise of co–curricular activities such as expert lectures, self-study, games, hobby classes like photography, painting, singing etc. seminars, declamation contests, educational field visits, NCC, NSS, library and other cultural activities.

5) Project work

A project work has been included in the curriculum to enable the student get familiarize with the practices and procedures being followed in the industries and provide an opportunity to work on some live projects in the industry

2- PROGRAM OUTCOMES (POs)

PO1: Basics and Discipline specific Knowledge
Assimilate knowledge of basic mathematics, science, engineering fundamentals.

PO2: Problem's Analysis and solution
Identify, analyse and solve problems using standard methods and established techniques.

PO3: Design and Development
Design solutions for technical problems.

Assist in designing components, systems, or processes to meet specific requirements.

PO4: Engineering Tools, Experimentation, and Testing
Use modern engineering tools and appropriate techniques to conduct experiments as per BIS standard.

PO5: Socio/ Economic /Environmental impact assessment/remedy.

Apply relevant technologies while considering societal needs, environmental impact keeping in view sustainable and ethical responsibilities.

PO6: Project Management and Communication
Apply engineering management principles, work effectively as an individual or in a team, and communicate clearly on activities.

PO7: Lifelong Learning
Recognize the importance of continuous learning and actively pursue self-improvement to keep pace with technological developments.

3 EMPLOYMENT OPPORTUNITIES OF DIPLOMA HOLDERS IN GLASS & CERAMIC ENGINEERING

Employment opportunities for diploma holder in Ceramic Engineering are visualized in following industries at various levels/positions.

i) White Ware Industry
(a) Sanitary ware
(b) Tiles
(c) Crockery
(d) Pottery ware
(e) Handicraft
ii) Refractories
iii) Glass Industry
iv) Cement Industry
v) Modern Ceramic industries-metallurgical cosmoferrites, modern insulators, Special Ceramic as High alumina , Zirconium, etc
vi) Iron and Steel Industry
vii) DRDO, ISRO, NNFL (National Nuclear Fuel Limited), NALCO (National Aluminum Cooperation Limited), BALCO (Bharat Aluminum Cooperation Limited)
viii) Lab Instructor in teaching institution
ix) Self employed in setting up small units

- Ceramic Engineer/Ceramist/Glass Technologist in small and medium industries.
- Quality Control and Inspection Supervisors.
- In plant Laboratory Supervisor/R & D Supervisor.
- Sales or Marketing Officer.
- Conducts tests on raw materials and ascertain their suitability.
- Supervises milling operations, glaze preparation, body preparation, shaping, drying and firing of ceramic goods.
- Selects appropriate processes and machines for manufacture of ceramic goods and glassware.
- Makes batch calculations.
- Plans men, materials and machines for achieving target production.
- Conducts quality control tests from raw materials and finished products.
- Detects common faults in processes, equipment and furnaces and suggests remedial measures.
- Make cost calculations of ceramic goods.

- Keep record of production.
- Conducts market survey and promotes sales.
- Assist in testing laboratories.
- Assist in R & D laboratories.

4. LEARNING OUTCOMES OF THE PROGRAMME GLASS AND CERAMIC ENGINEERING

Sr. No.	Learning Outcomes
After due completion of the course, a GLASS AND CERAMIC ENGINEERING will be able to:	
1.	Read and interpret any engineering drawing.
2.	Plan, schedule, organize direct, control and coordinate men, materials and machines for the production of ceramic/glass products.
3.	Knowledge of physical, chemical and thermal properties of raw materials, additives and finished product.
4.	Select appropriate raw materials, processes, machines and make cost calculations for production of ceramic/glass products.
5.	Knowledge of work measurement and materials handling techniques.
6.	Detect faults in equipment's / processes / product and suggest remedial measures.
7.	Undertake quality control tests on raw materials, materials in the process and finished products.
8.	Assist in developmental activities at any label
9.	Knowledge of marketing and sales promotion of ceramic/glass products.
10.	Ability to manage stores and Ware house
11.	Knowledge of labour laws, factory safety rules, and handling of labour problems.
12.	Establish and run a small enterprise & Select material as per desired application
13.	Use electrical and electronic instruments to measure various engineering parameters
14.	Use various measuring and gauging instruments
15.	Understand the general Layout of Plant, process, equipments and testing
16.	Understand different renewable sources of energy and their applications.
17.	Understand different process in different plants and maintenance of their using equipments
18.	Understand the factory acts, laws and taxes
19.	Use various software tools for automation and process development.
20.	Communicate effectively in English and local language in oral and written form with others

21.	Prepare detailed project proposal and report.
22.	Plan and execute given task/project as a team member or leader
23.	Use computer and IT tools for creating documents, making spread sheet, DPR and making presentation
24.	Use various software tools for automation and process development.
25.	Handle the customers Effectively as Sales Person and Increase the Sales
26.	Prepare the Planning for Production and Maintenance schedule also
27.	Apply the Basic Knowledge of Electrical, Mechanical, and Civil Engg. Etc.
28.	Select the Refractory for the different types of Furnace / Kiln as Processed material
29.	Modify the Process / Furnace / Batch composition and take the corrective action
30.	Testing carryout of Ceramic raw materials as IS specification
31.	Understand and carryout the different Testing of Ceramic Finished Products as IS specification
32.	Determined the Physical & Mechanical Properties of Raw materials and Finished Product
33.	Carryout the Chemical Analysis of Ceramic Raw materials Finished Product
34.	Understand and execute the different techniques in Glass decoration
35.	Understand the manufacturing of Models / Statue, Working Mould & Master Mould of POP
36.	Understand the manufacturing process and Testing of Lime, Cement, High Alumina Product

5- ABSTRACT OF CURRICULUM AREAS

HUMANITIES & SOCIAL SCIENCES COURSES [HS]

- Communication Skills in English
- Sports and Yoga
- Entrepreneurship and Start-ups

BASIC SCIENCES COURSE [BS]

- Mathematics
- Applied Physics
- Applied Chemistry

ENGINEERING SCIENCE COURSES [ES]

- Engineering Graphics
- Engineering Workshop Practice
- Introduction to IT Systems
- Fundamentals of Electrical & Electronics Engineering
- Engineering Mechanics

PROGRAM CORE COURSES [PC]

- Introduction to Glass & Ceramics
- Industrial Operation
- Industrial Calculation
- Pottery & Refractory
- Fuel Furnace & Pyrometers
- Elementary Geology & Mineralogy
- Pottery & Refractory Lab
- Elementary Geology & Mineralogy Lab
- Metallurgy & Material Chemistry
- Glass & Ceramic Engg. Drawing –I
- Glass, Enamel & Ceramic Coating
- Cement & Lime Technology
- Pottery & Porcelain-I
- Glass Technology-I
- Glass ,Enamel & Ceramic Coating
- Lab
- Essence Of Indian Knowledge And Tradition (Q)

PROJECT WORK, SEMINAR AND INTERNSHIP IN INDUSTRY OR ELSEWHERE

- Summer Internship – I (4 weeks) after IInd Sem
- Summer Internship – II (6 weeks) after IVth Sem
- Major Project(In-House) / Internship / Industrial Training

AUDIT COURSES [AU]

- Environmental Science
- Essence of Indian Knowledge and Tradition
- Indian Constitution

6 -STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN GLASS AND CERAMIC ENGINEERING
THIRD SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/ Week			Credit	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External	Course/ Exam Type
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT						
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot		
3.1	Introduction to Glass & Ceramics	3	-	-	3+0=3	40	-	40	60	3	-	-	60	100	Theory
3.2	Industrial Operation	2	-	2	2+1=3	20	20	40	60	3	-	-	60	100	Practicum/ Theory
3.3	Industrial Calculation	3	-	-	3+0=3	40	-	40	60	3	-	-	60	100	Theory
3.4	Pottery & Refractory	2	-	-	2+0=2	40	-	40	60	3	-	-	60	100	Theory
3.5	Fuel Furnace & Pyrometers	2	-	2	2+1=3	20	20	40	60	3	-	-	60	100	Practicum/ Theory
3.6	Elementary Geology & Mineralogy	2	-	-	2+0=2	40	-	40	60	3	-	-	60	100	Theory
3.7	Pottery & Refractory Lab	-	-	4	0+2=2	-	60	60	-	-	40	3	40	100	Practical
3.8	Elementary Geology & Mineralogy Lab	-	-	4	0+2=2	-	60	60	-	-	40	3	40	100	Practical
3.9	@Industrial Training-I (4 Weeks)	-	-	-	1	-	50	50	-	-	-	-	-	50	Practical
#Student Centred Activities (SCA)		-	-	10	-	-	50	50	-	-	-	-	-	50	-
Total		**14**	**-**	**22**	**21**	**200**	**260**	**460**	**360**	**-**	**80**	**-**	**440**	**900**	**-**

@ Industrial training-I (summer internship-I) (After 2nd Semester 4 Weeks)

Student Centred Activities will comprise of co-curricular activities like extension lectures, self study, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities, disaster management and safety etc.

STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN GLASS AND CERAMIC ENGINEERING

FOURTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/ Week			Credit	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External	Course/ Exam Type
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT						
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot		
4.1	Metallurgy & Material Chemistry	2	1	-	3+0=3	40	-	40	60	3	-	-	60	100	Theory
4.2	Glass & Ceramic Engg. Drawing –I	1	-	4	1+2=3	20	20	40	60	3	-	-	60	100	Practicum/ Theory
4.3	Glass, Enamel & Ceramic Coating	2	-	-	2+0=2	40	-	40	60	3	-	-	60	100	Theory
4.4	Cement & Lime Technology	2	-	2	2+1=3	20	20	40	60	3	-	-	60	100	Practicum/ Theory
4.5	Pottery & Porcelain-I	2	1	-	3+0=3	40	-	40	60	3	-	-	60	100	Theory
4.6	Glass Technology-I	2	1	-	3+0=3	40	-	40	60	3	-	-	60	100	Theory
4.7	Glass ,Enamel & Ceramic Coating Lab	-	-	4	0+2=2	-	60	60	-	-	40	3	40	100	Practical
4.8	(Q) Essence Of Indian Knowledge And Tradition (Q)	2	-	-	-	50*	-	-	-	-	-	-	-	-	Qualifying
#Student Centred Activities (SCA)		-	-	10	-	-	50	50	-	-	-	-	-	50	-
Total		**13**	**3**	**20**	**19**	**200**	**150**	**350**	**360**	**-**	**40**	**-**	**400**	**750**	**-**

- Industrial training(summer internship-II) (After 4th Semester) (6 Weeks)

Student Centred Activities will comprise of co-curricular activities like extension lectures, self study, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities, disaster management and safety etc.

3.1	INTRODUCTION TO GLASS & CERAMICS	L	T	P
THEORY		3	0	0

COURSE OBJECTIVE:

The study of the subject is required to introduce the students with the materials used in ceramic engineering i.e. glass, enamel, pottery, refractory & cement. The only elementry knowledge of the raw materials used in different fields of ceramic industry and their applications is kept in the subject.

COURSE OUTCOMES

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

- Basic idea about Glass & Its raw material
- How makes the Glass
- How many types of Glasses
- Basic idea about Enamel & Its raw material
- Basic idea about Pottery & Its raw material
- Basic idea about Refractory & Its raw material
- Basic idea about Special/Modern Ceramic

DETAILED CONTENTS

Unit No.	Content	Periods
1	**Glass** 1.1 History of Glass 1.2 Elementary knowledge of raw materials 1.3 Manufacturing process of glass by flow chart 1.4 Types of glass - container glass, sheet glass, plate glass, bulb glass, laboratory ware glass, 1.5 Decoration of Glass, types/method of decoration	7
2	**Enamel** 1.1 History of Enamel, Definition of Enamel 1.2 Elementary knowledge of Enamel's raw materials 1.3 Manufacturing process of Enamel Slip 1.4 Making of enamel frits by quenching process 1.5 Classification of Enamels and their applications 1.6 Application methods of enamels	6
3	**Pottery-** 1.1 History of pottery 1.2 Definition of pottery 1.3 Elementary knowledge of raw materials . 1.4 Manufacturing methods of pottery wares with flow chart 1.5 Types of pottery wares- White wares as Earthen ware, stone ware, sanitary wares, Porcelain, and terracotta 1.6 Uses of pottery wares	6
4	**Refractory** 1. History of refractory 2. Definition of refractory materials 3. Elementary knowledge of raw materials considered as refractories , 4. Types of refractory acid refractory ,basic refractory , neutral refractory. 5. Manufacturing method of refractory 6. Properties of refractory bricks 7. Applications of refractory bricks	6
5	**Cements-** 1. History of cements	6

	2. Definition of cements 3. Elementary idea of cements , raw materials 4. Types of cements 5. Manufacturing methods of cements by different methods 6. Application of Cement	
6	**Composites-** Introduction to Ceramic Composites, Classification of composites, Properties & application, Define Cermet, application	4
7	**Electronic Ceramics**- Ceramic Capacitor, transistor, Piezo Electric Ceramic	4
8	**Non Oxide Ceramic** - Define & classify with example	3

INSTRUCTIONAL STRATEGY

Teacher should show Raw material of Glass, Pottery wares, Enameled ware/Enameled Iron sheet, Refractory brick etc. The raw material should be show in both form Lumps & Grain/powder.

MEANS OF ASSESSMENT

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Actual Lab & Practical Work,
- Viva Voice

RECOMMENDED BOOKS

1. Elementry of Ceramic Engineering by B.L. Yadav
2. Elements of Ceramics by F.H.Norton
3. Introduction to Glass Science Technology by James E. Shelby
4. Enamels by Andrewl & Andrewl
5. Technology of Enamels by V.I Vargin

WEBSITE REFERENCE

- https://www.ceramics.org
- https://www.matweb.com

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	7	15
2	6	15
3	6	15
4	6	15
5	6	15
6	4	10
7	4	10
8	3	5
Total	**42**	**100**

3.2	INDUSTRIAL OPERATION	L	T	P
PRACTICUM/THEORY		2	-	2

COURSE OBJECTIVE:

Glass & Ceramic Engineering Diploma holder has to interact with engineering and technicians in the Field of Ceramic engineering. This subject has been kept in the curriculum to provide a knowledge as working principle about the equipment and machines which are using in Ceramic Industry. Teachers should lay more emphasis on basic concept while teaching the subject.

COURSE OUTCOMES

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

- Understand the theory of crushing and grinding machines/mills
- Understand the principle/function of screening, Conveying, pugging, pressing, equipments
- Understand the types filtrations and for its equipment.
- Understand the function as mechanical, hydraulic, Pneumatic & Electrical power press
- Understand the type of mixing equipments
- Understand the type of conveyers

DETAILED CONTENTS

Unit No.	Content	Periods
1	**Introduction:** • Concept and rule of unit operation in process industries and House Keeping. • Properties of Fluids • Types of Flow : Laminar & Turbulent, Newtonian and Non-Newtonian fluids • Concept of Bernoulli equation and its application	4
2	**Size reduction:** • Theory of crushing Rittinger's law and Kicks law, Classification and their general description of crushing and grinding machines as – a) Crusher - Jaw crushers, , gyratory crushers, roll crushers, hammer mills, b) Grinder - ball mills, tube mills, vibrating mills, Raymond mill • Maintenance of open circuit and closed circuit operations in ceramic machinery • To decide optimum speed of ball mill for best grinding and mill discharges. • Introduction & Construction of ball mill as Ball mill size, types of Lining • Determination of Ball size & ratio of Ball • Determination surface area of materials	6
3	**Handling of Solids & Slurries:-** • Screening and grinding of solid particles. Standard screening equipments and standard sieves. Conveying equipments, classification, their general construction, industrial application and operation, belt conveyors, chain conveyors, screw conveyors, bucket conveyors, pneumatic conveying system, pumping and transportation of slurry and their flow control.	6
4	**Mechanical Operation:-** • Screen analysis, Tyler standard screen series, screen effectiveness, Types of screening equipment i.e. gyrating screens, stationary screens and vibrating screens, Screen efficiency, Screen capacity, Type of filtration apparatus their general construction, application and operation of filter press and rotary, filters, filter aids centrifugal filtration. Types of mixing equipment used in ceramic industry.	6

	Introduction for modernization of ceramic machineries	
5	**Heat Transfer & Thermodynamics** • Modes of heat transfer – conduction, convection and radiation • First law of thermodynamics: calculation of internal energy, enthalpy, heat and work • Second law of thermodynamics and its applications • Third law of thermodynamics and its applications	6

INSTRUCTIONAL STRATEGY

- Sketches
- Drawing
- Practical in Lab
- Showing the models/Out door visit

MEANS OF ASSESSMENT

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Actual Lab & Practical Work,
- Viva Voice

RECOMMENDED BOOKS

1. Mechanical Operations by Swain Palra, G.K. Roy, Tata McGraw Hill Publication
2. Mechanical Operations by Kiran D. Patil, Nirali Publication
3. Chemical Engineering, Vol. I and II by Coulson and Richardson, Pergamon Press Publication
4. Unit Operation of Chemical Engineering by McCabe and Smith; McGraw Hill Publication
5. Introduction to Chemical Technology by Badger and Banchero, McGraw Hill Publication
6. Unit Operations Vol. I & II by Chatterjii, Khanna Publishers,
7. Engineering Thermodynamics by P.K.Nag

WEBSITE REFERENCE

- https://nptel.ac.in
- https://ocw.mit.edu
- https://www.engineeringtoolbox.com

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	5	13
2	6	25
3	6	25
4	6	25
5	5	12
Total	**28**	**100**

3.3	INDUSTRIAL CALCULATION	L	T	P
THEORY		3	0	0

COURSE OBJECTIVE:

Glass & Ceramic Engineering Diploma holder has to interact with engineering and technicians in the Field of Ceramic engineering. This subject has been kept in the curriculum to provide a knowledge as working principle about the equipment and machines which are using in Ceramic Industry. Teachers should lay more emphasis on basic concept while teaching the subject.

COURSE OUTCOMES

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

- Have understanding of scope of material and balance in chemical industries.
- Carry out conversions of units and equations.
- Have knowledge of the solution concentrations, specific gravity, density, molarity, normality, molality in the chemical industries.
- Find the contents and properties of given analyzed gas.
- Find out quantity of material input and outputs of various unit operations.
- Calculate material input and outputs of chemical reactions to identify excess and limiting reactants.
- Calculate the enthalpy associated with a reaction.
- Calculate the quantities of utility required.
- Carry out combustion calculations, proximate analysis and ultimate analysis

DETAILED CONTENTS

Unit No.	Content	Periods
1	**Introduction & Scope** Introduction & Scope of material and Energy Balances in Ceramic Industry	5
2	**Unit Conversion** Unit conversion of units, and their conversion factors, S.I Units, MKS System, CGS System, FPS	5
3	**Stoichiometric and composition relationships -** Conservation of mass, mass and volume relationships in chemical reactions, concept of gram-mole and gram-atom, mass and volume relationship for gaseous substance, use of molal units, choice of basis of calculation.	6
4	**Gases and Gas Mixture** Ideal gas law, Boyle's law, Charles's law, value of universal gas Constant, Behavior of ideal gases - P & T relationship, standard condition, gauge pressure, Dalton and Amagat's laws, average molecular weight of a gaseous mixture.	5
5 6	**Humidity and Saturation** Simple problem using Chart **Material Balance** Drying and firing problems. Solving problems on various unit operations like drying, evaporation, crystallization, distillation, mixing, blending, absorption, extraction.	5 5
7	**Combustion processes** Analysis of the products of combustion: proximate and ultimate analysis. Problems of fuel analysis, air fuel ratio, theoretical oxygen/air required. Problems of fuel analysis Oxidation of sulphur and its compounds	5
8	**ENVIRONMENT & POLLUTION**	6

	Ceramic industry and its influence on the environment. How to make it environment friendly. Major pollutants and their remedies. Industrial waste disposal. Waste minimization and recycling. Reduction of GHS (Green House Gases), Control of combustion by improved process (Reduction in fuel consumption)	

INSTRUCTIONAL STRATEGY

Teacher should give small assignments to the student. Give industrial based practical problems for material and energy calculations

MEANS OF ASSESSMENT

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Actual Lab & Practical Work,
- Viva Voice

RECOMMENDED BOOKS

1. Stoichiometry by B. I. Bhatt &S. M. Vora; McGraw Hill Publication
2. Material Science by Narula and Gupta
3. Engineering Materials by B.K. Agarwal
4. Material Science by R.K. Rajput; SK Kataria and Sons, Ludhiana
5. Introduction to Matrial Science for Engineers by J.F. Shackelford,
6. Chemical Process Principles Part-1 by O.A. Hougen and K.M. Watson.
7. Chemical Process Principles Part-1 by R.A. Rastogi
8. Solved Examples in Chemical Engineering by G.K. Ray

WEBSITE REFERENCE

- https://nptel.ac.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	5	10
2	5	15
3	6	15
4	5	10
5	5	10
6	5	15
7	5	10
8	6	15
Total	**42**	**100**

3.4	POTTERY AND REFRACTORY	L	T	P
THEORY		2	0	0

COURSE OBJECTIVE:

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

COURSE OUTCOMES

- After undergoing this course, the students will be able to:
- Know various raw materials used in white ware and heavy clay wares
- Know the process of manufacturing of various white ware & heavy clay wares
- Understand various composition and body formulation of various types of white ware& heavy clay wares their manufacturing process and the characteristic
- Understand various qualities and process of testing of various ceramic products
- Know the general idea about the specification as per the BIS for white ware and heavy clay wares

Unit No.	Content	Periods
	SEC. A - POTTERY	
1	**Introduction:** Ancient pottery, Definition of pottery, Classification of Pottery ware	3
2	**Raw Materials:** Origin of clay, Principle of formation and classification. Primary and secondary clays, washing methods of clays. Winning and mining of clays. Behavior, functions and physical properties of the important pottery raw materials -china clay, ball clay, fire clay, Red burning clay, quartz, feldspar, nepheline syenite, whitening ,talc, pyrophyllite, sillimanite group minerals and bone ash, places of occurrence of important raw materials in India.	4
3	**Body Preparation & Shaping:** Raw material unloading and storage, batch calculations, ball milling, batching, blunging, , screening, dewatering clay slips, casting slip, plastic forming, dry press bodies. Jiggering, i.e. Jolly and rotary Table type Jigger, extrusion, dry pressing different types of dry pressing, finishing, drying. The casting process, different types of casting- • Ordinary or Notch casting • Bench/Batch casting • Battery casting • Capillary casting	4
4	**Drying:-** Removal of water, factors affecting drying, types of driers-batch & continuous, hot flow, steams pipes, chamber driers & tunnel driers etc., defects in drying.	3
5	**Firing:** Describe the different Firing stages for pottery wares, kiln furniture's and placing of wares in kiln, Effect of heat on clay & other materials	3
6	**Mould Materials:** Mould materials and their properties. (Different Types of dies and mould), Process of mould making using POP. Rubber Mould,	3

	SEC. B - REFRACTORIES	
1	**Raw Materials:** Classification of refractory materials, clay minerals, alumina silica, magnesite, dolomite, chromite, and other refractory oxides. Synthetic raw materials - Fused alumina, sintered alumina.	3
2	**Making of Refractory Bricks:** Moulding methods, drying, effect of heat on clay, Manufacture and properties of silica and semi-silica refractories, fire clay and other alumino silicate refractories, application of phase diagrams related to the manufacture of above refractories.	3
3	**Manufacturing of Crucibles & Saggers:** A detailed study of the manufacture of crucibles, furnace blocks, refractory block for furnace, saggars and muffles used in different industries.	2

INSTRUCTIONAL STRATEGY

Students must visit various industries like White ware industries, Glass industries; refractory industries etc. to get exposure to various raw materials used indifferent ceramic industries.

MEANS OF ASSESSMENT

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Actual Lab & Practical Work,
- Viva Voice

RECOMMENDED BOOKS

1. Industrial Ceramic by Singer & Singer
2. White ware by W. Ryan & Redford
3. Pottery Industry by H.N.Bose
4. Modern pottery Manufacture by H.N.Bose
5. White wares by S.Sen
6. White ware by F.H.Norton

WEBSITE REFERENCE

- https://nptel.ac.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
	SEC. A - POTTERY	
1	3	10
2	4	15
3	4	15
4	3	10
5	3	10
6	3	10
	SEC. B - REFRACTORIES	
1	3	10
2	3	10
3	3	10
Total	**28**	**100**

3.5	FUEL FURNACE AND PYROMETERS	L	T	P
PRACTICUM/THEORY		2	0	2

COURSE OBJECTIVE:

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. For measuring the high temperature we know pyrometer equipment & their uses.

COURSE OUTCOMES

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

- Understand types of fuels required for ceramic industry
- Know in detail of various solid, Liquid & Gaseous fuels base kilns
- Know the construction & operation of various type Ceramic Kilns
- Know regarding various types of metallurgical furnaces and their Construction & Operation
- Know the conservation of energy in the of ceramic Kilns
- Understand general idea on Pyrometer, Pyroscope, Thermocouple

DETAILED CONTENTS

Unit No.	Content	Periods
1	**INTRODUCTION TO FUEL & COMBUSTION** 1. State & Explain introduction to solid, Liquid and Gaseous fuels 2. Explain Non-conventional source of energy for burning ceramic Kiln 3. State and explain combustion of fuels 4. Combustion calculation 5. Spontaneous combustion, its causes and remedy. 6. Terms & Definition relating to Fuel testing **A. Solid Fuels:** a. State various types of solid fuels b. Classify solid fuels c. Describe the methods/ theories of formation of Coal d. State & explain the properties/nature of Coal and occurrence, e. Describe impurities in coal, grading of coal, reason for washing of coal, f. Describe hardness and grindability of coal, agglomeration and swathing of coal, calorific value of coal, coal ash and clinkering. g. Describe in detail how coke is prepared in coke oven and state properties of coke **B. Liquid Fuels:** a. State various types of liquid fuels b. Classify liquid fuels, Nature of oil, its origin and composition c. Describe the process of refining for the crude petroleum product-petrol, kerosene, d. Diesel e. Describe the procedure for storage and handling practices of liquid fuels in industry. f. State the advantages of liquid fuels over solid fuels. g. Testing of liquid fuels such as flash point, fire point, pour point, smoke point, dew point **C. Gaseous Fuels:**	6

	a. Classify gaseous fuel b. Design and description of producer gas plant, chemical reactions, composition and calorific value in relation to operating conditions and quality of coal. c. Describe the manufacturing method of Bio Gas d. Describe Water Gas, Carburetted water gas. Coke oven Gas, Blast furnace Gas, Coal Gas, Oil Gas, BOF Gas, Refinery Gases, low and high temperature carbonisation, e. Describe the Natural Gas-Composition and calorific value. f. Explain the advantages of gaseous fuel over liquid and solid fuel g. Describe the Rocket Fuels h. Describe the Nuclear Fuels	
2	**CERAMIC KILNS** 1. Define the Kiln, Furnace and Oven 2. Classify ceramic kiln/Furnace in details – as per used fuel, Shape, working method(Periodic, Continuous kiln) 3. List the advantage of continuous kiln over periodic kiln 4. Describe various type of kiln furniture used in ceramic kilns 5. Describe the construction & operation of the following kilns with sketch in detail :- i. Scobs /woodfibre kiln ii. Down Draft Kiln iii. Up Draft Kiln iv. Chamber kiln v. Muffle kiln - Modern muffle kilns for enamel industries. vi. Shaft kiln vii. Tunnel kiln - advantages of muffle type tunnel kiln. viii. Rotary kiln ix. Roller hearth kiln	5
3	**FURNACES** 1. Classification of Furnaces 2. Furnace used in Glass plant & their classification 3. Furnace & Fuel used in Steel plant & their classification 4. Sketch the following furnaces showing various section i. Glass Melting Tank Furnace ii. Glass Melting Pot Furnace (Day tank furnace) iii. Blast Furnace iv. Muffle Furnace- v. Cupola vi. Open Hearth Furnace vii. Basic Oxygen Furnace (BOF) viii. Electric Arc Furnace	5
4	**Continuous Kilns** Fundamentals of continuous kilns - construction, working and firing circuits Methods of setting in continuous kilns.	3
5	Importance of Chimney for Kiln & Furnaces: chimney construction, draught pressure and chimney draught.	3
6	Burner & Blower Equipments	3

	Design and operation of Burners, Burner efficiency, blowers And measurement of air flow meater, regenerator, recuperator etc.	
7	**Pyrometry :** a. Definition pyroscope & pyrometer, classification of pyrometers, b. seger cones - classification of cones, Behaviour of cones etc. c. Thermo electric pyrometers - general principle, Material used for thermal junction - chromel-Alomel, Platinum -Rhodiun etc., d. Indicators, recorders, Advantage of thermo electric method of measuring e. Optical pyrometers: General Prinicple, Lien's law of Ferry's optical pyrometer, Le – Chateleir's optical pyrometer, colour extinction pyrometer. f. Resistance Pyrometers, Radiation Pyrometers: Ferry's mirror pyrometer, Ferry's spiral radiation pyrometer, indicators for radiation pyrometers.	3

INSTRUCTIONAL STRATEGY

The teachers should give emphasis on the basic concepts and principles in the subject.

MEANS OF ASSESSMENT

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Actual Lab & Practical Work,
- Viva Voice

RECOMMENDED BOOKS

1. Fuels and Combustion by S.Sarkar
2. Fuels Solid, liquid & Gaseous by J.S.S.Brame & King
3. Furnace by Trink
4. Industrial Ceramic by singer and singer
5. Fuels Furnace Refractory by O.P.Gupta

WEBSITE REFERENCE

- https://nptel.ac.in
- https://ocw.mit.edu
- https://www.engineeringtoolbox.com

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	6	15
2	5	15
3	5	15
4	3	11
5	3	12
6	3	10
7	3	12
Total	**28**	**100**

3.6	ELEMENTRY GEOLOGY & MINERALOGY	L	T	P
THEORY		2	0	0

COURSE OBJECTIVE:

The knowledge of geology is essential for the students of ceramic and glass engineering with related to the raw materials used in the industry. It will help them to understand the industrial map of industry in the country and sources of raw materials used in the industry.

COURSE OUTCOMES

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

- Understand importance of Geology in the field of ceramic engg.
- Know the formation of rocks, minerals and Clay.
- Know the classification of rocks in details.
- Understand Physical properties of minerals.
- Understand types of clay and other important raw materials, their properties, Sources and application in ceramic industries.
- Understand the process of beneficiation of ceramic raw materials.

DETAILED CONTENTS

Unit No.	Content	Periods
1	**ELEMENTRY GEOLOGY** 1. Various Branches of Geology 2. Origin of earth and earths crust 3. Geological ages 4. Elementary and general idea of rocks and minerals 5. Utility of geology specially for ceramic industries. 6. Occurrence of ceramic raw materials in India.	6
2	**PHYSICAL GEOLOGY & PETROLOGY** 1. Define Petrology 2. Discuss the types of weathering 3. Discuss various types of weathering agencies 4. Discuss the process of weathering	5
3	**PETROLOGY** 1. Formation of rocks, classification of rocks 2. Geological characters of rocks 3. General characters of rocks 4. Engg. Properties of rocks/ Lab Test of rocks 5. Rocks a construction material a) For Building b) For Roads • Define & Describe stratigraphy, Principal of stereography.	5
4	**MINERALOGY** 1. Define mineralogy 2. Describe various process of formation of minerals – Rock forming minerals. 3. State & explain Formula/Composition of minerals 4. Explain the following physical properties of the minerals :- a. Color b. Streak c. Luster d. Cleavage	3

	e. Hardness f. Crystal Form g. Fractures h. Specific Gravity i. Texture 5. Describe various process of testing of minerals	
5	IMPORTANT CERAMIC RAW MATERIALS 1. Describe the types of clays and Clay minerals 2. State & Explain the physical and chemical properties of clay 3. Describe availability of various ceramic raw materials in India and Special emphasis to state of Uttar Pradesh 4. Discuss the properties and uses of the following ceramic raw materials a. Silica –Quartz, Quartzite, Glass Sand b. Lime stone, Dolomite, Magnesite, Calcite, Gypsum c. Alumina Anhydrous – Bauxite, Diaspore, Pyrophilite d. Alumino silicate – Sillimanite, Kaynite, Andalusite e. Magnesium silicate – minerals – Talc, Forsterite, Steatite f. Flourine Minerals – Flourspar, Cryolite g. Boron Compound – Borax h. Feldspar and other fluxes, Nephline, Sodalite, Wolastonite, Bentonite i. Graphite, Chromite, Zircon j. Miscellaneous – Olivine, Asbestos, Rutile, Vermiculite, Mica, Beryal, Lithium minerals	3
6	**ECONOMIC GEOLOGY WITH REFERENCE TO CERAMIC:** Economic use of ceramic raw materials such as Clay, Silica, Felspar, Talc, Limestone, Dolomite, Gypsum, Magnesite, Chromite, Bauxite, Sellimanite, Kyanite and Andalusite, Zircon, Mica, Calcite, Pyrophilite.	3
7	Petrological microscope, study of physical and optical properties with special reference to the following minerals-Quartz, china clay, ball clay, feldspar, mica, basalt calcite, lime stone, gypsum, corundum.	3

INSTRUCTIONAL STRATEGY

Teacher should give emphasis on 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.

MEANS OF ASSESSMENT

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Actual Lab & Practical Work,
- Viva Voice

RECOMMENDED BOOKS

1. A Text book of Geology by P. Singh
2. Geology by G.B.Mahapatra
3. Text Book of Geology by P.K.Mukharjee
4. Engineering & General Geology by Praveen Singh

WEBSITE REFERENCE

- https://nptel.ac.in
- https://ocw.mit.edu

- https://www.engineeringtoolbox.com

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	6	15
2	5	15
3	5	15
4	3	11
5	3	12
6	3	10
7	3	12
Total	**28**	**100**

3.7	POTTERY AND REFIACTORY LAB	L	T	P
PRACTICAL		0	0	4

COURSE OBJECTIVE:

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

COURSE OUTCOMES

- After undergoing this course, the students will be able to:
- Know various raw materials used in white ware and heavy clay wares
- Know the process of manufacturing of various white ware & heavy clay wares
- Understand various composition and body formulation of various types of white ware& heavy clay wares their manufacturing process and the characteristic
- Understand various qualities and process of testing of various ceramic products
- Know the general idea about the specification as per the BIS for white ware and heavy clay wares

Unit No.	LIST OF PRACTICALS Emphasis should be given to Testing and quality Control wherever applicable.	Periods
1	**SEC. A - POTTERY PRACTICALS:**	
	1. Determination water of plasticity of clays 2. Determination Water content in prepared body for making the ware by jiggering method 3. Determination the Particle size distribution in Clay by Anderson Pipette 4. Determination the Moisture content in china clay/given sample. 5. Determination of dry and fired shrinkage of china clay/test specimen of body. 6. Determination the Relative density/Specific gravity of casting slip by R.D. Bottle 7. Preparation of different types bodies and their glazes. Fabrication of test specimens by different process 8. Preparation of suitable casting slip by Filter Cakes/body for making the white ware by Casting Method 9. Determination the fineness of various grind/pulverize raw materials used for white ware bodies. 10. Making the white ware cup/Plate by casting/Jiggering method.	
2	**REFRACTORY PRACTICALS:**	
	1. Determination the Particle size of refractory raw materials by sieve analysis. 2. Determination the packing density of given raw material 3. Determination the Green & Fired Density of given refractory Sample 4. Determination the Porosity/ Water Absorption of fired test specimen 5. Preparation of refractory sample by dry press. 6. Firing of sample at appropriate temperature. 7. Determination the modules of rupture (MOR) of different green and fired refractory bricks 8. Determination the Cold Crushing Strength (CCS) of different fired refractory bricks 9. Study the density Variance with Pressure Variance 10. Determination the following properties by water absorption test- a. Percentage of water absorption b. Bulk density & specific gravity c. Apparent specific gravity d. Apparent porosity 11. Capillary casting	

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

INSTRUCTIONAL STRATEGY

Students must visit various industries like White ware industries, Glass industries; refractory industries etc. to get exposure to various raw materials used indifferent ceramic industries.

MEANS OF ASSESSMENT

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Actual Lab & Practical Work,
- Viva Voice

RECOMMENDED BOOKS

1. Industrial Ceramic by Singer & Singer
2. White ware by W. Ryan & Redford
3. Pottery Industry by H.N.Bose
4. Modern pottery Manufacture by H.N.Bose
5. White wares by S.Sen
6. White ware by F.H.Norton

WEBSITE REFERENCE

- https://nptel.ac.in

3.8	ELEMENTARY GEOLOGY & MINERALOGY LAB	L	T	P
PRACTICAL		0	0	4

COURSE OBJECTIVE:

The knowledge of geology is essential for the students of ceramic and glass engineering with related to the raw materials used in the industry. It will help them to understand the industrial map of industry in the country and sources of raw materials used in the industry.

COURSE OUTCOMES

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

- Understand importance of Geology in the field of ceramic engg.
- Know the formation of rocks, minerals and Clay.
- Know the classification of rocks in details.
- Understand Physical properties of minerals.
- Understand types of clay and other important raw materials, their properties, Sources and application in ceramic industries.
- Understand the process of beneficiation of ceramic raw materials.

Unit No.	LIST OF PRACTICALS	Periods
1	1. Identification & describe the physical characteristics of hand specimen as Colour, lusture, streak, hardness, cleavage, fracture, Crystal System(tenacity), structure, and specific gravity. of the following rocks and minerals- Talc, Graphite, Basalt, Sand Stone, Kaolinite, Diaspore, Quartz, Quartzite, Feldspar, Calcite, Baryte, Bauxite, Dolomite, Limestone, Hematite, Magnetite and Magnesite. 2. Determination of specific gravity of minerals 3. Determination the Hardness of minerals by Moh's scales. 4. Identification of rocks/Minerals in hand specimen as igneous / Sedimentary / Metamorphic rocks 5. Study the optical Properties of minerals by Polarizing Microscopic:- Light, ordinary light, double refraction, refractive index, optical axis, positive and negative minerals 6. Study the Crystal system of minerals	

INSTRUCTIONAL STRATEGY

Students must visit various industries like White ware industries, Glass industries; refractory industries etc. to get exposure to various raw materials used indifferent ceramic industries.

MEANS OF ASSESSMENT

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Actual Lab & Practical Work,
- Viva Voice

RECOMMENDED BOOKS

1. Introduction of Physical Geology - A. K. Datta
2. Optical Mineralogy - A. F. Rogers & P. F. Kerr
3. Fundamental of Engg. Geology by
4. Mineral & Crystal Science by B.C.Jaish

WEBSITE REFERENCE

- https://nptel.ac.in

3.9	INDUSTRIAL TRAINING -I (4 WEEKS)	L	T	P
		0	0	4

COURSE OBJECTIVE:

Demonstrate awareness of organizational structure, professional conduct, safety norms, and discipline followed in industrial settings related to glass, ceramics, and refractories. Correlate classroom-based theoretical concepts with real-world industrial practices in manufacturing, testing, and quality control of glass and ceramic materials. Gain hands-on experience in handling raw materials, operating machinery such as kilns, furnaces, extruders, and forming/shaping tools under supervision. Describe and follow the step-by-step production process for products such as container glass, tiles, sanitary ware, refractories, etc., including forming, drying, glazing, and firing. Assist in the quality control and inspection of raw materials and finished products using standard ceramic and glass testing procedures. Identify common hazards in glass and ceramic industries and follow appropriate safety measures, waste management, and environmental regulations. Maintain work diaries, prepare process sheets, and submit reports with observations, problems encountered, and solutions adopted during the training. Observe and analyze production issues and contribute to basic troubleshooting and process optimization suggestions. Communicate effectively with supervisors, engineers, and fellow trainees, and work collaboratively in teams to achieve production targets. Identify emerging trends, automation, digital monitoring, and sustainability practices in modern glass and ceramic industries.

COURSE OUTCOMES

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

- Understand Industrial Work Culture
- Apply Theoretical Knowledge in Practice
- Operate Industrial Equipment and Processes
- Understand Production Processes
- Participate in Quality Control and Testing
- Follow Safety and Environmental Guidelines
- Develop Technical Documentation and Reporting Skills
- Improve Problem-Solving and Decision-Making Skills
- Enhance Communication and Teamwork Abilities
- Gain Exposure to Industry Trends and Technology

4.1	METALLURGY AND MATERIAL CHEMISTRY	L	T	P
THEORY		2	1	0

COURSE OBJECTIVE:

Metallurgy and Material Chemistry has intricate and profound relationship with technology. This curriculum includes those topics of Metallurgy and Material chemistry which enable a technician for better application of technology. Metals and compounds related to ceramic & glass technology are included in the subject to give better understanding of the technology.

COURSE OUTCOMES

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

- Understand the source and use of different compound's in Glass, Enamel, Glaze etc
- Understand the different compound's properties for Glass ,Enamel, Glaze etc.
- Utilize theoretical knowledge for fundamental Glass, Enamel, Pottery etc.
- Identify the coloring oxides and their occurred color in acidic or basic nature.

DETAILED CONTENTS

Unit No.	Content	Periods
1	**Compounds of** • Li, Na, K, Cu, Ag, Au. • Mg, Ca, Sr, Ba, Pb, Cd, Zn. With special reference to their oxides, nitrates, halides, sulphates). their properties and application in ceramic industry.	3
2	**Compounds of:-** • Ti, V, Cr, Mn, Fe, Co, Ni. • Si, Ti, Zn. With special reference to their oxides and other compounds related to ceramic industry) Colour Produce by these compounds in glass ,Enamel and Glaze	4
3	Phase rule, one component system (SiO_2,Al_2O_3, ZrO_2), Two component systems (Al2O3-SiO2, Na2O-SiO2, CaO-SiO2, CaO-Al2O3	3
4	Compound of Al and B with special reference to aluminates and Borates and oxides.	3
5	Selenium and sulfur and their compounds used in ceramic industry.	3
6	Compound of Ce and Nd	3
7	**Metallurgy :-** Introduction to Metallurgy, Ferrous Metallurgy- Steel Making (Introduction, manufacturing methods), Non Ferrous metallurgy- Aluminum (Ores of aluminum, Extraction of aluminum from Bauxite)	3
8	**Paints & Varnishes :-** Constituents of Paints & their functions, Constituents of a good Varnish, Classification and types of Varnishes	3
9	**Metalls & Alloys :-** Introduction, Metals and Non metals & theirs ores	3

INSTRUCTIONAL STRATEGY

Teachers may take help of various oxides and their uses in different objects as in Glass, Glaze, Enamel, Cement etc. 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.

MEANS OF ASSESSMENT

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Actual Lab & Practical Work,
- Viva Voice

RECOMMENDED BOOKS

1. Engineering Chemistry by P.C.Jain and Monica Jain
2. Physical Chemistry by Puri, Sharma, Pathania
3. Applied Chemistry –II by Prof. Durga Nath Dhar
4. Modern Inorganic chemistry by Dr. K.N.Sharma

WEBSITE REFERENCE

- **https://nptel.ac.in**
- **https://ocw.mit.edu**
- **https://www.edx.org**

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	3	12
2	4	15
3	3	10
4	3	10
5	3	11
6	3	10
7	3	10
8	3	12
9	3	10
Total	**28**	**100**

4.2	GLASS AND CERAMIC ENGINEERING DRAWING	L	T	P
PRACTIUM/THEORY		1	0	4

COURSE OBJECTIVE:

Drawing of all ceramic equipment and Machinery. 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.

COURSE OUTCOMES

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

1. Student will take the knowledge how to make the symbol of different electrical equipment's
2. Knowledge of about simple domestic wiring circuit diagram etc.
3. Knowledge of making the drawing of pulleys, Bearings, Blocks, Brackets, Joints etc.
4. Knowledge of making 3D view of all Ceramic Machinery and equipment's.
5. Basic knowledge of about Auto CAD

DETAILED CONTENTS

Unit No.	Content	Periods
1	**UNIT - I** 1. Detail use of abbreviation in electrical drawing symbols for simple equipment used in circuit, lamp, switches, condenser, resistance, reactors, transformer and motor. Sheet-1 2. Simple domestic wiring circuit diagram. . Sheet-1 3. Wiring diagrams of simple switch board(lab), general electrical layout for substation. . Sheet-1	2
2	**UNIT - II** 1. Types of pulleys, bush bearing, foot step bearing, plumber block, wall brackets. Sheet-2	2
3	**UNIT - III** 1. Sectional views of cotter-joint, knuckle joint, Jib and cotter joint, flange coupling. Sheet-2	2
4	**UNIT - IV** Pictorial views of the following ceramic machinery. (a) Ball Mill (b) Edge runner mill . Sheet-2 (c) Jaw Crusher (d) Plunger (e) Filter press	4
5	**UNIT – V AUTOCAD** 1. To Study the basis of Auto Cad 2. To draw 2 D ceramic drawing of block diagram, plot layout, machine and lilne 3. To draw simple 3 D ceramic Product (i) Porcelain Insulator (ii) Refractory Product	4

INSTRUCTIONAL STRATEGY

Teacher should show model of equipment's and component/part whose drawing is to be made. Emphasis

should be given on cleanliness, dimensioning and layout of sheet. The institute should procure Auto CAD or other engineering graphics software for practice in engineering drawings. Teachers should undergo training in Auto CAD/Engineering Graphic. Separate labs for practice on Auto CAD should be established.

MEANS OF ASSESSMENT

- Sketches making
- Drawing Sheet work

RECOMMENDED BOOKS

1. Engineering Drawing by Surjit Singh; Dhanpat Rai & Co., Delhi
2. Engineering Drawing by PS Gill; SK Kataria & Sons, New Delhi
3. Engineering Drawing I & II by JS Layall; Eagle Parkashan, Jalandhar
4. Engineering Drawing I by DK Goel, GBD Publication.

WEBSITE REFERENCE

- **https://nptel.ac.in**

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	2	20
2	2	20
3	2	20
4	4	25
5	4	15
Total	**14**	**100**

4.3	GLASS, ENAMEL AND CERAMIC COATING	L	T	P
THEORY		2	0	0

COURSE OBJECTIVE:

A thorough knowledge of different type of coatings done on ceramic & metallic materials in the ceramic industries enable the students to know different type of coatings and their application methods.

COURSE OUTCOMES

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

1. Understand about the Raw materials of Glass, Enamel & Its Batch Calculation
2. Understand about the Melting of Glass, Enamel & Refining of Molten Glass
3. Understand about How to Quality control of Glass, Enamel & Coating
4. About different types of coatings applied over metals & other materials
5. We get an idea about metallurgy industries where maximum tonnage of ceramic materials are used
6. Students get a knowledge about Enameling on Different Metal & How to Melt the Enamel
7. Students get an idea about Stenciling on Enameling surface then Cover coat enamel applied and Firing in furnace
8. Students get an idea about Enamel's Defect & Its remedies.

DETAILED CONTENTS

Unit No.	Content	Periods
1	**SECTION A – GLASS** 1. **Raw Materials:** Chemical and Physical Characteristics of principal glass making batch materials, their storage, mixing and conveying , minor ingredients and their function, factor influencing choice of batch materials.. 2. **Batch Calculation:** Calculation of glass batch oxide composition to raw material And raw material composition to oxide composition. 3. **Typical Commercial Glasses:** Types of glass and their chemical composition, container glass, sheet and plate glass, scientific laboratory glass. 4. **Melting and Refining:** Essential requirements of glass melting, mechanization of melting, thermal currents, production of homogeneous liquid, refining, shaping and moulding. 5. Quality Control & Test: Quality control/methods of testing of glass	10
2	**SEC. B – ENAMEL** 1. History of enameling, Definition of Enamel, Classification of Enamels, Types of enamels, raw materials for enamels, Base metal preparation by smelting & Pickling, 2. Preparation & Application:- Batch composition, Frit making,	10

	Preparation of Enamel slip, milling additives. Methods of enameling by dipping, spraying, Brushing, and screen print in. 3. Defects in Enamel: control firing, Under fired, rolling, scaling, chipping, pinholes, crazing, & their causes and remedies. 4. Quality Control and Testing Enamel	
3	**SEC. C – CERAMIC COATING** 1. Introduction of Glaze: Definition of Glaze, Similarities & Dissimilarities between glaze and glasses. Classification of glazes, Definition and explanation of Raw glaze, Fritted glaze, Lead glaze, Leadless glaze, Vapour glaze, Opaque glaze, Matt glaze & Crystalline glaze 2. Preparation of glaze: Selection of raw materials, composition, batch preparation, mixing, grinding. Definition of frit, preparation of frit & importance of fritting Application Methods of glaze: Dipping, brushing, pouring & Spraying 3. Firing of glazed ware: Drying, placing precautions of glazed ware before firing. Glaze defects & remedies : Crazing, Crawling, Peeling, Pin hole discuss their causes and remedies 4. Decorations: Under glaze, in glaze & on glaze decorations, Decoration methods like painting, stamping, stenciling, screen printing, & chromolithography	8

INSTRUCTIONAL STRATEGY

Students must visit different ceramic industries to know more about different coating techniques and defects in coating

MEANS OF ASSESSMENT

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Actual Lab & Practical Work,
- Viva Voice

RECOMMENDED BOOKS

1. Porcelain Enamels by Andrew
2. Industrial ceramics by Singer F and Singer SS
3. Modern pottery by HN Boss
4. Hand Book of ceramics
5. White ware by W. Rayan
6. Fine ceramics by FH Norton.

WEBSITE REFERENCE

- https://nptel.ac.in
- https://en.wikipedia.org
- https://coatingsdirectory.com

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	10	40
2	10	40
3	8	20
Total	**28**	**100**

4.4	CEMENT AND LIME TECHNOLOGY	L	T	P
PRACTICUM/THEORY		2	0	2

COURSE OBJECTIVE:

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 the subject, the students will be able to:

- Know Lime & Lime Stone, their qualities, calcinations and Cementing properties
- Understand details about Portland cement
- Understand manufacturing of various type of cement, their qualities
- Know about cement Kiln and its operation
- Know various method of testing quality of cement
- Know various types of cement concrete product and its manufacturing process
- Know details about gypsum, Plaster of Paris and plaster product

DETAILED CONTENTS

Unit No.	Content	Periods
1	**LIME** 1. Origin of lime stones, Varieties of lime stones and chemical composition of lime stone. 2. Properties of lime stone & uses, Burning of lime stone 3. Explain Calcinations and Slaking of Lime stone 4. Describe with sketch calcinations of lime stone in lime kilns 5. Effect of the presence of magnesia and use of lime mortar. 6. Preparation of hydrated lime, grinding the quick lime, mixing with water. **Practical's** 1. Identify the varieties and chemical composition of different limestones. 2. Study the physical properties and common uses of limestone. 3. Perform calcination of limestone to produce quicklime (CaO). 4. Observe and understand slaking (hydration) of quicklime. 5. Analyze how magnesia (MgO) affects lime properties.	14
2	**CEMENT** 1. Definition and Raw material of cement, Chemistry of anhydrous and hydrated cement compounds. The constitution of Portland cement. Method of manufacture of port land cement, and testing. Action of acid and sulphate water on port land cement, the physical and chemical properties of port land cement, defects causes and remedies. 2. Different types of cements, e.g. Portland cement, quick setting cement, pozzolanas and pozzolanic cement, high alumina cement, water proof cement, oil well cement, hydrophobic cement, masonry cement, white cement, colored cement, rapid hardening cement, castable refractories, low and ultra low Cement Castable. 3. Additives - accelerators, retarders, water proofers, pigments, dispersing agents. 4. Testing of Cement :- Fineness of cement, Initial and final setting time of	14

	cement, Expansion of cement, Compressive and tensile strength, Impurities in cement, Specific gravity of cement, Chemical analysis of cement. **Practical's** 1. Determination of fineness of cement. 2. Determination of water cement ratio. 3. Determination of initial & final setting time of cement. 4. Determination of tensile strength of cement mortar bracket. 5. Determination of cold crushing strength of cement cubes 6. Determination of soundness of cement by Le Chatteliers apparatus.	

INSTRUCTIONAL STRATEGY

Students must visit cement plants to be familiar with raw materials and manufacturing process of cement. And another way is to showing the slide & video

MEANS OF ASSESSMENT

- Assignments and quiz/class tests,
- Mid-term and end-term written tests
- Actual Lab & Practical Work
- Model Making,

RECOMMENDED BOOKS

1. Text Book of Cement and Concrete by Lee
2. Advances in Cement Technology by S.M. Ghose
3. Hand book on Cement Technology by Dudda

WEBSITE REFERENCE

- https://nptel.ac.in

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	14	50
2	14	50
Total	**28**	**100**

4.5	POTTERY AND PROCELAIN-I	L	T	P
THEORY		2	1	0

COURSE OBJECTIVE:

In this specialized subject, Pottery & Porcelain-I inputs are provided to the students about raw materials, processes, fabrication, drying and firing techniques.

COURSE OUTCOMES

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

1. Know the various raw materials used in white ware Industries
2. Know the process of manufacturing of various white ware
3. Understand various composition and formulation of various types of white ware & their characteristic
4. Understand various qualities and process of testing of various ceramic products

DETAILED CONTENTS

Unit No.	Content	Periods
1	**POTTERY** 1. A study of the various ceramic fabrication process (for manufacture of Products). 2. A detailed study of the manufacture of floor and wall tiles, sanitary ware, table ware, parian art ware, semi-vitreous bone china, chemical stone ware, chemical porcelain, electrical porcelain. 3. Ceramic glazes - Different types of glazes, their composition preparation and application. 4. Ceramic Stains - Their composition, preparation, application & use. Decoration with stains. 5. Ceramic Transfer - Their preparation, application and firing. 6. Mechanization in pottery works - Introduction to simple hand tools, equipment's & Machines. **NOTE: Recapitulation of main topics from III Semester.**	12
2	**PORCELAIN** 1. Definition of porcelain, Describe the different types of porcelain as Hard porcelain, Soft Porcelain, Chemical Porcelain, Dental Porcelain, Electrical Porcelain, Bone China etc. 2. High and low tension insulators : High voltage low frequency application Porcelain Insulator, Low voltage high frequency application, Steatite, Magnesium titanate, cordierite, Porcelain. 3. Lithography : (A) Lithium Compounds (B) Prepare and Design For making Lithograph transfer. 4. Quality Control & Testing a). Green and dry properties of body mixes such as shrinkage, bulk density, strength. b). Fired charactertics such as fired shrinkage, fired strength (MOR and Compressive strength), water absorption, apparent porosity, bulk density, fired colour at different temperatures. c). Pressing effect on the fired and green bodies. d). Thermal expansion of body and Glaze.	16

	e). Testing - Physical testing : thermal behavior, MOR, Porosity, Density, Crazing, etc	

INSTRUCTIONAL STRATEGY

Students must get industrial exposure of various white ware/ Pottery industries to know more about process and products

MEANS OF ASSESSMENT

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Actual Lab & Practical Work,
- Viva Voice

RECOMMENDED BOOKS

1. Ceramic Whitewares by Sudhir Sen
2. Industrial Ceramics by Singer & Singer, Khanna Publishers, New Delhi
3. Handbook of Ceramics by S. Kumar & Others, Prentice Hall of India
4. Whiteware by W. Rayan

WEBSITE REFERENCE

- **https://nptel.ac.in**

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	12	45
2	16	55
Total	**28**	**100**

4.6	GLASS TECHNOLOGY-I	L	T	P
THEORY		2	1	0

COURSE OBJECTIVE:

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

COURSE OUTCOMES

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

1. Know various types of raw materials for glass making & formulating batch composition
2. Understand general ideas about glass melting furnace & glass melting process
3. Know knowledge about strain in glass & its elimination
4. Understand idea about the various process of glass forming methods
5. Understand general idea about the quality of glass
6. Understand different glass defects & their remedies
7. Know the decoration of glass and Special glass making
8. Know idea on layout of modern glass plant

DETAILED CONTENTS

Unit No.	Content	Periods
1	**RAW MATERIAL & BATCH** Storage of raw materials, batch house, melting furnace, fabrication-machines, annealing Lehar, sorting and packaging section, ware house.	3
2	**GLASS MELTING PROCESS** Batch calculation of raw materials for glass making, Process of glass formation, Refining of glass, refining mechanism, refining agent, factor affecting refining, Role of viscosity in glass refining, Colourising and Decolourising- Theory and agent	3
3	**MANUFACTURING & FORMATION OF GLASS WARE** Various methods used for glass products making, Various machines used for glass making, Manufacturing of glass by blowing & manual process, float process, semi automatic & Automatic process, Manufacturing of glass bottle, glass Jar glass sheet, Picture tube, thermo flask, electric bulb & tube, glass bangles, Manufacturing of fiber glass, glass wool, Optical fiber, Manufacture of sheet, plate and rolled glass, toughened glass, laminated safety glass. Optical Glass- Composition, manufacture of optical glass quality control measures.	4
4	**ANNEALING & TOUGHENING OF GLASS** Describe the annealing, process of annealing, aim of annealing, determine annealing schedule for various glass products, Define the Toughening of glass, Explain tempering of glass by various methods, State & explain Chemical & mechanical toughening of glass, Relation between annealing and viscosity of glass.	4
5	**PROPETIES OF GLASS** Describe the following properties of glass – Viscosity, Density, Thermal properties,	2

	optical properties, Electrical properties, Chemical durability. Viscosity, variation with temperature and composition, transformation range	
6	**DEFECTS IN TESTING OF GLASS** Describe in brief – defects of glass by visual observation as cords, Blister, Seeds, Bad colours, etc, Describe their causes and remedies. Origin of thermal stresses, generation and release of stresses, strain viewer. Chemical durability of glass measurement of chemical durability by A.S.T.M & I.S.I Method, Effect of glass composition and its significance in glass processes & its measurements.	3
7	**GLASS DECORATION** Describe the following methods of glass decoration in brief – Grinding, Polishing, Etching, Sand Blasting, Painting, Engraving, Cutting, Staining, Englobing, Lustering, Enameling	3
8	**SPECIAL GLASSES** Define & describe the characteristics and application of the following glasses - 1. Borosilicate glass 2. Vycor glass 3. Pyrex glass 4. Heat resisting glass 5. Coloured glass 6. Ruby glass 7. Glass for electrical & electronic Industries 8. Laminated glass 9. Glass for optical communication 10. Alumina silicate glass, Alkali Silicate glass, Vitreous Silica glass, Lead glass	6

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 an products etc.

MEANS OF ASSESSMENT

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Actual Lab & Practical Work,
- Viva Voice

RECOMMENDED BOOKS

1. A Hand Book of Glass (Vol. I & II) by F.B. Tulley
2. Modern Glass Practice by S.G. Scholse, Publisher McGraw Hill
3. Glass by Scholes
4. Glass by R. Charan
5. Glass by Shand

WEBSITE REFERENCE

- **https://nptel.ac.in**

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	3	12
2	3	12
3	4	18
4	4	18
5	2	7
6	3	8
7	3	8
8	6	15
Total	**28**	**100**

4.7	GLASS, ENAMEL AND CERAMIC COATING LAB	L	T	P
PRACTICAL		0	0	4

COURSE OBJECTIVE:

A thorough knowledge of different type of coatings done on ceramic & metallic materials in the ceramic industries enable the students to know different type of coatings and their application methods.

COURSE OUTCOMES

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

- Understand about the Raw materials of Glass, Enamel & Its Batch Calculation
- Understand about the Melting of Glass, Enamel & Refining of Molten Glass
- Understand about How to Quality control of Glass, Enamel & Coating
- About different types of coatings applied over metals & other materials
- We get an idea about metallurgy industries where maximum tonnage of ceramic materials are used
- Students get a knowledge about Enameling on Different Metal & How to Melt the Enamel
- Students get an idea about Stenciling on Enameling surface then Cover coat enamel applied and Firing in furnace
- Students get an idea about Enamel's Defect & Its remedies.

Unit No.	LIST OF PRACTICALS	Periods
1	**GLASS PRACTICALS:** 1. Purification & Sieve Analysis of Sand 2. Removal of iron from sand & Compounding of glass batches. 3. Weighing, Mixing & Melting of simple Glass Batch 4. Weighing, Mixing & Melting of color Glass Batch 5. Density of glass by float and sink method 6. Simple decoration processes e.g. etching, silvering staining, sand-blasting, lustering, cutting and polishing. 7. Examination the Common defects & strain in glass ware 8. Determination the refractive index of glass 9. Determination the thermal expansion of glass. 10. Determination the low temperature viscosity. 11. Determination the viscosity of molten glass	
2	**ENAMEL PRACTICALS:** 1. Weighing, Mixing & Melting for Prepare the Enamel frit 2. Grinding the enamel frit in pot mill to prepare the enamel slip and its application 3. Determination the Fineness test of enamel slip. 4. Determination the Density of enamel slip using specific gravity bottle. 5. Smelting, Cleaning and pickling of small mild steel plates for enameling 6. Application of Enamel slip on Iron sheet for making sign plates. 7. Firing and fusion of applied enamel slip on M.S. Iron Sheet	

INSTRUCTIONAL STRATEGY

Students must visit different ceramic industries to know more about different coating techniques and defects in coating

MEANS OF ASSESSMENT

- Assignment & Quiz,
- Mid-Term and End-Term written test,
- Actual Lab & Practical Work,
- Viva Voice

RECOMMENDED BOOKS

1. Porcelain Enamels by Andrew
2. Industrial ceramics by Singer F and Singer SS
3. Modern pottery by HN Boss
4. Hand Book of ceramics
5. White ware by W. Rayan
6. Fine ceramics by FH Norton.

WEBSITE REFERENCE

- https://nptel.ac.in
- https://en.wikipedia.org
- https://coatingsdirectory.com

4.8	Essence of Indian Knowledge and Tradition (Q)	L	T	P
THEORY		2	0	0

LEARNING OUTCOMES

It is essential for students to understand the fundamental aspects of the Indian Knowledge System, its integration with modern science, principles of Yoga and holistic healthcare, and practical applications in contemporary contexts.

COURSE OUTCOMES

Upon completion of the course, the student will be able to demonstrate knowledge of the following topics:

- Overview, importance, and relevance of the Indian Knowledge System, including Vedas, Upavedas, Vedangas, and Upangas.
- Relevance of science and spirituality, and contributions of ancient Indian science and technology.
- Basic principles of Yoga, benefits of holistic healthcare, and integration with modern healthcare.
- Practical applications and case studies of the Indian Knowledge System's relevance today.

DETAILED CONTENTS

Unit No.	Content	Periods
1	**Unit 1: Introduction to Indian Knowledge System** Overview of Indian Knowledge System - Importance and relevance • Introduction to the Vedas • Upavedas • Vedangas • Upangas	16
2	**Unit 2: Modern Science and Indian Knowledge System** • Relevance of Science and Spirituality, • Science and Technology in Ancient India,	6
3	**Unit 3: Yoga and Holistic Healthcare** • Basic principles of Yoga • Benefits of holistic healthcare practices • Integration with modern healthcare	4
4	**Unit 4: Case Studies / Assignment** • Practical Applications / Case studies demonstrating the relevance of Indian Knowledge System in modern times.	2

INSTRUCTIONAL STRATEGY

One may use lectures, group discussions, and guest speakers to teach this subject. Present

case studies that highlight the contributions of ancient Indian scientists and their relevance today. Organize workshops on holistic healthcare practices and their integration with modern healthcare.

MEANS OF ASSEESSMENT

- Assignments and quiz/class tests
- Sessional test
- Viva-voce

REFERENCE BOOKS/ ONLINE RESOURCES

1. Essence of Indian Traditions by Dr. Om Prakash Mishra, Khanna Publishers.
2. Indian Knowledge Systems by Kapil Kapoor and Avadhesh Kumar Singh
3. The Vedas: An Introduction to Hinduism's Sacred Texts by Roshen Dalal
4. Yoga and Ayurveda: Self-Healing and Self-Realization by David Frawley
5. Ancient Indian Science and Technology by Bal Ram Singh

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	16	50
2	06	20
3	04	20
4	02	10
Total	**28**	**100**

8 RESOURCE REQUIREMENT

PHYSICAL RESOURCES

(A) Space requirement

Norms and standards laid down by All India Council for Technical Education (AICTE) are to be followed to work out space requirement in respect of class rooms, tutorial rooms, drawing halls, laboratories, space required for faculty, student amenities and residential area for staff and students.

(B) Equipment requirement:

Following Laboratories are required for Diploma Programme in Glass & Ceramic Engg.

- Communication Laboratory
- Applied Physics Laboratory
- Applied Chemistry Laboratory
- Applied Mechanics Laboratory
- Engineering Drawing
- Basics of Electrical, Mechanical, Civil Engg.
- Basics of IT/Computer Applications \Laboratory
- Carpentry Shop
- Painting and Polishing Shop
- Plumbing Shop
- Welding Shop
- Fitting and Plumbing Shop
- Sheet Metal Shop
- Black smithy / Mason Shop
- Machine Shop
- Pottery & Refractory Lab and Modeling & Mould Lab
- Glass, Enamel & Ceramic Coating Lab
- Elementary Geology & Mineralogy Lab
- Energy Conservation Lab
- G.C. Workshop Practice Lab
- Silicate Analysis Lab
- Physical testing of Ceramic Lab

EQUIPMENT REQUIRED FOR

COMMUNICATION SKILLS LABORATORY			
Sr. No.	Description	Qty	Total Price (Rs)
1.	Stools	40	10,000
2.	Display Board/Screen	2	6,000
3.	Sound recording and playing system	1	6,000
4.	Audio cassettes	60	2,000
5.	Overhead Projector	1	5,000
6.	Transparencies slides	100	500
7.	TV, VCR and camera for video recording	1 each	20,000
8.	English spoken course	1	2,000
9.	A Quiz room equipped with two way audio system, back projection system and slide projector	1	30,000
10.	Miscellaneous	LS	1,500

APPLIED PHYSICS LABORATORY			
Sr. No.	Description	Qty	Total Price (Rs)
1.	Vernier calipers Working length 160 mm, Internal and external dia with locking arrangement	12	2,000
2.	Screw Gauges Working length 15 mm, pitch 0.5 mm, least count .005 mm	12	2,000
3.	Spherometers Distance between legs 2.5 mm, pitch 0.5 mm, least count .005 mm.	12	2,000
4.	Mirrors (convex, concave)	5 Each	1,500
5.	Pendulum Setup	02	4,000
6.	Gravesand's Apparatus	02	3,000
7.	Inclined Plane Setup	02	2,000
8.	Flywheel Setup	02	4,000
9.	Prism	05	1,500
10.	Spectrometer	02	25,000
11.	DC Ammeters Moving coil weston-type ammeter with ebonite stand	10	3,500
12.	DC Miliammeters	2	1,000
13.	DC Microammeters	2	700
14.	DC voltmeters	10	700
15.	DC Millivoltmeters	10	2,000
16.	Sensitivity Galvanometer	2	800
17	Student Galvanometers	10	4,000
18.	Demonstration type DC Ammeters Range; 0 to 1 Amp.	2	1,000
19.	D type DC Voltmeter Range : 0 to 1 Volt	2	1,000
20.	D type Galvanometers Sensitivity : 20 microamperes per scale division,	8	8,000
21.	Resistance boxes (dial type) assorted	8	8,000
22.	Rheostats	10	4.000
23.	Miscellaneous items (Spring, Pan, Glycerine, Optic fibre, Ferromagnetic material)	LS	2,000
24.	Fortin's Barometer (Wall type)	2	20,000
25.	Stoke's Apparatus	2	10,000
26.	Gumther's Apparatus	2	16,000
27.	Resonance Tube Apparatus with accessories and Tuning fork set	2	14,000
28.	Sodium Lamp setup with Biprism	2	10,000
29.	Ohmic resistance coil	10	5,00

30.	Slide wire bridge	2	8,000
31.	PN Junction diode Apparatus	2	10,000
32.	Laser (as per requirement)	1	1,00,000
33.	Numerical aperture setup	1	25,000
34.	Miscellaneous	LS	3,000

APPLIED CHEMISTRY LABORATORY			
Sr. No.	Description	Qty	Total Price (Rs)
1.	Digital Balance	1	80,000
2.	Burette 50ml	30	3,000
3.	Pipette 25ml	60	4,000
4.	Beakers 100ml	60	4,000
5.	Burette stand	30	30,000
6.	Glazed tile	30	1,000
7.	Conical flask 50ml (Titration flask)	60	4,000
8.	Standard (Measuring) flask (to prepare standard solution) 250ml/100ml	30	6,000
9.	Able's Flash Point apparatus	2	10,000
10.	(1/10)°C thermometer	06	6,000
11.	Candles	20	100
12.	Crucible with lid	06	2,000
13.	Muffle furnace	1	18,000
14.	Decicators	06	8,000
15.	Pair of tongue (small and big)	24 (small) 2 (big)	2,000
16.	Chemicals EDTA-1 kg Eriochrome Black-T(solochrome black T)-200g Buffer solution (NH3 - 2.5 ltr, NH4Cl – 1 kg) Zinc sulphate- 500g H2SO4- 2.5 ltr Phenolphthalein indicator (as per requirement) Methyl orange indicator (as per requirement) Charcoal (as per requirement) Kerosene- 1 ltr	LS	20,000
17.	Miscellaneous	LS	2,000

APPLIED MECHANICS LAB				
Sr. No.	Description	Qty	Rs	Total Price
1	Polygon of Forces Apparatus	4	1500	6000
2	Universal Force Table	2	2500	5000
3	Principle of Moment Apparatus Bell Crank lever	4	1500	6000
4	Combined Inclined plane & Friction apparatus	4	1500	6000
5	Simple wheel and axle	2	2500	5000
6	Differential wheel and axle	2	3500	7000
7	Double sleave Pulley Block	1	800	800
8	Simple Screw Jack	4	3000	12000
9	System of pulleys (Any I,II,III)	2 set	4000	8000
10	Worm & Worm wheel	2 set	5000	10000
11	Simply Support Beam with different weights (2 Sets)	2	3000	6000
12	Jib Crane	2	2500	5000
13	Jointed Roof Truss Apparatus	2	2500	5000
14	Misc. Lum Sum			5000

ENGINEERING DRAWING LAB			
Sr. No.	Description	Qty	Total Price (Rs)
1.	Drawing Boards (700 x 500mm)	60	25,000
2.	Draughtsman Tables	60	1,80,000
3.	Draughtsman Stools	60	40,000
4.	Computer Aided Drawing (CAD) Software	30 User	5,00,000
5.	Model of different wooder joints	1	1,000
6.	Model of different screw threads	1	1,000
7.	Model of various locking devices	1	1,000
8.	Model of various joints	1	1,000
9.	Cut section Model of various couplings	1	3,000
10.	Miscellaneous	LS	5,000
BASICS OF IT LABORATORY/COMPUTER LABORATORY			
Sr. No.	Description	Qty	Total Price (Rs)
1.	Computer System with latest configuration	30	8,00,000
2	Printer (MFP)	1	25,000
3	Printer (Laser)	1	35,000
4.	Plotter	1	75,000
5.	Digitiser	1	50,000
6.	Antivirus Software	LS	10,000
7.	Internet Facility on Computers	LS	2,00,000
8.	LCD Projector	1	35,000
9.	UPS	60	1,20,000
10.	Software (latest windows, latest MS Office)	1	1,00,000
11.	Scanner	1	10,000
12.	Miscellaneous	LS	5,000
CARPENTRY SHOP			
1	Work benches fitted with carpenter vices	5	20,000
2.	Circular saw grinder	1	6,000
3.	Wood cutting band saw-vertical	1	10,000
4.	Bench grinder	1	5,000
5.	Drilling machine	1	8,000
6.	Wood turning lathe	1	40,000
7.	Wood Planner	1	20,000
8.	Tool accessories measuring and marking Instruments	25	25,000
9.	Band saw blade brazing unit	1	10,000
10.	**Miscellaneous**	**LS**	**1,500**
PAINTING AND POLISHING SHOP			
1.	Spray gun with hose pipe	1	1,000
2.	Paint brushes	20	2,000
3.	Paint/Varnish	LS	2,000
4.	Air Compressor with 2 hp motor	1 set	10,000
5.	Miscellaneous	LS	2,000
ELECTRICAL SHOP			

1.	Tool kit (Plier, Screw driver, Knife, Steel rule, hammer, scriber, pincer steel tape etc.)	20	20,000
2.	Fuses, Switches, Plugs, Sockets, Ceiling rose, Wires, cleats, Clamps, Test lamp, Tester.(as per requirement)		8,000
3.	Electric Iron	1	1,500
4.	Electric kettle	1	1,500
5.	Ceiling fan/table fan	1	2,500
6.	Desert cooler	1	5,000
7.	Lead acid battery	2	8,000
8.	Battery Charger	1	6,000
9.	Miscellaneous		3,000

SMITHY SHOP			
Sr. No.	Description	Qty	Total Price (Rs)
1.	Black smithy forge (with open hearths, accessories to match the forge)	20	40,000
2.	Wrought iron anvils	20	20,000
3.	Swage blocks	4	8,000
4.	Blower with accessories, motor switch etc	1	6,000
5.	Work benches with vices	2	6,000
6.	Power hammer	1	20,000
7.	Tools and accessories – hammers, swages, tongs, pokers, pullers etc	20	10,000
8.	**Miscellaneous**	**LS**	**1,500**
FITTING AND PLUMBING SHOP			
1.	Work benches with vices (4 vices on each bench)	5	30,000
2.	Marking tables with scribers	4	24,000
3.	Surface plates	5	20,000
4.	Accessories like calipers, V blocks, height, gauges steel rules and scribers	25	50,000
5.	Tool kits – taps, dies, drills	25	40,000
6.	Tool kits – chiesels, hammers, files, hacksaw	25	25,000
7.	Drilling machine	2	12,000
8.	Pipe vice	4	1,000
9.	Chain wrenches	5	1,250
10.	Ring spanner set	5	600
11.	Pipe die set 2”	2 set	1,000
12.	Pipe bending device	1	5,000
13.	Various plumbing fittings	LS	2,000
14.	*Miscellaneous*	*LS*	*1,500*

SHEET METAL SHOP			
Sr. No.	**Description**	Qty	Total Price (Rs)
1.	Hammers	8	3,000
2.	Mallets (Hard & Soft)	5	2,000
3.	Sheet and wire Ganges	LS	8,00

4.	Shearing Machine	1	20,000
5.	Bar folding Machine	1	20,000
6.	Burring machine	1	10,000
7.	Various sheet (black plain, galvanized iron, corrugated, Aluminum)	1 Each	1,000
8.	Hand Shears/Snippers	4	2,000
9.	Nuts, Bolts, Rivets, Screw	LS	5,00
10.	*Miscellaneous*	*LS*	*1,000*
WELDING SHOP			
1.	Electrical welding transformer set with accessories	3	30,000
2.	Gas Cutting Unit	1	3,000
3.	Work benches with vices	3	5,000
4.	Welding generator set	1	10,000
5.	Oxy acetylene welding set with accessories	1	7,000
6.	Acetylene generating set	1	6,000
7.	Electric welder tool kit	10	10,000
8.	Projection welding machine	1	15,000
9.	Brazing equipment with accessories	1	10,000
10.	Soldering irons	3	1,000
11.	Pedestal grinder	1	10,000
12.	Metal spraying gun	1	10,000
13.	Spot welder	1	25,000
14.	TIG welding set	1	1,00,000
15.	MIG welding set	1	1,00,000
16.	Welding Partition Screen	5	2,500
17.	*Miscellaneous*	*LS*	*3,000*

FOUNDRY SHOP			
Sr. No.	Description	Qty	Total Price (Rs)
1.	Moulding boxes	40	8,000
2.	Ladles	5	2,000
3.	Tool Kits	10 set	5,000
4.	Quenching tanks	2	5,000
5.	Portable grinder	1	3,000
6.	Pit furnace with blower	1	10,000
7.	*Miscellaneous*	*LS*	*1,000*
MACHINE SHOP			
1.	Centre lathes	10	6,00,000
2.	Grinder	1	10,000
3.	Universal milling machine	1	1,25,000
4.	Shaper	2	1,20,000
5.	Plainer	2	1,20,000
6.	Work bench	3	10,000
7.	Precision instruments	1	10,000
8.	Hand tools and accessories	2	8,000
9.	CNC trainer lathe	1	4,00,000
10.	*Miscellaneous*	*LS*	*5,000*

ENVIRONMENT ENGINEERING LABORATORY			
	pH Meter	01	500
	Turbidity Meter	01	5000
	Oven with Temperature Controller and Forced Air Circulation Type	01	20000
	B.O.D. Incubator	01	25000
	Water Analysis Kit	01	5000
	High Volume Sampler	01	40000
	Electrical Balance for weighing upto 1/10 of milligram (capacity)	01	1000
ENERGY CONSERVATION LABORATORY			
1	Clamp meter	02	5000
2	Multimeter	02	2000
3	Power Analyzer	01	20000
4	Different types of lamps (LS) 60 W lamp, 230 V , 100 V 200 W lamp 500 W lamp 100 W lamp, 110 V, 150 V	10	500
5	Lux meter	02	5000
6	Centrifugal pump, 1 kW	1	15,000
7	Standard window A.C.	01	20000
8	Anemometer	02	5000
9	Thermometer	03	2000
10	Flow meter	02	10000
11	Pumping set with at least two pumps of different capacity.	1 set	10000
12	Pressure gauge fitted on discharge lines	1 set	2000
13	Variable Frequency Drive	02	50000
14	A small compressor with a small network of pipe line fitted with suitable pipeline, pressure gauge, safety valve and loading / unloading pressure switch.	1	3000
15	Small blower (1.5 kW motor) with inlet and outlet ducts of approximately one meter length on both sides	1	10000
16	Black Box (for checking lamp efficacy including stand and luxmeter)	1	25000

ENERGY CONSERVATION LABORATORY

Sr. No	Particulars	Qty	Estimated Cost (Rs)
1	Multimeter	1	17,000
2	Power Analyzer	1	20,000
3	Luxmeter	1	5,000
4	Black Box (for checking lamp efficacy including stand and luxmeter)	1	25,000
5	Centrifugal pump, 1 kW	1	15,000
6	Variable Frequency drive	2	50,000
7	Water Flow meter	1	10,000
8	Pressure Gauge	1	2,000
9	Experimental Set up for Valve Throttling vs VFD	1	50,000
10	Compressor, 20 cfm, single-stage	1	50,000
11	Air leakage meter	1	18,000
12	Blower (2 HP)	1	8,000

1	**POTTERY & REFRACTORY LAB**			
S. No	**Name of Equipment**	**Qty**	**Rs.**	**T. Rs.**
1	Ball Mill(Porcelain line inside with pebbles)Capacity-2 Cubicfeet	1	20000	20000
2	Pot Mill Rotatary with pot & grinding media	1	8000	8000
3	Screw Blunger Lab Size	1	5000	5000
4	Wooden Plunger Lab Size	1	5000	5000
5	Vibrating m/c	1	3000	3000
6	Filter Press Lab Size with Diaphram Pump	1	30000	30000

7	Universal Jigger Jolleys	2	5000	10000
8	Toygle Press Lab Size	1	10000	10000
9	Jaw Crusher Capacity small Lab size	1	10000	10000
10	Double Roller crusher 10"x8" Roller size. Lab Size	1	20000	20000
11	Hand Screw Press (No.-1or 2)	1	10000	10000
12	Hot air oven (Heavy Duty)inner size-14"x14"x14"	1	8000	8000
13	Kanthal Furnace upto 1200^0C	1	25000	25000
14	High temperature furnace horizontal type up to 1450^0C	1	200000	200000
15	Ph meter	2	1500	3000
16	Test Sieves set (No of sieves-10 of different micron size)	2	2500	5000
17	Adherence test Apparatus.	1	5000	5000
18	Vernier Calipers (Branded) Plane & Dial type	2	1500	3000
19	Permanent Magnet for casting slip	1	500	500
20	De-airing pug mill Lab Size	1	25000	25000
21	Painters Wheel (H x Dia)-18”x10”	2	1000	2000
22	Cyclone Dryer / Separator Small / Lab Size	1	10000	10000
23	Travelling Microscope	1	10000	10000
24	Permeability App.	1	6000	6000
25	Hydraulic press (25 MT Capacity) Lab Size	1	250000	25000
26	Diamond Cutter Tile cutter with dia of blade (8"/10")	1	5000	5000

2	GLASS, ENAMEL & CERAMIC COATING LAB			
S. No	**Name of Equipment**	**Qty**	**Rs.**	**T. Rs.**
1	Physical Balance (Branded -max capacity-250 gm)	1	5000	5000
2	Silica Crucible (50 ml, 100 ml) =(Lump sum)		2500	2500
3	Platinum Crucible 50 ml & weight >50 gm	2	20000	40000
4	Strain Viewer	1	1000	1000
5	Thermal baths for thermal shock	1	15000	15000
6	High Temp.Furnace, bottem moveable,vertical type upto1450^{0}C	1	200000	200000
7	Lens Grinding & Polishing m/c. Small Size	1	25000	25000
8	Sand blasting m/c. Small Size with Compressor	1	15000	15000
9	Electric Muffle Furnace Small size 1200^{o}C	1	20000	20000
10	Electric furnace 30x30x30cm.Temp.1000^{o}C	1	25000	25000
11	Enamel slip Spray gun	2	1500	3000
12	Softening Point testing app. for Glass.	1	80000	80000
13	Thermal Expansion Testing App. for Glass	1	100000	100000
14	Ultrasonic Drilling Machine	1	25000	25000
15	Thickness Viewer for non-metal coating on metal	1	10000	10000
16	Ultra Violet Glass Viewer	1	25000	25000
17	Graphite Paddles For Glass Beeds Making	1	50000	50000
18	Optic Moulds for millefiori Glass rods	10	10000	100000
19	Optical Microscope of high magnify power with light	2	20000	40000
20	Optical Microscope (Ordinary)	2	800	1600

3	SILICATE ANALYSIS LAB.			
S. No	**Name of Equipment**	**Qty**	**Rs.**	**T. Rs.**
1	Chemical Balance(Branded -max capacity 250 gm)	2	5000	10000
2	Digital Electronic Balance (Branded-max 200gm,min least count 0.001gm)	1	15000	15000
3	Hot Plate 2KW	1	3000	3000
4	Hot air oven (Heavy Duty)inner size-14"x14"x14"	1	8000	8000
5	Platinum Crucible with lid 25 ml.& Weight >25gm	3	10000	30000
6	Platinum Disc with lid 5 cm dia, weight 20 gm approx	2	8000	16000
7	Platinum dish with lid 10 cm dia, weight 35 gm approx	1	14000	14000
8	Hydro Flourication Chamber	1	10000	10000
9	Calorimeter for determination of Iron titanium content in clay	1	6000	6000
10	Lovibond comporotor with test tube.	1	1500	1500
11	Flame Photometer	1	4000	4000
12	Water Bath	3	4500	4500
13	Water De-ioniser Plant Glass Made	1	5000	5000
14	Glass Ware (Lump sum)		2500	2500
15	Silica Crucible (25 ml, 50 ml)		2000	2000
16	Tongs (Stainless Steel) size 10” & 12”	5	100	500

4	PHYSICAL TESTING OF CERAMIC LAB			
S. No	**Name of Equipment**	**Qty**	**Rs.**	**T. Rs.**
1	Physical Balance (Branded -max capacity-250 gm)	1	5000	5000
2	Electronic Digital Physical Balance-max capacity-250gm	1	8000	8000
3	Auto clave Testing for Crazing deffect	1	15000	15000
4	Vicats Needle apparatus	2	500	1000
5	Le Chatteliers apparatus.	2	500	1000
6	Density Comparator Testing App.	1	3000	3000
7	Infra Red Moisture Balance	1	12000	24000

8	Speedy moisture test for direct reading	1	12500	12500
9	Electric Muffle Furnace Small size 1000°C	1	25000	25000
10	Refractometer & Glossy Meter	1	3500	3500
11	Optical pyrometer Range 400 to 1600°C	1	25000	25000
12	Radiation Pyrometer up to 1600°C	1	80000	80000
13	Thermo couples upto 1500°C With Digital Indicator	1	10000	10000
14	Red Wood Viscometer	1	11500	23000
15	Orset apparatus for Gas Analysis	1	5000	5000
16	Bomb calorimeter with complete accessories	1	50000	50000
17	Flash point Apparatus for liquid fuel	1	5000	5000
18	Thermal Expansion Apparatus up to 1000°C.	1	100000	100000
19	Planetary Ball Mill PM 100 with complete accessories	1	500000	500000
20	Ultimate Tensile strength testing machine	1	40000	40000
21	Apparatus for testing c.c.s. of refractory/Concrete cube	1	40000	40000
22	Rotory Viscosity meter/ Torsion viscosity meter	1	5000	5000
23	Softening point apparatus			
	i. Vertical tubler furnace upto 1000°C	1	10000	10000
	ii. Thermocouple	1	3000	3000
	iii. Temperature indicator	1	5000	5000
	iv. Vertical Graduated Telescope	1	40000	40000
24	Low temperature viscosity apparatus			
	i. Tubler furnace upto 1000°C.	1	25000	25000
	ii. Thermocouple	1	3000	3000
	iii. Temperature indicator	1	3000	3000
	iv. Vertical graduated telescope	1	10000	10000
	v. 1/2 kg. weight	1	100	100

v

5 GEOLOGY & MINERALOGY LAB.				
S. No	**Name of Equipment**	**Qty**	**Rs.**	**T. Rs.**
1	Mineralogical Microscope	6	10000	60000
2	Steel Books Shelves	2	6000	12000
3	Electronic Digital balance Max capacity-25kg/100 kg	2	1500	3000
4	Moh's Scale for hardness	10	500	5000
5	Rockwell Hardness Tester with computer Programming	1	120000	120000
6	Grinding & Polishing Machines for sample preparation	1	30000	30000

NOTE:

In addition to the above, laboratories in respect of physics, chemistry, Computer Centre etc will be required for effective implementation of the course. Provision for photocopiers, PC facilities along with LCD Projection System etc. has also to be made.

(C) Furniture Requirement

Norms and standards laid down by AICTE be followed for working out furniture requirement for this course.

Human Resources Development:

Weekly work schedule, annual work schedule, student teacher ratio for various group and class size, staffing pattern, work load norms, qualifications, experience and job description of teaching staff workshop staff and other administrative and supporting staff be worked out as per norms and standards laid down by the AICTE.

9 EVALUATION STRATEGY

INTRODUCTION

Evaluation plays an important role in the teaching-learning process. The major objective of any teaching-learning endeavor is to ensure the quality of the product which can be assessed through learner's evaluation.

The purpose of student evaluation is to determine the extent to which the general and the specific objectives of curriculum have been achieved. Student evaluation is also important from the point of view of ascertaining the quality of instructional processes and to get feedback for curriculum improvement. It helps the teachers in determining the level of appropriateness of teaching experiences provided to learners to meet their individual and professional needs. Evaluation also helps in diagnosing learning difficulties of the students. Evaluation is of two types: Formative and Summative (Internal and External Evaluation)

Formative Evaluation

It is an on-going evaluation process. Its purpose is to provide continuous and comprehensive feedback to students and teachers concerning teaching-learning process. It provides corrective steps to be taken to account for curricular as well as co-curricular aspects.

Summative Evaluation

It is carried out at the end of a unit of instruction like topic, subject, semester or year. The main purpose of summative evaluation is to measure achievement for assigning course grades, certification of students and ascertaining accountability of instructional process. The student evaluation has to be done in a comprehensive and systematic manner since any mistake or lacuna is likely to affect the future of students.

In the present educational scenario in India, where summative evaluation plays an important role in educational process, there is a need to improve the standard of summative evaluation with a view to bring validity and reliability in the end-term examination system for achieving objectivity and efficiency in evaluation.

STUDENTS' EVALUATION AREAS

The student evaluation is carried out for the following areas:

- Theory
- Practical Work (Laboratory, Workshop, Field Exercises)
- Project Work
- Professional Industrial Training

A. 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 sessional /class- tests, home-assignments, tutorial-work, seminars, and group discussions etc. For end-term evaluation of theory, the question paper may comprise of three sections.

Section-I

It should contain objective type items e.g. multiple choice, matching and completion type. Total weightage to Section-1 should be of the order of 20 percent of the total marks and no choice should be given in this section. The objective type items should be used to evaluate students' performance in knowledge, comprehension and at the most application domains only.

Section-II

It should contain short answer/completion items. The weightage to this section should be of the order of 40 percent of the total marks. Again, no choice should be given in section-II

Section-III

It may contain two to three essay type questions. Total weightage to this section should be of the order of 40 percent of the total marks. Some built-in, internal choice of about 50 percent of the questions set, can be given in this section

Table II : Suggested Weightage to be given to different ability levels

Abilities	Weightage to be assigned
Knowledge	10-30 percent
Comprehension	40-60 percent
Application	20-30 percent
Higher than application i.e. Analysis, Synthesis and Evaluation	Upto 10 percent

B. Practical Work

Evaluation of students performance in practical work (Laboratory experiments, Workshop practicals /field exercises) aims at assessing students ability to apply or practice learnt concepts, principles and procedures, manipulative skills, ability to observe and record, ability to interpret and draw conclusions and work related attitudes. Formative and summative evaluation may comprise of weightages to performance on task, quality of product, general behaviour and it should be followed by viva-voce.

C. Project Work

The purpose of evaluation of project work is to assess students ability to apply, in an integrated manner, learnt knowledge and skills in solving real life problems, manipulative skills, ability to observe, record, creativity and communication skills. The formative and summative evaluation may comprise of weightage to nature of project, quality of product, quality of report and quality of presentation followed by viva-voce.

10 RECOMMENDATIONS FOR EFFECTIVE CURRICULUM IMPLEMENTATION

This curriculum document is a Plan of Action and has been prepared based on exhaustive exercise of curriculum planning and design. The representative sample comprising selected senior personnel (lecturers and HODs) from various institutions and experts from industry/field have been involved in curriculum design process.

The document so prepared is now ready for its implementation. It is the faculty of polytechnics who 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 a proper mix of different teaching methods in all these places of instruction only can bring the changes in stipulated students behaviour as in the curriculum document. It is important for the teachers to understand curriculum document holistically and further be aware of intricacies of teaching-learning process (T-L) for achieving curriculum objectives. Given below are certain suggestions which may help the teachers in planning and designing learning experiences effectively. These are indicative in nature and teachers using their creativity can further develop/refine them. The designers of the programme suggest every teacher to read them carefully, comprehend and start using them.

(A) *Broad Suggestions:*

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 and made available to all polytechnics well in advance. The Principals have a great role to play in its dissemination and, percolation upto grass-root level. Polytechnics, in turn are supposed to prepare institutional academic plan.

3. HOD of every Programme Department along with HODs and incharges of other departments are required to prepare academic plan at department level referring to institutional academic plan.

4. All lecturers/Senior lecturers are required to prepare course level and class level lesson plans referring departmental academic plan.

(B) *Course Level Suggestions*

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.

Polytechnic 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 of time. It is essential for them to use the given time judiciously by planning all above activities properly and ensure execution of the plan effectively.

Following is the gist of suggestions for subject teachers to carry out T-L process effectively:

1. Teachers are required to prepare a course plan, taking into account departmental academic plan, number of weeks available and courses to be taught.

2. 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. They may follow steps for preparing lesson plan e.g. drawing attention, state instructional objectives, help in recalling pre-requisite knowledge, deliver planned subject content, check desired learning outcomes and reinforce learning etc.

3. Teachers are required to plan for expert lectures from field/industry. Necessary steps are to plan in advance, identify field experts, make correspondence to invite them, take necessary budgetary approval etc.

4. 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.

5. Concept and content based field visits may be planned and executed for such content of course which is abstract in nature and no other requisite resources are readily available in institute to impart them effectively.

6. There is a dire need for planning practical experiences in right perspective. These slots in a course are the avenues to use problem based learning/activity learning/ experiential learning approach effectively. The development of lab instruction sheets for the course is a good beginning to provide lab experiences effectively.

7. Planning of progressive assessment encompasses periodical assessment in a semester, preparation of proper quality question paper, assessment of answer sheets immediately and giving constructive feed back to every student

8. The student centred activities may be used to develop generic skills like task management, problem solving, managing self, collaborating with others etc.

9. Where ever possible, it is essential to use activity based learning rather than relying on delivery based conventional teaching all the time.

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 for wastage of energy and other resources etc.

12. Students may be given relevant and well thought out project assignments, which are purposeful and develop practical skills. This will help students in developing creativity and confidence for their gainful employment.

13. A Project bank may be developed by the concerned department of the polytechnics in consultation with related Industry, research institutes and other relevant field organizations in the state.

11- GUIDELINES FOR ASSESSMENT OF STUDENT-CENTRED ACTIVITIES (SCA)

It was discussed and decided that the maximum marks for SCA should be 50 as it involves a lot of subjectivity in the evaluation. The marks may be distributed as follows-

15 Marks for general behaviour and discipline

(by HODs in consultation with all the teachers of the department)

10 Marks for attendance as per following:

(by HODs in consultation with all the teachers of the department)

a) 75 - 80% 06 Marks

b) 80 - 85% 08 Marks

c) Above 85% 10 Marks

25 Marks maximum for Sports/NCC/Cultural/Co-curricular/NSS activities as per following:

(by In-charge Sports/NCC/Cultural/Co-curricular/NSS)

a) 25 - State/National Level participation

b) 20 - Participation in two of above activities

c) 15 - Inter-Polytechnic level participation

12 LIST OF PARTICIPANTS

The following experts have participated /contributed in workshop for Developing the Curriculum scheme/competency profile according to AICTE and NEP-2020 of Three Year Diploma Course in Glass & Ceramic Engineering at Central For Development of Glass Industry (C.D.G.I), Firozabad.

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