STUDY GUIDE	
PROGRAM	**BDS**
COURSE TITLE	**Dental Materials**
ACADEMIC YEAR	**2nd year, 2023**
INTRODUCTION	This course delivers the didactic knowledge of basic principles of dental materials along with training the students in various laboratory and clinical techniques. It familiarizes the future dentists with clinical selection and handling techniques of various dental materials.
RATIONALE	Dentists are the end-users of dental materials, in student as well as professional life. It is essential to study Dental Materials Science to enhance understanding of properties and clinical uses of all the things they will be handling in their future as a dentist for betterment of the patients.
OUTCOMES	By the end of the course students will be able to select, handle and manipulate dental materials in the best interest of patients.
DEPARTMENTS INVOLVED	Department of Dental Materials
COURSE OBJECTIVES	By the end of the course, the students will be able to: <u>INTRODUCTION, SELECTION AND EVALUATION OF DENTAL MATERIALS</u> • Define Dental Materials Science. • Identify the different materials used in dentistry. • Classify the various dental materials. • Report the criteria for dental material selection and evaluation in relation to the clinical problem to be addressed. <u>BIOCOMPATIBILITY AND BIOLOGICAL EVALUATION OF MATERIALS</u> • Define biocompatibility, post-operative sensitivity, hypersensitivity (Type IV). • Discuss the toxicity-corrosion • Discuss the influence of dental materials on biological systems • Discuss the performance of dental materials with regard to in-vitro and in-vivo tests and clinical trials. <u>BIOMATERIALS</u>

	• Relate interaction of dental biomaterials (DBMs) with the biological system. • Discuss the use of DBMs in the body • Describe the scaffolds in materials • Explain the tooth and tissue engineering. • Describe different biomaterials in use. <u>BIOMECHANICS</u> • Discuss biomechanics of dental amalgam, metals, ceramic and resin-based materials. <u>BIOMATERIAL TESTING</u> • Discuss the in-vivo and in-vitro models • Discuss the three levels of testing and usage of dental biomaterials. • List the names of biomaterial quality assurance and monitoring agencies. • Discuss the importance of clinical tests and randomised clinical trials (RCTs) as the gold standard in biomaterial testing. <u>PROPERTIES OF DENTAL MATERIALS</u> • Describe the ideal properties of dental materials. • Discuss the various physical, mechanical, thermal, rheological, biological and chemical properties of materials • Describe wettability and its significance • Describe the stress and strain relationships of different dental materials • Illustrate stress and strain relationships of different dental materials • Describe tooth wear and its types • Discuss the reaction of material under oral conditions • Describe risk/benefit analysis • Differentiate between/among the following: - Absorption, adsorption and sorption; - Adhesion and cohesion; - Mechanical and chemical adhesion;

	- Radioopacity and radiolucency; - Thermal conductivity and thermal diffusivity; - Creep and flow; - Chemical and electrochemical corrosion. • Describe the factors affecting color, appearance and selection of materials. • Justify the selection of materials on the basis of their mechanical properties. • Relate flow characteristics of dental materials with their behavior. • Compare the different features of fluid behavior. • Discuss the various states of materials during their mixing, manipulation and oral conditions <u>ELASTIC AND NON-ELASTIC IMPRESSION MATERIALS</u> • Classify impression materials. • Describe ideal properties of impression materials. • Explain the steps of impression making and significance of each step • Describe impression materials as duplicating materials • Describe the general requirements, manipulative variables, application and clinical considerations of impression materials • Describe the tissue management and cross infection control • Discuss the composition, properties, indications, contraindications of elastic impression materials. • Identify the different types of impression materials used in dentistry. • Justify selection of impression materials for different cases • Mix alginate impression powder and water in the recommended ratio. • Record an alginate impression on a phantom head. <u>GENERAL INTRODUCTION AND CLASSIFICATION OF GYPSUM PRODUCTS</u> • Write the chemical formula of dental gypsum • Write the setting reactions of dental plaster and dental stone.

	• Describe the compositions of dental plaster and dental stone. • Classify gypsum according to ISO standard. • Describe the requirements of dental cast materials. • Describe the setting characteristics of dental plaster and the set material. • Define die and cast. • Describe the advantages and disadvantages of gypsum • Describe the various types of die materials. <u>MANIPULATIVE VARIABLES AND SETTING CHARACTERISITICS</u> • Manipulate gypsum materials using the recommended technique. • Build a plaster slab following the allocated dimensional guidelines. • Justify any visualised change in slab dimensions during and after completion of setting • Pour plaster models according to the recommended technique • Fabricate plaster models. • Trim plaster models. • Perform finishing of plaster models. <u>MANUFACTURING PROCESSES</u> Explain dry and wet calcination for producing dental plaster and dental stone <u>IDEAL REQUIREMENTS,PROPERTIES,APPLICATIONS AND CLASSIFICATION OF DENTAL WAXES</u> • Classify dental waxes according to their use and origin. • Explain the components and applications of different types of dental waxes in dentistry. • Describe the ideal requirements for wax pattern materials • Describe the Properties of dental waxes; • Describe the steps of partial dental construction. • Design partial denture on study models. • Identify Kennedy's Class (including modifications) on models and pictures of dentures and dentition

	• Justify the use of waxes for partial denture pattern. • Perform wax-up on dental model according to the recommended guidelines SYNTHETIC POLYMERS • Define polymethylmethacrylate (PMMA), synthetic resins, acrylics, polymer, monomer, polymerization and self-, light- and heat-cured • Describe stages of polymerization. • Describe structure and properties of synthetic polymers. • Classify synthetic and prosthetic laboratory resins. • Describe the types, composition, characteristics, clinical application, manipulation the of synthetic and prosthetic laboratory resins. DENTURE BASE POLYMERS • Discuss the requirement of denture base materials • Describe the properties of acrylic resin as a denture base material • Describe the composition, manipulation and processing of denture base polymers • Explain the Alternative denture base material; • Discuss the temporization (chairside and laboratory) in light of appropriate PMMA material based selection and setting chemistry. • Mix monomers according to standard ratios. • Identify the physical stages of PMMA polymerisation (cold cure). • Fabricate an acrylic partial denture. DENTURE LINING MATERIALS • Discuss the hard reline materials, tissue conditioners, temporary soft lining materials and permanent relining materials. SEPERATING MEDIA • List the different types of separating media used in dentistry. • Discuss the clinical and laboratory indications and applications of separating media. INTRODUCTION AND CLASSIFICATION OF DENTAL CEMENTS

	• Classify dental cements. • Differentiate between temporary and final cements. <u>MANIPULATION AND SETTING CHARACTERISTICS</u> • Mix zinc phosphate cement as a luting agent and base following the recommended technique • Mix glass ionomer cement as a luting agent following the recommended technique • Mix calcium hydroxide as a cavity lining agent following the recommended technique <u>APPLICATION OF DENTAL CEMENTS</u> • Compare the types of dental cements on the basis of their uses as intra pulpal medicaments, bases, lining, luting and restorative materials. • Discuss the requirements of dental cements for cavity lining, luting, endodontic and orthodontic purposes. <u>INTRODUCTION, STRUCTURE AND PROPERTIES OF METALS AND ALLOYS</u> • Discuss microleakage, creep, galvanism, tarnish, corrosion • Discuss the significance of cubic crystal structure and eutectic alloys • Discuss the properties of alloys; • Discuss the crystallization process in metals • Discuss the coring, homogenization and solid-state reactions occurring in alloys. • List different methods of metal shaping in dentistry. <u>GOLD AND ALLOYS OF NOBLE METALS</u> • Discuss the types and properties of pure gold fillings and casting gold alloys • Discuss heat treatments. • Compare the soldering and brazing materials on the basis of their properties. • Describe composition of pure gold fillings and casting gold alloys.

	• Classify gold and alloys of noble metals. BASE METAL CASTING ALLOYS • Compare the different types of base metal casting alloys on the basis of their properties and clinical indications. STEEL AND WROUGHT ALLOYS • Identify the different types of wrought alloys. • Discuss cold working, annealing, welding and soldering. • Discuss the properties of steel and wrought alloys with respect to their clinical applications. • Construct alphabets A, B, G, S using 0.7 mm SS wire on the given outlines • Construct clasps for partial denture according to the standard protocol INVESTMENT MATERIALS • Differentiate between different types of investment materials. • Discuss the composition and physicochemical properties required to manipulate investment materials. CASTING • Illustrate the formation of investment mould • Illustrate the casting process/lost wax technique. • Discuss casting process/lost wax technique. • Discuss the faults in casting COMPOSITION AND PROPERTIES OF CERAMICS AND POCELAIN FUSED TO METAL • Classify the major types of ceramics. • Compare the major types of ceramics on the basis of their composition, physical and optical properties. • Relate the composition and properties of ceramics to their manufacturing clinical applications and performance. PREPARATION OF PORCELAIN AND TYPES OF CERAMIC • Discuss compaction and firing.

	• List types of ceramic restorations. • Describe the principles of preparation of ceramic restorations. CAD CAM RESTORATIONS • Discuss the fundamental concept behind computer aided prosthesis design. INTRODUCTION TO DENTAL AMALGAM • Discuss the requirements and historical perspective of direct restorative materials. • Describe the primary purpose of each component of amalgam alloy. • Discuss the importance of the role of mercury/alloy ratio and its effect on the setting reaction and restorative procedures. SETTING CHARACTERISTICS AND PROPERTIES • Discuss the setting chemistry associated with amalgam production. • Discuss properties of dental amalgam. CLINICAL HANDLING AND MANIPULATIVE VARIABLES • Discuss the ideology of Black's cavity design; • Discuss the cavity design and matrices with regard to properties of the material. • Justify Black's cavity design as an unchallenged baseline • Relate the manipulative parameters of amalgam with the properties of the final restoration. ENVIRONMENTAL CONSIDERATIONS OF DENTAL AMALGAM • List the hazards of incorrect handling of mercury. • Discuss the importance of mercury hygiene, mercury/amalgam scrap handling and disposal at chair side. INTRODUCTION TO DENTAL COMPOSITE RESIN BASED RESTORATIVE MATERIALS • Classify dental composites. • Describe historical pretext of dental composites • Describe components and composition of dental composites.

	• Discuss the use of resin based dental composite materials for restorative procedures PROPERTIES AND SETTING CHARACTERISTICS OF RESIN BASED RESTORATIVE MATERIALS • Discuss general properties of composites. CLINICAL HANDLING AND MANIPULATIVE VARIABLES • Discuss the filler particle size, setting reaction and method of manufacture of dental composite resin based restorative materials with respect to the properties and behavior of the materials in situ. • Discuss the use of composites in vivo. • Describe new resin-based restorative material variants INTRODUCTION TO ADHESION • Describe adhesion, acid etching, conditioning and priming. • Illustrate the general mechanistic aspects and approaches to adhesion. BONDING SYSTEMS AND SMEAR LAYER • Describe the enamel and dentin bonding agents; • Discuss the various bonding systems. • Discuss the smear layer and its importance as a determinant of clinical success of dental composites BONDING AT TOOTH RESTORATION INTERFACE • Describe hybridization in relation to dental composites. • Discuss the dental composite adhesion to tooth structure based on the principles of micromechanical attachment. INTRODUCTION TO GLASS IONOMER • Discuss the historical importance of glass ionomer cements (GIC) as restorative cements. • Discuss the constituents of GIC with respect to its properties. SETTING CHARACTERISTICS AND MANIPULATIVE VARIABLE OF GIC • Describe the setting reaction of GIC • Describe fluoride release and ion exchange

	• Describe the interaction among GIC and the external environment and tooth interface • Describe the dimensional stability of GIC • Relate the properties of set GIC to its clinical manipulation and performance. <u>MODIFIED GIC RESTORATIVE MATERIAL</u> • Justify the development of resin-modified glass ionomers. • Discuss the significance of modified GIC constituents, their influences on properties and clinical performance of material. • Discuss the properties, performance and clinical indications of cermet. <u>INTRODUCTION TO ENDODONTIC MATERIALS</u> • Describe root canal treatment. <u>IRRIGANTS AND LUBRICANTS</u> • Discus the intra-canal medicaments and filling materials used in endodontic treatments • Discuss clinical handling characteristics of endodontic materials for optimal treatment outcomes <u>PROPERTIES AND CLINICAL APPLICATIONS OF ARTIFICIAL TEETH</u> • Describe the techniques for manufacturing artificial teeth. • Differentiate between acrylic and porcelain teeth. • List the requirements of artificial teeth. • Perform teeth set-up on the given model using the recommended technique • Justify selection of artificial teeth in various clinical applications. • Identify the various types of artificial teeth and waxes <u>INTRODUCTION AND GENERAL CONCEPTS OF FINISHING AND POLISHING MATERIALS</u> • Describe finishing and polishing of dental prostheses and restorative materials.

	• Identify equipment used in finishing and polishing of dental restorations.
PRACTICALS	By the end of the course, students of 2nd year BDS will be able to: <u>PLASTER SLAB AND PLASTER BLOCK FABRICATION</u> • Fabricate at least two plaster slabs and plaster blocks (approved by the supervisor) following the mixing guidelines for gypsum and water as given in the logbook. <u>WIRE BENDING</u> • Fabricate at least two A, B, G and S (approved by supervisors) with 0.7mm wire using different pliers following the instructions given in the logbook. <u>FABRICATION OF ADAM'S CLASP</u> • Fabricate at least one Adam's clasp (approved by supervisors) with 0.7mm wire using different pliers on a plaster model following the instructions given in the logbook. <u>IMPRESSION TAKING</u> • Take impressions of both maxilla and mandible of a simulated patient following the guidelines provided in logbook. <u>POURING</u> • Make a model/cast by pouring dental stone in the impressions taken, following the recommended guidelines.
INTERNAL ASSESSMENT	10% (Pre-professional Examination, Midterm Examination, Assignments and Class Presentations)
ANNUAL EXAMINATION	90% (MCQS, OSPE)
COURSE EVALUATION	This course will be evaluated as per JSMU & HEC policies