

DCI - CBCS Framework for BDS 2022

Course (Subject) Name: Dental Materials

Aim and Scope of Dental Materials:

Aim of the course is to present basic chemical and physical properties of Dental materials as they are related to its manipulation to give a sound educational background. To understand the evolution and development of the science of dental material. Knowledge of physical and chemical properties. Knowledge of biomechanical requirements of particular restorative procedure. Search for newer and better materials which may answer our requirements with greater satisfaction.

Course Prerequisites:

Candidates should have completed the following courses to be eligible to take up this course. Universities can have additional prerequisites in their curriculum.

1. NIL

Course Credits:

Each theory credit is equivalent to 1 theory hour / week / semester; each practical credit is equivalent to 2 practical hours per week per semester. According to Dentist act 1948 dental schools should work for 240 working days and this computes to 20 weeks per semester inclusive of the exam duration. Therefore, as per regulations, 1 dental theory credit is equivalent to 20 lecture hours and 1 dental practical credits is equivalent to 40 practical/ clinical hours.

Universities shall have the freedom to increase the credits based on needs in their curriculum but the total credits cannot be lesser than that prescribed by the DCI.

	Credits	Hours
Theory	4	80
Practical/ Clinical	6	240
Total	10	320

Course Deployment:

Universities can choose to train their students using the following modules and/or design additional core / elective modules without reducing the minimum required total credits.

Option 1 : Single Module				
	Course Name	Didactic Credits	Practical Credits	Total Credits
1	Dental Materials	4	6	10
Total Credits: 10				

Course Objectives:

The Student should be able to

1. Understand about the various categories of materials used in dentistry – metals, polymers, ceramics, cements, along with its chemistry and their applications
2. Have theoretical knowledge on the Indications, Composition, Setting reaction, Physical and Mechanical properties and technical considerations for all materials.
3. Should develop basic knowledge about new material development for use in dentistry.

DOMAINS:

Knowledge and Understanding: The student should demonstrate adequate knowledge about the various categories of materials used in dentistry – metals, polymers, ceramics, cements, along with its chemistry. Should have theoretical knowledge on the Indications, Composition, Setting reaction, Physical and Mechanical properties and technical considerations for all materials.

Applications: The student should demonstrate adequate knowledge about the indications and applications of various dental materials and to manipulate and utilize dental materials for chair side and laboratory procedures. They should also be capable of applying the theoretically obtained knowledge in new material development

Procedural Skills to acceptable level of competency: The student should demonstrate procedural skills to acceptable level of competency in manipulation of various dental materials and technical considerations pertaining to the same.

Course Content

Theory: The theoretical aspects in Dental Materials would encompass the following areas.

1. Basic properties of Dental Materials - physical chemical and mechanical properties, chemistry of polymerization and biocompatibility - 10%
2. Impression material composition and its properties- 10%
3. Gypsum products and waxes and the laboratory procedures associated with its use in denture fabrication- 10%
4. Direct Restorative material properties and its application- 20%
5. Indirect Restorative materials and its application- 20%
6. Denture Base resins - 10%
7. Implant and maxillofacial biomaterials- 10%
8. Metallurgical characteristics, wrought alloys, soldering and welding - 10%

The teaching learning and assessment strategy adopted should be feasible, appropriate at the undergraduate level. Non-didactic modes like Flipped classroom, problem based learning, case based/modified case based learning, problem solving strategies can be adapted for teaching theoretical aspects. Maximize the use of demonstration of concepts or techniques using videos, role plays and other audio-visual aids. All the assessment of theoretical components should be carried out using assignments, unit tests, mini interviews and internal assessment. The completion of the above only be considered for eligibility to appear and internal assessment apart from the attendance. Final assessment would be done through structured written examination and structured viva —voce examinations.

Horizontal and Vertical Integration: Please refer to the section on integration for the list of integrated topics. Individual institutions can integrate in other areas which are found appropriate for development of modules for training. [See document on Integration]. The number of hours for integration of all the courses should be consolidated and checked for availability with the total number of hours distributed.

Practical/Clinical Procedures: All the Practical and Procedural Skills should be taught using standard /innovative methods in educational sciences which is deemed appropriate for the specialty. Feasibility of training and assessment should be checked before implementation. All practical procedures should be taught using DOAP — Demonstration, Observation, Assisting and Performance approach. Individual supervision with constructive feedback and student's reflections form a crucial part in the teaching/ training/ learning of a particular skill.

Demonstration of Practical/Clinical Procedures: The student should demonstrate the learning, during assessment in the formative, internal and summative examination. Criteria based/ checklist based assessment should be used for assessment. DOPS — Direct Observation of Practical Skills should be used for assessing the demonstrable

skills like practical procedures. The demonstration of procedures/practical skills should be based on a blueprint declared in the scheme of examination. [See document on Scheme of Examination] Number of Competencies which needs certification: [20]

Recommended Book and Reading

1. Phillips' Science of Dental Materials; Kenneth Anusavice, ChiayiShen, H.Ralph Rawls; 12th Edition; Saunders (Elsevier); 2012.
 2. Restorative Dental Materials – 10 edn. Robert G.Craig
 3. Notes on Dental Materials – E.C. Combe
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Course Competency Outcomes:

A candidate completing this course should be able to demonstrate

No:	Major Competencies	Detailed Competency Codes
Knowledge and Understanding, Application		
MC1	Should have knowledge and understanding about physical, chemical, mechanical properties, biocompatibility of dental materials.	1.1,1.2,1.3,1.4,1.5,1.6,3.5
MC2	Should have theoretical knowledge on the Indications, Composition, Chemistry, Properties and use of auxiliary dental materials (Impression materials, Gypsum products, Waxes, Casting investment and casting procedures, materials for finishing and polishing)	2.1,2.3,2.5,2.6,2.7,2.9
MC3	Should have theoretical knowledge on the Indications, Composition, Chemistry, Properties and use of direct restorative materials (Bonding, Composites, Cements Direct filling gold and amalgam)	3.3,3.8,3.10,

MC4	Should have theoretical knowledge on the Indications, Composition, Chemistry, Properties and use of indirect restorative materials (Ceramics, Casting alloys, Wrought alloys)	2.6,2.8,3.9,3.12,3.13
MC5	Should have theoretical knowledge on the Indications, Composition, Chemistry, Properties and use of denture base resins and oral and maxillofacial prosthetic materials	3.1,3.2,3.14,3.15
Procedural Skills		
MC6	Ability to manipulate and utilize dental materials for chair side and laboratory procedures.	2.2,2.4,3.4,3.7,3.11
Evidence Based Learning		
MC7	Consolidate all above-mentioned major competencies acquired during the course and integrate newer evidence based knowledge to display expertise in the application of various dental materials into clinical practice	

CO Competency Attainment Evaluation:

Each course evaluation shall be conducted for 200 marks.

- Summative theory 70 marks
- Summative practical 90 marks
- Viva 20 marks
- Formative Assessment (IA) 20 marks

Universities can add additional formative theory and practical scores to improve student engagement. These scores can be added to their CGPA, however, they cannot be computed below the minimal stipulated requirements prescribed by the DCI. These scores can be converted to CGPA as per [UGC guidelines to prepare marksheets and transcripts](#).

1. **Summative Theory (Competency 7).** The final exam should test all the knowledge consolidated across various formative exams and also explore the students ability to interpret and integrate new information into their existing

understanding. Universities shall conduct theory exams for 70 marks that can include but not limited to the following domains.

- a. Evidence Based Dentistry
 - b. Concept mapping/ Short notes
 - c. Objective type questions (Clinical situations/ Case based Scenarios/ Analytical questions)
2. **Formative Theory:** The following major competencies need to be evaluated during various formative theory exams.
- a. Major Competency 1,
 - b. Major Competency 2,
 - c. Major competency 3
 - d. Major competency 4
 - e. Major competency 5

Universities or Departments can mandate individual exams with focus on each major competency to easily document / analyze competency attainment across all enrolled students. If the department chooses to conduct a combined exam to evaluate 2 or more competencies, then it is suggested that the question papers are divided into sections to focus on a single major competency. In such cases, result analysis should be done for each section to measure competency attainment.

3. **Summative Practical**

The final practical exam shall be conducted for 90 marks. The following skills / competencies can be evaluated in the final exam.

- A. Manipulation of impression material (Major competency 6)
- B. Manipulation of restorative material (Major competency 6)
- C. Spotter identification (Major competency 2,3,4,5)

Modern methods of evaluations like OSCE, OSPE can be used to document student performance. Institutions should deploy at least one innovative evaluation method and evaluate its effectiveness as a part of education development.

4. **Viva-voce** (Major Competency 1,2,3,4,5)

The final exam should test all the knowledge consolidated during the entire course and also explore the students ability to interpret and integrate new evidence based information into their existing understanding.

5. **Formative Practical**

The evaluation shall include but not be limited to the following exercises. Formative evaluation shall be consolidated into internal marks of 20 in the overall grading. Universities are encouraged to include additional formative scores for grading

but this cannot affect student progression. These additional scores can only be used for merit but not to determine pass / fail of a candidate.

- A. Documentation of restorative materials manipulation (Amalgam, Zinc phosphate cement - luting & base, glass ionomer cement - type 1 & 2, Zinc polycarboxylate cement, zinc oxide eugenol cement, intermediate restorative material, calcium hydroxide powder, Dycal, resin cement) - (Major competency 5)
- B. Documentation of impression materials manipulation (Impression compound, Zinc Oxide Eugenol, Irreversible Hydrocolloid, Elastomeric Impression materials) (Major competency 5)
- C. Documentation of manipulation of auxillary dental materials (Model plaster, dental stone, die stone) (Major competency 5)
- D. Manipulation and handling of Restorative material (Major Competency 5)
- E. Manipulation and handling of Impression materials (Major Competency 5)
- F. Documentation of manipulation auxillary materials (Major Competency 5)
- G. Identification and description about application of dental materials - Spotters (Major Competency 2,3,4,5)

Departments can conduct individual exercises with focus on each major competency to easily document / analyze competency attainment across all enrolled students. If the department chooses to conduct a combined exercise to evaluate 2 or more competencies, then it is suggested that the assessment rubrics are divided into sections, with each section focusing on a single major competency.

Detailed Competency Framework grouped Based on Domains and Levels

Knowledge:

1. An overview and introduction to Dental Materials

1.1 Describe the role of standards and organisations in materials, requirements of materials, classification of materials.

1.2 Explain the structure of matter and materials used in dentistry in their basics and help the students to understand the nature of the materials based on their structural components.

1.3 Describe the importance of adhesion with respect to restorative materials used in dentistry along with properties of wetting ability and contact angle of various dental materials.

1.4 To explain the physical properties like rheology, flow, optical properties, tarnish, corrosion, creep and flow of various dental materials and their application in clinical practice.

1.5 To explain the mechanical properties like modulus of elasticity, interpret stress strain curve, differentiate between strength toughness, fatigue failure, fracture resistance, endurance limit, impact strength and hardness with various dental examples.

1.6 To understand the importance of biological compatibility of various dental materials used and to realize various reactions that could occur in normal and compromised conditions of the body.

2. Auxiliary dental materials

2.1 Describe various gypsum products with respect to origin, chemical formula and reactions, classification, types, mode of supply, explain their composition and their commercial name, structure of each type manipulation characteristics, uses, mechanical behavior, handling of the material including disinfection and their properties when it is put to use in dentistry, and recent advancements.

2.3 Describe the background of evolution of various dental impression materials, definition, classify them, explain their composition and their commercial name, manipulation, mode of supply, shelf life and storage, disinfection, chemical reactions, ideal properties, clinical applications, advantages, disadvantages, and recent advances.

2.5 Explain the evolution of wax as an impression material and auxiliary material for laboratory use, mode of supply, their classifications and types, basic composition, source, uses, understand their manipulation characteristics, properties including recent advances.

2.6 Explain the use of various casting investments, classification, composition, setting reaction, properties, manipulation, technical considerations including recent advances.

2.7 Explain the steps involved in casting procedure from wax pattern to casting finishing and polishing. List causes of failure and steps to prevent them.

2.8 Explain soldering, welding and brazing, flux, solders - types, requirements, composition, indications, specifications and techniques in dental use including recent advances.

2.9 Explain abrasion, cutting, grinding, contouring, finishing and polishing - definition, indications, types, principles, desirable characteristics, technical considerations.

3. Restorative dental materials:

3.1 Explain evolution, chemistry of synthetic resins, classification, requirements, applications, polymerisations, properties and structure.

3.2 Explain the mode of polymerization supply, application, composition, technical considerations, properties of denture base resins, soft liners, provisional crown materials, resin teeth, infection control including denture cleansers and denture adhesives including recent advancements

3.3 Explain the evolution, types, mode of supply of composite resin including composition, polymerization, Properties, applications, biocompatibility, Manipulation, techniques of insertion, Finishing and polishing of restoration, Repair of composites Bonding, Enamel, dentin bonding acid etching, extended application for composites resins including recent advances.

3.5 Explain the structure and behavior of metals and alloys, solidification, mechanism of crystallization, classification, constitutional phase diagrams, properties, solid state reaction, heat treatment.

3.6 Explain the evolution with reference to the current state of the use of Dental Amalgam including definition, application, classification, manufacture, composition, mode of supply, setting reaction, properties, Clinical performance, manipulation, restoration and repair of amalgam, mercury toxicity, mercury hygiene.

3.8 Explain the evolution of direct filling gold its properties, classification, manipulation.

3.9 To explain types, structure, properties and manipulation and clinical use of wrought alloys.

3.10 Explain various forms of cements, liners, varnishes, restorative, luting cements and pulp protecting agents in their mode of supply, chemical composition, nature, setting mechanism, manipulation characteristics and usage in clinical dental practice including recent advances.

3.12 Explain the evolution of various types of ceramics [PFM and metal free ceramics] with respect to composition, properties, methods of strengthening, biocompatibility and manipulation, fabrication techniques including CAD CAM, technical considerations including recent advances.

3.13 Explain various procedures involved in porcelain fused to metal and metal

free ceramic restorations including CAD CAM.

3.14 Explain the development of maxillofacial materials with special importance to acrylic, silicones and their manipulation, including characterisation using colouring agents and adhesives used.

3.15 Explain the development and classification, including properties and surface characteristics of implant materials including biomaterials used for grafting and osseointegration.

SKILLS:

2.2 Manipulate model plaster and dental stone and die stone and understand the importance of W:P ratio, influence of various external physical conditions and chemical agents on the working time and setting time.

2.4 Manipulate irreversible hydrocolloids, impression compound, zinc oxide eugenol and elastomeric impression materials and observe their behavior under various physical conditions, influence of external agents and their properties of elastic recovery, dimensional stability, detail reproduction including disinfection

3.4 Manipulate resins under controlled conditions with correct specifications and understand their behavior of stages during setting, mode of setting with their manipulation characteristics composite resins, denture base resins.

3.7 Manipulate silver amalgam alloy and demonstrate mercury hygiene practice

3.11 Manipulate various dental cements using appropriate instruments.