ME 495 Proposals for Term 192

#	Faculty Name	Research Title	Research Description	Area of research
1	Dr. Atia Khalifa	Desalination using Membrane Distillation (MD) Technique	The student is expected to build a good background on the technique of membrane distillation (MD) and its common designs for water desalination. The student is going to design and experimentally test a modified MD module to improve the productivity of fresh water. The student will study the system performance at different operating conditions and conduct the energy analysis.	thermofluids
2	Dr. Ahmet Z. Sahin	Reverse Osmosis Desalination using Solar and Wind Energy	Modelling and analysis of a hybrid solar/wind desalination system to investigate the feasibility of sweet water production from the brackish water using Reverse Osmosis (RO) desalination system under the climatic conditions of Saudi Arabia. Parametric analysis is to be performed for optimization purposes to achieve cost optimization.	thermofluids
3	Dr. M. Abdul Samad	Fabrication and Tribological evaluation of polymer nanocomposite coatings	The student will be responsible to conduct an extensive literature review on the topic and conduct some experiments to fabricate and evaluate the tribological performance of epoxy nanocomposite coatings in terms of friction and wear. The student will be exposed to different coating fabricating techniques, wear testing techniques and characterization techniques such as SEM, profilometry etc. The outcome of this project may be a Journal paper or a conference paper, which help the students in getting good scholarships in reputed universities for their higher studies.	materials and manufacturing
4	Turki Baroud	Developing Novel Material For Renewable energy application	Highly efficient material will be synthetized and evaluated as back electrode for Dye Sensitized Solar Cells	materials and manufacturing
5	Turki Baroud	Novel material for water treatment application	Polymeric membrane will be fabricated and characterized for water treatment purposes	materials and manufacturing
6	Turki Baroud	Characterization of Polymeric membrane	In this project the student will work on evaluating the mechanical and texture characteristics of polymeric membrane	materials and manufacturing

7	Turki Baroud	Synthesis and functionalization of carbon material	In this project the student will work the synthesis of carbon material that can be used in wide range of applications.	materials and manufacturing
8	Turki Baroud	Machine learning for water treatment application	Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. In this project, data sets will be gathered and analyzed by machine learning for specific water treatment application	materials and manufacturing, Machine learning
9	Zuhair Gasem	Effect of Sensitization on Tensile and Corrosion Properties of Rolled Plates of AISI 304 Stainless Steel	Stainless Steel 304 is widely used in the oil & gas and in the petrochemical industries. Sensitization of 304 results in degradation of tensile and corrosion properties. The aim of this project is to investigate whether this degradation is sensitive to the orientation of a rolled 304 plate.	materials and manufacturing
10	Dr. Jafar Albinmousa	Fatigue and Fracture	The research is focused on using an analytical Strain Energy Density method to predict fracture load of notched components. Specimens with V and U notches are tested. Analytical and finite element predictions will be examined.	Mechanics and design
11	Ihsan ulhaq Toor	Evaluating the effect of microstructure on the corrosion performance of carbon steel and stainless steel alloys in different environments with and without green inhibitors.	Heat treatment is widely used in the industry to control the desired microstructure of materials, especially in steels. These microstructures/phases can seriously affect the mechanical and corrosion resistance performance of these alloys. In this research work, the student will 1st design different heat treatment cycles in order to achieve different microstructures and subsequently will investigate their corrosion performance in different corrosive environments with and without green inhibitors.	materials and manufacturing
12	Ihsan ul haq Toor	Evaluating the “Microbial Induced Corrosion (MIC) performance of different steels/stainless steels, Al and Cu alloys.	MIC is a major problem in many industries such as chemical processing, water treatment, and nuclear power generation. The increased water wetting in oil and gas transportation because of increased use of water flooding for enhanced oil recovery, is causing many MIC failures of the infrastructure. In this project, the student will evaluate the corrosion performance of different alloys because of different types of microbes.	materials and manufacturing

13	Samir Mekid	Modeling and Experimentally Validating New Concepts of Whiskers Sensors with High Sensitivity	Whiskers in cats or mice are natural sensors which have no receptors along the length of hair but at the base where it connects the skin. If such whisker sensors are artificially invented, they could be used in many applications involving autonomous detection of obstacles, mapping of surface contour, long pipelines leak detection or developing sensory devices. The research can be divided into three categories; static and dynamic modeling, material and geometry selection and experimental analysis. Analytical static and dynamic model (including bending) of whisker is achieved by using different beam deflection theories thereby formulating the best mathematical equation for various possible geometries of the whisker. From this analysis, suitable materials with appropriate shapes and sizes are to be chosen on which experimental tests should be be conducted to screen out the undesired material and geometry selections. The objective is to look for the highest sensitivity with the corresponding material characteristics allowing perfect sensing of surroundings. We connect sensor at the base of the whisker since all the sensing happens at this location as mentioned above.	materials and manufacturing, instrumentation, sensing

14	Samir Mekid	Modeling/simulation with experimental validation of nervous materials	A new type of nervous materials to emulate human perception of external effects and react accordingly will be investigated. After some conceptual analysis, an experimental study will be proposed to validate the numerical analysis performed on a model of this nervous material. The considered material will be manufactured by embedding a set of carbon fibers acting as sensors and patching a layer of piezoelectric sheet acting as an actuator. The model is used primarily to support better placement of the carbon fibers in specific locations and orientations based on desired measurement control while printing the sample specimen using a flexible material. The sample specimen will be tested under different conditions of static as well as dynamic loading and the relevant material behavior through the induced electric field or voltage in the sensors will be recorded accordingly. It is meant for the material to properly react to specified internal or external effects in terms of deformation limit or developed stress. The principle can be extended to other limitations e.g. vibrations. The strength of this material will be analyzed to validate its integrity within the specified range of operations. Nervous materials are pivotal in various sensitive applications e.g. structural health monitoring and personal protection.	materials and manufacturing, Dynamics and control, Sensing, Actuation

15	Syed Sohail Akhtar	Investigation and optimization for the development of thermally conductive polymer matrix composites with inter-connect network of fillers	Polymers have the potential to replace metallic components in many engineering and real-life applications. Low density, small carbon footprint, high corrosion and chemical resistance, easy processing, and flexible manufacturability are the few advantages of polymer-based materials. Many heat transfer applications, such as heat exchangers and thermal interface materials involve low working temperatures and therefore polymers can effectively replace their metallic counterparts. Polymer matrix composites (PMCs) are widely accepted in many heat transfer applications such as heat exchangers, thermal management of electronics and thermal interface materials. For such applications, thermal conductivity (TC) must be good enough to dissipate the waste heat leading to a reasonable effectiveness of heat transfer. In this view, scientists are working to enhance the TCs of PMCs synergistically. Synergistic enhancement in TC of PMCs can be made by using hybrid fillers such as mixtures of differently composed, differently sized, or differently shaped particles. The key to synergistic enhancement in TC is to develop a percolating network of high TC fillers in the final product. Among different approaches, one is to follow a methodology in which the particulate fillers are forced to connect each other, for example, layer-by-layer fabrication by doctor blading, and structuring of flakes by high-speed mixing and hot compressing. Another way is to use expandable graphite (EG). Once expanded, EG forms a fully connecting skeleton and leads to high TC. Similarly, foams or porous structures of thermally conducting ceramics can be infiltrated with polymeric materials to have inter-connecting heat pathways throughout. On the same lines, forming a segregated structure of thermally conductive fillers following a two-stage mixing route can lead to ultrahigh TCs. The aim of this work is to investigate, compare and optimize the methods for the development of thermally conductivity composites with interconnected network of thermally conductive fillers.	materials and manufacturing

16	Syed Sohail Akhtar	Design and development of high-performance thermal management composites	The management of heat dissipation in electronic packaging and heat spreaders has become critical due to the increased device output power. Hence, for efficient thermal management, it becomes essential to develop well-designed tailored composites with high thermal conductivity and low coefficient of thermal expansion to match that of electronic packages to minimize thermal stresses and hence thermal deformation. In the proposed project, a systematic computational material design approach will be used in the development of metal composites with tailored structural and thermal properties for applications in electronic package and thermal management. Numerous potential matrices (such as aluminum and copper) with potential inclusions will be considered for developing high performance composites. To validate the numerical predictions, the designed composites will be developed using Spark Plasma Sintering Process (SPS) in line with predictions followed by properties measurement and characterization.	materials and manufacturing
17	Abduljabar Alsayoud	Evaluation of potential gas sensing materials using Density Functional Theory (DFT)	The project aims to select and test materials suitable for gas sensing applications using DFT computational method. This method is well suited for electrochemical gas sensors where adsorption of gas molecules influences the electronic behavior of the material that changes its conductivity and thus the current passing through it. The change can then be interpreted to recognize the type of gas and its concentration. Generally, gas sensors have two main functions: receptor function to sense the gas type and transducer function to convert this sensing into a signal. This project focuses on evaluating the receptor function of the desired material for sensing certain gases. Properties like adsorption energy, charge transfer, work function and density of states are evaluated using DFT which gives good indications about the selectivity and sensitivity of the material in question.	materials and manufacturing

18	Syed Sohail Akhtar	Functionally Graded Ceramic composites for cutting tool inserts	Functionally graded (FG) Ceramic composites will be computationally designed take advantage of the heat and corrosion resistances of ceramic and the mechanical strength, high toughness good machinability and bonding capability of second-phase particles in ceramic matrices. The spark plasma sintering (SPS) method will be used to sinter the designed high-performance composites for cutting tool applications for validation. The feasibility of fabrication of functionally graded materials by the SPS process using dies of special configuration will also be demonstrated.	materials and manufacturing

19	Hussain Alqahtani	Thermoelastic waves in phononic structures	The stability of the system from inevitable vibrations is of great importance and has been the subject of study since the inception of the reciprocating or the rotating devices. The study of flexural waves in the structure, also known as Structural Acoustics or Vibroacoustics, deals with analyzing the response of the system when such waves pass through them, specifically thin plates, shells, beams, frames, rods etc., which are the preferred elements in most of the engineering applications such as large submarines & ships, experimental tables and construction buildings. Radiation of energy from the submarine in service to the surroundings can expose its position and jeopardize its safety and in other application such as the vibrations of an experimental table affects the accuracy of the results, hence the propagation of flexural waves should be stopped or at least attenuated. The unique properties of metamaterials make them capable of providing band gaps or stop bands for the spread of flexural elastic waves. Phononic crystals have the capabillity of providing Bragg gaps and for attenuation of lower frequencies the concept of local Resonators has been used. The proposed work aims at finding the band gaps/stop bands for the Edge Waves when they are propagating along the free edges of the Kirchhoff Plate, carrying an array of local resonators, on Winkler foundation which is resting on the periodically varying base. Structural Element Method (SEM) is used to find the stop bands. Parametric study, by varying the stiffness, mass, unit cell length, is also done to find how the attenuation constant varies with change in the mentioned properties. Vibration transmission from the resonators to the plate resting on the foundation would also be found to understand the behavior of the plate especially at the resonating frequency of the resonators.	Dynamics and control
20	Mohamed Antar	Performance of air and water heated Cross flow HDH unit	a HDH Desalination system in the desalination lab is to be tested for air and water heated mode. a comparison between water, heated, air heated and this mode to assess the effectiveness of the desalination process.	thermofluids

21	Dr M. Mustafa Kamal	Conceptual design of a renewable energy based air liquefaction system	Renewable energy is of intermittent nature and thus requires a robust storage mechanism for the energy produced during off-peak hours. This research work will assess the usage of liquefied-air as an energy storage and subsequently put together a 'conceptual design' of a basic air liquefaction system powered by renewable energy. Liquefying air would convert renewable energy to cold energy. This energy can be later on extracted by expanding the air, converting the stored cold energy to kinetic energy to run turbines and produce electricity.	thermofluids
22	Khaled Al-Athel	CFD Analysis of Foam Materials	Metallic and ceramic open foams are widely used in thermal applications to enhance the heat transfer required for the component. Due to the complex geometrical nature of these foams, analytical solutions are very difficult to attain, and experimental work is time consuming and difficult to control. In this work, computational fluid dynamics (CFD) analysis will be used to investigate the thermal performance of foams under various conditions.	thermofluids
23	Fadi Al-Badour	Friction Stir welding of Mg alloy Zk60	in this research work, welding Zk60 will be performed using solid state technology (friction stir welding). The main objectives are: 1. Understand the effect of welding conditions on microstructural and mechanical properties of the produced weld. 2. Optimizing welding conditions for the mentioned grade of Mg alloy (Zk60), to achieve 100% efficiency.	materials and manufacturing
24	Fadi Al-Badour	Underwater Friction Stir Welding (FSW)	Experimental setup for underwater friction stir welding will be developed, the effect of process parameters on joint integrity will be investigated. targeted materials: aluminum alloys.	materials and manufacturing
25	IHSAN UL HAQ TOOR	Design and evaluate the corrosion behavior of hybrid nanocomposites.	In this research student will 1st design and develop the hybrid nanocomposites and evaluate their metallurgical behavior. Later he will evaluate the corrosion performance of these novel nanocomposites in different environments.	materials and manufacturing
26	IHSAN U HAQ TOOR	Identifying the effect of CO_2 saturated environment on the corrosion of carbon steel	In this project student will evaluate the effect of CO_2 concentration, temp., pH on the corrosion of APIX65 carbon steel with and without different green corrosion inhibitors.	materials and manufacturing