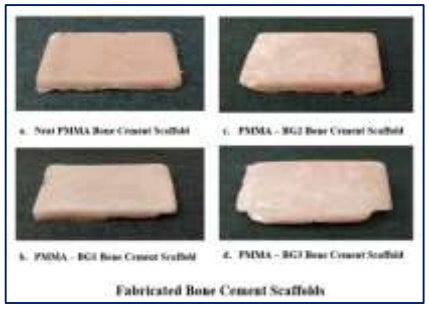
Final Year Project Showcase for Batch-2016

Department of Biomedical Engineering

1	**Project Idea**	Bone cement is a major source to achieve the bone fixation through cemented anchorage. For over 60 years, PMMA-based bone cement is playing significant role in surgical fixation of artificial joints. PMMA-based bone cements have been used due to their cost effectiveness, biocompatibility, good mechanical strength and easy processing. However, these materials lack in suitable biodegradation rate, bioactivity and connectivity with host bone tissues. These limitations can be tailored by inclusion of different components (such as: bio-glass, hydroxyapatite or nanofillers). In this research work, we proposed to solve these limitations by incorporation of bioglass with variations in its composition. For this purpose, we prepared different samples of PMMA-based bone cement with varying composition of bioglass and characterized to study the effects on mechanical, physical and thermal properties.
2	**Process**	Product manufacturing takes place in biochemistry laboratory of biomedical department, NEDUET where raw materials are converted into gel form, followed by aging and drying process at specific temperature in lab oven. Dried samples are then thermally treated in muffle furnace, resulting crystalline compound which is then blended manually with other materials to obtain our final product. Proper handling and keen observations are required during its production**.** The completed item is then lab-tried for intensity, which is finished by parcel number for this purpose product samples are sent to materials department, NEDUET.
3	**Outcome**	Sample materials are characterized by specialized or proprietary machinery such as Fourier Transform Infrared Spectroscopy (FTIR), X-Ray Diffraction (XRD), Thermogravimetric Analysis (TGA), Diffraction Scanning Calorimetry (DSC), Vickers Hardness and Stereo microscopy.
4	**Evidences (Theoretical Basis)**	FYP thesis has been submitted to FYP coordinator of our department.
5	**Competitive Advantage or Unique Selling Proposition** Among different types of bio glass (such as silicate, borate, phosphate and metallic), silicate-based bio-glass (45S5) has been selected due to excellent biocompatibility, bioactivity, biodegradability and osteogenesis. From market analysis, most bone cements are PMMA based but either they have poor strength or poor biological response for long term use, and they need to be replaced after surgery. To the best of our knowledge, the effect of 45S5 bio-glass composition variation (using ‘Magnesium’ and ‘Borate’ elemental doping) has not been studied together with PMMA-based cement. We believe that our product would be of unique nature in all these aspects and will aid to commercialization for long term positive biological responses.	

a	**Cost reduction of existing Product**	As our product is in introductory stage of product life cycle and unique product as well so we will be using skimming price strategy (i.e., setting a high price to collect maximum profit in short duration).
b	**Process Improvement which leads to superior product or cost reduction, efficiency improvement of whole process**	Issues which we faced during production and potency test is unavailability of certain specific equipments. **Our Suggestion**: Either high potency test equipments/facilities should be arranged within biomedical department of N.E.D. university or university fund regulating bodies should provide enough funds so that we can characterize and easily produce our desired product on bigger and better scale by sending our product samples to different institutes within home city Karachi or abroad.
c	**Attainment of any SDG**	Every day several individuals fall victim to accidents leading to severe bone injuries and trauma mainly caused by bicycles/motor vehicle accidents and they may lose fragments of bone which obligate immediate bone implantation. The unavailability of donors and cadaveric tissues suffice for synthetic bone cement. Therefore, need of synthetic bone cement is increasing day by day. We intend to resolve this need by our research work. This research will provide synthetic bioactive bone cement which can address such problems by its excellent biocompatibility, strength, rapid bone formation and its antibacterial as well as bioactive nature.
d	**Expanding of Market share**	The worldwide bone concrete market is developing effectively from 2019 to 2027 certify to the ascent in hip and knee substitution methods, spinal medical procedures, and dental inserts on a worldwide scale. The polymethyl methacrylate (PMMA)- based acrylic bone concrete is broadly used and produced greatest income share comprehensively. The new dispatch of biomaterials with higher compressive quality as powder and fluid will drive the market development soon. An upcoming Transparency Market Research (TMR) report reveals insight into the momentum and future patterns of the worldwide orthopedic bone concrete market**.** The advancement of current treatment alternatives has demonstrated as broad development roads for a few business sectors. The global orthopedic bone cement market is one among them. The market has grown at a steady pace in the past few years and is expected to climb at a competitive rate in the coming years**.** The key benefit of our product is that it can perform not only the commercially available bone cement functions but also have some additional properties like antibacterial property, fast bone formation, stable bone cement formation, excellent biocompatibility

		and low toxicity all in one product, which is an edge over existing bone cement products.
e	**Capture new market**	• Bone Cement venture capitalists. • Insurance providers (payers).
f	**Any Environmental Aspect**	There is no environmental aspect of our manufactured product.
g	**Any Other Aspect**	Biocompatible, Bioactive, Antibacterial, Rapid bone formation, Safe degradation products, Good mechanical strength, Good thermal stability.
6	**Target Market**	The potential customers of our product are all over the country. This healthcare product facilitates the following areas: • Research and consulting firms. • Healthcare institutes (hospitals, medical schools, diagnostic centers and surgical units). • Research institutes. • Venture capitalists. • Insurance providers (payers).
7	**Team Members (Names & Roll No.)**	Nehan Kanwal (BM-16044) Aiman Saeed (BM-16049) Muniza Sami (BM-16063) Manal Naushad (BM-16081)
8	**Supervisor Name**	Dr. Engr. Eraj Humayun Mirza (dreraj@neduet.edu.pk) Dr. Alidad Chandio (alidad@neduet.edu.pk)
9	**Pictures**	 Fabricated Bone Cement Scaffolds